



# Assessing Knowledge Gaps on Diabetes Prevention Among Biology Graduates: A Study in Pondicherry

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## Abstract

**Background:** Diabetes Mellitus represents a significant global health issue, with its prevalence steadily increasing. In 2014, approximately 422 million people were living with diabetes, highlighting an urgent need for effective prevention strategies. This study aimed to evaluate the existing knowledge about diabetes among biology graduates in Pondicherry, India, to enhance awareness of its root causes. **Methods:** A cross-sectional survey was conducted with 642 participants using a structured, pre-tested questionnaire covering essential fatty acids, glycation, glycemic index, autoimmune responses to gluten, and types of diabetes. **Results:** Results revealed that only 17% of participants understood the role of essential fatty acids in cell membranes, 25% were aware of glycation processes, and 28% recognized the autoimmune risks associated with gluten-rich foods. Awareness of low glycemic index foods was noted in 45%, while 44% understood that muscle glycogen does not enter the bloodstream. Most participants were knowledgeable about insulin action (93%), types of diabetes (90%), and symptoms of diabetes (100%). Despite this, only 15% demonstrated a comprehensive understanding of diabetes's root causes and preventive measures. **Conclusion:** The study underscores the need for enhanced

educational efforts focused on the preventive aspects of diabetes, including dietary influences and cellular mechanisms. Addressing these gaps through targeted public health initiatives and educational programs is crucial for effective diabetes prevention and management.

**Keywords:** Diabetes Mellitus, Preventive Education, Essential Fatty Acids, Glycation, Knowledge Assessment

## Introduction

Glucose is a fundamental energy source in biology. Elevated blood sugar levels trigger the release of insulin, which enhances cellular glucose uptake for energy. Excess glucose is either converted to glycogen and stored in the liver and muscle cells or utilized in adipose tissue for fat production (American Diabetes Association [ADA], 2018). When blood glucose levels decrease several hours post-food intake, insulin production decreases, and glucagon secretion rises, stimulating the breakdown of glycogen into glucose to maintain blood glucose levels around 80 mg/dl (World Health Organization [WHO], 2016). If glycogen stores are depleted, the liver and muscle cells then utilize fatty acids from adipose tissue as an energy source.

Diabetes Mellitus arises from inadequate insulin production or ineffective insulin function, resulting in elevated blood glucose levels. This condition leads to frequent urination and, if untreated, can progress to severe complications or death. In 2012, diabetes was the eighth leading cause of death, accounting for approximately 1.5 million deaths (Shaw & Sicree, 2010). By 2014, 422 million people globally were living with diabetes, reflecting an 8.5% prevalence

**Significance** | This study determined critical gaps in preventive diabetes knowledge among biology graduates, highlighting the need for improved educational strategies on root causes and prevention.

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rate. The prevalence of diabetes has been increasing, particularly in low- and middle-income countries, with around 62% of individuals with diabetes remaining undiagnosed (Seuring & Archangelidi, 2015). China, India, and the USA have the highest diabetic populations. In India alone, diabetes cases surged from 11.9 million in 1980 to 64.5 million by 2014, with prevalence rates doubling among men (3.7% to 9.1%) and increasing by 80% among women (4.6% to 8.3%) (Chen, Magliano, & Zimmet, 2012).

The global annual expenditure on diabetes exceeds USD 827 billion, placing a substantial economic burden on healthcare systems (Li, Zhang, & Wang, 2018). Preventing and effectively managing diabetes should be a public health priority to reduce mortality and financial strain. Awareness and education play crucial roles in improving screening, control, and management of diabetes. Despite over 80% of the population being aware of diabetes, India remains the second-largest diabetic population globally, following China (Brenan, 2020). Current awareness and education primarily focus on treatment aspects rather than prevention. Research indicates that awareness studies and educational programs predominantly address symptoms, screening, and management, with insufficient emphasis on preventive measures and root causes of diabetes (Aziz et al., 2015).

The present study aims to evaluate existing knowledge about diabetes and enhance awareness of its root causes among science graduates in and around Pondicherry, India, using a structured, pre-tested questionnaire (Deepa et al., 2014). This approach seeks to foster better understanding and preventive practices, potentially enabling graduates to educate their communities about diabetes management and lifestyle adjustments.

## 2. Materials and Methods

### 2.1 Study Design and Setting

This cross-sectional study was conducted from January to June 2017 among science graduates in and around Pondicherry, India. The study aimed to assess and enhance the understanding of diabetes and its prevention. Ethical approval was obtained from the Institutional Ethics Committee of [Name of Institution] prior to data collection.

### 2.2 Participants

A total of 642 participants were recruited, including medical (MBBS), paramedical (BDS, nursing, physiotherapy), and arts and science graduates (anatomy, physiology, biochemistry, microbiology, pharmacology, zoology, biotechnology). Participants were selected through voluntary participation, with informed consent obtained from all individuals. They were provided with a detailed briefing on the study's objectives and assured that their personal data would remain confidential.

### 2.3 Data Collection

A structured, pre-tested questionnaire was employed to evaluate participants' knowledge regarding the causes, complications, and symptoms of diabetes. The questionnaire covered topics such as the role of essential fatty acids in cell membranes, the impact of glycation, and the effects of gluten-rich foods on autoimmune responses. Each correct response was assigned one point to facilitate scoring.

### 2.4 Procedure

Upon completion of the questionnaire, participants received a 15-minute educational session that included information on the role of cell membranes in diabetes, the importance of omega-3 and cis-unsaturated fatty acids, dietary recommendations, and the mechanisms of diabetes complications and prevention. This session aimed to enhance participants' understanding of diabetes and its prevention.

### 2.5 Ethical Considerations

The study adhered to ethical standards involving human subjects. Participants were informed about the study's purpose, their right to withdraw at any time, and the confidentiality of their responses. All data were anonymized and handled with strict confidentiality to ensure privacy. The study was conducted in accordance with the Declaration of Helsinki and local ethical guidelines.

### 2.6 Statistical Analysis

Descriptive statistics were used to analyze the data. Knowledge levels were expressed as percentages, with correct responses calculated for each area of knowledge assessed. Statistical software (SPSS v 15.0) was used for data analysis.

## 3. Result

A total of 642 science graduates from Pondicherry, India, participated in this study, including 384 males and 258 females. Knowledge assessment revealed significant gaps in understanding the root causes of diabetes despite high awareness of its symptoms and management.

Only 17% (119 participants) were knowledgeable about the roles of Omega-6 and Omega-3 essential fatty acids, as well as cis- and trans-unsaturated fatty acids in cell membranes. Awareness of glycation, resulting from excess blood glucose, was present in 25% (159 participants). Similarly, 28% (180 participants) understood the autoimmune risks associated with gluten-rich foods.

In contrast, 45% (292 participants) were aware of the benefits of low glycemic index foods, and 44% (283 participants) recognized that glycogen stored in muscle cells cannot be released into the bloodstream. Most participants demonstrated strong awareness of insulin action (93%, 599 participants), the types of diabetes (90%, 580 participants), and the symptoms of diabetes (100%, 642 participants).

Overall, only 15% of participants showed a comprehensive understanding of diabetes's root causes and preventive measures.

This indicates a critical need for enhanced education on the fundamental aspects of diabetes prevention, particularly concerning dietary influences and cellular mechanisms.

The study highlights that while general knowledge about diabetes symptoms and treatment is widespread, there is a substantial lack of awareness regarding preventive aspects, such as the impact of essential fatty acids on cell membrane function and the role of glycation and gluten in disease progression. This gap underscores the importance of incorporating preventive education into public health strategies to address the rising incidence of diabetes.

#### 4. Discussion

The study reveals a critical gap in knowledge about the root causes of diabetes among biology graduates, highlighting a broader issue of awareness regarding preventive aspects of the disease. Despite high levels of awareness about the symptoms and management of diabetes, there is a notable deficiency in understanding the underlying mechanisms that contribute to the development of diabetes, particularly type 2 diabetes.

##### 4.1 Knowledge Gaps in Preventive Aspects

Our study found that while nearly all participants were aware of the symptoms and types of diabetes, only a small fraction understood the fundamental causes and preventive strategies. For instance, only 17% knew about the roles of Omega-6 and Omega-3 fatty acids in cell membranes and their impact on glucose uptake (Rameez et al., 2016). The shift in the balance between Omega-6 and Omega-3 fatty acids, particularly with the increased consumption of trans fats, leads to changes in cell membrane fluidity and contributes to insulin resistance—a key factor in type 2 diabetes (Simopoulos, 2016; Artemis, 2016). This knowledge is crucial as the high ratio of Omega-6 to Omega-3 fatty acids, driven by modern dietary trends, is associated with a higher risk of obesity and diabetes (Simopoulos, 2016).

Additionally, only 25% of participants were aware of glycation processes, where excess glucose in the blood leads to harmful cross-linking of proteins and DNA, resulting in complications such as neuropathy, kidney failure, and retinopathy (Artemis et al., 2016). This process impairs normal physiological functions and underscores the importance of controlling blood glucose levels to prevent long-term damage. The low awareness of the implications of gluten-rich foods (28%) and the mechanism of glycogen utilization (44%) further illustrates the gaps in understanding that contribute to diabetes management and prevention. Undigested gluten peptides can lead to autoimmune responses affecting various organs, including the pancreas, potentially triggering Type I diabetes (Artemis et al., 2016). Meanwhile, understanding the role of glycogen storage and its utilization during physical activity is essential for managing blood glucose levels effectively.

##### 4.2 Implications for Public Health

The high awareness of diabetes symptoms and types contrasts sharply with the low understanding of preventive measures, emphasizing a significant oversight in public health education. Diabetes is a global epidemic affecting over 422 million people, and despite the available knowledge, the prevalence continues to rise (Chen, Magliano, & Zimmet, 2012). This discrepancy suggests that increasing awareness alone is insufficient; it must be coupled with education on preventive strategies.

Recent literature highlights the importance of focusing on lifestyle and dietary changes to prevent diabetes. For example, the Finnish Diabetes Prevention Study demonstrated that lifestyle interventions, including dietary modifications and increased physical activity, can significantly reduce the risk of developing type 2 diabetes (Tuomilehto & Lindström, 2011). However, our findings indicate that even among those with a biology background, there is insufficient awareness about these critical preventive measures.

##### 4.3 Recommendations for Improving Awareness

To address these gaps, it is essential to integrate comprehensive education on the root causes of diabetes into public health initiatives. This should include:

**Educational Campaigns:** Public health campaigns should focus on the biochemical and physiological aspects of diabetes, including the roles of essential fatty acids, glycation, and autoimmune responses. Such campaigns can help bridge the gap between general awareness and actionable knowledge.

**Curriculum Integration:** Educational institutions, particularly those offering biological sciences, should incorporate modules on diabetes prevention, emphasizing dietary and lifestyle factors. This approach could help future healthcare professionals and the public understand the significance of preventive measures.

**Community Outreach:** Government and non-governmental organizations should collaborate to create targeted outreach programs that address specific knowledge gaps identified in this study. These programs should be designed to reach diverse populations, including those with different educational backgrounds.

**Ongoing Research:** Further research is needed to explore knowledge gaps across various demographic groups and disciplines. This research should aim to develop effective educational strategies tailored to different audiences, ensuring a comprehensive understanding of diabetes prevention (American Diabetes Association, 2018; Aziz et al., 2015; Baig et al., 2015; Bhopal et al., 2014; Brenan, 2020; Campbell et al., 2020; Cannon et al., 2020; Constantino et al., 2013; Covidence systematic review software [Computer program], 2022; Dabelea et al., 2014; Deepa et al., 2014; Gierer & Mittlmeier, 2015; Li et al., 2018; Rameez et al., 2016; Seuring et al., 2015; Shaw & Sicree, 2010; World Health Organization, 2016).

## 5. Conclusion

The present study highlights a critical need for improved awareness about the root causes of diabetes and preventive strategies. While there is substantial knowledge about diabetes symptoms and management, the lack of understanding of underlying causes such as dietary impacts on cell membranes, glycation, and autoimmune triggers is concerning. Addressing these knowledge gaps through targeted education and public health initiatives is essential for effective diabetes prevention and management. By enhancing awareness and understanding, we can work towards reducing the global burden of diabetes and improving public health outcomes.

## Author contributions

S. P., P. K., and K. P. all contributed significantly to the research. S. P. conceptualized the study and analyzed the data. P. K. provided substantial input in interpreting the results and drafting the manuscript. K. P. reviewed and critically revised the manuscript for important intellectual content. All authors discussed the results and contributed to the final manuscript.

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## Competing financial interests

The authors have no conflict of interest.

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