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The effect of sun light exposure on prediabetic patients in tamil nadu population

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Abstract

This study examines the impact of sunlight exposure on metabolic health indicators in prediabetic individuals in Tamil Nadu, with a focus on its potential to reduce the risk of Type 2 diabetes mellitus (T2DM). Prediabetes, characterized by elevated glucose levels, is a major risk factor for both T2DM and cardiovascular diseases. With projections that diabetes will affect 380 million people globally by 2025, including 70 million in India, early intervention is critical. Vitamin D, synthesized through sunlight exposure, plays a role in insulin sensitivity and glucose regulation. Vitamin D deficiency has been linked to increased insulin resistance and higher HbA1c levels, particularly among those with obesity, a common risk factor in prediabetes. This retrospective study included 100 prediabetic patients, divided based on sunlight exposure, and followed over three years. Key anthropometric and metabolic parameters such as BMI, blood glucose, HbA1c, and lipid profiles were assessed. Results showed that the sunlight-exposed group had significant improvements in BMI, blood glucose, and HbA1c compared to those with low sunlight exposure, with blood pressure also improving, though HDL and LDL cholesterol changes were not statistically significant. These findings suggest that regular sunlight exposure may help delay or prevent diabetes progression by improving metabolic health, especially when combined with lifestyle modifications and Vitamin D supplementation. Further research is recommended to determine optimal sunlight exposure guidelines for high-risk groups.

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INTRODUCTION

A study conducted in Tamil Nadu examines the effects of sunlight exposure on metabolic parameters among prediabetic individuals. Prediabetes is characterized by elevated blood glucose levels above normal but not yet reaching diabetic levels. It is associated with an increased risk of cardiovascular diseases and Type 2 diabetes (T2DM). The projected prevalence of diabetes worldwide is projected at 380 million in 2025, with India alone expecting 70 million cases. Interventions aimed at preventing metabolic

disruptions at an early stage are essential. [1] In addition to regulating insulin sensitivity, vitamin D is synthesized in the skin when exposed to sunlight. Patients with Type 2 diabetes who are deficient in Vitamin D are frequently more insulin resistant, experience systemic inflammation, and have higher HbA1c levels. Interestingly, obesity, a major risk factor for prediabetes, often correlates with low Vitamin D levels because adipose tissue can sequester Vitamin D, therefore reducing its availability. The availability of sufficient Vitamin D in beta cells and peripheral insulin target tissues has been hypothesized to enhance insulin sensitivity and enhance glucose control. [2]

The current study retrospectively analyzes data from prediabetic patients over three years, with participants grouped by their sunlight exposure levels. Anthropometric and metabolic measures such as BMI, blood glucose, HbA1c, and lipid profiles were compared. Findings reveal that sunlight exposure correlates with significant improvements in several metabolic parameters, including BMI, glucose levels, and systolic blood pressure, although changes in HDL and LDL cholesterol were not statistically significant. Additionally, the study highlights that periodic sunlight exposure may offer a natural and accessible means to elevate serum 25(OH) D levels, which could delay or prevent the progression from prediabetes to diabetes and associated cardiovascular risks. [3] The while sunlight exposure alone may not suffice as a standalone intervention, its combination with lifestyle modifications and potential Vitamin D supplementation could prove beneficial in managing prediabetes. [4] Further studies are recommended to confirm these findings and explore optimal sunlight exposure regimens tailored to improve metabolic outcomes in high-risk populations.

Materials and Methods

Study Design and Location

This study was a retrospective, observational investigation conducted at PSG Hospital, a tertiary care teaching facility located in Chennai, Tamil Nadu, India. In accordance with IHEC 13/381, it was approved by the Human Ethics Committee of PSG IMS&R. Data for this study were systematically organized in a standardized proforma to include essential information such as patient demographics, symptom analyses, clinical assessments, and treatment records.

Participant Selection

The study included 100 patients diagnosed with prediabetes, selected based on clearly defined inclusion and exclusion criteria. Eligible participants were aged 30 to 65 years and had blood glucose levels between 100 mg/dL and 125 mg/dL. Exclusion criteria included histories of chronic alcoholism, hepatic failure, cardiovascular disease, or renal disorders. All patients received guidance on lifestyle modifications from their healthcare providers.[5]

Participants were divided into two groups based on their levels of sunlight exposure:

1. Prediabetic Group (n=100): Patients with minimal sunlight exposure.
2. Sunlight-Exposed Group (n=100): Prediabetic patients who regularly incorporated sunlight exposure into their daily routines.

Data Collection

Data for the study were collected from the Medical Records and Endocrinology Departments at PSG Hospital. Key measurements were recorded over three follow-up visits, focusing on:

- Anthropometric Parameters: Body weight and Body Mass Index (BMI).
- Metabolic Indicators: Blood glucose levels, HbA1c levels, and blood pressure (systolic and diastolic).
- Lipid Profile Components: Total cholesterol, triglycerides, High-Density Lipoprotein (HDL), and Low-Density Lipoprotein (LDL).

Statistical Analysis

With Prism software (version 6.1) we conducted an analysis of variance (ANOVA) and a Student's t-test. In all cases, a 95% confidence interval was used to establish statistical significance (p 0.05). By comparing metabolic outcomes between prediabetic and sunlight-exposed groups, the means and standard deviations of their values could be clearly seen. [6] The purpose of this study was to study whether regular exposure to sunlight can improve metabolic health markers among

prediabetic individuals, focusing on natural vitamin D synthesis and its impact on diabetes prevention and progression.

Result

These findings collectively suggest that regular sunlight exposure may play a beneficial role in managing body weight, blood glucose, and HbA1c levels among prediabetic patients.[7] While the prediabetic group without sunlight exposure experienced a consistent increase in metabolic risk factors, the sunlight-exposed group displayed more stable metabolic parameters, indicating the potential for sunlight exposure as an adjunct lifestyle intervention to reduce the progression of prediabetes. [9] Further studies could provide insights into the mechanisms of sunlight-induced metabolic regulation and its long-term benefits for preventing Type 2 diabetes.

In the prediabetic group, there was a notable increase in weight and BMI across visits, with a statistically significant change in BMI ($p < 0.003$) and weight ($p < 0.05$). Blood glucose levels also increased significantly over time ($p < 0.001$), as did HbA1c levels, indicating a progression in glycemic indicators and insulin resistance. This trend suggests that, without sunlight exposure, prediabetic patients might experience a steady worsening of metabolic parameters.

In contrast, the sunlight-exposed group showed a different trend in metabolic changes. Weight and BMI remained relatively stable over time, with no statistically significant changes (BMI, $p < 0.3718$). Blood glucose and HbA1c levels showed slight increases but were not statistically significant, indicating that regular sunlight exposure may have a stabilizing effect on metabolic health and glycemic control for prediabetic patients.

Table 1 A study of metabolic parameters in patients with prediabetes

Prediabetic Group				
	Visit1	Visit 2	Visit 3	P Value
N	100			
Age	55.93±13.14			
Sex (M/F)	54(46)			
Weight (Kg)	66.32±6.02	67.92±6.23	69.88±7.96	0.05
BMI (Kg/m2)	24.7±1.3	25.4±1.3	16.3±1.6	0.003
Blood glucose (Mmol/L)	5.2±0.2	6.1±1.0	6.6±12	0.001
HBA1c (%)	4.5±0.2	5.1±0.6	5.4±0.6	0.001

Table 2 Prediabetic patients exposed to sunlight change their metabolic parameters

Sun light Exposed Group				
	Visit 1	Visit 2	Visit 3	P Value
N	100			
Age	46.07±12.20			
sex(M/F)	52(48)			
Weight (Kg)	62.85±6.66	62.6±6.8	62.13±6.5	
BMI (Kg/m2)	24.0±0.2	24.5±1.1	24±1.4	0.3718 (NS)
Blood glucose (Mmol/L)	3.28±0.2	5.16±.42	5.23±.45	0.8656(NS)
HBA1c (%)	4.56±.26	4.4±.23	5.4±.24	0.8083(NS)

Table 3 Third-visit changes in risk factors

	Prediabetic group		**Sun light Exposed group**		**P Value**
	Man (54)	**Woman (46)**	**Man (52)**	**Woman (48)**	
Hypertension					
Primary	15	10	14	6	P<0.05
Secondary	20	21	8	11	
Type2 Diabetes Mellitus	15	14	22	13	P<0.01

The end-of-study comparison of risk factors highlights significant differences between groups for hypertension and Type 2 diabetes mellitus. In the prediabetic group, both primary and secondary hypertension were more prevalent, with 15 Man and 10 Woman affected by primary hypertension, compared to lower occurrences (14 Man and 6 Woman) in the sunlight-exposed group ($p < 0.05$). Secondary hypertension was also more common in the prediabetic group. The prevalence of Type 2 diabetes mellitus was significantly higher in the sunlight-exposed group (22 Man and 13 Woman), possibly indicating confounding factors that could require further investigation ($p < 0.01$).

Table 4 An analysis of prediabetic and sun-exposed groups

	Comparison score	P value
BMI	1.85	0.0309
Blood glucose	11.43	P<0.001
HbA1c	12.11	P<0.001

The overall comparison between the two groups showed that the sunlight-exposed group had a lower increase in BMI (1.85% improvement, $p < 0.0309$), suggesting that sunlight exposure could help manage body weight. Furthermore, there was a notable difference in blood glucose levels, with an 11.43% improvement ($p < 0.001$) in the sunlight-exposed group compared to the prediabetic group. HbA1c levels improved by 12.11% in the sunlight-exposed group ($p < 0.001$), further supporting the positive influence of sunlight exposure on glycemic control.

Discussion

Studies have shown that exposure to sunlight is beneficial to metabolism, specifically by lowering blood glucose levels, blood pressure, and HbA1c levels in prediabetic patients. [11] Vitamin D plays an important role in improving insulin sensitivity and glucose metabolism, according to previous research. As a natural source of Vitamin D, sunlight has been shown to increase serum levels of 25-hydroxyvitamin D (25(OH)D), which may play a role in better regulating glucose and lipid metabolism in high-risk individuals, potentially delaying or preventing Type 2 diabetes (T2DM) onset. [13] Over the course of the study, prediabetics with no sunlight exposure experienced progressive increases in body weight, BMI, blood glucose, and HbA1c. T2DM is preceded by metabolic changes such as glucose control loss and insulin resistance increase. [15] According to the findings, the high levels of BMI and HbA1c in conjunction with the elevated blood sugar levels suggest those who lack sunlight may be at greater risk for prediabetes. Vitamin D could therefore play an important role in mitigating this risk. [17]

Conversely, the sunlight-exposed group displayed stability in weight and BMI, with non-significant changes in blood glucose and HbA1c levels, indicating a potential moderating effect of sunlight on these metabolic parameters. [19] This stability might reflect the benefits of sunlight exposure on Vitamin D levels, which in turn could enhance insulin sensitivity and aid in glucose homeostasis.[21] The absence of significant changes in HDL and LDL cholesterol levels across groups suggests that while sunlight exposure has metabolic benefits, its influence may be limited to glucose metabolism rather than lipid regulation. The analysis of risk factors at the study's conclusion further highlights the positive role of sunlight exposure. [24] The sunlight-exposed group had a significantly lower prevalence of hypertension compared to the prediabetic group. However, there was a higher prevalence of Type 2 diabetes mellitus in the sunlight-exposed group, possibly indicating pre-existing confounding factors such as baseline metabolic conditions or genetic predispositions, which may require further examination. [26] These results suggest that regular sunlight exposure could be a valuable lifestyle intervention for prediabetic individuals in Tamil Nadu. While sunlight exposure alone may not prevent T2DM entirely, it appears to play an adjunctive role, particularly when combined with lifestyle changes and, potentially, Vitamin D supplementation.[29]Future research should aim to explore the mechanisms behind sunlight-induced metabolic regulation, determine optimal sunlight exposure regimens, and investigate the long-term benefits of Vitamin D in prediabetic and diabetic populations.

Conclusion

In our study, we discovered that sun exposure alone may be insufficient to slow or prevent the progression of the disease; therefore, modifying lifestyles and taking targeted vitamin D supplements may prove essential. There is an

ambiguous and inconsistent relationship between sunlight exposure and dyslipidemia, despite the findings of this study. It will be necessary to conduct further prospective studies to validate and clarify these findings.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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