"A ONE YEAR OBSERVATIONAL STUDY TO ASSESS THE KNOWLEDGE ATTITUDE AND PRACTICES ABOUT HYPOGLYCEMIA IN DIABETIC PATIENTS PRESENTING WITH HYPOGLYCEMIA IN A TERTIARY CARE CENTRE OF NORTH KARNATAKA (DR. PRABHAKAR KORE HOSPITAL AND M.R.C)"

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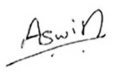

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A ONE YEAR OBSERVATIONAL STUDY TO ASSESS THE KNOWLEDGE ATTITUDE AND PRACTICES ABOUT HYPOGLYCEMIA IN DIABETIC PATIENTS PRESENTING WITH HYPOGLYCEMIA IN A TERTIARY CARE CENTRE OF NORTH KARNATAKA (DR. PRABHAKAR KORE HOSPITAL AND M.R.C)",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

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LIST OF ABBREVIATIONS

Sl. No	Abbreviation	Full Form
1	DM	Diabetes Mellitus
2	T1DM	Type 1 Diabetes Mellitus
3	T2DM	Type 2 Diabetes Mellitus
4	HbA1c	Glycated Hemoglobin
5	KAP	Knowledge, Attitude, and Practice
6	HAAF	Hypoglycemia-Associated Autonomic Failure
7	DKA	Diabetic Ketoacidosis
8	RBS	Random Blood Sugar
9	SES	Socio-Economic Status
10	SPSS	Statistical Package for the Social Sciences
11	IEC	Institutional Ethics Committee
12	NPDR	Non-Proliferative Diabetic Retinopathy
13	PDR	Proliferative Diabetic Retinopathy
14	VEGF	Vascular Endothelial Growth Factor
15	GFR	Glomerular Filtration Rate
16	TNF-α	Tumour Necrosis Factor-alpha
17	IL-6	Interleukin-6
18	LDL	Low-Density Lipoprotein

19	CVD	Cardiovascular Disease
20	PAD	Peripheral Arterial Disease
21	ADR	Adverse Drug Reaction
22	TEP	Therapeutic Education Program
23	HR-QoL	Health-Related Quality of Life
24	DKTS	Diabetes Knowledge Test Score
25	ICU	Intensive Care Unit

ABSTARCT

Background*:* Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from insulin deficiency, insulin resistance, or both. Stringent glycemic control, although beneficial in reducing complications, increases the risk of hypoglycemia, which remains a serious concern among diabetic patients. Understanding the knowledge, attitudes, and practices (KAP) related to hypoglycemia is essential for effective diabetes management. This study aims to assess the KAP regarding hypoglycemia among diabetic patients and explore its association with glycemic control.

Objectives*:* The primary objectives of this study were to evaluate the knowledge, attitudes, and practices regarding hypoglycemia among diabetic patients, to assess the association between glycemic control, as indicated by HbA1c levels, and the incidence of hypoglycemia, and to identify key demographic and clinical factors influencing knowledge and management practices related to hypoglycemia.

Methods*:* A cross-sectional observational study was conducted among 60 diabetic patients presenting with hypoglycemia at a tertiary care hospital in North Karnataka. Data collection was carried out using a structured questionnaire that covered socio-demographic details, knowledge, attitudes, and practices regarding hypoglycemia, along with clinical history. Blood samples were analyzed for HbA1c levels. Statistical analysis was performed using SPSS version 27.0. Descriptive statistics and inferential tests, including the Chi-square test, t-test, and Mann-Whitney U test, were used to assess associations between variables.

Results*:* The study population consisted of 58.3% males and 41.7% females, with a majority of 58.3% residing in rural areas. Most participants had completed secondary education (61.7%) and belonged to socio-economic class III (45.0%). The mean

HbA1c level among participants was 7.96% with a standard deviation of 1.75. Patients on oral hypoglycemic agents demonstrated significantly better glycemic control compared to those on insulin therapy ($p = 0.01$). Only 48.3% of participants were aware that diabetes treatment could cause hypoglycemia, and 88.3% could not correctly identify the plasma glucose threshold for hypoglycemia. Furthermore, 71.7% of participants lacked knowledge regarding preventive measures for hypoglycemia. Although 85.0% of participants regularly monitored their blood glucose levels, misconceptions about hypoglycemia were common, with 33.3% believing that very low blood sugar levels were beneficial. Adherence to a diabetic diet was reported by 90.0% of participants. Healthcare engagement was high, with 96.7% of participants consulting doctors for dose adjustments and 93.3% relying on doctors as their primary source of diabetes-related information. **Conclusion:** The study reveals substantial knowledge gaps and misconceptions regarding hypoglycemia among diabetic patients. Although adherence to glucose monitoring and dietary recommendations was relatively high, a lack of awareness regarding hypoglycemia symptoms, causes, and preventive strategies remains a significant concern. Targeted educational interventions focusing on insulin users, rural populations, and individuals with poor glycemic control are necessary to improve patient outcomes. Healthcare providers play a pivotal role in delivering structured education programs to enhance diabetes management and prevent complications associated with hypoglycemia.

Keywords: Diabetes mellitus, Hypoglycemia, Knowledge, Attitudes, Practices, Glycemic control, HbA1c, Insulin therapy, Patient education.

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INTRODUCTION

Background

Diabetes mellitus (DM) is a chronic and complex metabolic disorder characterized by hyperglycemia due to defects in insulin secretion, insulin action, or both. The condition has reached epidemic proportions globally, with the International Diabetes Federation estimating that 537 million adults aged 20-79 years were living with diabetes in 2021, a number expected to rise to 783 million by 2045.[1] The disease significantly contributes to morbidity and mortality, with approximately 6.7 million deaths annually. Among the two primary types of diabetes, type 2 diabetes mellitus (T2DM) accounts for 90–95% of cases globally and is primarily influenced by factors such as obesity, sedentary lifestyles, and aging populations, while type 1 diabetes mellitus (T1DM) is autoimmune in nature and commonly affects younger individuals.[2]

Achieving glycemic control is the cornerstone of effective diabetes management, aimed at reducing the risk of acute and chronic complications. Despite its benefits, stringent glycemic control is associated with an increased risk of hypoglycemia, particularly in individuals receiving insulin therapy or insulin secretagogues. Hypoglycemia, characterized by blood glucose levels below 70 mg/dL, can lead to severe outcomes, including seizures, coma, and death, especially when left unmanaged.[3] This highlights the need for improved knowledge, attitudes, and practices (KAP) among diabetic patients to enhance their ability to recognize, prevent, and manage hypoglycemia effectively.

Significance of the Study

Hypoglycemia poses significant health and economic challenges for individuals with diabetes. It adversely affects quality of life, as patients experiencing frequent hypoglycemic episodes often report psychological distress, social withdrawal, and fear of future episodes, which can hinder effective diabetes management. Severe hypoglycemia has been associated with cardiovascular complications, neurological deficits, and increased mortality. Moreover, hypoglycemia-related hospitalizations and complications impose a substantial economic burden on healthcare systems.

Understanding the gaps in KAP related to hypoglycemia is crucial to addressing these issues. Many patients lack awareness of hypoglycemic symptoms, triggers, and preventive measures, leading to delayed interventions and adverse outcomes. Attitudinal barriers, such as fear of insulin or misconceptions about diabetes management, and poor practices, including inconsistent glucose monitoring and medication non-adherence, further exacerbate the problem.

This study is particularly significant in the context of North Karnataka, where socio-cultural barriers, low literacy levels, and inadequate access to specialized diabetes care limit effective management of the disease. Targeted educational interventions, informed by the specific KAP gaps in this population, can empower patients with the knowledge and skills required to manage hypoglycemia, ultimately improving health outcomes and reducing the burden on healthcare systems.

RESEARCH OBJECTIVES

Primary Objective:

- To assess the knowledge, attitudes, and practices (KAP) regarding hypoglycemia among diabetic patients presenting with hypoglycemia.

Secondary Objective:

- To evaluate the relationship between strict glycemic control (as indicated by HbA1c levels) and the occurrence of hypoglycemic episodes.

Research Questions

1. What is the level of knowledge regarding hypoglycemia symptoms, causes, and prevention among patients with hypoglycemia?
2. What attitudes do diabetic patients hold toward hypoglycemia management and prevention?
3. What practices are adopted by diabetic patients to manage and prevent hypoglycemia?
4. What is the relationship between strict glycemic control (HbA1c levels) and the frequency of hypoglycemic episodes?
5. What are the specific socio-cultural and educational barriers affecting KAP related to hypoglycemia in the North Karnataka population?

Research Hypotheses

Null Hypothesis (H_0):

- There is no significant association between the level of knowledge, attitudes, and practices regarding hypoglycemia and the incidence of hypoglycemia among diabetic patients.

Alternative Hypothesis (H_1):

- There is a significant association between the level of knowledge, attitudes, and practices regarding hypoglycemia and the incidence of hypoglycemic among diabetic patients.

Null Hypothesis (H_0):

- Strict glycemic control (HbA1c levels) is not significantly associated with the incidence of hypoglycemia among diabetic patients.

Alternative Hypothesis (H_1):

- Strict glycemic control (HbA1c levels) is significantly associated with the incidence of hypoglycemic among diabetic patients.

REVIEW OF LITERATURE

1. A study conducted by Isnani, Macalalad-Josue, and Jimeno in 2021 examined the knowledge, attitudes, and practices (KAP) of health care providers at the Philippine General Hospital regarding hypoglycemia management among non-critically ill patients using a validated, self-administered survey tool. The study involved two phases: the development and validation of a 43-item KAP survey tool and the assessment of KAP among nurses and residents through analytic cross-sectional studies and focused group discussions (FGDs). The results showed a low overall mean score (12.56 ± 2.11) in the knowledge domain, despite higher scores (4.88 ± 1) for knowledge on hypoglycemia management, while 52.8% of respondents demonstrated correct practices. Additionally, 99.31% of participants recognized the correlation between fewer hypoglycemia events and better clinical outcomes and expressed willingness to adopt a nurse-driven protocol. FGDs further identified facilitators and barriers to hypoglycemia management.[4]
2. A study by Bhutani et al. (2015) investigated the impact of diabetic education on the knowledge, attitudes, and practices (KAP) of diabetic patients regarding hypoglycemia prevention. This longitudinal study used a structured questionnaire to collect baseline information on patients' KAP related to hypoglycemia. Following this, patients received education from their treating doctors about hypoglycemia, its symptoms, and prevention strategies. The same questionnaire was administered after one month, and the frequency of hypoglycemic symptoms was compared before and after the intervention. The findings revealed a significant improvement in KAP scores and a notable decrease in hypoglycemic episodes, demonstrating that diabetic education plays

a critical role in enhancing patient awareness and promoting better practices to prevent hypoglycemia.[5]

3. A study by Asmelash et al. (2019) assessed the knowledge, attitude, and practice (KAP) towards glycemic control and its associated factors among diabetic patients attending the University of Gondar Hospital between March and May 2018. This cross-sectional study involved 403 participants selected through a simple random sampling technique, with data collected using structured questionnaires. The findings revealed that 62% of participants had good knowledge, 67.2% demonstrated a positive attitude, and 74.4% exhibited good practices towards glycemic control. Multivariate logistic regression analysis identified occupational and marital status as significant factors influencing knowledge, while educational status, occupational status, and marital status significantly influenced both attitude and practice. The study concluded that while most participants demonstrated favorable KAP towards glycemic control, socio-demographic factors played a vital role in shaping these outcomes.[6]

4. A study by Magbol et al. (2024) explored the knowledge, attitudes, and practices (KAP) of diabetic patients regarding hypoglycemia symptoms at Atbara Teaching Hospital, Sudan, between December 2022 and October 2023. This descriptive cross-sectional study included 200 diabetic patients selected through total coverage sampling, with data collected using a close-ended questionnaire. The results indicated an equal male-to-female ratio, with most participants aged 20-35 and HbA1c levels between 7% and 10%. Forty-four percent of participants had diabetes for less than 10 years, and the majority were on oral hypoglycemic drugs with good adherence. Tremor was the most

commonly reported hypoglycemia symptom, and most patients managed symptoms independently.[7]

5. A study by Ngo et al. (2020) assessed the knowledge, attitude, and practice (KAP) of Vietnamese diabetic outpatients regarding hypoglycemia, insulin use, and insulin pens, as well as the factors influencing KAP, adverse drug reactions (ADRs), and glycemic control. The study involved interviews using a structured questionnaire and observation of insulin pen injection techniques among 148 participants (response rate: 74%). Results revealed that 45.9% had good knowledge, 78.4% demonstrated a positive attitude, and 44.6% showed good practice. Common errors in insulin pen use included skipping priming the pen needle (90.9%) and not removing used needles after use (87.8%). Better KAP was associated with longer insulin use, prior health professional counseling, and a positive attitude toward insulin's role. Poor practice correlated with higher ADR incidence at injection sites, and inadequate knowledge increased hypoglycemia risk.[8]
6. A multinational cross-sectional study by Naser et al. (2019) explored the attitudes, perceptions, and problem-solving abilities of patients with diabetes mellitus towards hypoglycemia across Jordan, Saudi Arabia, and Kuwait. Conducted from October 2017 to May 2018, the study included 895 patients who were prescribed antidiabetic therapy and had experienced hypoglycemic events in the previous six months. Using the Hypoglycemia Problem-Solving Scale, the study found that patients demonstrated moderate problem-solving abilities, with better scores in problem-solving skills (68.1%) than in problem orientation (58.3%). Detection control, goal setting, and strategy evaluation had the highest sub-scale scores (75.0%), while problem-solving perception and immediate management scored lowest (50.0%). Significant predictors of

problem-solving ability included older age, education, marital status, type 2 diabetes mellitus, insulin use, and lack of recent hospital admission for hypoglycemia ($p < 0.05$).[9]

7. A study by Huang et al. (2022) assessed the knowledge, attitudes, and practices (KAP) of ICU staff regarding glycemic management in critically ill adult patients through a multicentre cross-sectional survey involving 403 participants from nine tertiary hospitals in China. Most respondents were nurses (93.4%), predominantly female (82.4%), with an average work experience of 8.88 years. The scoring rates for knowledge, attitudes, and practices were 82.35%, 87.69%, and 76%, respectively. Factors influencing KAP included knowledge awareness, recognition of importance ($p < 0.001$), and glucose control training ($p = 0.004$). The study concluded that while ICU staff demonstrated acceptable KAP levels, there is a need for enhanced training on nutrition, glucose variability, and practical glucose management skills.[10]
8. A study by Al-bawi et al. (2022) assessed the knowledge and attitudes of nurses towards hypoglycemia in diabetic patients hospitalized at Marjan Teaching Hospital, Babylon, Iraq. This cross-sectional descriptive study included 172 nurses selected through purposive sampling, with data collected using a questionnaire comprising demographic information, knowledge assessment, and attitude evaluation. Findings revealed that most participants were women (55.8%), predominantly aged 20-29 years. Nurses demonstrated a moderate level of knowledge, scoring an average of 57.47 out of a possible 70, with 59.86% of knowledge points related to hypoglycemia achieved. The average attitude score was 17.41 out of 24, indicating a generally positive outlook towards managing hypoglycemia.[11]

9. A study by Abualhommos et al. (2024) evaluated the experiences and knowledge of adult diabetic patients in Saudi Arabia regarding hypoglycemia and its management. This online cross-sectional survey, conducted from September to October 2022, included 305 participants, with 56.4% diagnosed with type 1 diabetes mellitus. Approximately 65% of participants reported needing help during a hypoglycemic episode. Patients demonstrated moderate knowledge of hypoglycemia, achieving 57.5% of the total score, with correct responses to knowledge questions ranging from 15.4% to 71.1%. Notably, 32% of respondents could identify at least one method to reduce hypoglycemia risk. Factors positively influencing knowledge included older age (41-45 years and over 51 years), employment in healthcare or retirement, higher education levels, and being widowed ($p \leq 0.05$).[12]
10. A study by Al Zahrani et al. (2021) assessed the knowledge of adult diabetic patients in Jeddah, Saudi Arabia, about hypoglycemia and its management. Conducted at National Guard Primary Health Care Centers, the cross-sectional study involved 361 participants, predominantly women (57.6%) and Type 2 diabetes patients (94.5%). Using a newly developed self-administered questionnaire with a total score of 42, knowledge levels were categorized as good (≥31.5), moderate (21–31.5), and poor (<21). The majority (92.2%) demonstrated poor knowledge, with a mean score of 32.0 (±8.2). Factors significantly associated with better knowledge included being male, younger, a student, single, holding a bachelor's degree, earning a high income, having Type 1 diabetes, and prior hypoglycemia experience. For hypoglycemia management, 66.8% correctly identified "eating 15 g of fast-acting carbohydrate" as the appropriate response.[13]

11. A study by Alomani et al. (2021) assessed the knowledge and practices of primary care physicians in Saudi Arabia regarding impaired awareness of hypoglycemia (IAH), a critical condition that increases the risk of severe hypoglycemia and mortality in diabetic patients. This cross-sectional study involved 292 physicians from tertiary hospitals and primary care clinics in Riyadh between December 2018 and June 2019. The findings revealed that 59.9% of physicians had acceptable knowledge of IAH, while 40.1% had poor knowledge. Physicians with average or above-average familiarity with IAH scored higher on knowledge (mean 5.32 vs. 4.39, p=0.000), as did those who had managed IAH patients (mean 5.58 vs. 5.01, p=0.019). Significant differences in knowledge scores were associated with physicians' ages, training levels, and years of practice.[14]
12. A study by Larsson et al. (2018) investigated the self-management of overnight glycemia in adults with type 1 diabetes (T1D) through a survey conducted at two Australian tertiary referral diabetes clinics. The study included 205 participants, with a mean age of 41 years and a T1D duration of 20 years. Key findings revealed that many patients had suboptimal knowledge and behavior regarding nocturnal hypoglycemia (NH) management. While 36% treated NH with the recommended refined, then complex, carbohydrate, only 28% made safe choices in all bedtime blood glucose (BG) scenarios, with higher rates observed in insulin pump users ($p = 0.0005$). Participants with impaired hypoglycemia awareness (IHA) were more likely to seek further education (44%) compared to those without IHA (25%, $p = 0.006$).[15]
13. A study by Ishamael (2022) assessed diabetes knowledge, self-care practices, and glycemic control among type 2 diabetes patients at Kitui County Referral Hospital, Kenya. This descriptive cross-sectional study involved 152

participants, predominantly female (63.2%), with 43.4% aged between 50-59 years. Using the Diabetes Knowledge Questionnaire and Summary of Diabetes Self-Care Activities, the study found that 46.1% of participants had good diabetes knowledge, 44.7% practiced good self-care, and 29.61% achieved good glycemic control. Factors associated with better knowledge included higher education (AOR: 4.94, $p < 0.01$) and longer disease duration (>10 years). Patients with poor knowledge were significantly less likely to achieve good glycemic control (AOR: 0.40, $p = 0.015$), while those with good self-care practices were 2.7 times more likely to maintain glycemic control (AOR: 2.701, $p = 0.01$).[16]

14. A study by Lavu et al. (2016-2017) evaluated the effect of pharmacist-mediated counselling on the knowledge, attitude, and practice (KAP), health-related quality of life (HR-QoL), and glycemic control in diabetic patients on insulin therapy. Conducted as a prospective observational study in a tertiary care hospital, 50 patients were followed over six months, with counselling sessions provided at baseline and three months, and assessments at baseline, three months, and six months. The results showed significant improvements in KAP scores (baseline: 87.92±7.82, follow-up 1: 117.47±6.98, follow-up 2: 119.9±5.30; $p<0.001$) and HR-QoL across all domains, particularly in psychological and environmental aspects. Glycemic control, measured by HbA1C levels, improved significantly from 9.1±1.65 at baseline to 8.27±2.79 at three months ($p<0.05$) and 7.66±1.719 at six months ($p<0.001$).[17]
15. A study by Romalina et al. evaluated the effectiveness of booklets in improving the knowledge of families of diabetes mellitus (DM) patients about hypoglycemia management. Conducted at two public health centers in Indonesia, this quasi-experimental study involved 70 participants divided into

intervention and control groups, using a pre-test and post-test design. The intervention included providing a booklet on hypoglycemia management, with knowledge assessed before and after its use. Results demonstrated a significant improvement in family knowledge in the intervention group compared to the control group, with a p-value of 0.028. The study concluded that booklets are an effective educational tool for enhancing family knowledge on hypoglycemia management and recommended their use in internal medicine clinics and health centers to prevent acute complications of diabetes.[18]

16. A study by Ghadge et al. assessed the knowledge, attitude, and practice (KAP) regarding blood glucose monitoring among diabetic patients attending a tertiary care hospital in Karad, Maharashtra. This descriptive study involved 100 participants selected through purposive sampling from medical and surgical outpatient and inpatient departments. Using a structured questionnaire, the study found that 21% of participants had good knowledge, 70% had average knowledge, and 9% had poor knowledge. Positive attitudes were observed in 66% of participants, while 34% demonstrated negative attitudes. Regarding practice, 24% exhibited good practices, 48% had average practices, and 28% showed poor practices.[19]

17. A study by Vidal et al. (2020) evaluated the prevalence of hypoglycemia unawareness (HU) in young patients with type 1 diabetes (T1D) transferred from pediatric care to an adult center after completing a therapeutic education program (TEP). This program included a coordinated transfer process, individual appointments, and group courses. Fifty-six patients (mean age 18.1 years, 46% female, mean HbA1c 8.0%) participated in the study. At baseline, 16% of patients presented with HU, determined using the Clarke Test, and these patients experienced significantly higher rates of severe hypoglycemia (SH)

(0.33 vs. 0.09 episodes/patient/year, $p < 0.05$). Although the TEP reduced HU to 11% at 12 months, patients with HU continued to experience more frequent SH episodes (0.38 vs. 0.02 episodes/patient/year, $p = 0.04$).[20]

18. A systematic review by Hartill et al. explored the role of significant others (SO) in supporting patients with diabetes mellitus experiencing hypoglycemia unawareness (HU). The review adhered to PRISMA guidelines and analyzed five qualitative studies from an initial pool of 639, focusing on three main themes: the experiences and challenges faced by SO in managing HU, their support needs, and healthcare professionals' interventions. Findings revealed that SO often struggle with the emotional and practical demands of managing HU, which can strain relationships. Support needs of SO were primarily educational and psychological, including a need for greater awareness within the community. The study highlighted the importance of healthcare interventions, such as educational programs, psychosocial support, and practical strategies to assist SO in managing HU effectively.[21]
19. A study by Ejegi, Ross, and Naidoo (2016) assessed the knowledge of symptoms and self-management of hypoglycemia among adult diabetic patients attending a diabetic clinic in KwaZulu-Natal. This cross-sectional, descriptive study involved 200 participants and collected demographic data, details of current medication, and knowledge of hypoglycemia symptoms and responses through a validated questionnaire. Results showed that while most patients had fair to good knowledge of hypoglycemia symptoms, less than 25% were aware of appropriate actions to take when experiencing hypoglycemic symptoms. The study concluded that enhanced patient education is crucial, focusing on stepwise measures to prevent life-threatening complications associated with hypoglycemia.[22]

BASIC SCIENCE

Overview of Diabetes Mellitus

Diabetes mellitus (DM) is a group of chronic metabolic disorders characterized by persistent hyperglycemia due to impaired insulin secretion, insulin action, or both. It is a significant public health concern globally, associated with severe complications affecting multiple organ systems, leading to increased morbidity and mortality.

Pathophysiology of Diabetes Mellitus

The pathophysiological mechanisms of DM differ between Type 1 and Type 2 diabetes, but both ultimately result in hyperglycemia, which drives the development of long-term complications.

Type 1 Diabetes Mellitus

Type 1 diabetes mellitus is an autoimmune disorder primarily affecting children and young adults, although it can occur at any age. It is characterized by the immune-mediated destruction of insulin-producing β-cells in the pancreas, leading to absolute insulin deficiency. This form of diabetes accounts for approximately 5–10% of all diabetes cases and requires lifelong insulin therapy for survival.

The autoimmune destruction of β-cells is predominantly mediated by T-cells, with both genetic predisposition and environmental triggers playing significant roles. Genetic susceptibility is strongly associated with specific HLA haplotypes, such as HLA-DR3 and HLA-DR4. Environmental factors, including viral infections (e.g., enteroviruses) or toxins, may act as triggers for initiating the autoimmune response. The presence of specific autoantibodies, such as those targeting glutamic acid decarboxylase (GAD), islet cell antigens, or zinc transporter 8 (ZnT8), is a hallmark

of Type 1 diabetes and aids in its diagnosis, particularly in the early stages of the disease.[23]

Pathophysiologically, the complete destruction of β-cells results in an absolute insulin deficiency, leading to persistent hyperglycemia. In the absence of insulin, glucose uptake by insulin-dependent tissues such as skeletal muscle and adipose tissue is significantly reduced. This triggers a compensatory increase in hepatic gluconeogenesis, further exacerbating hyperglycemia. Additionally, the lack of insulin removes the inhibitory effect on lipolysis, resulting in the breakdown of stored triglycerides into free fatty acids. These fatty acids are then converted into ketone bodies by the liver, predisposing patients to ketosis and, if uncontrolled, diabetic ketoacidosis (DKA). This state is further compounded by dehydration and electrolyte imbalances, which are common in untreated or poorly managed cases.[24]

Type 1 diabetes requires early diagnosis and prompt initiation of insulin therapy to prevent life-threatening complications like DKA and to maintain optimal blood glucose control.

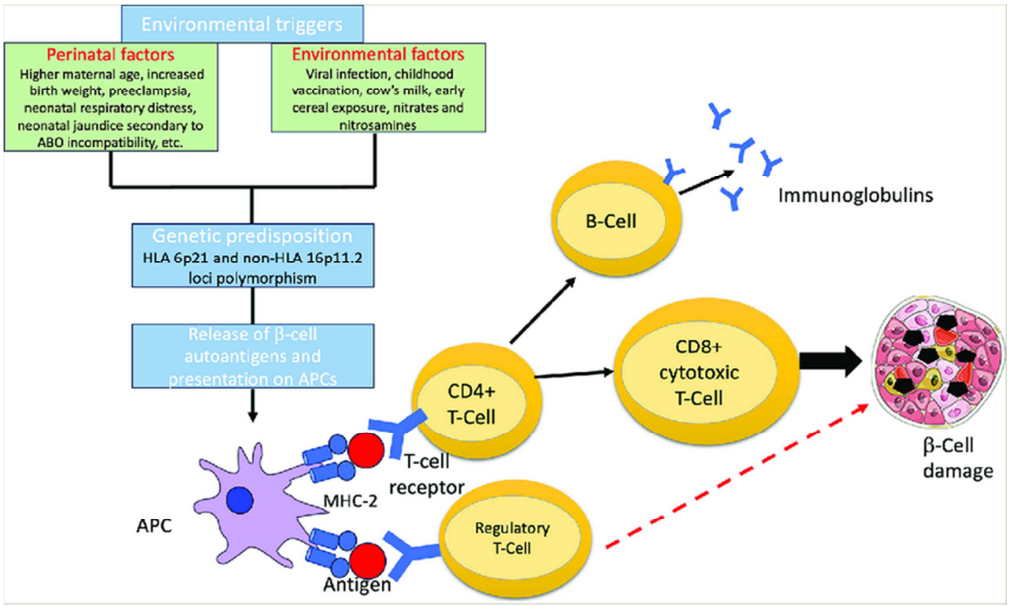

Figure 1: Pathophysiology of Type 1 Diabetes Mellitus

Type 2 Diabetes Mellitus

Type 2 diabetes mellitus is a complex, progressive metabolic disorder primarily affecting adults, though its prevalence in younger individuals has been rising due to increasing rates of childhood obesity and sedentary lifestyles. It is characterized by two major pathophysiological defects: insulin resistance and β-cell dysfunction, both of which contribute to chronic hyperglycemia. Unlike Type 1 diabetes, Type 2 diabetes usually has a gradual onset and is strongly associated with environmental factors, such as diet and physical inactivity, in addition to genetic predisposition.

Insulin resistance is a hallmark of Type 2 diabetes, where peripheral tissues, including skeletal muscle, adipose tissue, and the liver, exhibit impaired glucose uptake and utilization despite the presence of normal or elevated circulating insulin levels. This resistance stems from defects in insulin signalling pathways, particularly involving insulin receptor substrate (IRS) proteins and their downstream signalling cascades. In skeletal muscle, this results in reduced glucose uptake, while in the liver, it leads to excessive gluconeogenesis, further exacerbating hyperglycemia. The inability of adipose tissue to suppress lipolysis under insulin's influence contributes to elevated circulating free fatty acids, which impair glucose metabolism.

β-cell dysfunction in the pancreas is another critical factor in the pathogenesis of Type 2 diabetes. Over time, β-cells fail to compensate for increased insulin demand caused by insulin resistance. Chronic hyperglycemia (glucotoxicity) and elevated free fatty acids (lipotoxicity) directly impair β-cell function and promote β-cell apoptosis. Additionally, inflammatory cytokines, such as interleukin-1β and tumour necrosis factor-alpha (TNF-α), exacerbate β-cell stress and dysfunction. As a result, the ability of β-cells to secrete adequate insulin in response to glucose progressively declines, leading to worsening hyperglycemia.

Obesity and inflammation play pivotal roles in the development of insulin resistance in Type 2 diabetes. Dysfunctional adipose tissue in obesity secretes increased levels of pro-inflammatory adipokines, such as TNF-α and interleukin-6 (IL-6), which impair insulin signalling pathways. Additionally, reduced levels of protective adipokines, such as adiponectin, further worsen insulin sensitivity. This chronic low-grade inflammation contributes significantly to the systemic insulin resistance observed in obese individuals with Type 2 diabetes.[25]

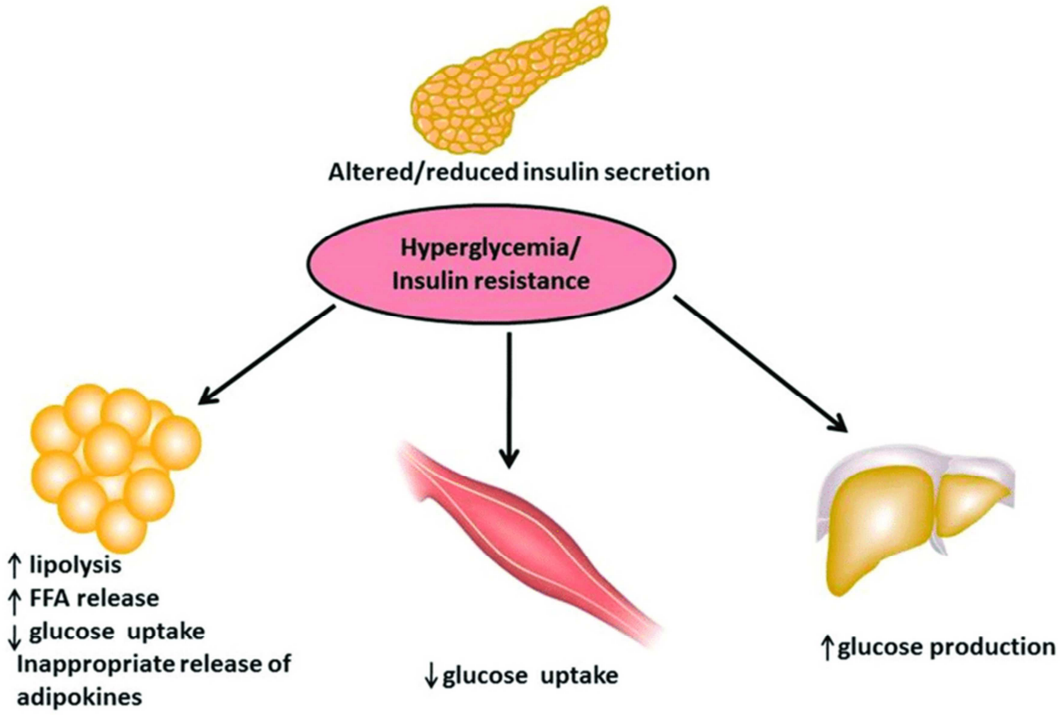

Figure 2: Pathophysiology of Type II Diabetes Mellitus

Table 1: Differences Between Type 1 and Type 2 Diabetes

Feature	Type 1 Diabetes	Type 2 Diabetes
Onset	Sudden, often in childhood	Gradual, typically in adults
Etiology	Autoimmune β-cell destruction	Insulin resistance and β-cell dysfunction
Insulin dependence	Required for survival	May be required later in disease
Autoantibodies	Present	Absent
Ketosis	Common in the absence of insulin	Rare unless under extreme stress
Familial risk	Low to moderate	Strong familial link

Diabetes mellitus is associated with significant long-term complications that arise from chronic hyperglycemia. These complications are broadly categorized into **microvascular** and **macrovascular** complications. The underlying mechanisms include oxidative stress, the formation of advanced glycation end-products (AGEs), chronic inflammation, and endothelial dysfunction, all of which contribute to tissue damage and impaired organ function.

Microvascular Complications

Diabetic Retinopathy

Diabetic retinopathy is a leading cause of vision loss in adults with diabetes. Chronic hyperglycemia damages the microvasculature of the retina, leading to increased vascular permeability, capillary occlusion, and ischemia. The disease progresses from **non-proliferative diabetic retinopathy (NPDR),** characterized by microaneurysms and intraretinal hemorrhages, to **proliferative diabetic retinopathy (PDR),** where neovascularization occurs due to ischemia-driven overexpression of vascular endothelial growth factor (VEGF). Macular edema, caused by vascular

leakage, is a significant cause of vision impairment in diabetics. If left untreated, PDR can lead to vitreous hemorrhage, retinal detachment, and blindness.[26]

Diabetic Nephropathy

Diabetic nephropathy is the leading cause of end-stage renal disease (ESRD) worldwide. It results from chronic hyperglycemia-induced changes in the renal microvasculature, including glomerular hyperfiltration, thickening of the glomerular basement membrane, and mesangial expansion. These changes lead to persistent proteinuria, declining glomerular filtration rate (GFR), and hypertension. The renin-angiotensin system (RAS) plays a critical role in the pathogenesis by promoting intraglomerular hypertension and podocyte injury. Early detection through markers such as albuminuria and aggressive management of glucose and blood pressure are essential to delay progression to ESRD.

Diabetic Neuropathy

Diabetic neuropathy is the most common complication of diabetes, affecting both the peripheral and autonomic nervous systems. Hyperglycemia-induced nerve damage occurs through mechanisms such as ischemia, axonal degeneration, and demyelination. Peripheral neuropathy typically manifests as sensory loss in a "glove-and-stocking" distribution, often accompanied by neuropathic pain. Autonomic neuropathy can cause gastroparesis, orthostatic hypotension, erectile dysfunction, and bladder dysfunction. The polyol pathway plays a significant role, with sorbitol accumulation in nerves contributing to oxidative stress and cellular damage.[27]

Macrovascular Complications

Cardiovascular Disease (CVD)

Diabetes significantly increases the risk of cardiovascular disease, which is the leading cause of death in diabetic patients. Chronic hyperglycemia accelerates atherosclerosis through mechanisms such as endothelial dysfunction, increased oxidative stress, low-density lipoprotein (LDL) oxidation, and chronic inflammation. These changes lead to plaque formation and vascular occlusion, increasing the risk of myocardial infarction, heart failure, and sudden cardiac death. Diabetic patients often have concomitant risk factors such as hypertension and dyslipidemia, further compounding their cardiovascular risk.

Cerebrovascular Disease

The risk of both ischemic and hemorrhagic strokes is significantly higher in diabetics. Chronic hyperglycemia promotes vascular stiffening, endothelial dysfunction, and prothrombotic states, leading to increased stroke risk. Hyperglycemia during an acute stroke further exacerbates neuronal damage and worsens outcomes. Early management of blood glucose, blood pressure, and lipid levels is critical to reducing the risk of cerebrovascular events.[28]

Peripheral Arterial Disease (PAD)

PAD is a common complication of diabetes, resulting from atherosclerotic occlusion of peripheral arteries, particularly in the lower extremities. It manifests as claudication, non-healing ulcers, and, in severe cases, gangrene. Reduced blood flow and impaired wound healing increase the risk of infections, often necessitating limb amputation. Early diagnosis through clinical examination and vascular imaging, along with aggressive management of glycemic control and atherosclerotic risk factors, is essential to prevent these debilitating outcomes.

Hypoglycemia in Diabetes

Definition and Clinical Classification of Hypoglycemia

Hypoglycemia, a condition of abnormally low blood glucose levels, is a common acute complication in diabetes management. It is clinically classified into **mild**, **moderate**, and **severe** categories based on symptom severity and required interventions. Mild hypoglycemia is characterized by autonomic symptoms like tremors and sweating, manageable by self-treatment. Moderate hypoglycemia involves neuroglycopenic symptoms such as confusion, requiring assistance but without loss of consciousness. Severe hypoglycemia leads to unconsciousness or seizures, necessitating external intervention for glucose administration. Biochemically, hypoglycemia is generally defined as a blood glucose level below 70 mg/dL, though the exact threshold may vary based on individual patient factors.

Mechanisms of Hypoglycemia in Diabetes

The primary mechanism of hypoglycemia is an imbalance between glucose utilization by peripheral tissues and glucose production by the liver. In individuals with diabetes, this imbalance is exacerbated by exogenous insulin or oral hypoglycemic agents that lower blood glucose levels beyond the physiological need.

- **Insulin and Counterregulatory Hormones:** Insulin reduces blood glucose by promoting cellular glucose uptake and inhibiting hepatic glucose production. Counterregulatory hormones like glucagon, adrenaline, cortisol, and growth hormone act as physiological safeguards against hypoglycemia. In diabetic patients, these mechanisms may be impaired. For example, prolonged insulin use can suppress glucagon release, and recurrent hypoglycemia can reduce adrenaline responses, leading to a vicious cycle of impaired recovery from hypoglycemia.

Causes of Hypoglycemia in Diabetic Patients

Several factors contribute to hypoglycemia in diabetes:

1. **Excessive Insulin or Oral Hypoglycemic Agents:** Overdosing on insulin or sulfonylureas can precipitate a rapid decline in blood glucose levels.
2. **Skipped Meals:** A mismatch between insulin administration and food intake disrupts glucose availability, leading to hypoglycemia.
3. **Excessive Physical Activity:** Exercise increases glucose uptake by skeletal muscles, and insufficient compensatory carbohydrate intake can precipitate hypoglycemia.
4. **Alcohol Consumption:** Alcohol inhibits gluconeogenesis in the liver, particularly in fasting states, amplifying the risk of hypoglycemia.[29]

Symptoms and Consequences of Hypoglycemia

Early Warning Symptoms

Hypoglycemia symptoms are divided into **neurogenic (autonomic)** and **neuroglycopenic** categories:

- **Neurogenic symptoms:** These include sweating, palpitations, tremors, and anxiety, resulting from activation of the autonomic nervous system.
- **Neuroglycopenic symptoms:** These occur when glucose supply to the brain is insufficient, leading to confusion, slurred speech, blurred vision, seizures, or coma.

Severe Outcomes

Untreated hypoglycemia can result in severe complications such as seizures, loss of consciousness, and even death. Chronic episodes can desensitize patients to early warning symptoms, a condition known as hypoglycemia unawareness, further increasing the risk of severe outcomes.

Long-Term Effects

Repeated hypoglycemia has long-term consequences, including potential damage to the brain due to recurrent glucose deprivation. Additionally, hypoglycemia-induced stress responses, such as tachycardia and vasoconstriction, can exacerbate cardiovascular risks, particularly in patients with pre-existing heart disease.[30]

Glycemic Control and Risk of Hypoglycemia

Role of HbA1c in Glycemic Control

HbA1c reflects the average blood glucose levels over the preceding 2–3 months and is a key marker for assessing long-term glycemic control. While lower HbA1c levels correlate with reduced risk of chronic complications, stringent targets may inadvertently increase the risk of hypoglycemia.

Impact of Stringent Glycemic Targets

Aggressive glycemic targets, especially in patients with longstanding diabetes, may predispose them to hypoglycemia due to reduced counterregulatory responses and adaptive mechanisms. Striking a balance between optimal glycemic control and minimizing hypoglycemia risk is essential.

Hypoglycemia-Associated Autonomic Failure (HAAF)

HAAF is a condition in which recurrent hypoglycemia blunts the body's autonomic response to subsequent episodes. This adaptation increases the risk of severe hypoglycemia and necessitates cautious glucose-lowering therapy adjustments.[31]

Role of Patient Education and Awareness

Effectiveness of Education Programs

Structured education programs significantly reduce hypoglycemia incidence by improving patient understanding of symptoms, triggers, and preventive measures. Interdisciplinary approaches involving healthcare professionals, dietitians, and psychologists enhance patient engagement and outcomes.

Interdisciplinary Support

Effective hypoglycemia management requires a collaborative effort. Medical teams provide pharmacological adjustments, dietitians design individualized meal plans, and psychological support addresses fears and anxieties associated with hypoglycemia episodes.[32]

Relevance to the Study Population

Prevalence of Diabetes in India

India is home to one of the largest populations of diabetics globally, with an estimated 77 million cases as of recent reports. The burden is particularly pronounced in regions like North Karnataka, where access to healthcare is often limited.

Unique Challenges in Hypoglycemia Management

Cultural and socioeconomic factors, including dietary habits, limited health literacy, and inconsistent access to medical care, pose significant challenges in managing hypoglycemia. Rural populations may have inadequate glucose monitoring facilities and limited access to trained healthcare professionals, further exacerbating risks.

MATERIALS AND METHODS

Study Design: This study employed a cross-sectional observational design to assess the knowledge, attitudes, and practices (KAP) regarding hypoglycemia among diabetic patients presenting with hypoglycemia.

Study Setting: The study was conducted at Dr Prabhakar Kore Hospital and Medical Research Centre, a tertiary care center located in North Karnataka.

Study Population: The study focused on diabetic patients presenting with hypoglycemia. Inclusion criteria consisted of patients with type 2 diabetes mellitus who had a documented blood sugar level of less than 70 mg/dL. Exclusion criteria included patients with type 1 diabetes mellitus, pregnant women with gestational diabetes mellitus, individuals with diabetes secondary to other systemic diseases, and patients not on any diabetes treatment.

Study Period: The study was conducted over one year, from 1st April 2023 to 31st March 2024.

Sample Size: The sample size was determined using the formula,

$$n = \frac{n'}{1 + \frac{(n' - 1)}{N}}$$

$$n' = \frac{p\,(100 - p)Z^2}{E^2}$$

Where n is the sample size required, n' is sample size when population size is unknown, N is population size, p is the percentage occurrence of a state or condition (proportion or prevalence), E is the percentage maximum error required, Z is the value corresponding to level of confidence required.

66.1% diabetic patients had good knowledge on hypoglycemia. As per the previous year data, the number of diabetic patients with hypoglycemia in KLE Hospital, Belagavi was 62 cases. Considering this at 95% confidence level and 5% of maximum error, the minimum sample size required is 53. As sample size increases, accuracy of result also increases.

Sampling Technique: Convenient sampling was used to recruit participants for the study.

Data Collection Tools: Data were collected using a structured questionnaire designed specifically for this study. The questionnaire comprised sections on sociodemographic details, KAP regarding hypoglycemia, and clinical history. Questions covered topics such as symptoms, preventive measures, and practices related to hypoglycemia. The questionnaire was pre-tested and, if applicable, translated into regional languages to ensure clarity and comprehension among participants.

Data Collection Procedure: Eligible participants were identified from hospital records and approached during their visits to the outpatient and inpatient departments. After confirming eligibility, informed consent was obtained in both English and regional languages, ensuring participants understood the study's objectives and their rights. Data collection was conducted through face-to-face interviews using the structured questionnaire. In addition to the questionnaire, blood samples were collected. A finger prick test was performed to measure random blood sugar (RBS) levels, while a venous blood sample was drawn to assess HbA1c levels, reflecting the participants' glycemic control over the past three months.

Study Variables: The independent variables included sociodemographic factors such as age, gender, income, and education, as well as clinical factors like the duration of

diabetes, comorbidities, type of medication, and HbA1c levels. Dependent variables comprised the level of knowledge, attitudes, and practices regarding hypoglycemia and the frequency of hypoglycemia episodes. These variables provided insights into the associations between sociodemographic and clinical factors and the participants' understanding and management of hypoglycemia.

Data Management and Analysis: The collected data were entered and cleaned using Microsoft Excel to ensure accuracy. Statistical analyses were performed using SPSS software (version 27.0) and Microsoft Excel. Descriptive statistics were used to summarize the data, with categorical variables expressed as frequencies and percentages and continuous variables as mean ± standard deviation (SD) or median (range), depending on their distribution. Normality of the data was assessed using the Shapiro-Wilk test and QQ plots. Inferential statistics included the Chi-square test to analyse associations between categorical variables and the two-sample t-test or Mann-Whitney U test to compare means or distributions between groups. A p-value ≤ 0.05 was considered statistically significant.

Ethical Considerations: The study received ethical approval from the Institutional Ethics Committee (IEC) of Dr Prabhakar Kore Hospital. Participants were assured of confidentiality and anonymity, with all data anonymized to prevent identification. Participation was voluntary, and participants retained the right to withdraw from the study at any point. The cost of blood tests for HbA1c was covered by the principal investigator to ensure equitable participation. No adverse events were anticipated, as the study did not involve any invasive or experimental procedures.

RESULTS

i. SOCIODEMOGRAPHIC DETAILS

Table 1: Distribution of Gender

Sex	Frequency	Percent
Female	25	41.7
Male	35	58.3
Total	**60**	**100.0**

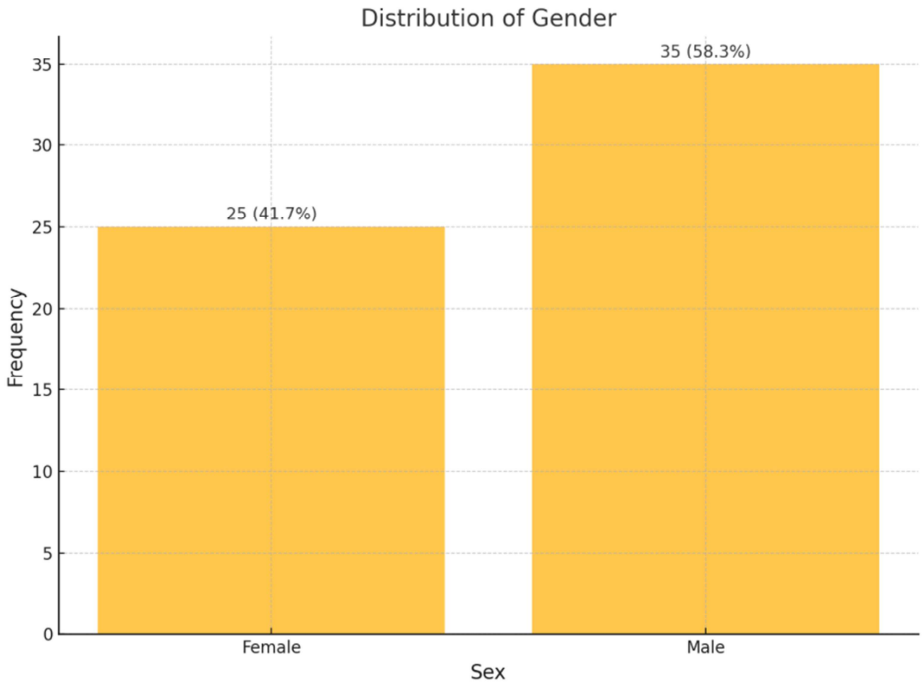

Figure 1: Distribution of Gender

Table 1 and Figure 1 show the gender distribution in the study: 41.7% of the participants are female (25 individuals), while 58.3% are male (35 individuals).

Table 2: Distribution of Place of Residence

Place of Residence	Frequency	Percent
Rural	35	58.3
Urban	25	41.7
Total	**60**	**100.0**

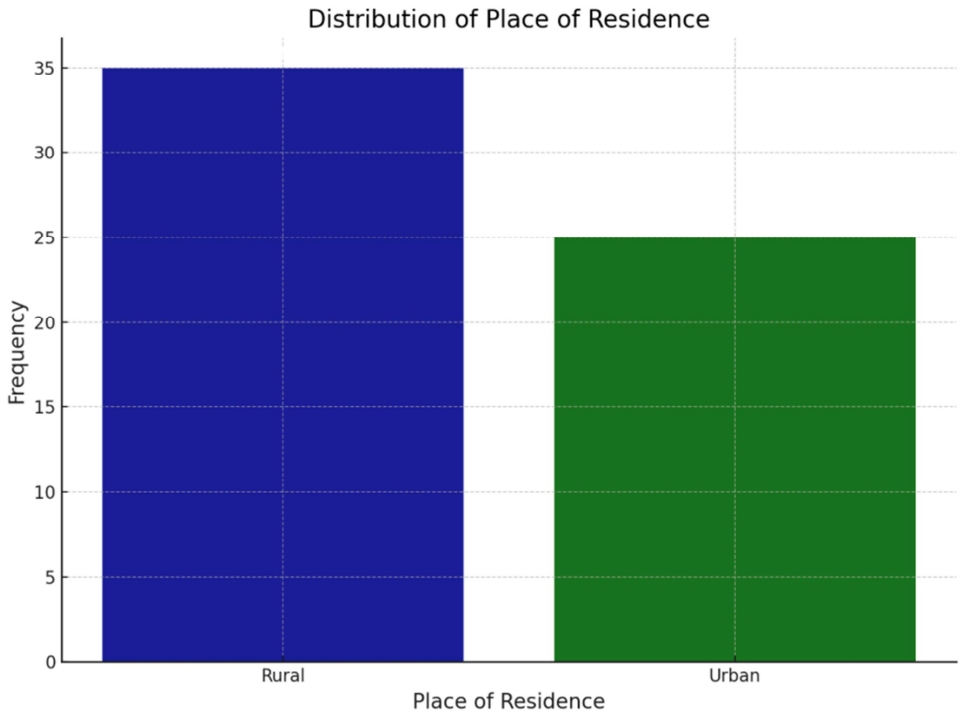

Figure 2: Distribution of Place of Residence

Table 2 and Figure 2 illustrate the distribution of the place of residence among participants. A majority of 58.3% (35 individuals) live in rural areas, while 41.7% (25 individuals) are from urban areas.

Table 3: Distribution of Educational Status

Educational Status	Frequency	Percent
Graduate	7	11.7
Illiterate	4	6.7
Primary	12	20.0
Secondary	37	61.7
Total	**60**	**100.0**

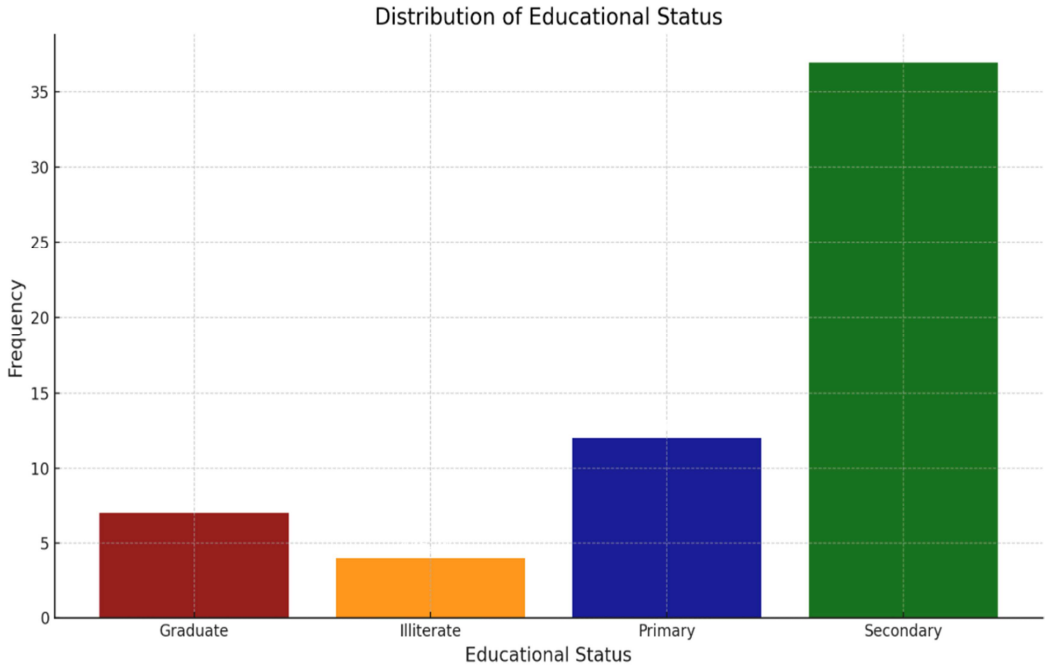

Figure 3: Distribution of Educational Status

Table 3 and Figure 3 illustrates the educational status of the participants. The majority, 61.7% (37 individuals), have completed secondary education. This is followed by 20.0% (12 individuals) with primary education, 11.7% (7 individuals) who are graduates, and 6.7% (4 individuals) who are illiterate.

Table 4: Distribution of Socio-Economic Status

Socio-Economic Status	Frequency	Percent
Class I	2	3.3
Class II	21	35.0
Class III	27	45.0
Class IV	10	16.7
Total	**60**	**100.0**

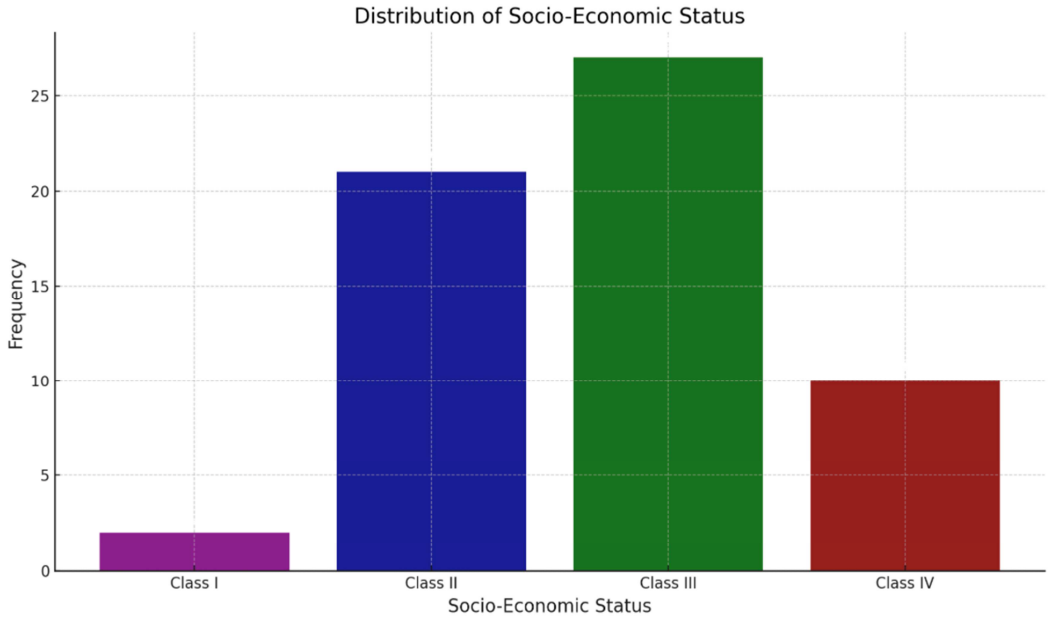

Figure 4: Distribution of Socio-Economic Status

Table 4 and Figure 4 show the socio-economic status distribution among participants. The majority, 45.0% (27 individuals), belong to Class III, followed by 35.0% (21 individuals) in Class II. Class IV represents 16.7% (10 individuals), while Class I comprises only 3.3% (2 individuals).

Table 5: Distribution of Diabetic Duration (Years)

Measurement	Mean	Standard Deviation
Diabetic Duration (Years)	10.85	4.39

Table 5 illustrates that the average diabetic duration among participants is 10.85 years, with a standard deviation of 4.39 years.

Table 6: Distribution of HbA1c (%)

Measurement	Mean	Standard Deviation
HbA1c (%)	7.96	1.75

Table 6 illustrates that the mean HbA1c level among participants is 7.96%, with a standard deviation of 1.75%

Table 7: Distribution of Treatment Type

Treatment	Frequency	Percent
Insulin	36	60.0
Oral hypoglycaemic agent	24	40.0
Total	**60**	**100.0**

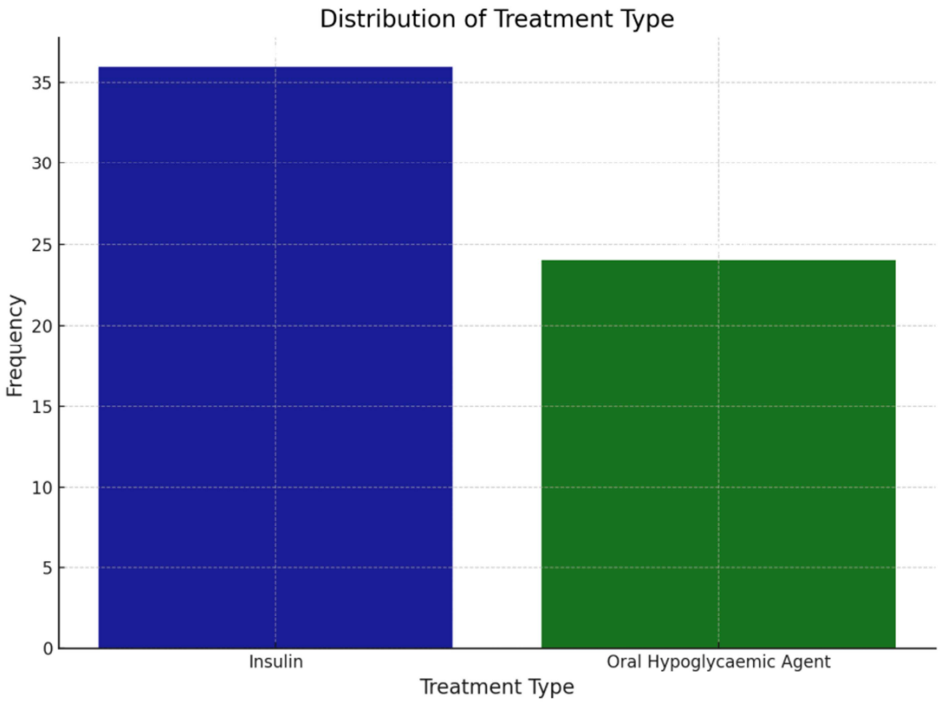

Figure 5: Distribution of Treatment Type

Table 7 and Figure 5 illustrate the distribution of treatment types among participants. The majority, 60.0% (36 individuals), are on insulin therapy, while 40.0% (24 individuals) are using oral hypoglycaemic agents.

Table 8: Distribution of Body Mass Index (Kg/m²)

BMI (Kg/m²)	Frequency	Percent
22	1	1.7
23	2	3.3
24	6	10.0
25	14	23.3
26	13	21.7
27	17	28.3
28	6	10.0
30	1	1.7
Total	**60**	**100.0**

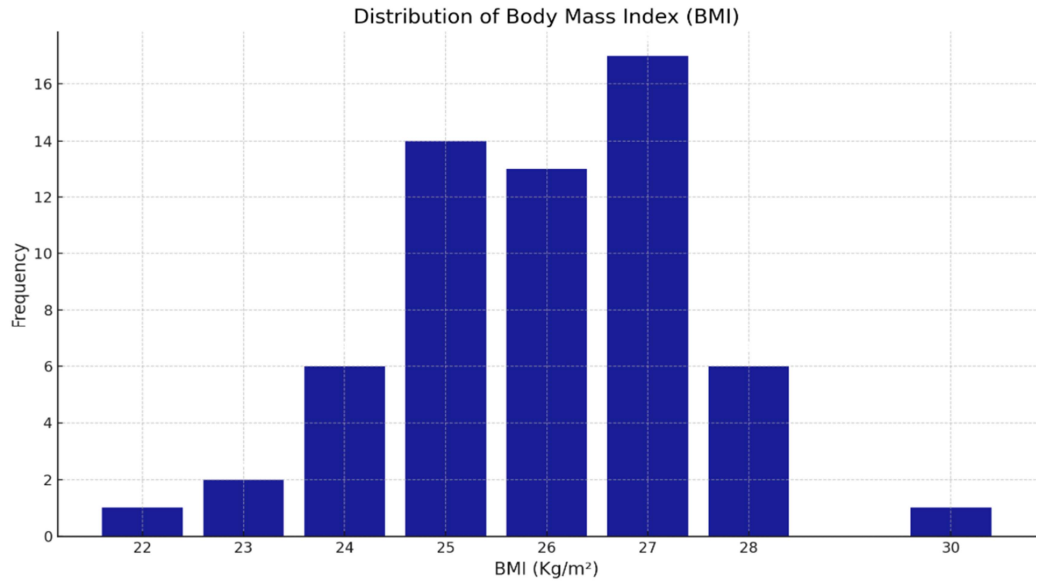

Figure 6: Distribution of Body Mass Index (Kg/m²)

Table 8 and Figure 6 depict the distribution of Body Mass Index (BMI) among participants. The majority, 28.3% (17 individuals), have a BMI of 27 Kg/m², followed by 23.3% (14 individuals) with a BMI of 25 Kg/m² and 21.7% (13 individuals) with a BMI of 26 Kg/m².

Table 9: Distribution of Diet Type

Diet Type	Frequency	Percent
Mixed	23	38.3
Vegetarian	37	61.7
Total	**60**	**100.0**

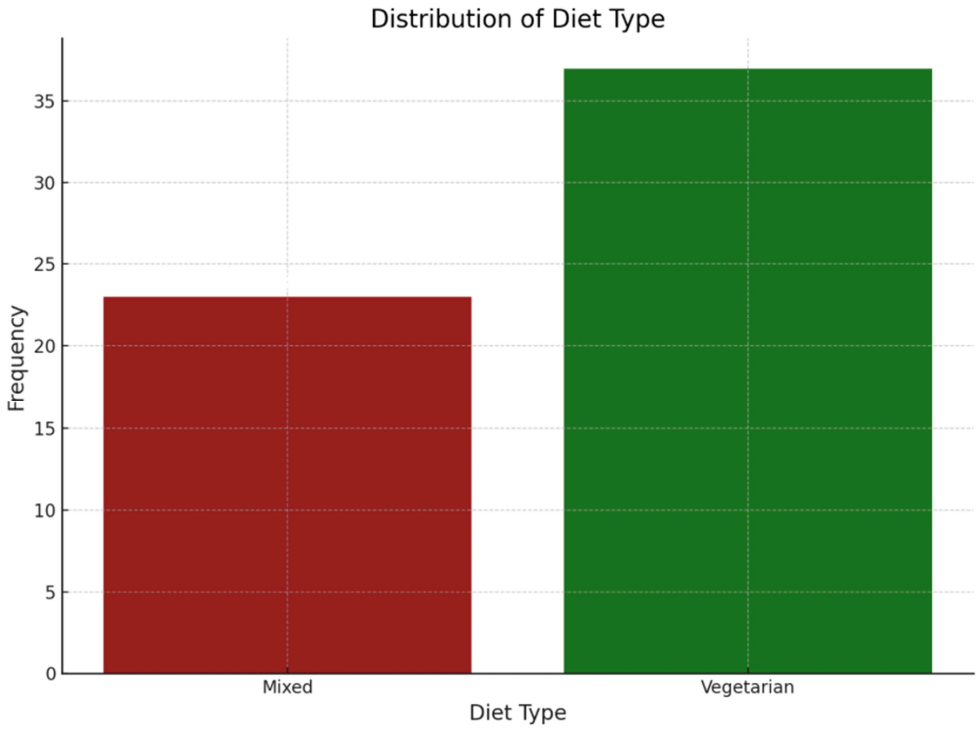

Figure 7: Distribution of Diet Type

Table 9 and Figure 7 present the distribution of diet types among participants. The majority, 61.7% (37 individuals), follow a vegetarian diet, while 38.3% (23 individuals) have a mixed diet.

Table 10: Distribution of Number of Meals per Day

Meals per Day	Frequency	Percent
2	2	3.3
3	50	83.3
4	8	13.3
Total	**60**	**100.0**

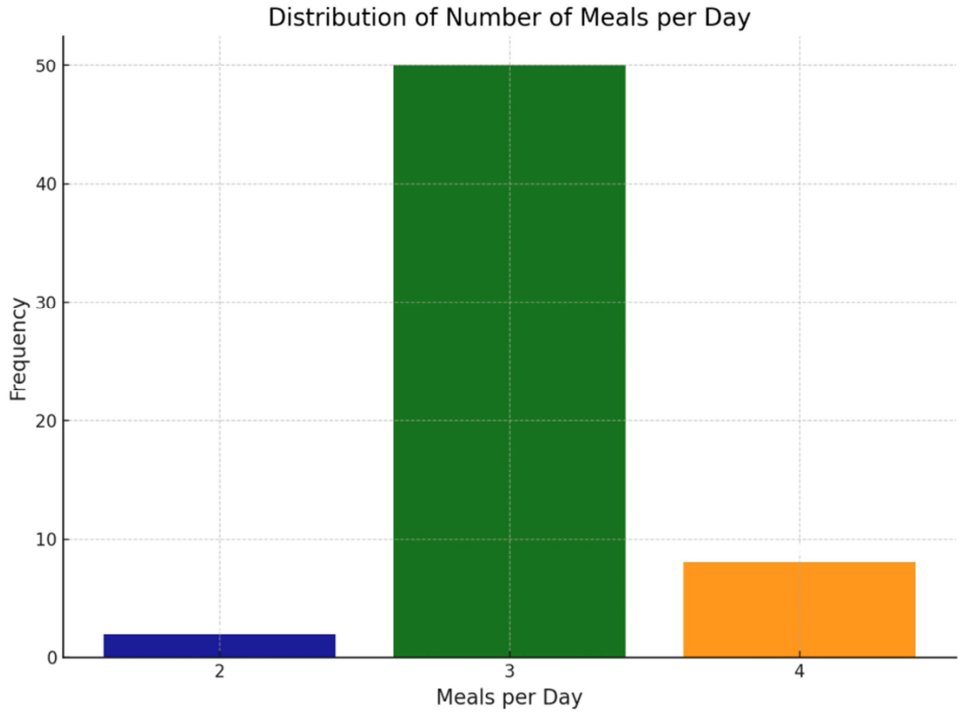

Figure 8: Distribution of Number of Meals per Day

Table 10 and Figure 8 show the distribution of the number of meals consumed per day among participants. The majority, 83.3% (50 individuals), consume three meals per day, followed by 13.3% (8 individuals) who consume four meals per day, and a small proportion, 3.3% (2 individuals), who consume two meals per day.

Table 11: Distribution of Medical Conditions Among Participants

Condition	Frequency	Percent
Chronic kidney disease	3	7.7
Cardiovascular disease	15	38.5
Hypertension	18	46.2
Infection	2	5.1
Thyroid	1	2.6
Total	**39**	**100.0**

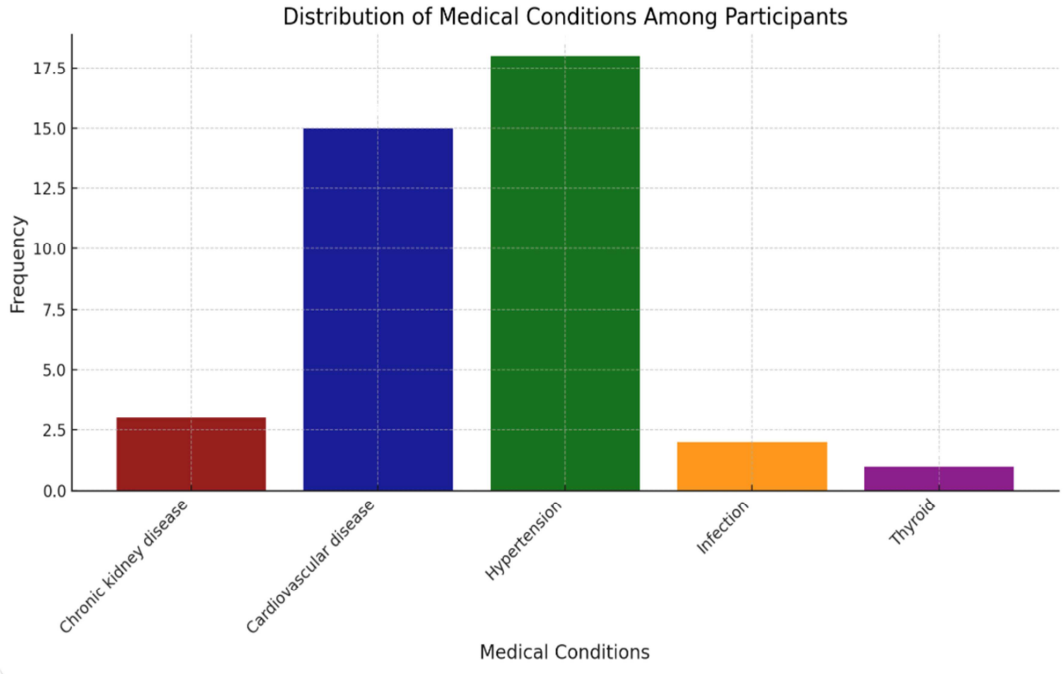

Figure 9: Distribution of Medical Conditions Among Participants

Table 11 and Figure 9 depict the distribution of medical conditions among participants. The most common condition is hypertension, affecting 46.2% (18 individuals), followed by cardiovascular disease at 38.5% (15 individuals). Other conditions include chronic kidney disease (7.7%, 3 individuals), infections (5.1%, 2 individuals), and thyroid issues (2.6%, 1 individual).

ii. KNOWLEDGE BASED QUESTIONS

Table 12: Are you aware diabetic treatment can sometimes lead to low blood sugars?

Response	Frequency	Percent
Yes	29	48.3
No	31	51.7
Total	**60**	**100.0**

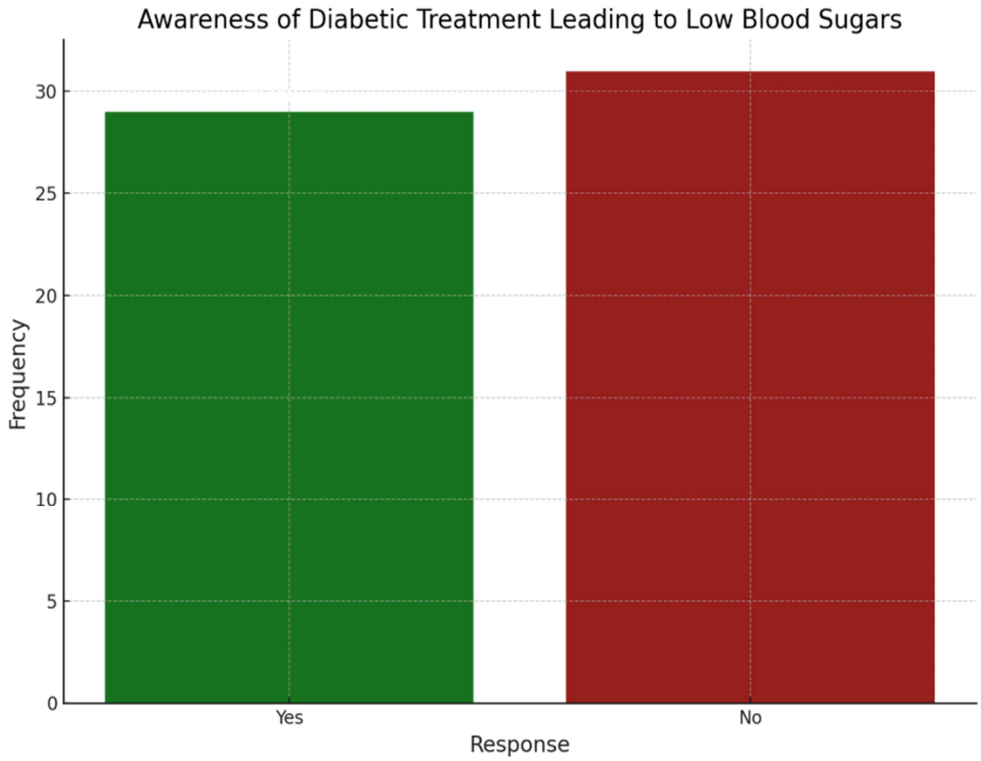

Figure 10: Awareness of Diabetic Treatment Leading to Low Blood Sugars

Table 12 and Figure 10 illustrate participants' awareness of diabetic treatment potentially leading to low blood sugar levels. A slight majority, 51.7% (31 individuals), are not aware of this risk, while 48.3% (29 individuals) are aware.

Table 13: Hypoglycaemia happen when

Response	Frequency	Percent
Plasma glucose concentration become under 80 mg/dl	3	5.0
Plasma glucose concentration become under 70 mg/dl	4	6.7
I do not know	53	88.3
Total	**60**	**100.0**

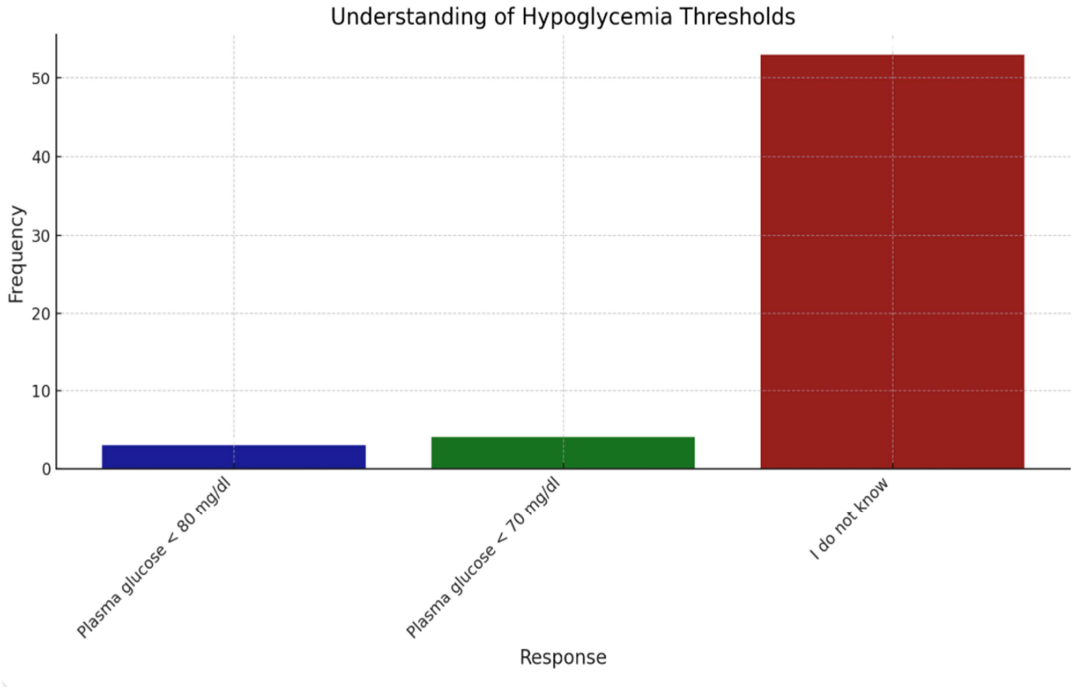

Figure 11: Understanding of Hypoglycaemia Thresholds

Table 13 and Figure 11 display participants' understanding of hypoglycemia thresholds. A significant majority, 88.3% (53 individuals), do not know the correct threshold for hypoglycemia. Only 6.7% (4 individuals) correctly identify it as plasma glucose levels below 70 mg/dl, and 5.0% (3 individuals) incorrectly think it occurs below 80 mg/dl.

Table 14: What are the reasons for hypoglycaemia?

Response	Frequency	Percent
Skipping meals	15	25.0
Excessive exercise	1	1.7
Overdose medication(s)	6	10.0
I do not know	38	63.3
Total	**60**	**100.0**

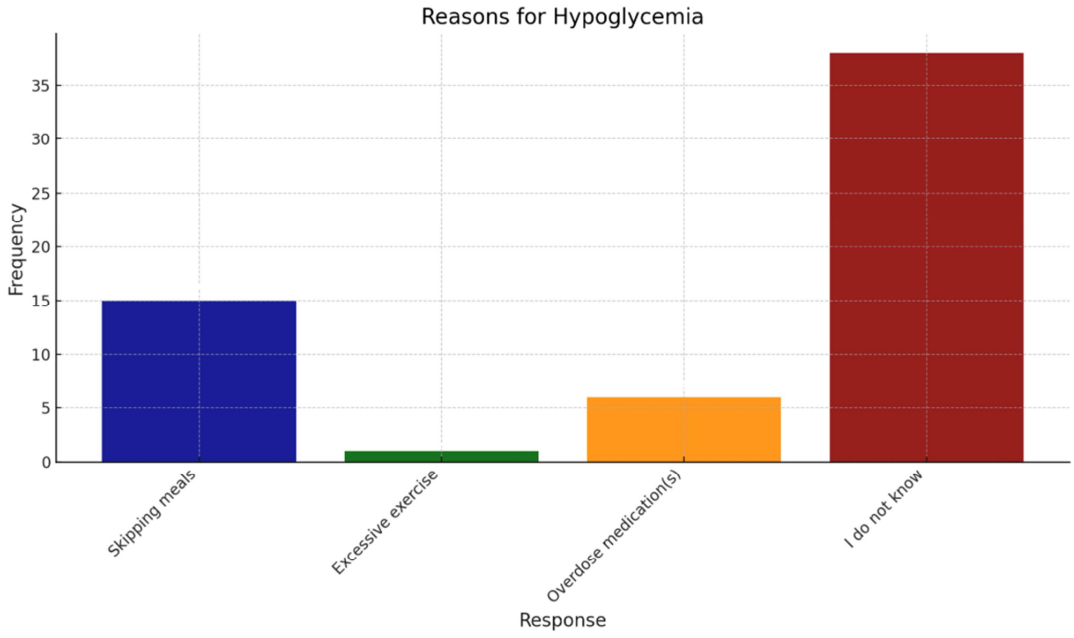

Figure 12: Reasons for hypoglycaemia

Table 14 and Figure 12 show participants' understanding of the reasons for hypoglycemia. The majority, 63.3% (38 individuals), do not know the causes. Among those who provided reasons, 25.0% (15 individuals) identified skipping meals, 10.0% (6 individuals) cited medication overdose, and only 1.7% (1 individual) mentioned excessive exercise.

Table 15: Do you know how to prevent hypoglycaemia?

Response	Frequency	Percent
Yes	17	28.3
No	43	71.7
Total	**60**	**100.0**

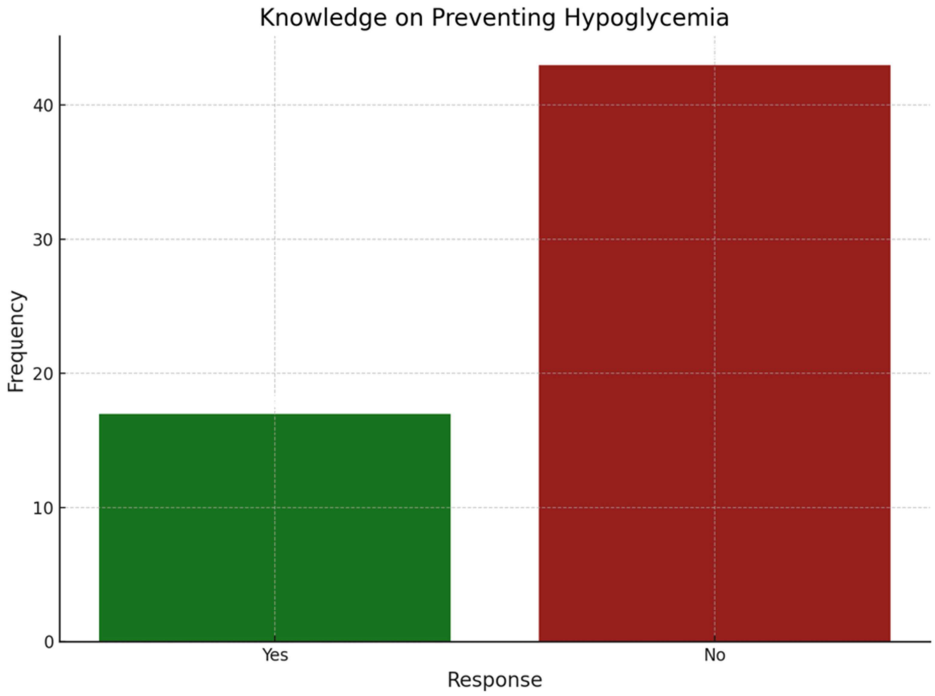

Figure 13: Knowledge on Preventing Hypoglycaemia

Table 15 and Figure 13 depict participants' knowledge of preventing hypoglycemia. The majority, 71.7% (43 individuals), are unaware of how to prevent hypoglycemia, while only 28.3% (17 individuals) have knowledge on prevention.

Table 16: If yes specify?

Response	Frequency	Percent
I eat after insulin injection	13	76.5
I eat before being physically active	1	5.9
I try to eat balanced meals and snacks containing protein, fat, fiber, and carbohydrates	1	5.9
Regular measuring of blood sugar	2	11.8
Total	**17**	**100.0**

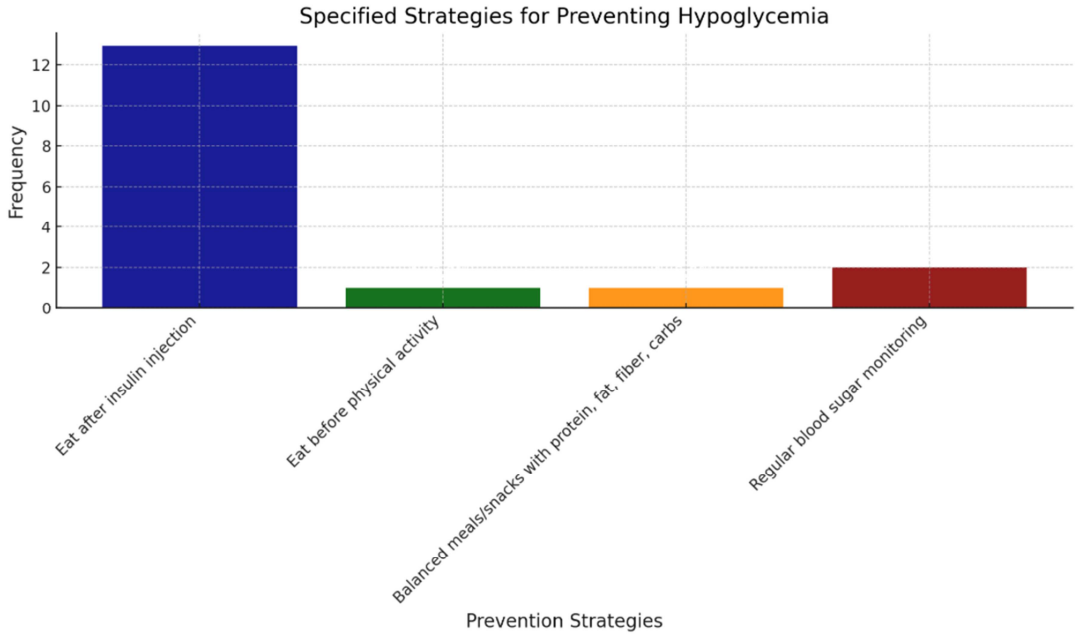

Figure 14: Specified Strategies for Preventing Hypoglycemia

Table 16 and Figure 14 highlight the specific strategies used by participants to prevent hypoglycemia. The majority, 76.5% (13 individuals), reported eating after insulin injections, while 11.8% (2 individuals) practiced regular blood sugar monitoring. A small percentage, 5.9% (1 individual each), mentioned eating before physical activity or consuming balanced meals and snacks containing protein, fat, fiber, and carbohydrates.

Table 17: What do you think is/are the complications of low blood sugar levels?

Response	Frequency	Percent
Kidney Disease	1	1.7
I do not know	59	98.3
Total	**60**	**100.0**

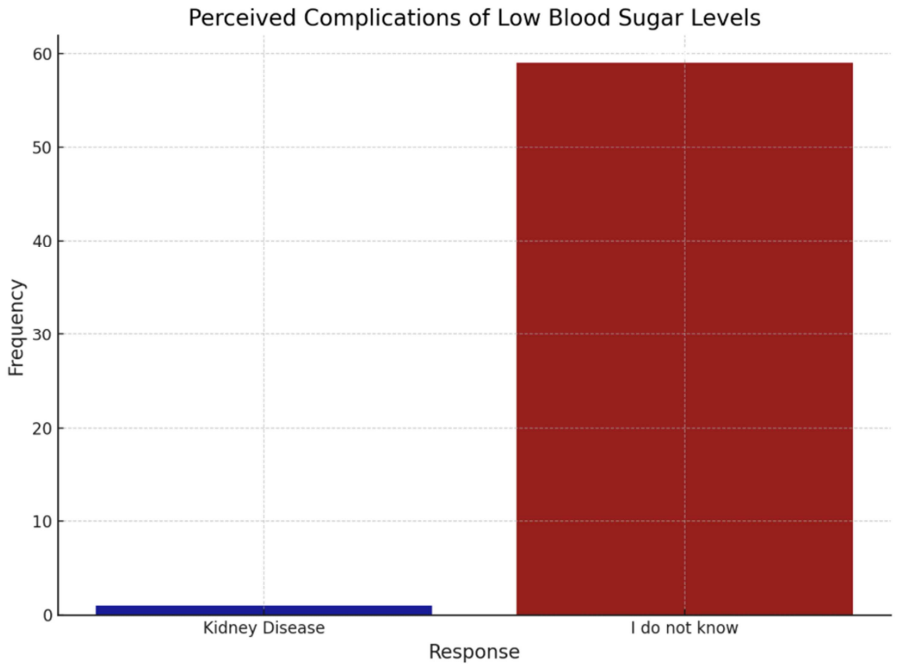

Figure 15: Perceived Complications of Low Blood Sugar Levels

Table 17 and Figure 15 reveal participants' perceptions of complications from low blood sugar levels. A majority, 98.3% (59 individuals), reported that they do not know the complications, while only 1.7% (1 individual) incorrectly associated it with kidney disease.

Table 18: Do you follow diabetic diet?

Response	Frequency	Percent
Yes	54	90.0
No	6	10.0
Total	**60**	**100.0**

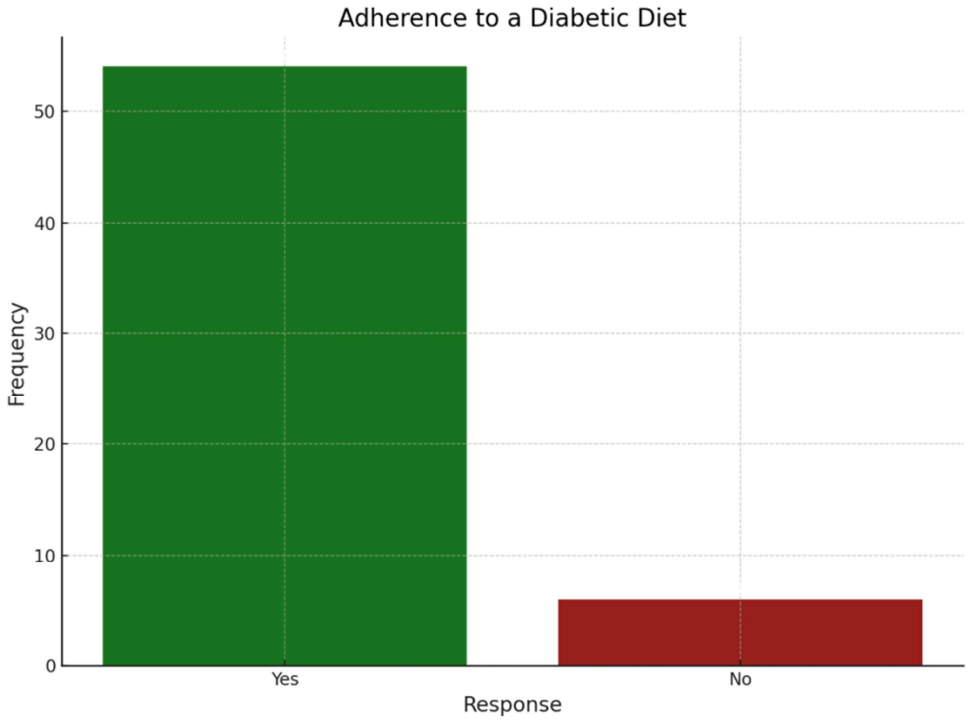

Figure 16: Adherence to Diabetic Diet

Table 18 and Figure 16 illustrate participants' adherence to a diabetic diet. The majority, 90.0% (54 individuals), reported following a diabetic diet, while 10.0% (6 individuals) indicated they do not.

Table 19: What is the best diet for diabetes

Response	Frequency	Percent
Family diet regardless of its content	3	5.0
Low fat, high fibre, and low-added sugar	8	13.3
Sugar-free diet	39	65.0
Eat fast-acting carbohydrate	6	10.0
Eat “slow carbohydrates”	3	5.0
I do not know	1	1.7
Total	**60**	**100.0**

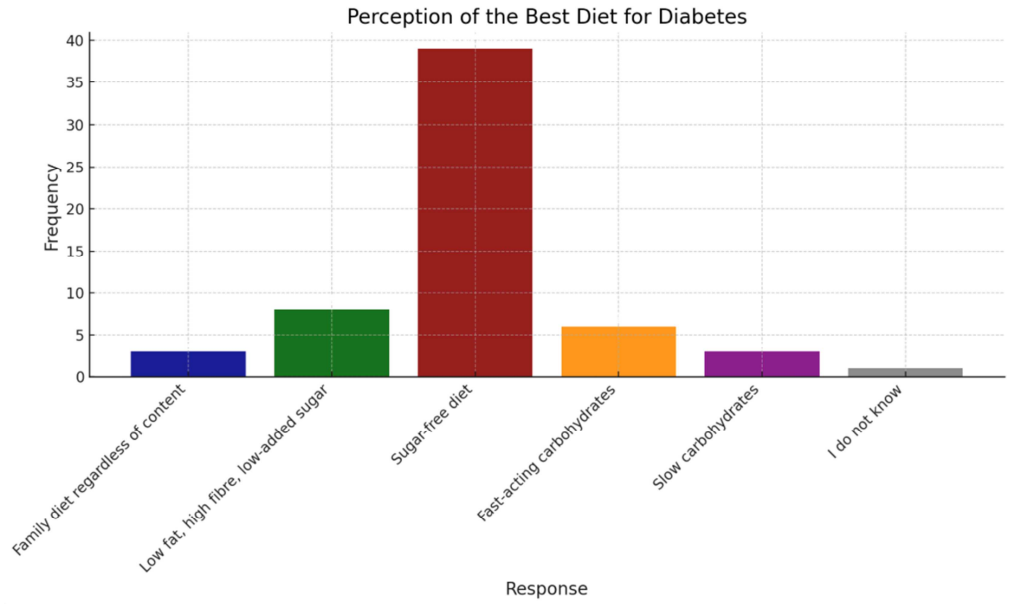

Figure 17: Perception of the Best Diet for Diabetes

Table 19 and Figure 17 depict participants' perceptions of the best diet for diabetes. The majority, 65.0% (39 individuals), consider a sugar-free diet as the best option. Other responses include low fat, high fiber, and low-added sugar diets (13.3%, 8 individuals), eating fast-acting carbohydrates (10.0%, 6 individuals), and family diets regardless of content or slow carbohydrates (5.0%, 3 individuals each). A small percentage, 1.7% (1 individual), expressed a lack of knowledge.

Table 20: Do you monitor blood glucose levels?

Response	Frequency	Percent
Yes	51	85.0
No	9	15.0
Total	**60**	**100.0**

Figure 18: Monitoring of Blood Glucose Levels

Table 20 and Figure 18 show participants' practices regarding blood glucose monitoring. A significant majority, 85.0% (51 individuals), reported monitoring their blood glucose levels, while 15.0% (9 individuals) do not.

Table 21: Are aware of symptoms of hypoglycaemia?

Response	Frequency	Percent
Yes	30	50.0
No	30	50.0
Total	**60**	**100.0**

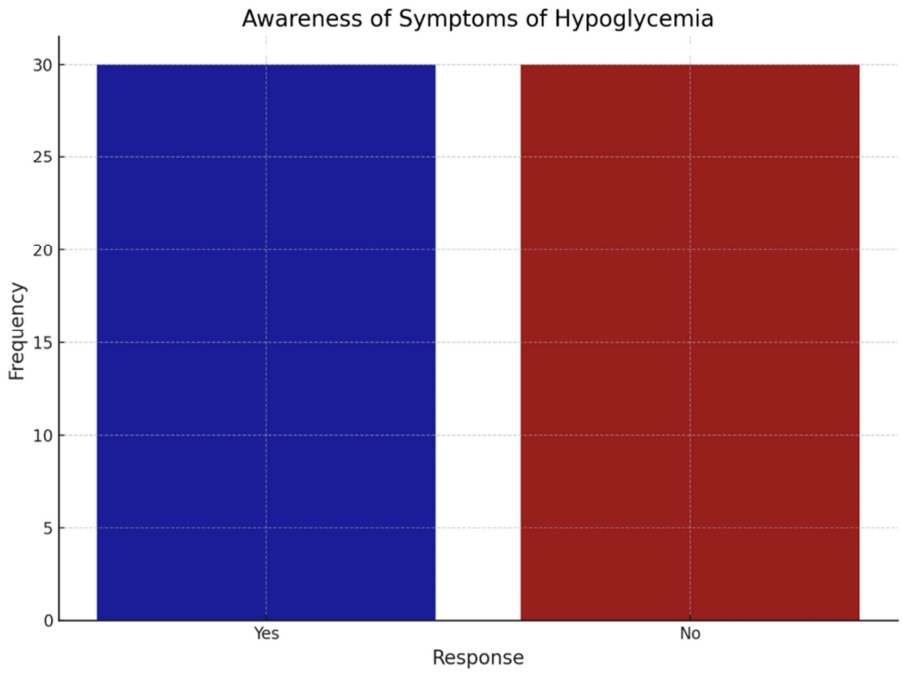

Figure 19: Awareness of Symptoms of Hypoglycemia

Table 21 and Figure 21 show participants' awareness of hypoglycemia symptoms. Awareness is evenly distributed, with 50.0% (30 individuals) indicating they are aware of the symptoms and 50.0% (30 individuals) stating they are not.

Table 22: If yes specify which of the following weakness

Response	Frequency	Percent
Dizziness	1	3.4
Excessive Hunger	22	75.9
Sweating	1	3.4
Palpitation	5	17.2
Total	**29**	**100.0**

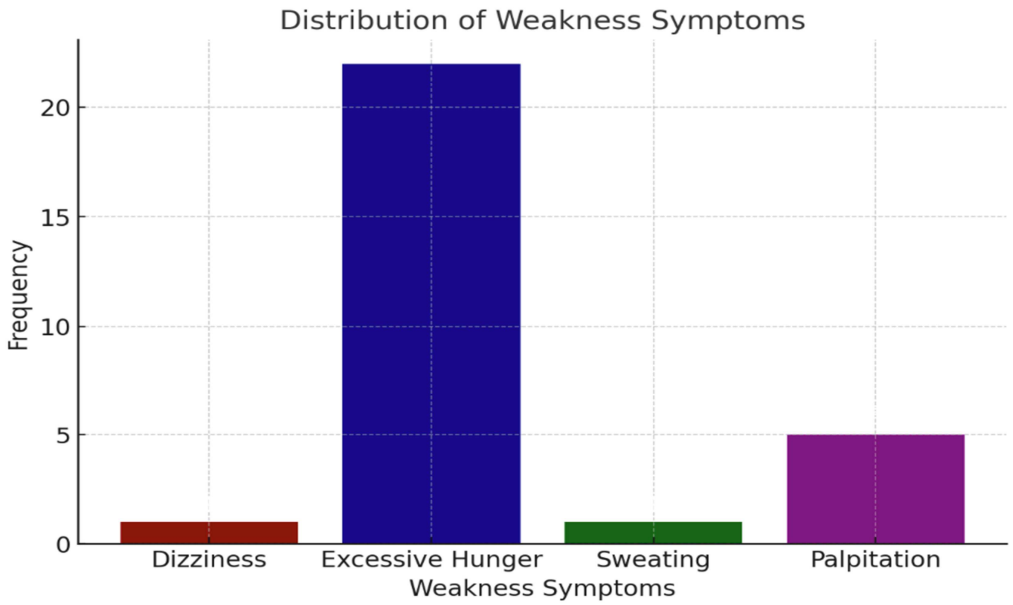

Figure 20: Distribution of Hypoglycemia Symptoms

Table 22 and Figure 20 highlight the frequency and percentage distribution of different weakness symptoms experienced by respondents. Among the 29 individuals who reported weakness, the most common symptom was excessive hunger (75.9%), followed by palpitation (17.2%). Dizziness and sweating were reported by only 3.4% of respondents each.

Table 23: What was your source of knowledge on hypoglycaemia?

Response	Frequency	Percent
Doctor	28	93.3
Relatives	1	3.3
Fellow patients	1	3.3
Total	**30**	**100.0**

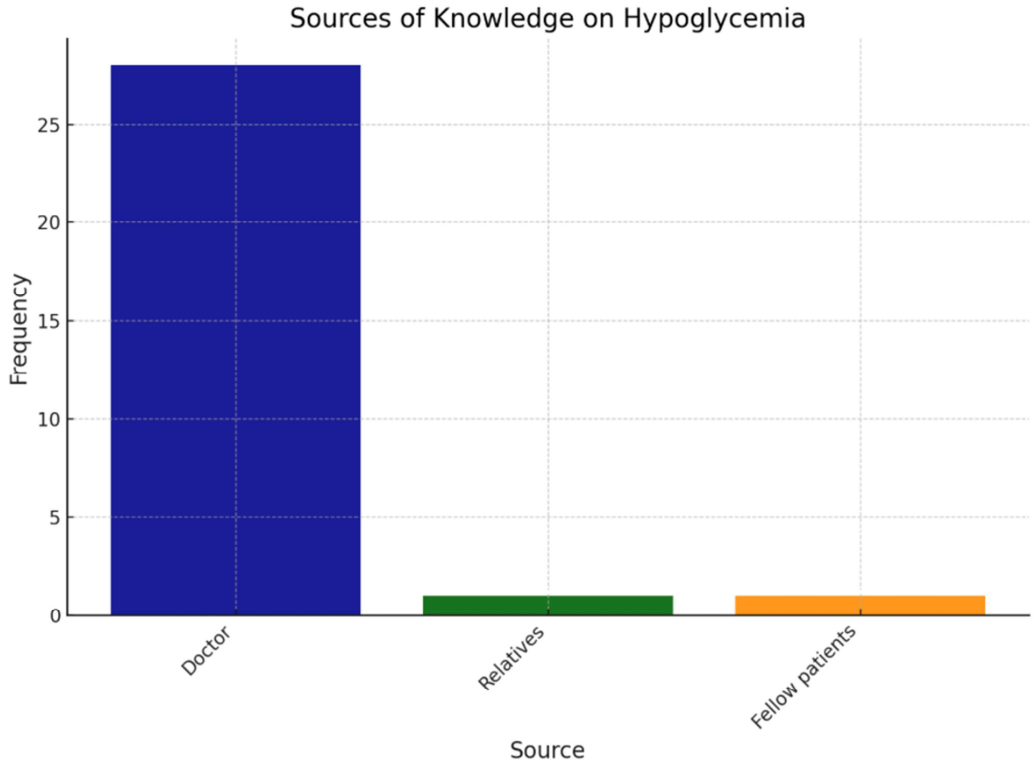

Figure 21: Sources of Knowledge on Hypoglycaemia

Table 23 and Figure 21 show the sources of knowledge about hypoglycemia among participants. The majority, 93.3% (28 individuals), reported their doctor as the primary source of information. A small percentage, 3.3% (1 individual each), mentioned relatives and fellow patients.

ATTITUDE BASED QUESTIONS

Table 24: Diet is responsible for hypoglycaemia

Response	Frequency	Percent
Yes	6	10.0
No	27	45.0
Not sure	27	45.0
Total	**60**	**100.0**

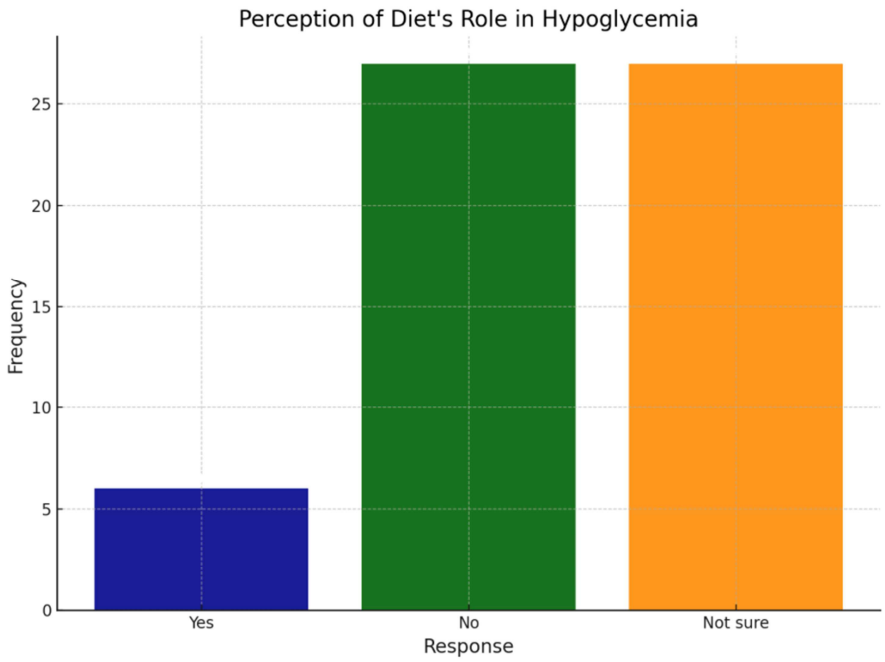

Figure 22: Perception of Diet's Role in Hypoglycaemia

Table 24 and Figure 22 illustrate participants' perceptions of the role of diet in causing hypoglycemia. While 10.0% (6 individuals) believe diet is responsible, 45.0% (27 individuals) disagree, and an equal 45.0% (27 individuals) are unsure.

Table 25: Very low blood sugars are good for health

Response	Frequency	Percent
Yes	20	33.3
No	29	48.3
Not sure	11	18.3
Total	**60**	**100.0**

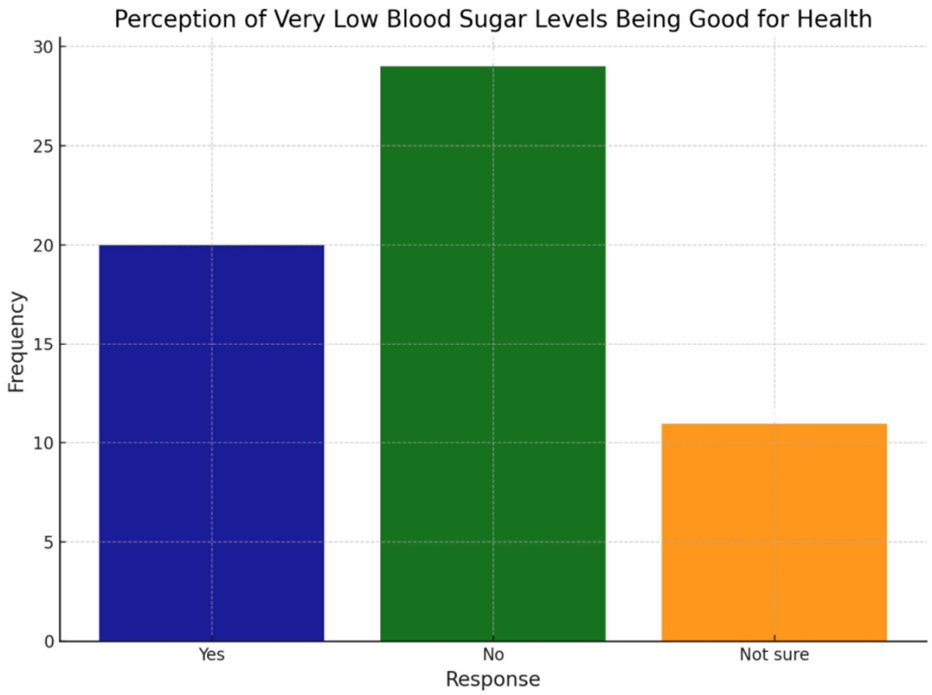

Figure 23: Perception of Very Low Blood Sugar Levels Being Good for Health

Table 25 and Figure 23 illustrate participants' perceptions of very low blood sugar levels being good for health. While 33.3% (20 individuals) mistakenly believe very low blood sugar levels are beneficial, 48.3% (29 individuals) correctly disagree, and 18.3% (11 individuals) are unsure.

Table 26: Skipping meals is good for sugar control

Response	Frequency	Percent
Yes	11	18.3
No	27	45.0
Not sure	22	36.7
Total	**60**	**100.0**

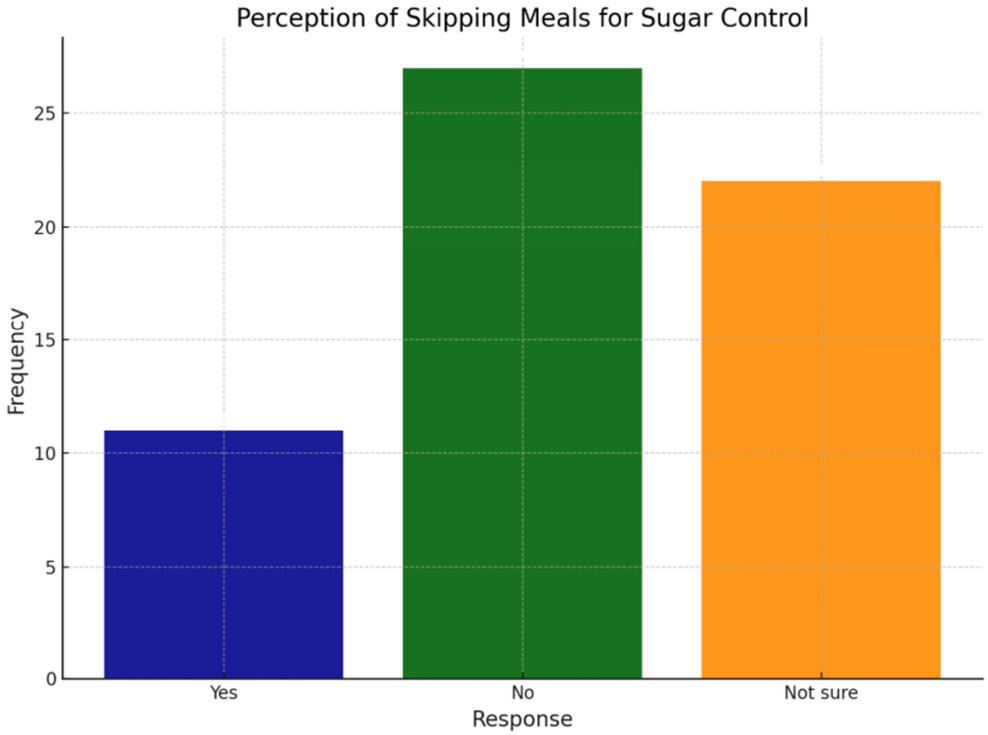

Figure 24: Perception of Skipping Meals for Sugar Control

Table 26 and Figure 24 present participants' perceptions of skipping meals as a strategy for sugar control. While 18.3% (11 individuals) believe skipping meals is good for sugar control, 45.0% (27 individuals) disagree, and 36.7% (22 individuals) are unsure.

Table 27: Vigorous exercises can help in diabetes management

Response	Frequency	Percent
Yes	1	1.7
No	18	30.0
Not sure	41	68.3
Total	**60**	**100.0**

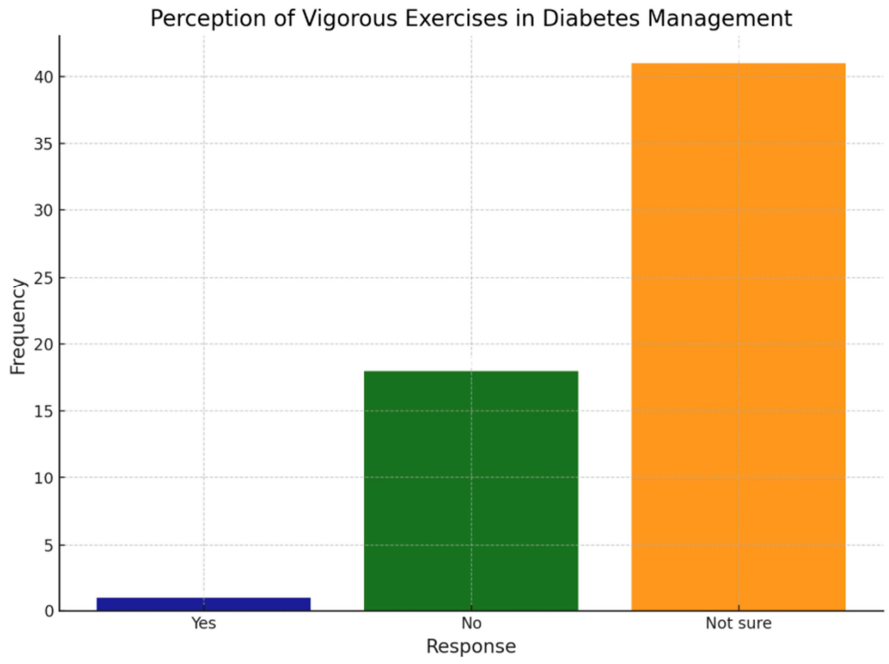

Figure 25: Perception of Vigorous Exercises in Diabetes Management

Table 27 and Figure 25 reveal participants' perceptions of vigorous exercises helping in diabetes management. Only 1.7% (1 individual) agree with this statement, while 30.0% (18 individuals) disagree, and the majority, 68.3% (41 individuals), are unsure.

Table 28: Do not consult a doctor when there is low blood sugar

Response	Frequency	Percent
Yes	18	30.0
No	20	33.3
Not sure	22	36.7
Total	**60**	**100.0**

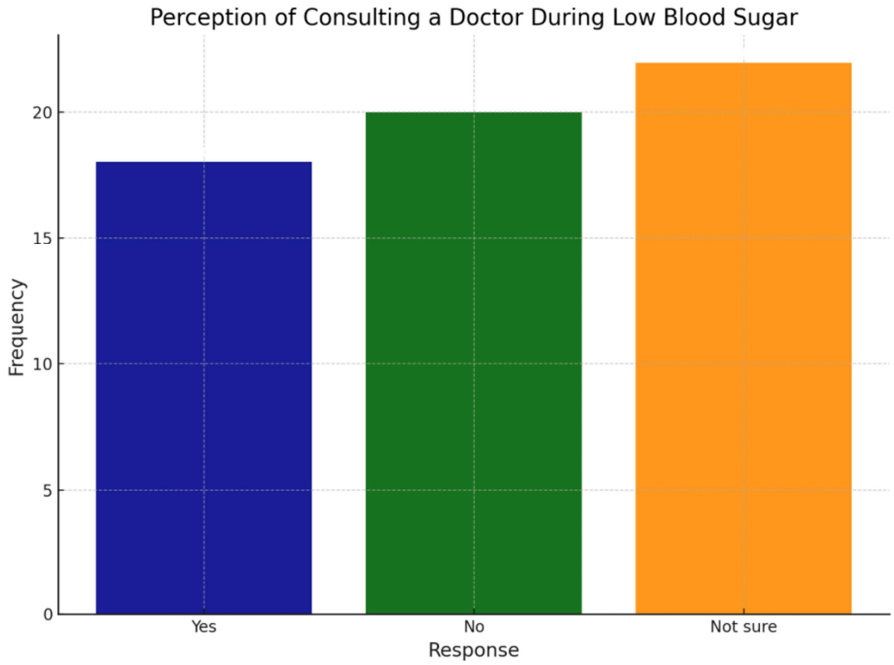

Figure 26: Perception of Consulting a Doctor During Low Blood Sugar

Table 28 and Figure 26 highlight participants' perceptions regarding consulting a doctor during low blood sugar episodes. While 30.0% (18 individuals) believe they should not consult a doctor, 33.3% (20 individuals) disagree, and 36.7% (22 individuals) are unsure.

Table 29: Low blood sugar level is not as dangerous as high sugar levels

Response	Frequency	Percent
Yes	22	36.7
No	17	28.3
Not sure	21	35.0
Total	**60**	**100.0**

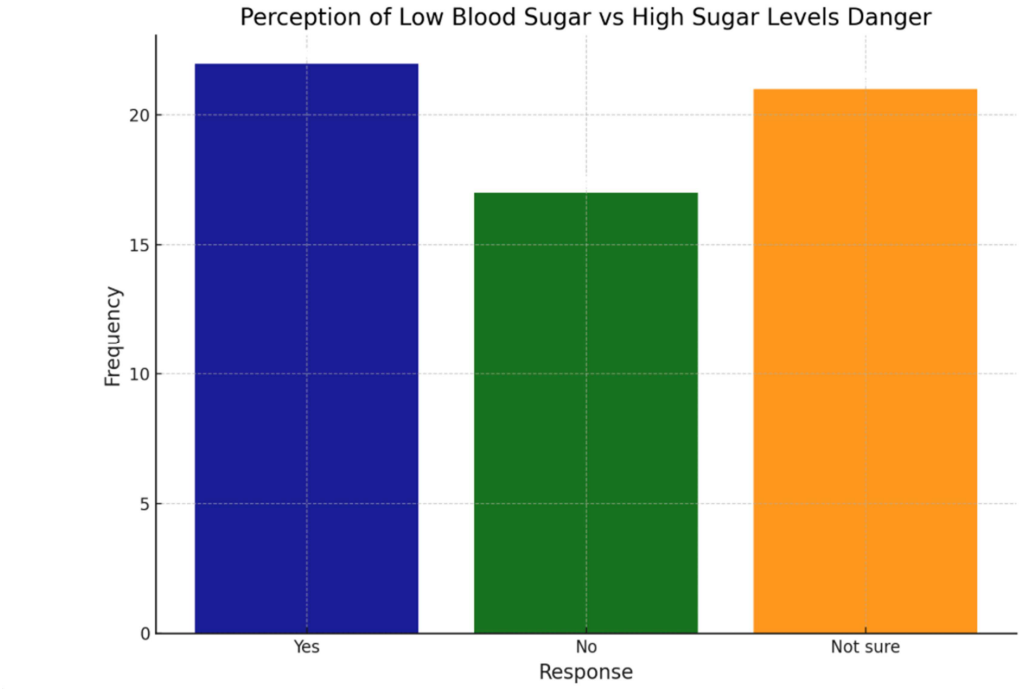

Figure 27: Perception of Low Blood Sugar vs High Sugar Danger

Table 29 and Figure 27 illustrate participants' perceptions of low blood sugar levels being less dangerous than high sugar levels. While 36.7% (22 individuals) agree with this perception, 28.3% (17 individuals) disagree, and 35.0% (21 individuals) are unsure.

Table 30: Check blood sugar levels when you experience symptoms

Response	Frequency	Percent
Yes	52	86.7
No	4	6.7
Maybe	4	6.7
Total	**60**	**100.0**

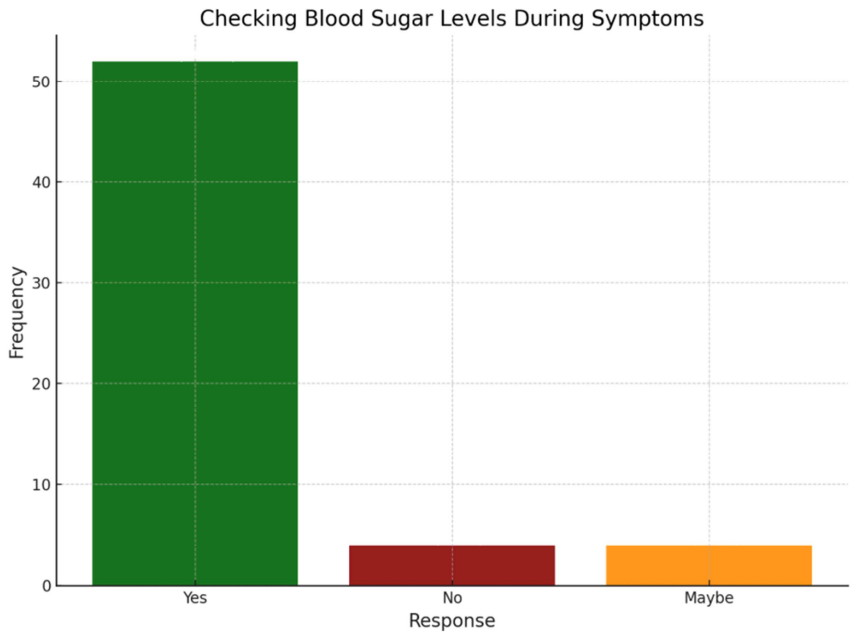

Figure 28: Checking Blood Sugar Levels During Symptoms

Table 30 and Figure 28 indicate participants' practices regarding checking blood sugar levels when experiencing symptoms. A significant majority, 86.7% (52 individuals), report that they check their blood sugar levels, while 6.7% (4 individuals) do not, and another 6.7% (4 individuals) are uncertain.

Table 31: Consult a doctor for dose adjustments

Response	Frequency	Percent
Yes	58	96.7
No	1	1.7
Maybe	1	1.7
Total	**60**	**100.0**

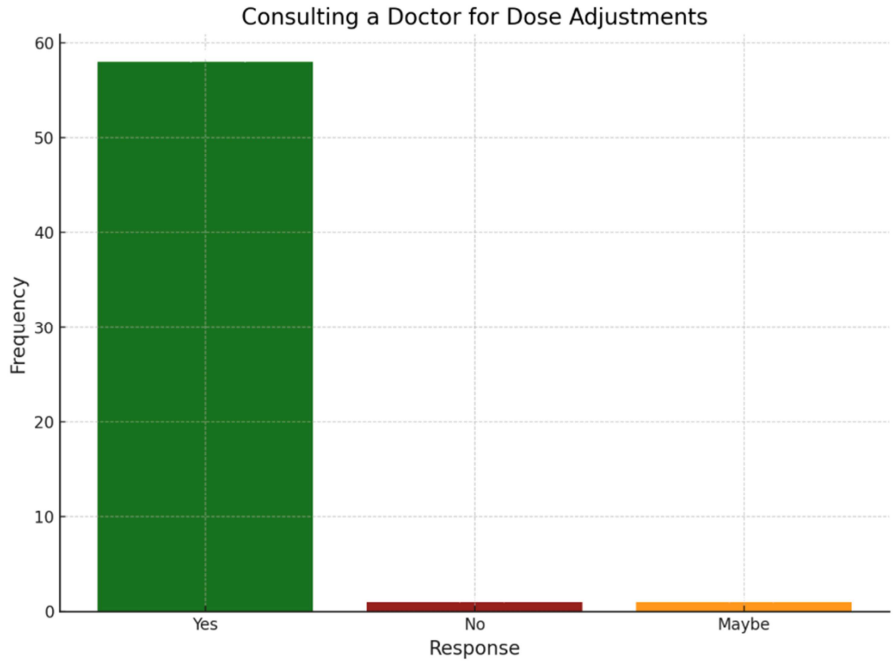

Figure 29: Consulting a Doctor for Dose Adjustments

Table 31 and Figure 29 reveal participants' practices regarding consulting a doctor for dose adjustments. A vast majority, 96.7% (58 individuals), reported consulting their doctor, while only 1.7% (1 individual) do not, and another 1.7% (1 individual) are unsure.

Table 32: Eat regular healthy meals

Response	Frequency	Percent
Yes	60	100.0
Total	**60**	**100.0**

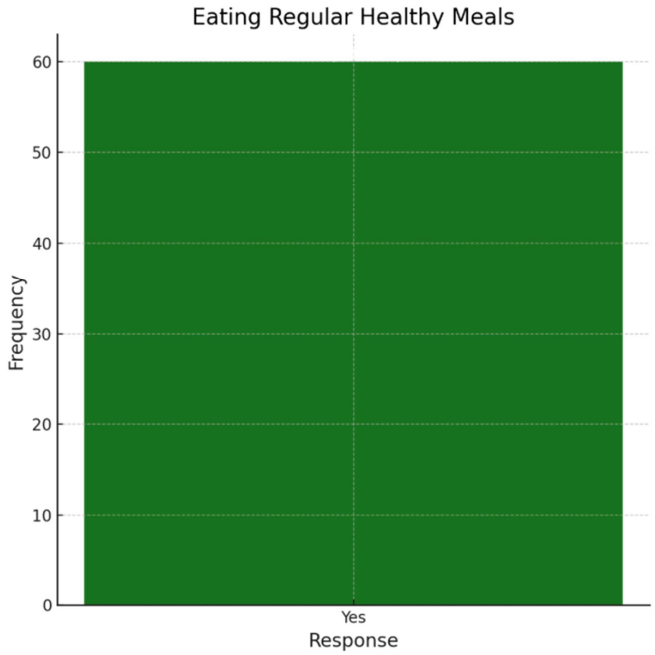

Figure 30: Eating Regular Healthy Meals

Table 32 and Figure 32 indicate that all participants, 100.0% (60 individuals), reported eating regular healthy meals.

Table 33: Be aware of symptoms of hypoglycaemia

Response	Frequency	Percent
Yes	47	78.3
No	2	3.3
Maybe	11	18.3
Total	**60**	**100.0**

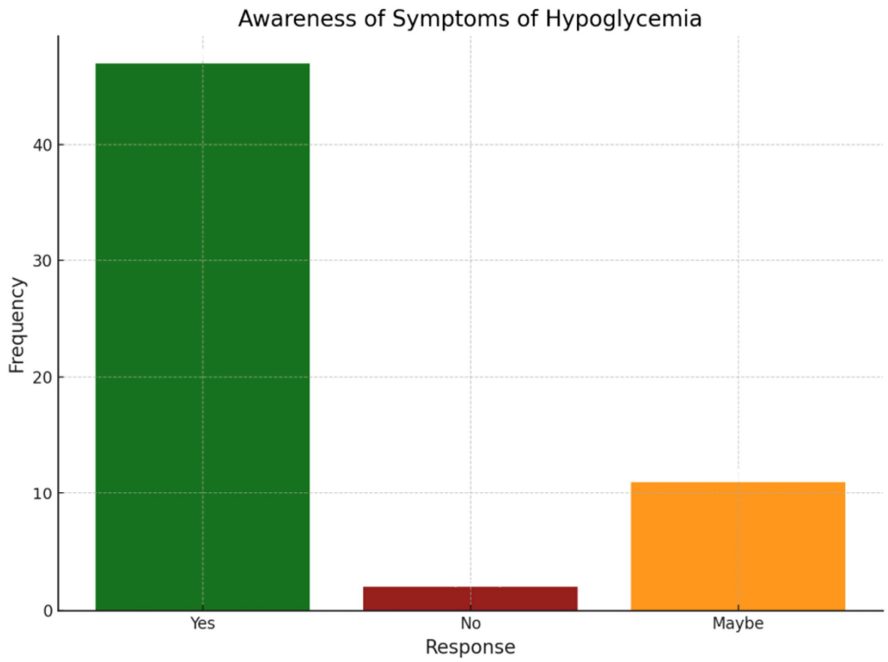

Figure 31: Awareness of Symptoms of Hypoglycemia

Table 33 and Figure 33 show participants' awareness of hypoglycemia symptoms. A significant majority, 78.3% (47 individuals), are aware of the symptoms, while 18.3% (11 individuals) are uncertain, and 3.3% (2 individuals) are unaware.

Table 34: Consult a doctor if you develop health issues

Response	Frequency	Percent
Yes	55	91.7
No	3	5.0
Maybe	2	3.3
Total	**60**	**100.0**

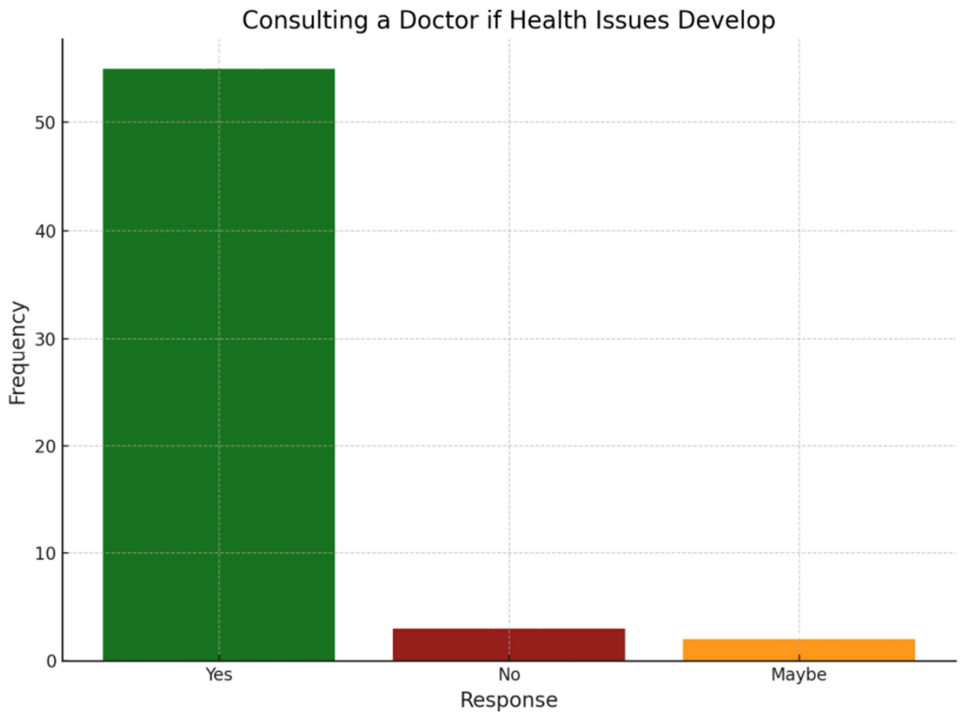

Figure 32: Consulting a Doctor if Health Issues Develop

Table 34 and Figure 32 illustrate participants' practices of consulting a doctor if health issues develop. A large majority, 91.7% (55 individuals), reported they would consult a doctor, while 5.0% (3 individuals) would not, and 3.3% (2 individuals) are uncertain.

Table 35: Association Between Demographic and Clinical Variables with HbA1c Levels

Variable	Category	HbA1c < 7.5	HbA1c ≥ 7.5	Total	P-Value
Sex	Female	10 (40.0%)	15 (60.0%)	25	0.04
	Male	23 (65.7%)	12 (34.3%)	35	
Place of Residence	Rural	18 (51.4%)	17 (48.6%)	35	0.51
	Urban	15 (60.0%)	10 (40.0%)	25	
Educational Status	Graduate	3 (42.9%)	4 (57.1%)	7	0.74
	Illiterate	3 (75.0%)	1 (25.0%)	4	
	Primary	6 (50.0%)	6 (50.0%)	12	
	Secondary	21 (56.8%)	16 (43.2%)	37	
Socio-Economic Status	Class I	1 (50.0%)	1 (50.0%)	2	0.98
	Class II	12 (57.1%)	9 (42.9%)	21	
	Class III	15 (55.6%)	12 (44.4%)	27	
	Class IV	5 (50.0%)	5 (50.0%)	10	
Comorbid Conditions	Cardiovascular Disease	8 (53.3%)	7 (46.7%)	15	0.91
	Chronic Kidney Disease	1 (33.3%)	2 (66.7%)	3	
	Hypertension	10 (55.6%)	8 (44.4%)	18	
	Infection	1 (50.0%)	1 (50.0%)	2	
	Thyroid	1 (100.0%)	0 (0.0%)	1	
Are you aware diabetic treatment can sometimes lead to low blood sugars?	Yes	14 (48.3%)	15 (51.7%)	29	0.31

	No	19 (61.3%)	12 (38.7%)	31	
Hypoglycaemia happen when RBS value is	< 80 mg/dl	2 (66.7%)	1 (33.3%)	3	0.43
	< 70 mg/dl	1 (25.0%)	3 (75.0%)	4	
	I do not know	30 (56.6%)	23 (43.4%)	53	
Are aware of symptoms of hypoglycaemia?	Yes	14 (46.7%)	16 (53.3%)	30	0.19
	No	19 (63.3%)	11 (36.7%)	30	
Very low blood sugars are good for health	Yes	11 (55.0%)	9 (45.0%)	20	0.99
	No	16 (55.2%)	13 (44.8%)	29	
	Not Sure	6 (54.5%)	5 (45.5%)	11	
Treatment	Insulin	15 (41.7%)	21 (58.3%)	36	0.01
	Oral Hypoglycaemic	18 (75.0%)	6 (25.0%)	24	

Table 35 shows that there is a significant association between sex and HbA1c levels, with males being more likely to have HbA1c < 7.5 compared to females ($p = 0.04$). Additionally, treatment type shows a notable difference, as participants on oral hypoglycemic agents are more likely to maintain HbA1c < 7.5, whereas those on insulin are more likely to have higher HbA1c levels ($p = 0.01$). Other demographic and clinical variables, including place of residence, educational status, socio-economic status, comorbid conditions, and knowledge or attitudes about diabetes management, do not exhibit significant associations with HbA1c levels (p-values > 0.05).

Table 36: Association Between Treatment Type and Knowledge on Hypoglycemia

		Treatment						Pvalue
		Insulin		Oral hypoglycemic		Total		
		n	%	n	%	n	%	
Are you aware diabetic treatment can sometimes lead to low blood sugars?	Yes	19	65.5	10	34.5	29	100.0	0.40
	No	17	54.8	14	45.2	31	100.0	
Do you monitor blood glucose levels?	Yes	31	60.8	20	39.2	51	100.0	0.77
	No	5	55.6	4	44.4	9	100.0	
Are you aware of symptoms of hypoglycemia?	Yes	21	70.0	9	30.0	30	100.0	0.11
	No	15	50.0	15	50.0	30	100.0	
What was your source of knowledge on hypoglycemia?	Doctor	20	71.4	8	28.6	28	100.0	0.68
	Relatives	1	100.0	0	0.0	1	100.0	
	Fellow patients	1	100.0	0	0.0	1	100.0	

Table 36 examines the relationship between treatment type (Insulin vs. Oral Hypoglycemic) and participants' responses to various questions regarding diabetes management. The findings suggest that while there are differences in knowledge between the two groups, none of these differences are statistically significant.

For the question, "Are you aware diabetic treatment can sometimes lead to low blood sugars?", insulin users (65.5%) showed a higher percentage of correct responses compared to oral hypoglycemic users (34.5%), however the p-value of 0.40 indicates no significant difference between the two groups. Similarly, for the question, "Do you monitor blood glucose levels?", insulin users (60.8%) had a higher level of correct responses compared to oral hypoglycemic users (39.2%), with the p-value of 0.77 indicating no statistical significance.

In the case of the question, "Are you aware of symptoms of hypoglycemia?", insulin users (70%) performed better than oral hypoglycemic users (30%), though the p-value of 0.11 suggests that the difference is not significant. For "What was your source of knowledge on hypoglycemia?", both groups relied on doctors as their primary source of information, with no significant difference between the two groups ($p = 0.68$).

Table 37: Association Between Demographic Variables and Knowledge on Hypoglycemia

		Are You Aware of Symptoms of Hypoglycemia?		Total	Pvalue
		Yes	No		
Sex	Female	14	11	25	0.432
	Male	16	19	35	
Total		30	30	60	
Place of residence	Rural	17	18	35	0.793
	Urban	13	12	25	
Total		30	30	60	
Educational status	Graduate	5	2	7	0.514
	Illiterate	2	2	4	
	Primary	7	5	12	
	Secondary	16	21	37	
Total		30	30	60	
Socio economic status	Class I	1	1	2	0.301
	Class II	7	14	21	
	Class III	16	11	27	
	Class IV	6	4	10	
Total		30	30	60	

Table 37 explores the relationship between various socio-demographic factors and participants' awareness of hypoglycemia symptoms. The findings suggest that socio-demographic factors did not significantly influence awareness of hypoglycemia symptoms. The study findings reveal no significant difference between males and females in their awareness of hypoglycemia symptoms, with a p-value of 0.432, indicating that sex does not impact knowledge of these symptoms. Similarly, the place of residence (rural vs. urban) did not significantly affect awareness, as evidenced by the p-value of 0.793. In terms of educational status, there were no statistically significant differences in awareness levels across educational groups ($p = 0.514$). While those with secondary education had the highest number of correct responses, these differences were not statistically significant. Socio-economic status also showed no significant association with awareness of hypoglycemia symptoms, with a p-value of 0.301.

Table 38: Association Between Demographic Variables and Knowledge of Hypoglycemia Symptoms

		Specify which of the following are symptoms of Hypoglycemia				Total	Pvalue
		Dizziness	Weakness	Sweating	Palpitation		
Sex	Female	0	11	1	2	14	0.538
	Male	1	11	0	3	15	
Total		1	22	1	5	29	
Place of residence	Rural	0	12	0	5	17	0.089
	Urban	1	10	1	0	12	
Total		1	22	1	5	29	
Educational status	Graduate	0	4	0	0	4	0.623
	Illiterate	0	1	0	0	1	
	Primary	0	3	0	3	6	
	Secondary	1	14	1	2	18	
Total		1	22	1	5	29	
Socio economic status	Class I	0	2	0	0	2	0.507
	Class II	0	3	0	3	6	
	Class III	1	11	1	2	15	
	Class IV	0	6	0	0	6	
Total		1	22	1	5	29	

Table 38 examines the relationship between socio-demographic factors (sex, place of residence, educational status, and socio-economic status) and participants' ability to identify symptoms of hypoglycemia, specifically dizziness, weakness, sweating, and palpitation. The study findings reveal no significant differences between males and females in recognizing hypoglycemia symptoms, as shown by a p-value of 0.538. When considering the place of residence, rural and urban participants displayed comparable knowledge of hypoglycemia symptoms, with a p-value of 0.089, suggesting that place of residence does not significantly impact the recognition of symptoms. In terms of educational status, the ability to identify hypoglycemia symptoms was similar across the different educational groups, with a p-value of 0.623, indicating no significant differences. Socio-economic status did not have a significant impact on the ability to identify symptoms of hypoglycemia, with a p-value of 0.507.

Table 39: Association Between Demographic Variables and Source of Knowledge on Hypoglycemia (Knowledge Q12)

		What was your source of knowledge on hypoglycaemia?			Total	Pvalue
		Doctor	Relatives	Fellow patients		
Sex	Female	12	1	1	14	0.294
	Male	16	0	0	16	
Total		28	1	1	30	
Place of residence	Rural	16	1	0	17	0.354
	Urban	12	0	1	13	
Total		28	1	1	30	
Educational status	Graduate	4	0	0	4	0.000
	Illiterate	0	1	0	1	
	Primary	6	0	0	6	
	Secondary	18	0	1	19	
Total		28	1	1	30	
Socio economic status	Class I	1	1	0	2	0.018
	Class II	6	0	0	6	
	Class III	15	0	1	16	
	Class IV	6	0	0	6	
Total		28	1	1	30	

Table 39 explores the relationship between socio-demographic factors (sex, place of residence, educational status, and socio-economic status) and participants' sources of knowledge regarding hypoglycemia, specifically whether they obtained their information from doctors, relatives, or fellow patients.

The study finding reveals that both males and females primarily cited doctors as their source of information (female: 12, male: 16), with no significant difference between the sexes ($p = 0.294$). Similarly, there were no significant differences between rural and urban participants in their sources of knowledge ($p = 0.354$), as the majority from both groups indicated doctors as their main source of information. Educational status, however, did show a significant impact on the source of knowledge. A p-value of 0.000 suggests a significant difference, with secondary-educated participants (18 out of 19) predominantly reporting doctors as their source, while those with a graduate or illiterate education had varying responses. Additionally, socio-economic status demonstrated a significant association with the source of knowledge ($p = 0.018$). Class I participants were the only ones to report relatives as their source of information, while others primarily relied on doctors, with no significant variation in sources across other socio-economic classes.

DISCUSSION

The current study presents a comprehensive analysis of the socio-demographic characteristics, knowledge, attitudes, and practices (KAP) related to hypoglycemia. The findings reveal critical gaps in awareness and practice and provide a foundation for comparison with existing literature to identify areas requiring intervention.

Socio-Demographic Characteristics

In this study, males constituted a higher proportion of participants (58.3%) compared to females (41.7%). This distribution aligns with findings from Magbol et al. (2024), which also reported similar trends among diabetic patients in Sudan.[7] The higher male representation could be attributed to gender-specific health-seeking behavior or regional differences in population dynamics. However, other studies, such as Larsson et al. (2018) and Ishamael (2022), reported a predominance of female participants, reflecting possible cultural and geographical variations in diabetes prevalence and awareness.[15]

The majority of participants in this study resided in rural areas (58.3%), highlighting the need for targeted diabetes education in these regions. This rural-urban disparity is consistent with findings from Asmelash et al. (2019), where rural residents exhibited lower KAP scores due to limited access to healthcare services and education.[6] Moreover, the predominance of secondary education among participants (61.7%) underscores the critical role of basic education in shaping health-related knowledge and practices. Isnani et al. (2021) and Ngo et al. (2020) emphasized the influence of educational attainment on diabetes awareness, with higher education levels correlating with better knowledge and adherence to treatment.[4,8]

Glycemic Control and Socio-Economic Status

The mean HbA1c level in this study was 7.96% (SD: 1.75), indicating suboptimal glycemic control among participants. This aligns with the findings of Bhutani et al. (2015) and Huang et al. (2022), which also reported poor glycemic control among diabetic populations. The study further revealed that socio-economic factors did not significantly influence HbA1c levels, with a majority of participants belonging to Class III (45.0%).[5,10] Asmelash et al. (2019) similarly found that socio-economic status had a limited direct impact on glycemic control but influenced access to care and adherence to treatment.[6]

However, prior studies suggest a more nuanced relationship between socio-economic status (SES), ethnicity, self-care practices, and glycemic control. Khanolkar et al. (2016) analyzed a large pediatric diabetic cohort in England and Wales and found that children from non-white ethnic groups and lower SES had significantly higher HbA1c levels.[33] Their study reported that black and mixed-ethnicity children had HbA1c levels 2.8-2.9% higher than white children, while those in the lowest SES group had HbA1c levels 2.8% higher than those in the highest SES group. These findings suggest that both ethnicity and socio-economic factors contribute to disparities in glycemic control, possibly due to differences in insulin pump access, healthcare utilization, or lifestyle factors.

Similarly, Larsson et al. (1999) conducted a cross-sectional study and found that diabetic patients in poor metabolic control (HbA1c >10%) had lower educational levels, higher sick leave days, and lower physical activity levels than those in acceptable control (HbA1c 6.5%-7.5%).[15] This study underscores the broader impact of SES on diabetes complications, employment status, and self-reported quality of life, reinforcing the need for targeted interventions, such as lifestyle modifications and

structured diabetes education programs, especially for socio-economically disadvantaged groups.

Further supporting these findings, Bachmann et al. (2003) investigated socio-economic inequalities in diabetes-related complications and healthcare utilization.[34] Their study reported that patients with lower educational attainment had a significantly higher prevalence of diabetic retinopathy and cardiovascular disease. Moreover, these individuals had higher general practice attendance but lower hospital visits, suggesting that barriers to specialist care may contribute to worse long-term outcomes. This highlights the importance of equitable healthcare access, particularly for lower-income groups who may face cost-related barriers, limited health literacy, or perceived discrimination in healthcare settings.

Kakade et al. (Integrative Obesity and Diabetes, 2020) further reinforce these findings, reporting that 91.8% of Type 2 diabetic patients had poor glycemic control.[35] Their study identified BMI, central obesity, dyslipidemia, and poor diabetes self-care practices (glucose management and dietary control) as significant determinants of poor glycemic control. This suggests that while SES may not directly impact glycemic levels, modifiable risk factors such as weight management, lipid control, and self-care behaviours play a critical role in achieving optimal HbA1c levels.

Similarly, Kadam et al. (2014) examined social determinants of glycemic control in Type 2 diabetic patients and found that literacy, disease duration, and awareness significantly influenced glycemic control. Interestingly, BMI, occupation, and income did not show a significant association with poor glycemic control, indicating that knowledge, behavioural factors, and healthcare access may be more critical determinants than income alone. Their study highlights the role of family

worries, limited affordability for medications, poor healthcare access, and lack of disease awareness as key barriers to glycemic control. This underscores the need for patient-centered diabetes education programs tailored to socio-economic contexts.[36]

The influence of socio-economic and cultural factors on Type 1 diabetes management was also examined by Mangla et al. (2020) in a tertiary care diabetes center in India. Their study found that HbA1c was negatively associated with diabetes knowledge scores (DKTS) and age group, while DKTS was positively associated with urban residence and maternal education. Interestingly, income did not directly impact HbA1c, suggesting that awareness, education, and healthcare access play a more prominent role in glycemic control than financial status alone. Their findings indicate that improving societal awareness about childhood diabetes and ensuring better diabetes education may significantly enhance glycemic outcomes.[37]

Taken together, these studies suggest that while SES may not always directly correlate with glycemic control, it plays a crucial role in diabetes management outcomes, access to healthcare, and overall disease burden. The lack of significant SES influence in the current study could be due to homogeneity in the socio-economic distribution of participants, differences in healthcare accessibility, or variations in self-management behaviours across socio-economic strata. However, given the broader evidence of socio-economic and behavioral disparities in diabetes management, future research should further explore the role of social determinants, healthcare accessibility, and ethnic disparities in glycemic control to inform targeted public health interventions.

Knowledge About Diabetes and Hypoglycemia

The results demonstrate significant knowledge gaps, particularly regarding hypoglycemia. For instance, 88.3% of participants were unaware of the correct plasma glucose threshold for hypoglycemia. This finding is consistent with Ejegi, Ross, and Naidoo (2016), who reported that less than 25% of diabetic patients understood appropriate responses to hypoglycemia.[22] Similarly, Ngo et al. (2020) found that only 45.9% of participants had good knowledge of hypoglycemia, underscoring the global challenge of educating diabetic patients about this critical complication.[8]

Despite 48.3% of participants being aware that diabetes treatment could cause low blood sugar, the lack of preventive knowledge (28.3%) remains concerning. Studies by Bhutani et al. (2015) and Abualhommos et al. (2024) demonstrated that structured education programs significantly improved knowledge, attitudes, and practices, emphasizing the importance of patient education.[5,12] In contrast, the reliance on doctors as the primary source of information (93.3%) in this study mirrors findings from Al-bawi et al. (2022), which highlighted the dependence on healthcare providers for diabetes education.[11]

Attitudes and Practices

The study revealed that 85.0% of participants regularly monitored their blood glucose levels, which is significantly higher than the 44.6% reported by Ngo et al. (2020) in Vietnamese diabetic outpatients.[8] This suggests strong adherence to monitoring practices in the study population. However, misconceptions persist, with 33.3% believing that very low blood sugar levels are beneficial—similar to findings by Isnani et al. (2021), where knowledge gaps contributed to the mismanagement of hypoglycemia.[4]

Interestingly, 90.0% of participants adhered to a diabetic diet, demonstrating good dietary practices. In comparison, Ahmed et al. (2023) reported that only 59.4% of Bangladeshi T2DM patients achieved good dietary control, highlighting the role of nutrition knowledge in effective.[38] However, only 28.3% of participants in our study were aware of specific strategies to prevent hypoglycemia, with most relying on eating after insulin injections (76.5%). This limited understanding of comprehensive preventive measures echoes the findings of Bhutani et al. (2015), which highlighted the effectiveness of education in improving preventive practices.[5]

Comparison of Treatment Modalities

A significant finding of this study was the association between treatment type and glycemic control. Participants on oral hypoglycemic agents were more likely to achieve HbA1c < 7.5 compared to those on insulin therapy ($p = 0.01$). This aligns with the findings of Vidal et al. (2020) and Naser et al. (2019), which reported that insulin therapy often correlates with higher HbA1c levels due to advanced disease stages and challenges in adherence.[20,9] This emphasizes the need for targeted interventions for insulin users, including counseling and support to improve glycemic control.

Implications for Interventions

The study highlights critical areas for intervention, particularly in hypoglycemia awareness and prevention. The findings align with studies like Bhutani et al. (2015) and Romalina et al., which demonstrated significant improvements in KAP scores following educational interventions.[5,18] Tailored programs focusing on rural populations, females, and insulin users could address these disparities effectively. Additionally, integrating educational tools such as booklets or structured

training sessions, as suggested by Romalina et al., could further enhance awareness and practices.

The reliance on healthcare providers for information underscores the need for healthcare-driven educational initiatives. Studies like Al Zahrani et al. (2017) emphasize that targeted interventions, particularly those addressing specific demographic factors such as education and income, can significantly improve outcomes.[13]

Limitations of the study

This study has several limitations that may affect the generalizability of its findings. The sample size of 60 participants, while sufficient for exploratory analysis, limits the ability to draw robust conclusions about the broader diabetic population. Additionally, the study was conducted in a specific geographical region, focusing on participants from North Karnataka. This regional focus may not fully capture the variations in socio-demographic factors, healthcare access, and diabetes management practices seen in other parts of the country or globally. As a result, the findings may not be entirely applicable to populations with different cultural, socio-economic, or healthcare contexts.

Another limitation is the reliance on self-reported data, which is subject to recall bias and may not accurately reflect participants' actual behaviours or practices. For instance, self-reported adherence to dietary recommendations and blood glucose monitoring could be influenced by social desirability bias, where participants provide responses they perceive as favorable. Furthermore, the cross-sectional design of the study prevents the establishment of causal relationships between variables, such as the association between treatment modality and glycemic control. Longitudinal studies

would be required to better understand these dynamics and assess the long-term impact of knowledge, attitudes, and practices on diabetes outcomes.

Strengths of the study

This study has several strengths that enhance its relevance and reliability in understanding diabetes and hypoglycemia management among patients. One of the primary strengths is the comprehensive data collection, which includes socio-demographic characteristics, clinical variables, and detailed assessments of knowledge, attitudes, and practices (KAP). By integrating these elements, the study provides a holistic view of the factors influencing diabetes management, offering valuable insights for healthcare providers and policymakers. Additionally, the study's focus on a specific region, North Karnataka, highlights region-specific challenges and opportunities, enabling the design of targeted interventions that address local healthcare needs.

Another notable strength is the detailed exploration of associations between demographic, clinical, and treatment-related variables with glycemic control (HbA1c levels). The identification of significant relationships, such as the association between treatment modality and glycemic outcomes, provides actionable insights for improving diabetes care. Furthermore, the study emphasizes the role of healthcare engagement, as evidenced by the high percentage of participants consulting doctors for dose adjustments and using doctors as a primary source of information. This highlights the potential to leverage healthcare providers for patient education and support, ensuring better diabetes outcomes. The inclusion of a diverse participant group, spanning various socio-economic classes and educational backgrounds, further enhances the study’s applicability to similar populations.

CONCLUSION

The study revealed important findings about the socio-demographic characteristics, knowledge, attitudes, and practices related to diabetes and hypoglycemia management among participants. Males constituted a higher proportion of the study population (58.3%), and a majority (58.3%) resided in rural areas. This highlights the need for targeted health interventions in rural communities. Most participants (61.7%) had completed secondary education, emphasizing the role of basic education in shaping health-related practices. Despite this, significant knowledge gaps and misconceptions about diabetes management persist, indicating the need for enhanced educational programs.

The mean HbA1c level among participants was 7.96% (SD: 1.75), reflecting suboptimal glycemic control. Participants on oral hypoglycemic agents demonstrated better glycemic control compared to those on insulin therapy. This finding underscores the challenges faced by insulin users, likely due to advanced disease stages or difficulties in adherence to treatment regimens. Addressing these challenges through targeted counseling and support programs for insulin users could significantly improve glycemic outcomes.

Knowledge gaps were evident, with 88.3% of participants unable to identify the correct threshold for hypoglycemia and 63.3% unaware of its causes. Additionally, 71.7% of participants did not know how to prevent hypoglycemia, with most relying on eating after insulin injections as a preventive measure. Misconceptions were also prevalent, with 33.3% believing very low blood sugar levels are beneficial. These findings align with existing literature and emphasize the

urgent need for structured educational interventions to address gaps in knowledge and correct misconceptions.

Encouragingly, positive practices were observed among participants. Most (85.0%) regularly monitored their blood glucose levels, and 90.0% adhered to diabetic dietary recommendations. Healthcare engagement was strong, with 96.7% consulting a doctor for dose adjustments. Additionally, doctors were the primary source of diabetes-related information for 93.3% of participants, highlighting the pivotal role of healthcare providers in diabetes education and management.

These findings underscore the critical need for tailored interventions to address knowledge gaps, promote effective practices, and correct misconceptions about diabetes and hypoglycemia management. Special focus should be directed toward rural populations, females, and insulin users, who are at higher risk of poor glycemic control. Targeted educational programs and support systems could significantly enhance diabetes management outcomes, reduce complications, and improve overall quality of life for diabetic patients.

SUMMARY

This study aimed to explore the socio-demographic characteristics, knowledge, attitudes, and practices (KAP) of diabetic patients regarding diabetes and hypoglycemia management, with a particular focus on their glycemic control as indicated by HbA1c levels. The study sample comprised 60 participants, with a higher representation of males (58.3%) and a majority living in rural areas (58.3%). Most participants had completed secondary education (61.7%), highlighting the need for educational interventions targeting both rural populations and those with lower levels of formal education. The mean HbA1c level among participants was 7.96%, suggesting that glycemic control was suboptimal, with insulin users exhibiting higher HbA1c levels than those using oral hypoglycemic agents. This aligns with findings from previous studies that suggest insulin therapy is often associated with poorer glycemic control due to challenges in adherence and advanced disease stages.

Knowledge gaps were evident in the study, particularly regarding hypoglycemia. A significant proportion (88.3%) of participants could not identify the correct plasma glucose threshold for hypoglycemia, and 63.3% were unaware of its causes. Furthermore, 71.7% did not know how to prevent hypoglycemia, indicating a critical need for structured educational programs. Participants demonstrated misconceptions, with 33.3% believing that very low blood sugar levels were beneficial, and only a small percentage were aware of preventive strategies. Despite these knowledge gaps, the study observed positive practices, with 85.0% of participants regularly monitoring their blood glucose levels and 90.0% adhering to a diabetic diet.

Healthcare engagement was high in the study, with 96.7% of participants consulting a doctor for dose adjustments and 93.3% relying on doctors as their primary source of diabetes-related information. This suggests that healthcare providers play a crucial role in patient education and management. The study also found a significant association between sex and HbA1c levels, with males more likely to achieve HbA1c < 7.5, and a notable difference between those on insulin therapy and those using oral hypoglycemic agents. These findings emphasize the need for tailored interventions to support insulin users and women, who are at a higher risk of suboptimal glycemic control. In conclusion, while the study highlights several positive practices among participants, it underscores the critical need for enhanced diabetes education, particularly in rural settings and among insulin users, to improve glycemic control and reduce the risks associated with hypoglycemia.

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ANNEXURE – I - INFORMED CONSENT FORM

KAHERs JNMC
BELAGAVI
INFORMED CONSENT FORM

"TO ASSESS THE KNOWLEDGE ATTITUDE AND PRACTICES ABOUT HYPOGLYCEMIA IN PATIENTS OF DIABETES PRESENTING WITH HYPOGLYCEMIA."

Name of Student/Principal Investigator:
Name of Guide:

Introduction: Hypoglycemia is a major complication and limiting factor in treatment of diabetes . As a part of raising awareness to this , you are being invited to participate in this study to find out how the level of knowledge attitude and practices of patients towards diabetes and hypoglycaemia can lead to prevention of such episodes.

Hypoglycaemia is a leading cause of both morbidity and mortality in diabetic population. Majority of such events are linked with the knowledge and practices of the patients, and can be prevented with appropriate patient education. So, this study is being done to gather information on how well the patient is aware about hypoglycaemia. The results from the study can be helpful in knowing the level of knowledge in patients and weather to further educate the diabetic population further regarding the same.

Participation in this study is completely voluntary.

Explanation of procedure: In this study, you will have to answer a few prepared questions about your Socio-demographic details, basic knowledge about hypoglycemia and your attitudes and practices towards it. A single blood sample will be withdrawn from you to asses your recent glycemic control by calculating Hba1c levels.If the patient is unable to provide informed consent then the consent will be obtained from immediate relative of the patient.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: Your participation ensures more people are aware of hypoglycemia and will work towards reducing its effects. Data gathered from your participation will help in assessing the level of knowledge and practices about hypoglycemia among the diabetic population ,and hypoglycemia being a preventable complication knowing the knowledge gap in patients and what to be educated about can benefit both the doctor community and patients.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations done during the course of study will be paid by the **principal investigator.**

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your personal identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact **"Dr.**

If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Institutional Ethical Committee for Human Subjects' Research of JNMC, Belagavi 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waiving off any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **"TO ASSESS THE KNOWLEDGE ATTITUDE AND PRACTICES ABOUT HYPOGLYCEMIA IN PATIENTS OF DIABETES PRESENTING WITH HYPOGLYCEMIA"**. My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE – II – RESEARCH QUESTIONNAIRE

KAHER

J.N.MEDICAL COLLEGE, BELAGAVI

DEPARTMENT OF GENERAL MEDICINE

ANNEXURE – II RESEARCH QUESTIONNAIRE

INVESTIGATOR:

(Note: The personal data provided by you will be kept confidential. Only aggregated results will be presented/published without revealing your personal identity).

Sl.NO. _____ DATE: _____

I. **SOCIODEMOGRAPHIC DETAILS:**

1. Name:
2. Age group : 30-40◯ 40-50◯ 50-60◯ 60-70◯ 70-80◯
3. Sex: Male◯ Female◯
4. Area of residence:
5. Education: illiterate ◯ primary level◯ secondary level◯ above secondary level◯
6. Total income of family per month: <10000◯ 10000-20000◯ 20000 -30000◯ >30000◯

II. GENERAL DETAILS

1. Body mass index: 18-23◯ 23-26◯ 26-30◯ >30◯
2. Duration of diabetes (years) 1-10◯ 11-20◯ >20◯
3. Latest Hba1c level <6◯ 6-7◯ 7-8◯ 8-9◯ >9◯
   Insulin◯ Type and dose ------
   Tablets◯ class and dose-------
   Both◯
4. Dietary habits
   Vegetarian◯
   Non-vegetarian◯
5. No of meals per day
   2 times a day◯
   3times a day◯
   4 times a day◯
6. Comorbidities
   Hypertension◯
   CAD◯
   CVA◯
   Infection◯

Asthma◯
Thyroid ◯
Steroid use◯
Other----

III. **KNOWLEDGE**

1. Are you aware diabetic treatment can sometimes lead to low blood sugars?
◯ Yes ◯ No

2. Hypoglycaemia happen when
Plasma glucose concentration become under 100 mg/dl.◯
Plasma glucose concentration become under 80 mg/dl. ◯
Plasma glucose concentration become under 70 mg/dl.◯
I do not know◯

3. What are the reasons for hypoglycaemia?(multiple answers)
Skipping meals ◯
Excessive exercise ◯
Illness ◯
Overdose medication(s) ◯
Smoking ◯
Alcohol ◯
I do not know◯

4. Do you know how to prevent hypoglycaemia?
◯ Yes ◯ No

5. If yes specify?
I eat after insulin injection ◯
I eat before being physically active ◯
I try to eat balanced meals and snacks containing protein, fat, fiber, and carbohydrates.◯
I try to follow a consistent daily routine (such as , medications, exercise, work and sleep)◯
Regular measuring of blood sugar ◯
Report low sugar episode to the doctor◯

6. What do you think is/are the complications of low blood sugar levels?
Heart attack ◯
Kidney diseases ◯
Seizure ◯

Hypertension ◯

Coma ◯

Death ◯

I do not know◯

7. Do you follow diabetic diet?
◯ Yes ◯ No

8. What is the best diet for diabetes
Family diet regardless of its content◯

Low fat, high fibre, and low-added sugar◯

Sugar-free diet ◯

Eat fast-acting carbohydrate ◯

Eat "slow carbohydrates" ◯

I do not know◯

9. Do you monitor blood glucose levels?
Yes ◯ No◯

10. Are aware of symptoms of hypoglycaemia?
Yes ◯ No◯

11. If yes specify which of the following

Dizziness ◯

Excessive Hunger◯

Sweating◯

Tremors◯

Palpitation◯

Shaking◯

Head ache◯

Weakness◯

Loss of consciousness◯

Confusion◯

Irritability◯

Blurred vision◯

Aggression◯

Seizures◯

12. What was your source of knowledge on hypoglycaemia?
Doctor◯ Relatives◯ fellow patients◯ tv◯ magazines◯ internet◯ hospital charts◯

IV. ATTITUDE

		Yes	No	Not sure
1.	Diet is responsible for hypoglycaemia	○	○	○
2.	Very low blood sugars are good for health	○	○	○
3.	Skipping meals is good for sugar control	○	○	○
4.	Vigorous exercises can help in diabetes management	○	○	○
5.	Do not consult a doctor when there is low blood sugar	○	○	○
6.	Low blood sugar level is not as dangerous as high sugar levels	○	○	○

V. PRACTICES

What do you practice in your life or what are you more likely to do in the following scenarios?

		Yes	No	Maybe
1.	Check blood sugar levels when you experience symptoms	○	○	○
2.	Consult a doctor for dose adjustments	○	○	○
3.	Eat regular healthy meals	○	○	○
4.	Be aware of symptoms of hypoglycaemia	○	○	○
5.	Consult a doctor if you develop ne health issues	○	○	○
6.	Quit alcohol and smoking (if applicable)	○	○	○

Name

Signature place

ANNEXURE – III – KEY TO MASTER CHART

Sex	
M	Male
F	Female
Place of residence	
U	Urban
R	Rural
Educational status	
Ill	Illiterate
Pr	Primary
Sc	Secondary
Gr	Graduate
Socio economic status	
I	Class I
II	Class II
III	Class III
IV	Class IV
V	Class V
Treatment	
In	Insulin
OHA	Oral hypoglycaemic agent

Diet	
Vg	Vegetarian
Mx	Mixed
Comorbid conditions	
HTN	Hypertension
CVD	Cardiovascular disease
CVA	Cerebrovascular accident
INF	Inection
AST	Asthma
THR	Thyroid
CKD	Chronic kidney disease
OTH	Others
Q1, Q4,Q7,Q9, Q10	
0	Yes
1	No
Q2	
0	Plasma glucose concentration become under 100 mg/dl
1	Plasma glucose concentration become under 80 mg/dl
2	Plasma glucose concentration become under 70 mg/dl
3	I do not know
Q3	
0	Skipping meals
1	Excessive exercise

2	Illness
3	Overdose medication(s)
4	Smoking
5	Alcohol
6	I do not know
Q5	
0	I eat after insulin injection
1	I eat before being physically active
2	I try to eat balanced meals and snacks containing protein, fat, fiber, and carbohydrates
3	I try to follow a consistent daily routine (such as , medications, exercise, work and sleep)
4	Regular measuring of blood sugar
5	Report low sugar episode to the doctor
Q8	
0	Family diet regardless of its content
1	Low fat, high fibre, and low-added sugar
2	Sugar-free diet
3	Eat fast-acting carbohydrate
4	Eat “slow carbohydrates”
5	I do not know
Q11	
0	Dizziness
1	Excessive Hunger
2	Sweating

3	Tremors
4	Palpitation
5	Shaking
6	Weakness
7	Loss of consciousness
8	Confusion
9	Irritability
10	Blurred vision
11	Aggression
12	Headache
13	Seizures
Q12	
0	Doctor
1	Relatives
2	Fellow patients
3	Television
4	Magazines
5	Internet
6	Hospital charts
A1 to A6; P1 to P6	
0	Yes
1	No
2	Not sure/May be

ANNEXURE – III –

MASTER CHART

MASTER CHART

Serial Number	Inpatient Number	Age (Years)	Sex	Place of residence	Educational status	Socio economic status	Diabetic duration (Years)	HbA1c (percent)	Treatment	Body mass index (Kg/m^2)	Diet	Number of meals per day	Comorbid conditions	Knowledge Q1	Knowledge Q2	Knowledge Q3	Knowledge Q4	Knowledge Q5	Knowledge Q6	Knowledge Q7	Knowledge Q8	Knowledge Q9	Knowledge Q10	Knowledge Q11	Knowledge Q12	Attitude Q1	Attitude Q2	Attitude Q3	Attitude Q4	Attitude Q5	Attitude Q6	Practices Q1	Practices Q2	Practices Q3	Practices Q4	Practices Q5	Practices Q6
1	10022416	74	f	r	ill	1	15	9	in	22	vg	3		1	3	6	0	4	6	0	3	0	0	1	1	2	1	1	1	1	0	0	1	0	0	0	
2	10034833	70	f	u	Sc	3	20	6	in	27	vg	2	HTN	1	3	0	1		6	1	1	1	1	1	2	0	1	0	1	0	0	0	0	0	0	0	
3	10023279	87	m	u	pr	3	20	6.5	oha	27	vg	3	INF	0	3	6	1		6	0	5	1	0			2	1	1	1	2	2	2	2	0	1	2	
4	10024216	65	f	r	ill	2	3	5	oha	23	mx	3	cvd	1	3	6	1		6	1	5	1	0			2	0	2	2	0	2	1	0	0	1	0	
5	7526932	55	f	r	ill	2	6	7.2	oha	23	mx	3		0	3	6	1		1	1	1	0	1			2	1	2	2	2	0	2	0	0	2	2	
6	10022910	66	m	r	sc	1	14	7	oha	25	vg	3		1	3	0	1		6	0	2	0	1	1	0	2	0	2	2	0	2	0	0	0	2	0	
7	7318392	68	m	u	pr	2	17	7.6	in	27	mx	3	inf	1	3	0	1		6	0	3	0	1			2	0	0	2	2	0	0	0	0	2	0	
8	7235734	54	f	u	sc	3	5	6.3	oha	26	vg	3	HTN	1	3	6	1		6	0	1	0	1			2	0	1	2	0	2	0	0	0	2	0	
9	7245689	62	f	r	pr	2	4	7.8	oha	24	vg	3	htn	1	3	6	1		6	1	2	1	1			2	0	2	2	0	1	0	0	0	2	0	
10	7632542	55	m	r	ill	2	13	7.3	in	28	vg	3	THR	1	3	1	1		6	0	2	0	1			2	0	0	1	1	0	2	0	0	0	0	
11	7432945	37	m	u	Gr	4	3	9	in	27	vg	2		0	3	3	1		6	0	2	0	0	1	0	2	1	0	2	0	0	0	0	0	0	0	
12	6485317	57	m	r	pr	2	10	7.1	oha	28	mx	3		1	3	6	1		6	0	2	0	1			1	0	0	2	2	0	0	0	0	2	0	
13	7391443	55	m	u	sc	3	15	5.9	oha	26	vg	3		0	3	3	0	0	6	0	2	0	0	1	0	0	2	1	2	0	2	0	0	0	0	0	
14	7394621	57	m	u	sc	3	12	6.3	oha	25	vg	3	cvd	0	3	3	0	0	6	0	2	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	
15	7395961	76	m	r	sc	4	18	6.8	oha	28	vg	3	htn	0	3	0	0	0	6	0	2	0	0	1	0	0	1	1	2	0	1	0	0	0	0	0	
16	7363907	45	m	r	sc	2	5	15	in	27	vg	3		1	3	6	1		6	0	0	1	1			2	0	0	2	1	0	1	0	0	2	0	
17	10048896	78	f	u	pr	4	15	7.6	oha	26	vg	3	htn	0	3	6	1		6	0	2	0	0	1	0	1	0	0	2	1	0	0	0	0	0	0	
18	16295555	45	f	u	gr	4	12	9.9	in	27	vg	3		0	2	0	0	0	6	0	2	0	0	1	0	1	1	0	2	0	0	1	0	0	0	0	
19	7378861	64	f	r	pr	2	11	7.6	in	24	vg	3	cvd	0	2	0	0	0	6	0	2	0	0	4	0	1	1	1	2	1	0	0	0	0	0	0	
20	7239326	54	m	r	sc	3	6	7.3	in	26	mx	3		1	3	6	1		6	0	2	0	1			1	0	0	2	1	0	1	0	0	2	0	
21	7896321	66	f	r	sc	3	13	8	in	25	mx	4	htn	0	3	0	1		6	0	2	0	0	1	0	0	0	1	2	0	2	0	0	0	0	0	
22	7689245	55	m	r	sc	3	14	9.5	oha	27	vg	3	CKD	0	3	6	0	1	6	0	2	0	0	4	0	1	1	1	1	1	1	0	0	0	0	0	
23	7286254	66	f	r	sc	4	8	8.6	in	27	vg	4	cvd	0	3	6	1		6	0	2	0	0	1	0	1	0	0	2	1	0	0	0	0	0	0	
24	7845120	68	m	r	sc	2	7	7	oha	24	vg	3	htn	0	3	6	0	4	6	0	2	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	
25	7892452	64	f	u	sc	3	5	13	in	28	mx	3	ckd	0	3	6	0	0	6	0	2	0	0	2	0	1	1	1	1	0	1	0	0	0	0	0	
26	73863452	55	m	u	sc	3	10	7.5	in	27	vg	3		1	3	6	1		6	0	2	0	1			2	0	2	2	2	0	0	0	0	0	0	
27	7456457	65	m	r	sc	3	9	7	in	26	vg	3		1	3	6	1		6	0	2	0	1			2	2	2	2	2	2	0	0	0	0	0	
28	6816978	33	f	u	gr	4	8	6	in	25	vg	3		0	1	6	0	0	6	0	2	0	0	1	0	1	1	1	2	1	1	0	0	0	0	0	
29	100474542	66	f	r	sc	3	15	9.8	in	26	vg	3	htn	1	3	6	1		6	0	2	0	1			1	2	2	2	2	2	0	0	0	0	0	
30	7456321	54	f	r	sc	2	9	9.3	oha	27	mx	4		1	3	6	1		6	0	2	0	1			1	0	2	2	2	0	0	0	0	2	1	
31	7362891	66	m	u	gr	4	7	6.4	oha	30	vg	3		1	3	6	1		6	0	2	0	1			2	2	2	2	0	1	0	0	0	0	0	
32	10051091	70	m	r	gr	3	13	7.2	oha	26	mx	3	cvd	0	2	0	0	2	6	0	1	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	

MASTER CHART

Serial Number	Inpatient Number	Age (Years)	Sex	Place of residence	Educational status	Socio economic status	Diabetic duration (Years)	HbA1c (percent)	Treatment	Body mass index (Kg/m^2)	Diet	Number of meals per day	Comorbid conditions	Knowledge Q1	Knowledge Q2	Knowledge Q3	Knowledge Q4	Knowledge Q5	Knowledge Q6	Knowledge Q7	Knowledge Q8	Knowledge Q9	Knowledge Q10	Knowledge Q11	Knowledge Q12	Attitude Q1	Attitude Q2	Attitude Q3	Attitude Q4	Attitude Q5	Attitude Q6	Practices Q1	Practices Q2	Practices Q3	Practices Q4	Practices Q5	Practices Q6
33	1402351	72	m	u	sc	3	8	6.7	in	27	mx	3	htn	1	3	6	1		6	0	3	1	1			1	1	1	1	1	1	0	0	0	0	0	
34	5998103	39	f	r	sc	3	5	8.7	in	26	vg	3		0	2	3	0	0	6	0	3	0	0	1	0	1	1	1	1	0	2	0	0	0	0	0	
35	6554261	66	m	r	sc	3	20	9	in	25	mx	3	cvd	0	1	0	0	0	6	0	3	0	0	1	0	1	1	1	2	2	0	0	0	0	0	0	
36	7090787	77	m	u	gr	3	10	7.6	in	26	mx	4	cvd	1	3	6	1		6	0	3	0	0			0	0	2	0	1	0	0	0	0	0	0	
37	7351175	63	m	r	sc	2	7	10.3	in	27	vg	3	cvd	1	3	6	1		6	0	2	0	1			2	2	0	2	1	0	0	0	0	0	0	
38	10049393	55	m	u	sc	3	12	7.4	in	27	vg	3	cvd	0	3	0	1		6	0	0	0	1		0	2	0	2	2	1	0	0	0	0	0	0	
39	10051790	63	m	u	sc	4	13	7	oha	24	mx	3	htn	1	3	6	1		6	0	2	0	1			2	1	1	1	0	1	0	0	0	0	0	
40	10050547	44	m	r	gr	4	11	11	oha	27	vg	3	htn	0	3	6	1		6	1	2	0	1			2	0	2	2	2	2	0	0	0	0	0	
41	10051966	50	f	U	Sc	3	8	7.3	oha	25	vg	4	cvd	1	3	6	1		6	0	2	0	1			1	0	2	2	2	2	0	0	0	0	0	
42	3060253	65	f	r	sc	3	20	7.2	in	27	mx	3	cvd	0	3	0	0	0	6	0	2	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	
43	7316677	45	f	u	sc	3	9	7.7	in	26	vg	3		1	3	6	1		6	0	1	0	1			1	1	1	1	2	2	0	0	0	0	1	
44	7209298	64	f	u	sc	3	18	6.3	in	25	mx	4	cvd	0	1	0	0	0	6	0	1	0	0	1	0	1	1	1	1	0	1	0	0	0	0	0	0
45	7316677	45	f	r	sc	2	9	12.4	in	25	mx	3		1	3	6	1		6	0	2	1	1			1	2	2	2	2	2	0	0	0	0	0	
46	5760680	66	m	r	pr	2	13	7.1	in	24	vg	3	CKD	0	3	0	1		6	0	2	0	0	4	0	2	1	1	1	1	1	0	0	0	0	0	
47	5313797	55	m	u	sc	3	11	10.1	in	25	mx	4		0	3	6	1		6	0	2	0	0	1	0	1	1	1	1	2	1	0	0	0	0	0	
48	6245602	55	m	u	pr	2	9	7	in	24	vg	4		1	3	6	1		6	0	1	0	0	1	0	1	1	2	2	2	2	0	0	0	0	0	
49	6856189	64	f	u	sc	3	13	8.4	in	28	mx	3	htn	1	3	6	1		6	0	2	0	1			2	2	2	2	0	2	0	0	0	0	0	
50	2890123	40	f	r	sc	2	4	7.4	in	27	vg	3		0	3	3	1		6	0	1	0	0	4	0	1	1	1	2	2	2	0	0	0	0	0	
51	10082600	58	f	r	sc	3	13	8.2	in	26	mx	3	cvd	0	3	6	0	0	6	0	2	0	0	1	0	1	1	1	1	0	1	0	0	0	0	0	
52	10082575	60	m	r	pr	3	12	6.9	in	25	mx	3	htn	0	3	0	1		6	0	2	0	0	4	0	1	1	1	2	2	1	0	0	0	0	0	
53	10082116	75	f	r	sc	2	9	7.5	oha	27	vg	3	htn	1	3	6	1		6	0	2	0	1			2	0	2	2	2	2	0	0	0	2	0	
54	10052339	75	m	r	sc	4	8	7.4	oha	25	mx	3	htn	1	3	6	1		6	0	5	0	1			2	2	2	2	1	2	0	0	0	0	0	
55	10096419	75	m	r	pr	2	13	8.1	in	26	vg	3	htn	0	3	3	1		6	0	2	0	0	1	0	2	1	1	2	2	2	0	0	0	0	0	
56	10096035	58	m	r	pr	2	8	7.4	oha	25	mx	3		1	3	6	1		6	1		1	1			2	0	2	2	2	0	0	0	0	0	0	
57	10096299	80	m	r	pr	2	11	8.4	oha	26	vg	3	cvd	1	3	6	1		6	0	2	0	1			2	2	2	2	0	2	0	0	0	0	0	
58	10095108	80	m	u	sc	2	14	7.5	oha	25	mx	3	htn	1	3	6	1		6	0	2	0	1			2	2	2	2	1	2	0	0	0	2	1	
59	10093314	80	m	u	sc	3	12	8.5	in	28	vg	3	htn	0	3	0	0	0	6	0	2	0	0	1	0	1	1	1	2	2	0	0	0	0	0	0	
60	10081383	72	m	r	sc	2	9	7.4	in	25	vg	3	cvd	1	3	6	1		6	0	0	1	1			2	2	2	2	2	0	2	0	0	0	0	