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# Awareness and perception of diet and nutrition in individuals with Diabetes Mellitus

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**ABSTRACT**

***Dietary knowledge and awareness in individuals with diabetes is an important aspect of diabetes management. Several studies have evaluated the awareness of diabetes among the diabetic population. However, limited studies have focused on the relation between nutrition awareness and dietary intake in Indian individuals with diabetes. The present study assessed the awareness and perception regarding the importance of nutrition in these individuals. It also aimed at identifying the knowledge gaps by evaluating the relationship between nutritional awareness and dietary self-care behavior in the subjects. The study design comprised a cross-sectional survey to assess the awareness about nutrition and nutrient intake in the diabetic population across India. A total of 1000 adults with diabetes were administered a diet-recall using Nutri-Calculator, an app-based nutrient calculator, and a structured questionnaire. The nutrient calculator recorded food intake in a 24-hr recall and analyzed nutrient intake in comparison with the respective RDAs (Recommended Dietary Allowances). The nutrient intake report was generated at the end, that mentioned the current intake against the RDA for each survey respondent. The questionnaire evaluated the awareness and perception of the subjects regarding the foods and nutrients that are important in diabetes. The survey was conducted using computer-aided telephonic interview (CATI) methodology and each survey was screened for quality checks after completion. After the survey analysis, it was observed that majority (95%) of the respondents were aware of the importance of protein intake in diabetes. Nearly, 86.5% assumed that they had an adequate intake of proteins; however, the nutrient intake analysis revealed only 14.8% of respondents were meeting their daily protein requirements. Of the total respondents, it was observed that 92% of the respondents were aware of the importance of fiber intake in diabetes. Nearly, 81.4% assumed that they had adequate intake of fiber; however, the nutrient intake analysis revealed that only 21.2% of the respondents were consuming a diet adequate in fiber. Furthermore, it was found that majority of the respondents did not meet the RDAs for micronutrients. Additionally, the study also revealed that dietary deficiency of macronutrients, namely fiber, and protein, resulted in greater hunger pangs in these individuals. In conclusion, the study revealed that the respondents were aware of the importance of protein and fiber in their diet; however, majority of the respondents consumed a diet deficient in these nutrients as well as micronutrients. This dietary deficiency could have led to an increased frequency of hunger pangs in these individuals. Furthermore, most of the respondents were unaware that a low glycemic index diet is beneficial in the management of diabetes. The study highlighted the need for an effective diet and lifestyle counseling for the management of diabetes.***

***Keywords***— *Nutrition awareness, dietary intake, protein-deficient diet, fiber, diabetes, glycemic index.*

## 1. INTRODUCTION

Diabetes mellitus is a public health burden that has impacted more than 500 million people globally. In India, type-2 diabetes mellitus (T2DM) has rapidly progressed into a major public health problem. A pooled analysis of 1.7 million adults has revealed a high burden of pre-diabetes and diabetes in rural and urban India.[1] Prolonged hyperglycemia promotes an increase in inflammation, oxidative stress, and vascular damage.[2] Uncontrolled and long-standing T2DM increases the risk of chronic diseases and other metabolic risk factors[3] and is associated with several macro-and micro-vascular complications.[4] Clinical evidence suggests that interventions designed to lower blood glucose levels can reduce the risk of developing diabetes-related complications.[2]

Medical nutrition therapy (MNT) and lifestyle interventions form an integral component of diabetes management.[6,7] Clinical evidence has shown that modification of lifestyle measures like promoting healthy eating, physical activity, and weight

 

management facilitates control and prevention of T2DM onset in high-risk individuals.[8] Furthermore, several studies have suggested that nutrient composition or dietary changes in people with diabetes may affect their glucose and lipid profile.[9]

Dietary proteins are important modulators of glucose homeostasis.[10] These have a positive effect on glycemic response[11], weight loss, and weight maintenance.[12] Current evidence suggests that a high-protein diet effectively controls hyperglycemia by lowering postprandial blood glucose levels[9] and promoting weight loss.[13] Regular intake of dietary fiber controls blood glucose levels, reduces insulin resistance, and improves metabolic profiles[14] by reducing subjective appetite, energy intake, and body weight.[15] Additionally, dietary fiber lowers the glycemic index of foods. The American Diabetes Association (ADA) recommends an intake of fiber-containing foods in patients with diabetes due to its ability to decrease the glycemic index of foods.[2] Indian diet is predominantly low in protein, in addition to a high intake of refined cereal grains.[16] Refined grains have ≤75% lower levels of dietary fiber than whole grains.[17]

Despite the availability of various guidelines and recommendations on MNT for diabetes management, individual nutritional needs based on personal and cultural preferences form a crucial part of patient counseling. Evidence has shown that individuals with diabetes who adhere to dietary self-care recommendations have better glycemic control. Furthermore, the need for individualized nutrition therapy in these subjects has been emphasized by many medical associations, such as the ADA. Therefore, assessment of nutrition intake is an integral step in diabetes management to individualize nutritional therapy as per the individual's needs.[18]

Dietary knowledge also plays an important role in meeting the nutritional needs of individuals with diabetes. In the non-diabetic population, studies have demonstrated a weakly positive relationship between nutrition knowledge and dietary intake. The most frequent association has been observed with higher knowledge and higher fruit/vegetable consumption. One study from Ireland revealed significant nutrition knowledge gaps in T2DM patients regarding the impact of macronutrients and foods on blood glucose and lipids. In this study, subjects with lower nutrition knowledge reported lower sugar and fruit/vegetable intake, than those with a higher level of diabetes-related nutrition knowledge.[19] Another study from Thailand demonstrated that individuals with T2DM consumed an excessive amount of saturated fat and free sugars while consuming insufficient amounts of dietary fiber. The compliance of Thai patients to dietary recommendations was not found to be satisfactory and thus addressing their knowledge gaps was considered important to enable them to adhere to medical nutrition therapy.[18] The relationship between nutrition awareness and dietary intake in Indian individuals with diabetes has not been widely evaluated across the various Indian geographies.

The objective of the present study was to thereby assess the awareness and perception regarding the importance of nutrition in individuals with diabetes. Furthermore, the study aimed to identify the relationship between nutritional awareness and dietary self-care behavior and the knowledge gaps in adhering to MNT in these subjects.

## 2. MATERIALS AND METHODS

### 2.1 Study design and Sampling

The study design comprised a cross-sectional survey to assess the knowledge of nutrition intake and physical activity in the diabetic population across India. The study population included individuals with diabetes aged above 20 years. Furthermore, individuals meeting the criteria of category A and B of the New Consumer Classification System (NCCS) were included in the study. Initially, the size of the population of the target group was estimated in each city and zone to select a representative sample with minimum sampling error. A stratified sample of 1000, with a minimum sampling error of 4.48% at a 90% confidence interval was arrived to gauge the response at a city and zonal level. Purposive sampling was used to recruit the subjects from eight cities, viz. Mumbai, Delhi, Bangalore, Hyderabad, Chennai, Kolkata, Patna, and Chandigarh, representing four geographical zones-North, South, East, and West, based on their willingness to participate in the survey.

### 2.2 Study tool

The data was collected using 24hr diet recall with an app-based nutrient calculator (Nutri-Calculator) and a structured questionnaire.

Diet-Recall: Dietary intakes of the survey respondents were assessed using the Nutri calculator web link. The Nutri-calculator has been developed by Nutricia International Pvt. Ltd. in association with Fitterfly Technologies Pvt. Ltd. This nutrient calculator recorded food intake as a 24-hr recall and analyzed nutrient intake in comparison with the respective RDAs (Recommended Dietary Allowances). The RDAs for nutrients were based on ICMR/NIN (2020).[20] The nutrient values of the foods in the database of this app were based on IFCT (Indian Food Composition Tables), NIN 2017.[21] The survey respondents were requested to visit the website (www.protinex.com) and click on the 'Nutrient-calculator' to enter the demographic details, height, weight, and dietary intake (major and minor meals) of the previous day. The nutrient intake report was generated at the end, that mentioned the current intake against the RDA for each survey respondent. Nutri-Calculator available at https://www.protinex.com/immuno-nutrient-calculator/

### 2.3 Data collection procedure

The survey was conducted between the 25$^{th}$ of September 2021 to 28$^{th}$ of October 2021. Global market research and public opinion specialist agency that abides by the European Society of Market Research (ESOMAR) protocol was engaged in conducting the survey. The agency followed the computer-aided telephonic interview (CATI) methodology to conduct the survey. Initially, all the subjects were telephonically contacted to verify their eligibility for participation in the survey. An informed consent form was taken from all the qualifying subjects. The subjects were administered the survey orally for 15-20 minutes after confirming their eligibility. Each completed survey was screened for quality checks by the market research team after the completion of data

 

collection. 20% of these surveys were further backchecked at random to ensure responses to all the questions were received and there were no misses or lapses.

### 2.2 Data Analysis

The responses obtained from the survey were analyzed using the Microsoft Excel spreadsheets version 2021. The mean, median, and mode for the data variables were analyzed using predefined formulas in the Microsoft Excel sheet.

## 3.RESULTS

### 3.1. Demographics of the respondents

Data of a total of 1000 subjects who had a history of diabetes without any co-morbidities were analyzed in the study. Out of the total respondents, 58.8% were male and 41.2% were female. Majority of the respondents had a long-standing history of diabetes of over 7 years. Figure 1 shows the age categorization of the respondents. Most of the respondents belonged to the age group 41-50 years.

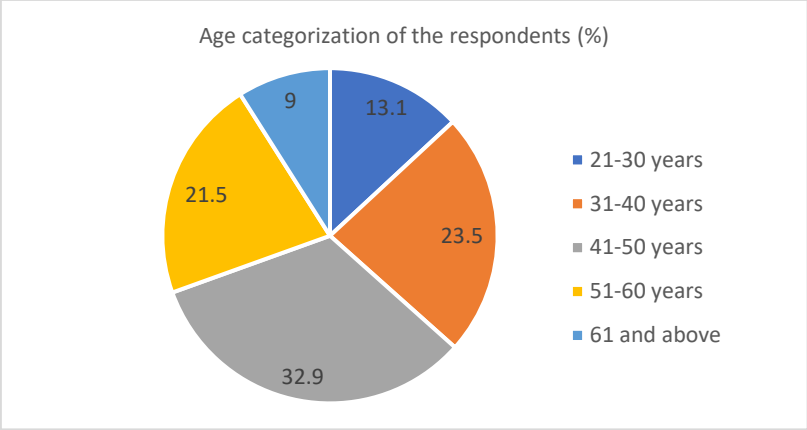


**Figure 1:** Age categorization of the respondents

The study analyzed subjects from both working and non-working groups. The working group was further divided into working professionals and self-employed/businesspersons. The non-working group was divided into housewives and the unemployed population. The occupational status of maximum respondents was either self-employed/businessperson (39.4%) or housewife (36.6%). Figure 2 categorizes the respondents based on their occupation.

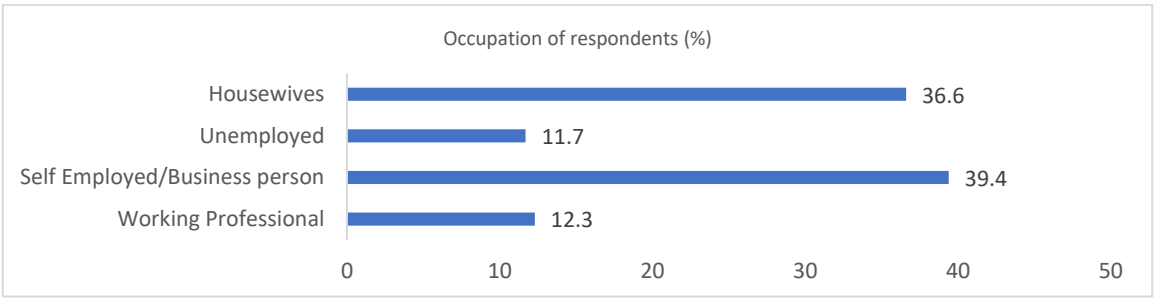


**Figure 2:** Occupation of the respondents

### 3.2. Importance of protein intake in diabetes

After the survey analysis, it was observed that 95% of the respondents were aware of the importance of protein intake in diabetes (Figure 3). Out of the 95% of respondents, 54.7% were male and 40.3% were female. Respondents in the age group 41-50 years were more aware of the importance of protein intake in diabetes than other age groups (Figure 4). When the respondents were assessed on the advantage of consuming protein-rich foods, a majority (52.4%) of the respondents believed that a protein diet is important for weight management (Figure 5).

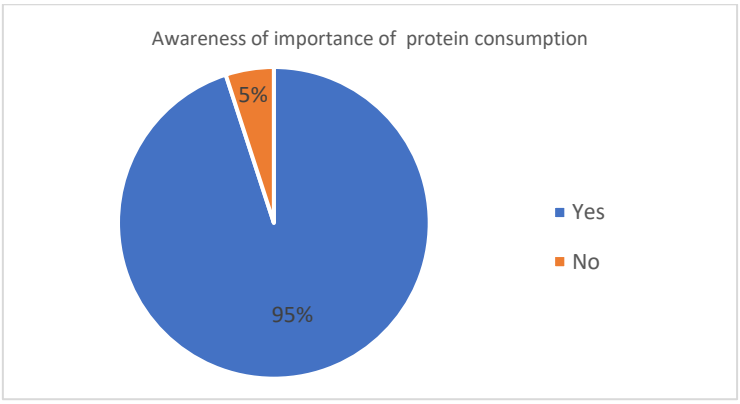


**Figure 3:** Awareness of the importance of protein intake

 

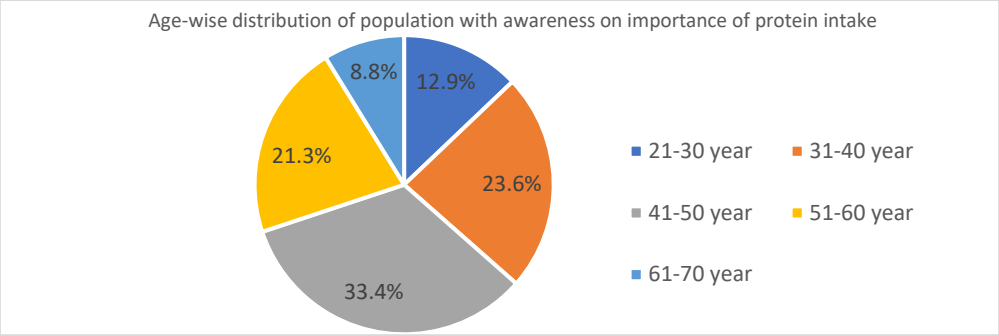


**Figure 4:** Age-wise distribution on the awareness of the importance of protein intake

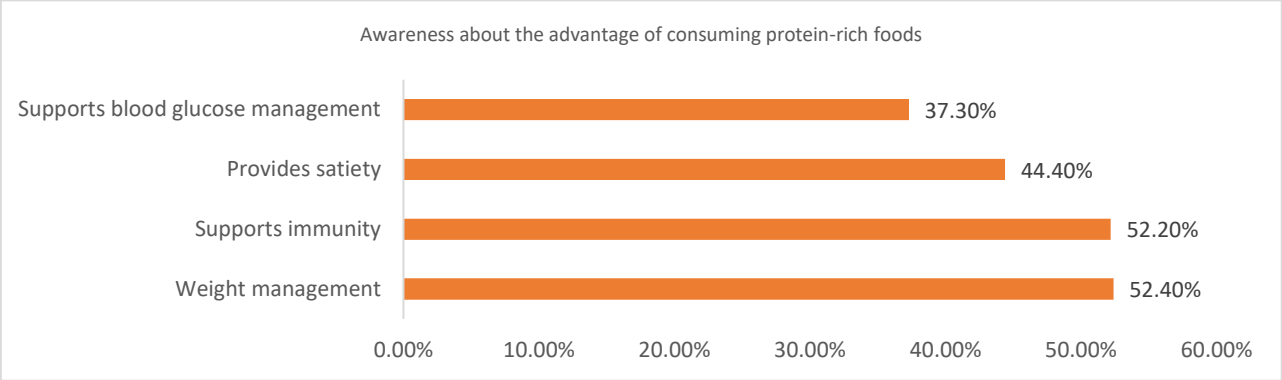


**Figure 5:** Awareness about the advantage of consuming protein-rich foods in diabetes

Of the total respondents surveyed, 86.5% assumed that they met the daily requirement of protein. However, the 24-hr diet recall revealed that only 14.8% of the people actually met the requirement (Figure 6) while 85.2% did not meet the requirement. Out of the respondents who did not meet the protein requirement, around 60% were male and 40% were female. Furthermore, it was seen majority of respondents (85.7%) belonging to the age group 41-50 years were consuming a diet deficient in protein. The highest percentage of respondent groups who had protein-deficient diets were self-employed (84.7%) and housewives (86.0%).

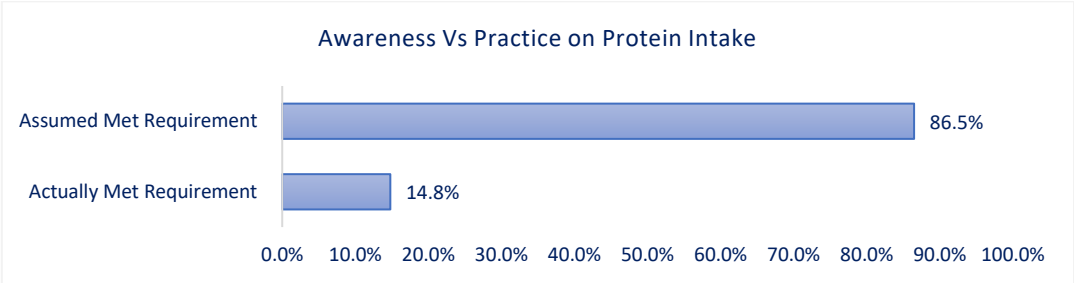


**Figure 6:** Percentage of people assumed protein requirement met and actually met

### 3.3. Importance of fiber intake in diabetes

Out of the total respondents, it was observed that 92% were aware of the importance of fiber intake in diabetes (Figure 7). Out of the 92% respondents, 56.7% were male and 43.3% were female. Respondents in the age group 41-50 years (31.1%) were more informed of the importance of fiber intake in diabetes than other age groups. When the respondents were assessed on the advantage of consuming fiber-rich foods, the majority (54.3%) of the respondents believed that a fiber-rich diet is important for better digestive health (Figure 8).

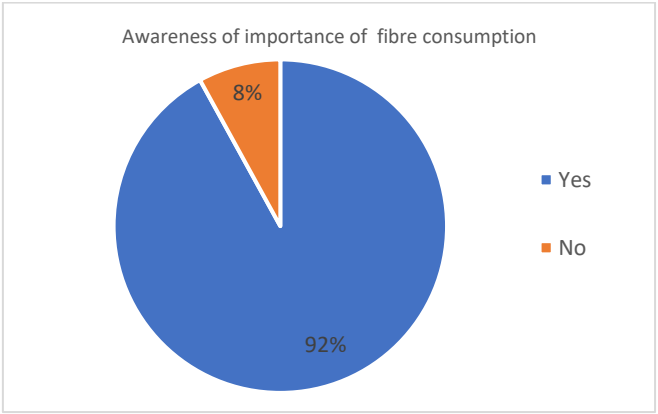


**Figure 7:** Awareness of the importance of fiber intake

 

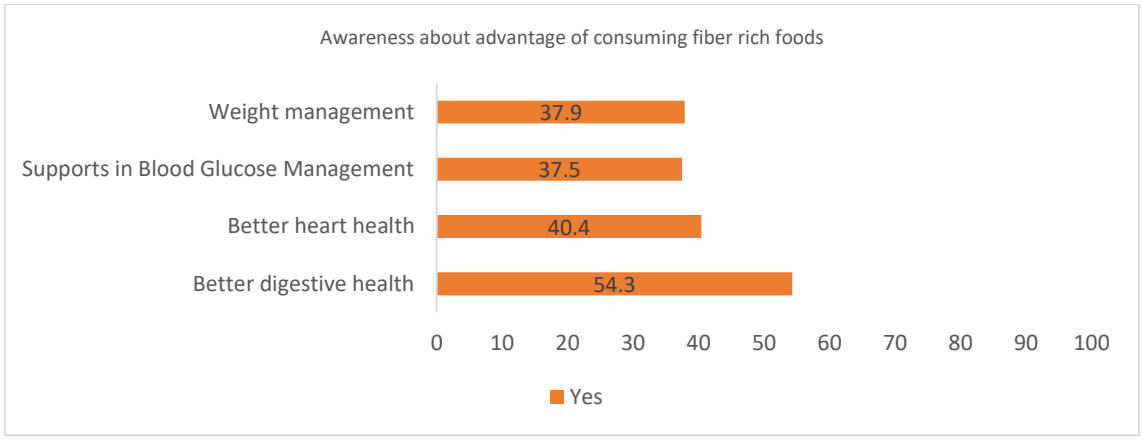


**Figure 8:** Awareness about the advantage of consuming fiber-rich foods in diabetes

Of the total respondents surveyed, 81.4% assumed that they met the daily requirement of fiber. However, the 24-hr diet recall revealed that only 21.2% of the people actually met the fiber requirement (Figure 9) while the majority (nearly 78.8%) of respondents did not meet the requirement. Of all the respondents who were consuming a fiber deficient diet, 57.8% were male and 42.2% were female. Furthermore, majority of respondents (79.9%) belonging to the age group 41-50 years were consuming a diet deficient in fiber. The highest percentage of respondent groups who had fiber-deficient diets were self-employed (78.4%) and housewives (79.2%).

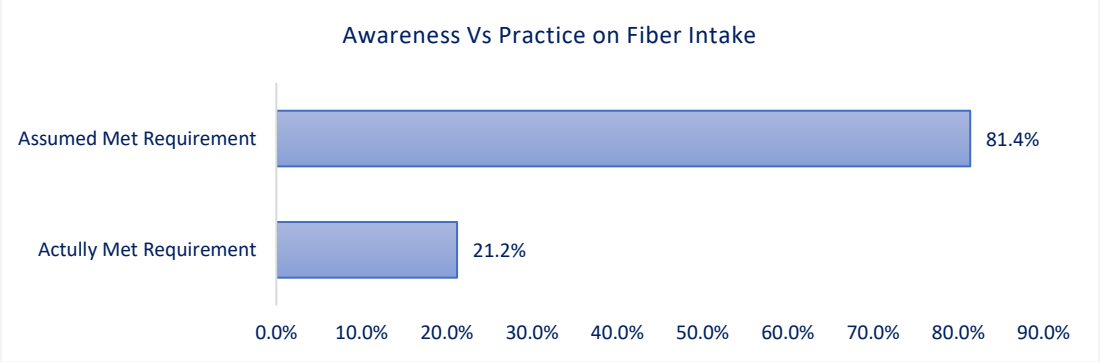


**Figure 9:** Percentage of people assumed fiber requirement met and actually met

### 3.4. Importance of glycemic index in diabetes

When the respondents were asked about the familiarity of the term glycemic index of foods/drinks, 79.1% of respondents were unaware of the term glycemic index. Amongst the respondents unaware of the term glycemic index, majority (60.2%) were male and the rest (39.8 %) were female. Furthermore, on analyzing the responses, it was observed that nearly 60% of the respondents were unaware whether foods with either a high glycemic index or low glycemic index were beneficial for them. Majority of the respondents in the age group 41-50 years (33.4%) were unaware of the importance of glycemic index of foods. Moreover, most of the respondents were oblivious of the ideal glycemic index for individuals with diabetes (Figure 10).

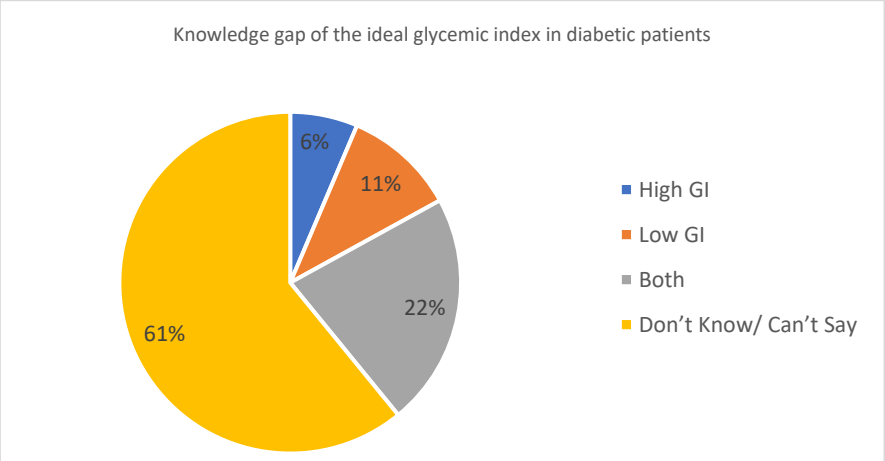


**Figure 10:** Knowledge gap of the ideal glycemic index in diabetic patients

### 3.5. Analysis of micronutrient intake

Additional analysis of micronutrient intake was done using the 24-hr diet recall Nutri-calculator to get an overall picture of the nutritional intake of the respondents. It revealed that majority of the respondents consumed a diet deficient in major micronutrients including calcium (98.4%), iron (93.7%), and vitamin D (100%) (Figure 11).

 

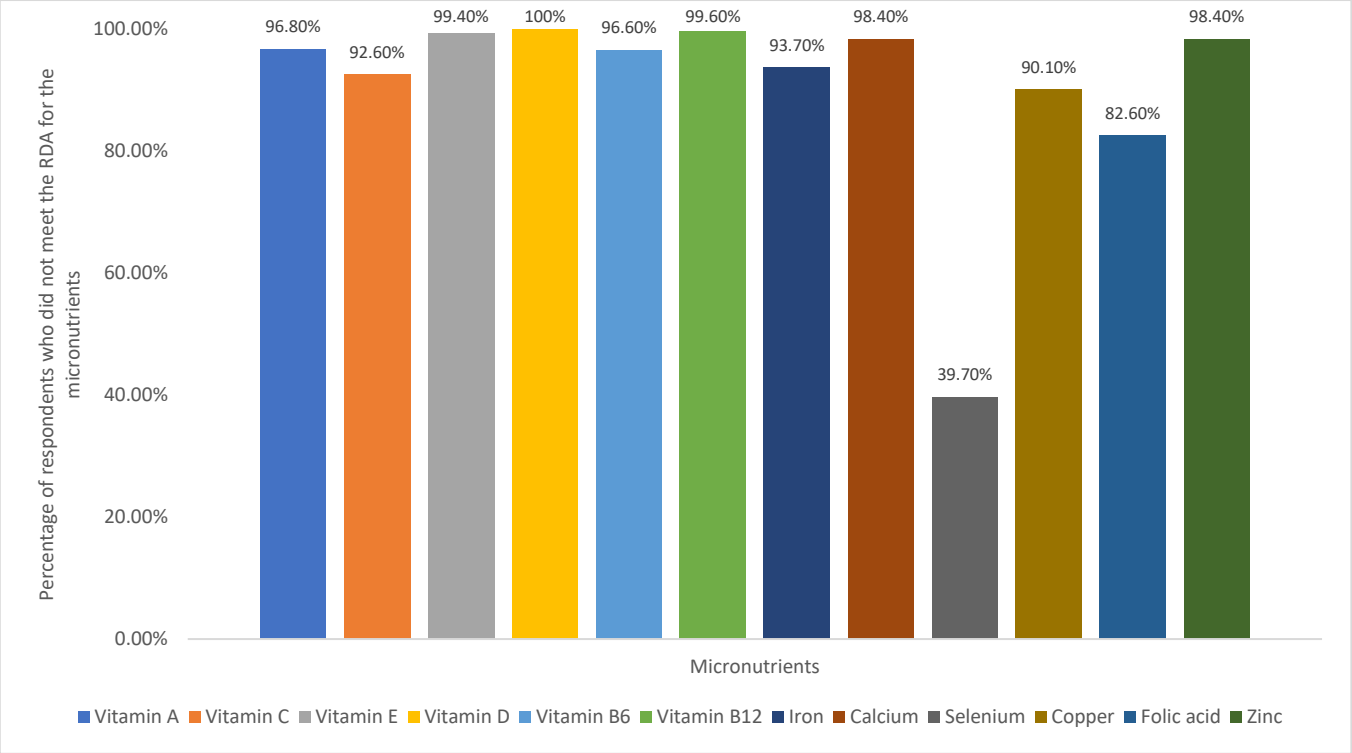


**Figure 11:** Percentage of participants consuming diets deficient in micronutrients

### 3.6. Relation of protein and fiber deficient diet in individuals with hunger pangs

Nearly 53.5% of respondents reported excess hunger pangs each day. On further analysis of the data, it was observed that maximum respondents with hunger pangs were consuming a diet deficient in proteins and fiber (Figure 12 and Figure 13). Amongst the people who consumed a protein-deficient diet, 52.7% reported having excess hunger pangs. (Figure 12). Similarly, excess hunger pangs were observed in people (51.9%) who consumed fiber deficient diets (Figure 13).

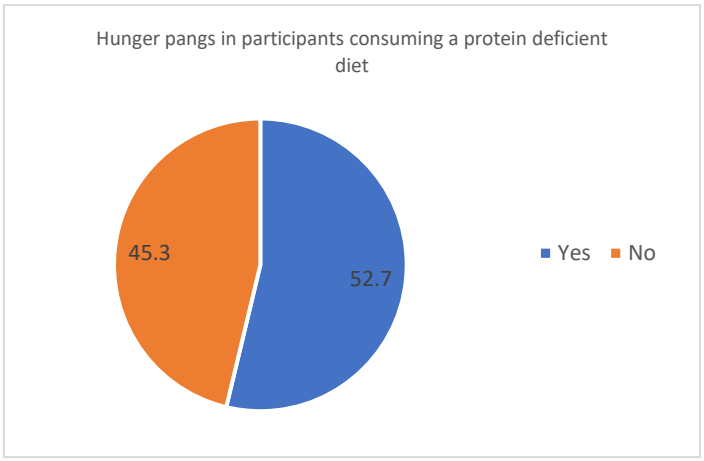


**Figure 12:** Percentage of people with hunger pangs who consumed protein-deficient diets

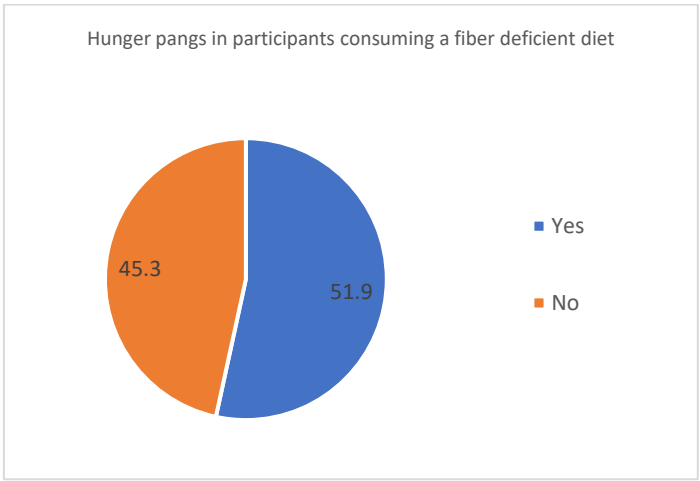


**Figure 13:** Percentage of people with hunger pangs who consumed fiber deficient diet

 

### 3.7. Analysis of participants feeling tired during the day

When the respondents were asked if they felt tired during the day, most of them (44.6%) reported that they sometimes felt tired during the day, 10.7% reported that they often felt tired during the day, and 7.9% reported that they always felt tired during the day (Figure 14).

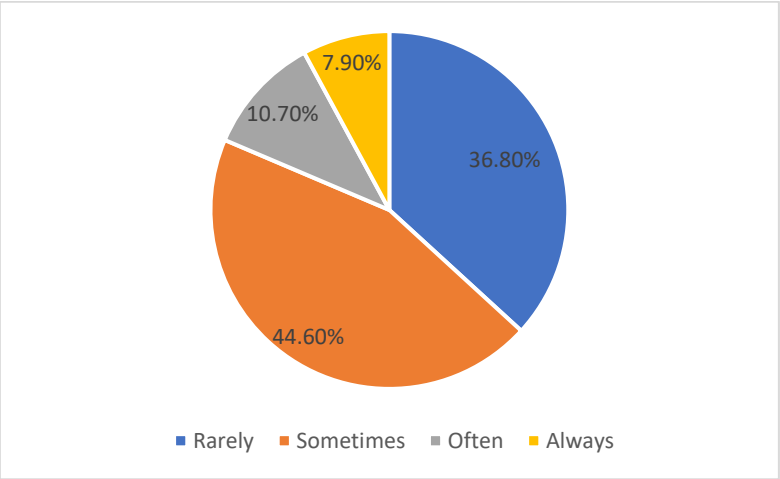


**Figure 14:** Percentage of participants feeling tired during the day

### 3.8 Engagement in physical activity

When asked about the physical activity, majority of the respondents (69.7%) said that they engaged in regular physical activity (Figure 15).

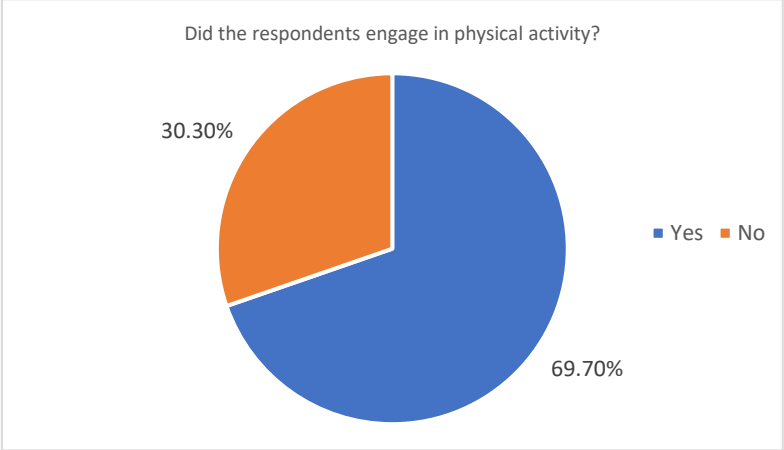


**Figure 15:** Percentage of participants engaging in physical activity

## 4. DISCUSSION

Diabetes mellitus can cause muscle mass and strength loss as a result of poor glycemic control, neuropathy or vasculopathy complications, overweight/obesity, insulin resistance, inflammatory cytokines, and endocrine changes. With a high prevalence of diabetes, fatigue symptoms such as frailty, muscle weakness, impaired mobility, functional limitation, and loss of independence are commonly reported. One of the risk factors, i.e., nutrition imbalance contributes significantly to muscle frailty and sarcopenia, and has been linked to fatigue symptoms. Thus, dietary intervention plays a very important role in the management of diabetes mellitus.[22] Generally, dietary recommendations for the diabetic population focus mainly on the intake of carbohydrates and fats. Proteins are considered only for the maintenance of lean body mass. However, studies report a synergistic effect on insulin secretion when protein was administered with glucose.[9] High protein and low carbohydrate diet have a beneficial effect on HbA1C and postprandial blood glucose. Furthermore, a short-term diet that replaces refined carbohydrates with proteins has been shown to improve cardiovascular risk factors by increasing weight loss and improving lipids.[13] Moreover, a higher protein intake reduces hunger, improves satiety, increases thermogenesis, and limits lean muscle mass loss during weight loss with a low-calorie diet and increased physical activity.[23] In the present study, majority of the respondents believed that a diet rich in protein is important for weight management while only a few respondents believed that proteins support the management of blood glucose levels.

Dietary fibers are known to decrease levels of total cholesterol and reduce hyperglycemia in individuals with diabetes. Moreover, fiber intake improves insulin sensitivity, reduces systemic inflammation, severity of type 2 diabetes mellitus, and occurrence of risk factors associated with cardiovascular diseases.[14] Most of the respondents in the present study believed that dietary fibers are responsible for better digestive health, while only a few respondents believed that dietary fiber aids in diabetes management. Dietary fibers aid in diabetes management by either of the following mechanisms: (1) reduces energy intake and appetite by reducing the energy density of foods; (2) increases sensory satiety and reduces meal size as fiber-rich foods take longer time to chew; (3) decrease in intestinal passage rates leading to a prolonged feeling of satiety; (4) fermentation of dietary fibers in the colon increasing the concentration of short-chain fatty acids and enhancement of satiety.[15]

Adequate knowledge of diabetes and nutritional management in individuals with diabetes is crucial in diabetic care. It enables diabetic individuals to make food choices that optimize metabolic self-management and quality of life. Furthermore, increasing

 

individual awareness of diabetes management increases compliance to treatment and decreases the risk of diabetes-related complications. Evidence have shown that individuals with diabetes usually have significant deficits in diabetes-related nutrition awareness.[24] The present study analyzed the knowledge and perception of the diabetic population on the importance of micro-and macro-nutrient intake. The respondents assumed that they had sufficient intake of the macronutrients namely protein and fiber; however, after analysis from the 24-hr diet recall, it was observed that maximum respondents did not meet the recommended dietary allowance (RDA) of both these nutrients. Additionally, the study also revealed that individuals on a protein and fiber-deficient diet had greater hunger pangs, thereby indicating a strong relation between nutritional deficiency and hunger pangs. In diabetic individuals, hyperglycemia might result in insulin resistance or lack of insulin where the body is unable to convert the food you eat into energy. As a result, hunger increases due to this lack of energy. Simply eating might just result in high blood glucose levels and thus here exercise and proper nutrition play an important role in stimulating insulin production and reducing blood sugar levels.[25]

Evidence suggests that a low glycemic diet lowers the glucose and insulin responses throughout the day, in addition to, improvement in lipid profile, and the capacity for fibrinolysis.[26] Low glycemic index diets have been shown to prevent coronary heart disease in both diabetic and nondiabetic individuals. Low-glycemic index meals also increase satiety and help in the control of food intake in obese or overweight people.[27] Awareness about the various food groups and their effect on blood glucose levels is vital and enables diabetic patients in reducing or avoiding certain foods that affect blood glucose levels.[24] In the present study, majority of respondents were unaware of the term glycemic index, and the ideal glycemic index for diabetic patients. Similar results were observed in one of the studies where the awareness about the glycemic index in diabetic individuals was studied. In that study, the dietitians reported that the glycemic index is very difficult for individuals to understand and apply. However, it was observed that when individuals with diabetes underwent GI education successfully it lowered their dietary GI.[28]

The 24-hr diet recall using Nutri-calculator also analyzed the dietary intake of micronutrients in the respondents of this survey. It was observed that only a small percentage of respondents met the RDAs of the micronutrients. Association between diabetes mellitus and alteration in micronutrients has been well-established in several trials. Reduced plasma levels of micronutrients in individuals with diabetes results from an increase in metabolic demand for micronutrients due to altered protein metabolism, as well as an increase in losses through body fluids. Several studies have reported that altered levels of micronutrients have a negative impact on glucose homeostasis and insulin sensitivity in subjects with type 2 diabetes and may lead to complications of the disease.[29]

## 5. CONCLUSION

Nutrition management is an important aspect of the regulation of glycemic control in individuals with diabetes. Adequate intake of dietary protein and fiber, in addition to a low glycemic index diet, is essential for the nutritional management of diabetes mellitus. A diet high in protein and fiber and low in glycemic index has been shown to reduce hunger pangs and improve satiety in individuals with diabetes mellitus. In the current study, it was observed that respondents were aware of the importance of dietary intake of protein and fiber. Despite the awareness of the importance of these nutrients, majority of the individuals did not meet the RDAs for both macro-and micro-nutrients. Furthermore, the awareness regarding the importance of glycemic index of foods was poor among these participants. This shows a gap between awareness and actual practice which is a major point of concern that has come to light in the present study. This needs attention not only from the healthcare and wellness sector but also from the individuals themselves. People with diabetes need to be counseled about diet and lifestyle for the effective management of this condition. Nutrient Calculator, similar to the one used in this study, can effectively be utilized to understand the nutrition gap between the current intake and the requirement.

## 6. ACKNOWLEDGEMENT

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