

**IMPACT OF PATIENT COUNSELLING ON KNOWLEDGE,
ATTITUDE AND PRACTICE IN THE MANAGEMENT OF TYPE
2 DIABETES MELLITUS: A PROSPECTIVE STUDY**

Thesis Submitted for the Award of the Degree of

DOCTOR OF PHILOSOPHY
in
Pharmacology

By

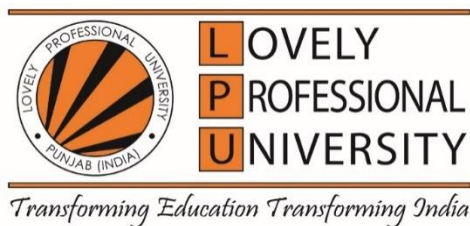
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2024

DECLARATION

I, hereby declare that the presented work in the thesis entitled ‘Impact of Patient Counselling on Knowledge, Attitude and Practice in the Management of Type 2 Diabetes Mellitus: A Prospective Study’ in fulfilment of degree of **Doctor of Philosophy (Ph.D.)** is outcome of research work carried out by me under the supervision of **Dr. Bimlesh Kumar**, working as Professor, in the School of Pharmaceutical Sciences of Lovely Professional University, Punjab, India. In keeping with general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of other investigator. This work has not been submitted in part or full to any other University or Institute for the award of any degree.

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CERTIFICATE

This is to certify that the work reported in the Ph.D. thesis entitled 'Impact of Patient Counselling on Knowledge, Attitude and Practice in the Management of Type 2 Diabetes Mellitus: A Prospective Study' submitted in fulfillment of the requirement for the reward of degree of **Doctor of Philosophy (Ph.D.)** in the School of Pharmaceutical Sciences, is a research work carried out by **Sanjeev Kumar Gautam**, Registration Number: **41800471**, is bonafide record of his/her original work carried out under my supervision and that no part of thesis has been submitted for any other degree, diploma or equivalent course.

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ABSTRACT

The emergence of diabetes mellitus (DM), a severe non-communicable disease is one of the major health problems of the twenty first century. It is a combination of many disorders that show up as episodes of high blood sugar and glucose intolerance brought by either insufficient insulin, inappropriate insulin action, or both. In India 9.1% of the population suffers from diabetes mellitus. Since diabetes is becoming more and more common around the world its knowledge, attitude and practice (KAP) evaluation is now crucial for guiding behavioural changes for those who already have the condition or are at risk. Research on KAP is essential to develop a personalized health plan to reduce the hazards associated with the condition. Diabetes is one of the most widely spread metabolic condition and was the cause of nearly 6.7 million deaths worldwide, in 2021. According to the IDF (International Diabetes Federation), 643 million people will have diabetes worldwide by 2030, up from 537 million (increasing at a CAGR of 2.02% from 2021 to 2030). Global healthcare spending was \$966 billion in 2021, and by 2030, it is anticipated to exceed \$1 trillion. Programmes for education and awareness and self-management are essential in light of rising healthcare expenses.

In this study, the objective was to assess the impact of counselling in improving the knowledge, attitude, and practice (KAP) levels of patients, which thereafter is expected to bring down blood sugar levels.

The KAP scores of 532 patients with type 2 diabetes (T2DM) were surveyed from hospital of Punjab. They were evaluated using a qualified questionnaire, and blood sugar levels were extracted from case sheets, at the start of the study. This was followed by counselling sessions to help them understand the need of self-care and management for T2DM control. At the end of the study the KAP scores, along with the blood sugar levels were reevaluated to determine the impact of counselling in creating positive outlook among patients and therefore better diabetes management.

The results were derived using statistical tests – T test, one-way ANOVA, and paired T-test. The initial scores for knowledge, attitude, and practice (KAP) were found to be inadequate (poor) in nearly 50%, 41%, and 40% of patients, respectively. The mean fasting blood sugar (FBS) was reported 277 mg/dL (above the permissible level of 99 mg/dL). Random blood sugar (RBS) was reported as 320 mg/dL (limit is 200 mg/dL). HbA1C was 8%, much higher than normal limit of

5.7%. After the counselling, the average FBS, RBS and HbA1C dipped to 140 mg/dL, 189 mg/dL and 7.5%, respectively. The KAP scores predominantly shifted to 'good' accounting for 43%, 44% and 45% patients, respectively. Among the three, the practice score was significantly impacted after counselling, and largely shifted to 'good' from 'average'.

It was concluded that patients and caregivers can learn about their ability to lessen the ill-effects of this metabolic condition through educational sessions and adequate counselling. In terms of performance, those with high KAP scores perform better self-management than those with low or limited KAP levels. Doctors, chemists, and other medical professionals can play a significant role, and become the opinion leaders, in guiding and counselling the patients and caregivers in better self-management of T2DM. Given that people's severe lifestyle changes are exacerbating the rise in T2DM, it is urgent that individuals become aware of these changes and adopt positive outlook regarding the management of the condition. In order to treat and manage the disease-related consequences, proper treatment and KAP are crucial. The study guides that to increase patients' understanding and lessen the harmful effects of type 2 diabetes mellitus, public entities such as the government, non-governmental organizations (NGOs), and health organizations can play an instrumental role in launching educational campaigns and patient counselling sessions.

Key words: knowledge, attitude, practice, KAP scores, fasting blood sugar, FBS, random blood sugar, RBS, patient counselling, HbA1C.

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Date of Submission

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1. INTRODUCTION

INTRODUCTION:

1.1 Background of KAP

The learning theory (Bandura, 1977) and the diffusion of innovation theory are the key sources of the Knowledge, Attitude and Practice (KAP) model (Roger, 1995).[1] A social system's members accept innovation through four stages over time, according to Roger (1995). The stages are information gathering, persuasion, decision-making, and confirmation. Additionally, it has been argued that social context has a role in the development of individual actions (Bandura 1977). [2]

A KAP survey is a quantitative approach that accesses both quantitative and qualitative data by using questions presented in standardised questionnaires. KAP surveys uncover misconceptions or misunderstandings that may hinder the implementation of targeted initiatives or serve as potential barriers to changing behaviour. It is founded on the "declarative," and is essentially records as "opinion" (i.e., statements). The only caveat in a KAP survey is the potential of discrepancy between what people say and what they execute [3,4].

Previous research has found numerous relationships between knowledge, attitudes, and practices (e.g., Valente et al., 1998). [5] Hungerford and Volk (1990) stated that knowledge of the issues and skill possession are necessary for behavioural transformation. According to Ajzen (1991), who studied the connection between attitudes and practices, people who exhibit positive attitudes and behaviours are more likely to be motivated to take action on a problem. Moreover, by establishing subjective standards, it highlights that - perceptions of behaviour control leads to the formation of behavioural intention. [6,7] The KAP model was created and is regarded as one of the most well-preferred survey instruments in the field of social research. It has been widely used to evaluate the relationship between knowledge, attitudes, and practices. It originated from the fields of population studies and family planning in the 1950s. The model relies on the questionnaire filled by a target audience that may measure and assess what is known (knowledge), believed (attitudes), and practised (practices) with reference to the subject in question (Nguyen et al., 2019; Andrade et al., 2020). As a result, the data from the KAP model can be used to discover knowledge gaps, attitude obstacles, and practice patterns that could assist people comprehend and act on a certain issue.[3,8] However, some key deterrents in leveraging KAP for T2DM management is the lack of authenticity of self-reported data and the measurement of intangible attributes such as attitude and behaviour.

Naeem and Khan (2016) conducted a study on patients with type 2 diabetes mellitus to assess their KAP. The findings revealed areas where patients lacked knowledge and identified challenges in self-management. This study emphasized the need for patient education and self-management support to improve diabetes outcomes. [9] Abdulrahman, Rampal, and Ibrahim (2018) focused on the KAP of diabetic patients in Saudi Arabia. Their study examined patients' understanding of diabetes, attitudes towards self-management, and adherence to treatment and lifestyle modifications. The research highlighted the factors influencing KAP and provided insights into areas that require improvement in diabetes care. [10] Saleh et al. (2016) explored the relationship between non-adherence to self-care practices and medications and health-related quality of life in patients with type 2 diabetes. Their study emphasized the significance of addressing patients' KAP to enhance adherence and overall well-being.[11] Kalra et al. (2020) reviewed the evolving role of insulin in managing type 2 diabetes. They underscored the importance of patient education, counselling, and support to optimize insulin use. This study highlighted the need to consider patients' knowledge, attitudes, and practices in promoting effective diabetes management.[12] Tol et al. (2011) conducted a qualitative study on Iranian mothers coping with adolescents with type 1 diabetes. The research explored the challenges faced by caregivers and the importance of educational and supportive interventions to empower mothers and improve diabetes management in this population. [13] All these studies have depicted the significance of counselling interventions to improve KAP levels in patients or caregivers, which in return has helped in disease management and improvement. Such interventions have a significant potential to support health care systems at a macro level.

1.2 Need of KAP

The uses of KAP range from determining the scope of study, improve status, determine effectiveness of program, and plan future activities on wider scale.

- a) Determine the scope of a known scenario, support or refute a theory, and offer fresh perspectives on the reality of the circumstance.
- b) Enhance understanding of specific issues and evaluate attitude and behaviour; take note of what is known and being done about various health-related topics.
- c) Establish the baseline (reference value) for future assessments to evaluate the efficacy of health education initiatives and their potential to change health-related behaviours.

- d) Create plans for activities that are appropriate for the people in question; recommend an intervention strategy that takes into account their particular cultural context and local circumstances. [9]

1.2.1 Knowledge

The Knowledge possessed by a community refers to their understanding of any given topic such as diabetes and preventive measures in this case.

1.2.2 Attitude

Three elements help build attitude: (a) the cognitive or knowledge component; (b) the affective or feeling component; and (c) the tendency to behave. According to one definition, attitude is a persistent grouping of beliefs about a particular thing, person, or idea that causes somebody to react in a particular way. [14]

1.2.3 Practice

Practice is the means by which members of the population exhibit their knowledge and attitude through their actions or activities. It refers to the behavioural aspect of the entity in observation.[15]

Various studies have taken place across globe for different health concerns, which highlight that KAP is crucial for evidence-based policies and interventions aimed at promoting better health outcomes and societal well-being. Female genital mutilation (FGM) KAP assessments among healthcare workers was conducted in Africa and offered useful insights, according to Musa and Akande (2018). It emphasised how crucial it is to comprehend the KAP of healthcare professionals in order to create interventions, enhance healthcare delivery, and eliminate harmful practices. [16] Goel and Bansal (2015) stressed the importance of evaluating medical and dental students' knowledge of the swine flu. Their study emphasised the importance to comprehend KAP of healthcare professionals-in-training in order to identify gaps, create effective interventions, and effectively promote disease preventive and control methods. [17] Bhutan's "Gross National Happiness Index" was examined critically by Sharma and Webster (2014), who also stressed the importance of KAP evaluations in gauging subjective well-being. The review emphasised how crucial it is to comprehend people's KAP in order to influence policies and interventions targeted at enhancing general happiness.[18] Village Health Teams (VHTs) in Uganda required to have their KAP evaluated, according to Buregyeya et al. (2013). This study emphasised how important it is to comprehend KAP of VHTs in order to assess their efficacy and enhance the provision of

community health services. [19] Yimer et al (2020) examined the requirement to evaluate the COVID-19 KAP of government health personnel in Ethiopia. The study emphasised how crucial it is to comprehend the knowledge, attitudes, and practices of healthcare professionals in order to enable efficient pandemic response and improve public health outcomes. [20,21]

1.3 Type of KAP Studies

First type of an observational study design is the cross-sectional KAP study design. In a cross-sectional KAP study, the researcher simultaneously assesses the study participants' exposures as well as their knowledge, attitude, and practice scores.

Second is a longitudinal KAP study, in which the same participants are regularly examined to look for any KAP changes that might happen over time. Researchers watch and gather KAP scores on participants in longitudinal studies, a sort of correlational study, without attempting to change any of the KAP variables.

Third, in prospective KAP research, people are monitored over time and information is gathered about them as their traits or KAP scores change. (figure 1)

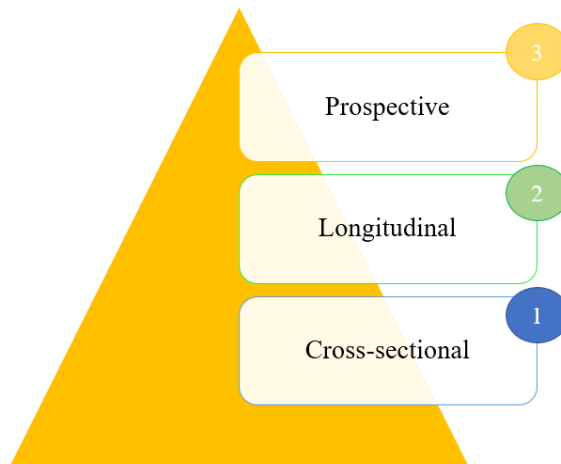


Figure.1. Types of KAP studies

In many different types of study, observational studies are essential for examining the connections between variables and comprehending phenomenon. The cross-sectional KAP study design is a typical observational study design. In this approach, the researcher simultaneously evaluates the exposures of the study subjects—such as their demographics or the incidence of diseases—as well as their KAP scores in relation to the particular issue of interest. Cross-sectional studies offer a picture of the participants' KAP levels and their potential connections with the exposures by

gathering data at a single moment in time. However, longitudinal KAP research provides a more thorough picture of how KAP alterations develop over time. In this research, the same participant group is tracked and assessed initially and after counselling to check for any changes in KAP scores. With the help of this design, researchers can monitor people's KAP scores and investigate how different variables or interventions may affect them. The dynamics and evolution of knowledge, attitude, and practice across time can be thoroughly analyzed using longitudinal studies' insightful insights into trends, patterns, and trajectories of KAP. Prospective KAP research, in contrast to cross-sectional and longitudinal studies, focuses on tracking individuals over time and gathering data when their characteristics or KAP scores change. Before certain events or interventions, data is gathered as part of this design. Researchers can explore the cause-and-effect linkages between particular factors, interventions, or exposures and the subsequent changes in people's KAP scores using prospective studies. Prospective studies offer important evidence of the influence and effectiveness of interventions, educational programmes, or policy changes on individuals' KAP by comparing the levels of KAP in individuals before and after specific events or interventions.

Overall, these various observational study designs, including cross-sectional, longitudinal, and prospective methods, give researchers useful instruments to investigate the intricate connections between exposures, KAP levels, and alterations over time. Researchers can learn more about how people's KAP are currently, monitor changes and trends, and assess the efficacy of treatments or strategies targeted at enhancing knowledge, attitude, and practice in a variety of domains by using these study designs.

1.4 Problem Statement

In order to manage type 2 diabetes mellitus (T2DM), the problem statement seeks to determine the effect of patient counselling on KAP. T2DM is a major public health concern in every country because of its rising prevalence and consequences. To effectively manage T2DM, people must be knowledgeable about the condition, have a supportive attitude towards self-care, and follow suggested lifestyle adjustments.

Numerous studies have emphasized the value of patient counselling in enhancing T2DM patients' results. It has been demonstrated that counselling interventions improve patients' knowledge of the illness, support a positive attitude towards self-management, and encourage the adoption of

healthy behaviours. Counselling sessions give patients the knowledge they need to make wise decisions about their health by educating them on T2DM, its origins, symptoms, and potential problems. [10-13]

Additionally, patient counselling is essential in influencing how patients view their disease and course of therapy. It tries to dispel any misperceptions, anxieties, or unfavourable notions that people may have regarded T2DM, its management, or the various treatments. Healthcare professionals can encourage a positive outlook in their patients through counselling, empowering them to feel competent and in control of their diabetes. Change in attitude is essential since it affects people's motivation, adherence to treatment regimens, and participation in healthy behaviours.

Patient counselling focuses on enhancing self-care behaviours in the management of T2DM in addition to information and attitude. Diabetes management includes lifestyle changes such as dietary adjustments, frequent exercise, medication compliance, and blood glucose monitoring. In counselling sessions, patients receive helpful advice on how to start and maintain these behaviours, deal with obstacles, and develop plans of action.

The effectiveness of patient counselling interventions in raising KAP in T2DM patients has been examined in a number of studies. These solutions make use of a range of strategies, such as individual counselling, group therapy, telemedicine platforms, and technological tools. The sessions typically include recurring education or advice by healthcare practitioners (during follow-ups), caregivers and via mass health campaigns and programs. They concentrate on providing persons with T2DM with personalized education, behaviour change strategies, and continuing support. These research findings have repeatedly shown that patient knowledge levels have increased, attitudes towards self-management have improved, and recommended practices are adhered to more closely.

The goal of the problem statement is to ascertain how patient counselling affects KAP in the treatment of type 2 diabetes. The goal of the study is to find out how counselling interventions can improve patients' understanding of T2DM as well as their attitudes towards it and their self-care routines. Patient counselling has the potential to enhance patient outcomes and help with better diabetes management by addressing information gaps, establishing positive attitudes, and encouraging behaviour change.

In the present investigation, the patient demographic variables such as age, height, weight, literacy status, per capita income, occupation, employment status, marital status, family history of diabetes, and duration of diabetes are considered. Fasting blood sugar (FBS), random blood sugar (RBS), and HbA1C glycaemic indicators were evaluated before and after counselling. The KAP scores were the key variables evaluated both before and after the counselling sessions. This study intends to augment the knowledge in the field of diabetes management by examining the effect of patient counselling on KAP in T2DM management. It aims to provide light on how counselling treatments can enhance patient outcomes, enhance self-care routines, and perhaps lessen the burden of problems associated with T2DM. The results of this study may help guide educators, policymakers, and healthcare professionals about the significance of including patient counselling in diabetes management programmes.

Improving KAP through ongoing counselling provided by healthcare practitioners, caregivers, and educational campaigns is pivotal as observed in multiple studies. These studies are indispensable for tailoring health programs aimed at mitigating the risks associated with T2DM. By equipping the public with comprehensive knowledge, individuals can grasp the severity of diabetes and its implications. This enables them to actively seek treatment for pre-existing conditions, adopt preventive measures, and cultivate a proactive approach to their well-being.

2. REVIEW OF LITERATURE

REVIEW OF LITERATURE:

The Knowledge-Attitude-Practice (KAP) hypothesis states that adopting conduct (or practice) is the final step in a process that begins with knowledge acquisition and goes through attitude development and conduct adoption. In other words, changing behaviour will be influenced by increased personal knowledge. Similar to this, the knowledge of diabetes will be a crucial determinant of whether the person can manage and protect themselves. The understanding, perspective, and behaviours of an individual have a significant impact on the efficacy of precautionary and preventative actions. According to studies, participants with better knowledge levels included those who were married, lived in metropolitan areas, and had higher educational status. It is common to witness that higher levels of education are associated with better knowledge scores. The fact that married persons performed better on knowledge tests than their counterparts who are not married is probably due to the added knowledge that comes from the spouse. Greater and easier access to awareness campaigns promoted through social, digital, or print media tends to make people in metropolitan areas more likely to have better knowledge scores than people who live in distant and rural locations.

2.1 Diabetes Mellitus

Diabetes, a metabolic condition, arises when the pancreas is unable to make insulin or when the body is unable to utilize the insulin that is produced. The hormone insulin, which is made by the pancreas, acts as a key to open the doors of the body's cells so that glucose from food may enter and be used to produce energy. Every item that contains carbs causes the blood to produce glucose. The cellular absorption of glucose is facilitated by insulin. Hyperglycemia, also known as inefficient insulin synthesis and utilization, causes an increase in blood sugar levels. Chronically high glucose levels have been related to organ and tissue failure as well as cellular degradation.

One of the top 10 global causes of death, diabetes, was responsible for 6.7 million fatalities in 2021. According to the International Diabetes Federation, there are currently 537 million diabetics worldwide. By 2030, that number is projected to rise to 643 million, with a CAGR of 2.02% from 2021 to 2030. Global healthcare spending reached USD 966 billion in 2021, and it is predicted to surpass USD 1 trillion by 2030. Adults with diabetes make about 75% of the world's poor or developing nations. People who have diabetes are more likely to experience a variety of major health issues. Serious disorders affecting heart, blood vessels, kidneys, eyes, nerves, and teeth can

result from persistently high blood glucose levels. Additionally, infections are more likely to affect those with diabetes. Diabetes is one of the prime causes of cardiovascular disease in practically all high-income nations. Diabetes problems can be postponed or avoided by keeping cholesterol, blood pressure, and blood glucose levels at or near normal levels. Therefore, those who have diabetes require constant observation.

Diabetes patients are more likely to experience serious health problems because their blood glucose levels are chronically raised. The heart, blood vessels, kidneys, eyes, nerves, teeth, and other bodily organs and systems may be impacted by these health issues. Diabetes patients are more likely to experience cardiovascular disorders including heart attacks and strokes, which are a major cause of death in high-income nations. It is essential to maintain ideal levels of cholesterol, blood pressure, and blood glucose in order to reduce the dangers related to diabetes. Individuals with diabetes can improve their overall health outcomes by constantly monitoring these measures and delaying or preventing the onset of problems. [16]

Diabetes patients are more prone to infections in addition to the chronic consequences. The immune system is weakened by high blood sugar levels, making it more difficult for the body to defend itself against pathogens. Urinary tract infections and more serious illnesses like diabetic foot ulcers are examples of infections that, if left untreated, might result in amputations. In order to avoid and treat infections quickly, people with diabetes need to practice excellent hygiene, maintain optimal blood glucose management, and seek the right medical attention when required.[17]

Diabetes has a significant economic cost on a global scale, and its prevalence is rising. Around 75% of diabetes people live in low- and middle-income nations, which shoulder a sizable amount of this burden. This unequal distribution emphasizes the need for comprehensive diabetes treatment measures, particularly in settings with limited resources. In order to properly manage their illness and lower the risk of complications, people with diabetes must have access to inexpensive healthcare, diagnostic equipment, medications, and education about diabetic self-care practices. [18]

A multidisciplinary strategy combining healthcare professionals, legislators, and the larger community is necessary to address the issues brought on by diabetes. Raising awareness about diabetes prevention, early detection, and the significance of lifestyle changes should be the main goal of public health programmes. The healthcare system must be improved, diabetes education

and counselling programmes must be strengthened, and technologies for monitoring blood glucose levels must be made more widely available at reasonable prices. We may endeavour to lessen the overall impact of this metabolic disease and enhance the quality of life for those with diabetes by embracing a holistic approach to diabetes care. [19]

As a result of insufficient insulin production or inefficient utilization, which results in increased blood glucose levels, diabetes is a metabolic disorder. It causes a variety of health issues and significantly increases morbidity and mortality globally. In addition to implementing healthy lifestyle habits, managing diabetes necessitates constant monitoring of blood glucose, blood pressure, and cholesterol levels. The prevalence of diabetes worldwide emphasizes the necessity of putting in place thorough prevention, detection, and management methods, especially in low- and middle-income nations. We can lessen the effects of complications associated to diabetes and enhance the general wellbeing of people with this chronic condition by giving priority to diabetes treatment and education. [20]

2.1.1 Types of Diabetes

There are 3 key diabetes types namely Type 1, Type 2 and gestational.

Type 1 diabetes is brought on by the body's immune system, wherein it destroys the cells that produce insulin. As a result, the body either produces very little insulin or none at all. Although the exact causes are still unclear, they are linked to a combination of inherited and environmental factors. It accounts for almost 10% of the whole diabetic population. Although type 1 diabetes can strike anyone at any age, it typically strikes children or young adults. People with type 1 diabetes require daily insulin injections to maintain blood glucose control. People with type 1 diabetes will not last long if they do not have access to insulin. Type 1 diabetes is assumed to be caused by a combination of genetic and environmental factors, while the exact causes are still not fully known.[22,23] (figure 2)

Type 2 diabetes: In T2DM, body develops insulin resistance, wherein it does not fully respond to insulin. Since insulin is unable to work properly, it causes blood glucose levels to keep rising. In some type 2 diabetics, this may gradually damage the pancreas, resulting in the body to produce less and less insulin and elevate blood sugar levels (hyperglycaemia). Type 2 diabetes is typically diagnosed in the elderly but is also becoming increasingly prevalent in children, adolescents, and younger adults as a result of rising obesity, inactivity, and poor diet rates.

A nutritious diet, more exercise, and maintaining body weight are the cornerstones of type 2

diabetes care. Additionally, oral medications and insulin are typically administered to manage blood glucose levels. Obesity, sedentary habits, and poor diet are the main lifestyle variables that contribute to type 2 diabetes. [24,25] (figure 2)

Gestational diabetes: Gestational diabetes affects approximately 3-10% of pregnancies worldwide. Hormonal changes and insulin resistance during pregnancy contribute to the development of gestational diabetes. Numerous adverse pregnancy outcomes are associated with gestational diabetes. Women who have gestational diabetes have a higher risk of getting type 2 diabetes in the future, especially three to six years after birth. Children that suffer hyperglycaemia while still in the womb are more likely to become overweight or obese as well as develop type 2 diabetes. If not properly managed, gestational diabetes can increase the risk of complications for both the mother and the baby. [26] (figure 2)

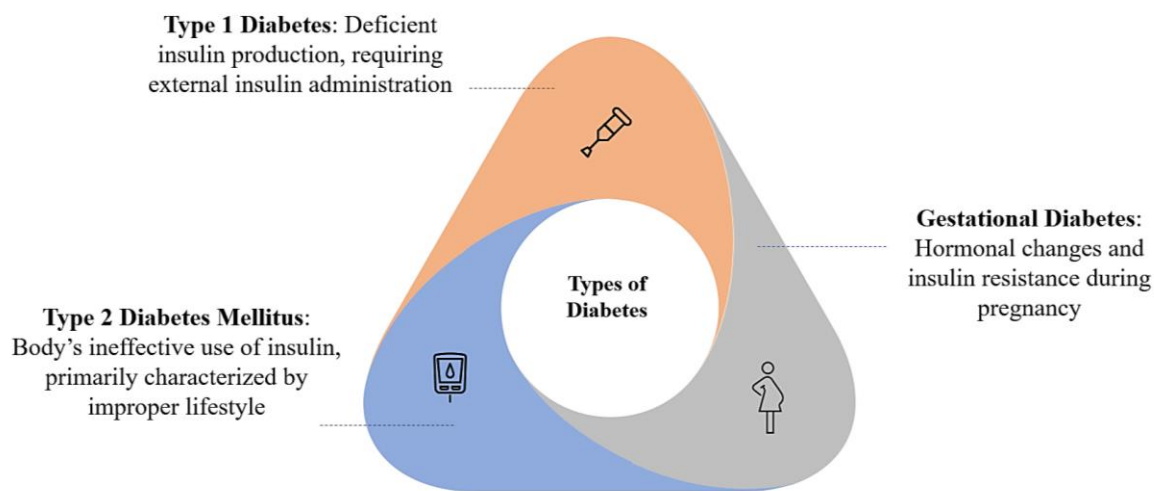


Figure 2: Types of Diabetes

2.2 Global Studies

Studies have been conducted globally to gauge the impact of KAP on the disease or disorder in discussion.

2.2.1 Africa:

A study conducted in **Ethiopia** between March and May 2018 at the University of Gondar Hospital on 403 participants revealed a correlation between knowledge and practice, and knowledge and

attitude, respectively. Knowledge and practice as well as knowledge and attitude all showed positive correlations ($r=0.68$ and $r=0.516$, respectively). Patients who had a good understanding of managing their diabetes themselves had better glycaemic control.[27] Numerous studies indicate that the two main indicators of DM are KAP levels and blood glucose. The study found that patients' attitudes and practices were influenced by their educational position as well as their occupation, marital status, and degree of education. The fact that Ethiopia's KAP score was much higher than that of other developing nations served as proof of the outcome, as did the regular blood sugar checks. [28] Another cross-sectional study was aimed to assess the KAP of patients with diabetes mellitus in Ethiopia. A structured questionnaire was used to gather data on participants' knowledge, attitudes, and practices related to diabetes management. The study revealed gaps in knowledge regarding diabetes symptoms, complications, and appropriate self-care practices. Attitudes towards diabetes management were generally positive, but adherence to recommended practices was low. The study emphasized the need for educational interventions to improve knowledge and promote better self-management practices. [29]

A study on the KAP scores of 197 diabetic patients who visited a clinic for diabetics in **Nigeria** revealed a connection between dietary instability and the health of the patients. All the patients that were seen were more than 30 years old, and 52% of them had completed tertiary education. The sample's 57% overweight and 12% obesity rate indicated poor nutritional condition. Patients had inadequate food management knowledge and attitudes, including poor adherence to dietary recommendations. Despite their educational background, patients' attitudes, and practices (related to food consumption) were found to be influenced by their lack of understanding about nutritional management.[30]

In a **South African** study, researchers reached out to 225 people who were using public healthcare facilities and had a median age of 57 years. Patients were discovered to be deficient in information, attitude, and practices. The study discovered that there was a dearth of patient knowledge on the illness, its effects, food, treatments, and blood sugar levels. A sample that was educated on the effects of diet and sickness lacked information about blood glucose levels and adherence, and vice versa. The general public had a negative attitude towards the condition; 71% believed that having diabetes was equivalent to being doomed to a lifetime of illness, 78% felt ashamed of having it, and 66% avoided telling people about it. Bad eating habits and little to no exercise were criticized

for the patients' poor practices. Only 30% of those with knowledge exercised frequently, and those who were aware of the benefits of exercise still did not practice it. Given that attitude and knowledge are related, it is crucial to give patients the tools they need to manage their conditions.[31]

A quasi-experimental study evaluated the impact of a diabetes self-management education program on the knowledge, attitude, and practice of patients with type 2 diabetes in a rural hospital in **Egypt**. The study found that the program significantly improved participants' knowledge and self-care practices, highlighting the importance of education and counselling in improving diabetes management. [32]

2.2.2 Asia:

There is evident research that prediabetic education programs have impacted patients. As per Hyder et al (2021), a programme to educate people about diabetes may significantly improve their knowledge, attitudes, and behaviour. The effectiveness of the prediabetes education programme was assessed in **South India** by administering a questionnaire before and after the programme with a 30-day gap. 90% of prediabetics were found to have low knowledge at baseline, but after completing the education programme, 43% were found to have average knowledge and 44% to have good knowledge. Following counselling, 68% of respondents who had a bad attitude at the beginning of the attitude assessment obtained a good attitude score. Regarding practice evaluation, 35% had very poor practice and 52% had demonstrated poor practice, but following the programme, 71% had demonstrated good practice and 15% had demonstrated very good practice. The baseline KAP survey reveals that newly diagnosed prediabetics need to be more health literate.[33]

According to Sunny et al' cross-sectional study in **Karnataka, India**, in 2021, the majority of the patients had poorly controlled blood sugar levels, and the mean KAP score was low at 65.05. Effective patient or caretaker education about insulin delivery and glycaemic control had the potential to raise KAP. A prospective cross-sectional study was conducted for 7 months in the general medicine department of a tertiary care hospital. It took into account historical information about insulin-treated patients who had previously visited the hospital. Out of 255 (the study size), 64.70% of patients (n = 165) and 35.29% of carers (n = 90) delivered the insulin injections,

respectively. The patients' collective age was 55.74 years old. Men made up the majority of patients (63.92%), followed by women (36.07%). The mean KAP scores for patients and carers who self-administered the test were 65.05 and 64.52, respectively ($p = 0.571$). The KAP ratings of diabetic patients and their respective care givers did not differ significantly. Among the cohort 7.45% of patients ($n = 19$) have managed their blood sugar levels with mean HbA1C levels of 6.25%, while 92.54% of patients ($n = 236$) did not, with mean HbA1C levels of 8.97%. It was observed that patients' economic position ($p < 0.05$), length of insulin treatment ($p < 0.05$), degree of education ($p < 0.05$), and occupation ($p < 0.05$) are all strongly connected with diabetic patients.[34]

A study involving patients in Jammu from October to September 2014 was carried out in **North India**. It was intended to measure the degree of KAP for diabetes mellitus among patients in rural areas of Jammu, in the state of J&K (Jammu and Kashmir). According to the findings, 90% of the sample knew how to monitor diabetes, how to manage it, and how important eating a balanced diet was. However, approximately 88% of patients reported missing medications and delaying routine glucose and urine testing, attitude and practice metrics were poor. Socioeconomic status was thought to be the main cause of the patients' negative attitudes. It was determined that although the patients in rural Jammu had comparable knowledge, their attitudes and practices were lagging behind. Given the current situation, government or non-governmental organisations must invest in public health programmes that not only provide education but also emphasise the value of attitude and practice.[35]

Similar research was done at the AIIMS in Rishikesh, **Uttarakhand, India** where 200 patients were contacted at the OPD. On average, 30% of patients had a normal BMI, and ones who were overweight did not consider it as dangerous. 90% of people believed that using insulin was harmful and should be avoided. Due to individual people's varied ideas, the aggregate attitudes and practices scores fell below the satisfaction threshold. Even while attitude and practice ratings were higher than knowledge scores, they were still low when compared to the community's 78% literacy rate.[36]

Findings from a cross-sectional study on patients with type 2 diabetes mellitus in **Gujarat, India** were similar to those from research done in Northern India. It aimed to determine KAP's impact

on type 2 diabetes and its connection to glycaemic control. The average KAP score was 19/30 among DM patients with an average age of 58 and a disease duration of nine years, according to the findings. KAP score was substantially linked with current age and education but not with gender, disease duration, or employment. Additionally, there was a favourable association between KAP score and glycaemic management. Poor attitude and practice scores were found in a study carried out in Vadodara, Gujarat, which confirmed the findings of the Gujarat region. Only 23% and 12% of patients scored well in attitude and practice, despite 60% of patients scoring well on knowledge tests. Because they maintained their physical activities and nutrition (making healthier food choices), the older population with diabetes was found to be shielded from the danger of complications, whereas the present younger generation has a significant risk of complications due to stress and a sedentary lifestyle.[37]

At the Bhimavaram Hospital in Bhimavaram, **Andhra Pradesh, India** a study was carried out from December 2015 to May 2016. The study came to the conclusion that patient education is a crucial component of DM management. It is anticipated that better metabolic and glycaemic control will postpone negative effects. It placed a strong emphasis on the necessity of spreading awareness and encouraging healthy behaviours in both diabetic and non-diabetic subjects.[38]

Another cross-sectional study assessed the KAP of patients with diabetes mellitus in India. A structured questionnaire was used to gather data on participants' knowledge, attitudes, and practices related to diabetes management. The study revealed gaps in participants' knowledge regarding diet, exercise, and medication adherence. Attitudes towards diabetes management were generally positive, but participants exhibited suboptimal self-care practices. The study emphasized the need for comprehensive educational programs that address the specific knowledge gaps and promote better self-management practices. [39]

Asian populations are more susceptible to diabetes, according to a **Malaysian** study, which is explained by poor lifestyle choices, ignorance of the disease, rapid westernisation, and unacceptable attitudes and practices about DM among the general public and diabetic patients. Similar to the Ethiopian study, it came to the conclusion that knowledge and practice, and knowledge and attitude were positively correlated. Additionally, among diabetes patients, there appears to be a disconnect between knowledge and attitude about the disease. Self-management,

social support, motivation, and the accessibility of resources are characteristics that go beyond knowledge and attitude and have a big impact on DM control. Even though the sample population had a positive outlook and a good deal of knowledge about the disease, their levels of practice and adherence were poor. In terms of food and medication, patients were less cautious. Unexpected results from the trial showed that KAP had no effect on the treatment of diabetic mellitus. It was revealed that while patients had a solid understanding of the condition and a positive attitude towards it, these factors had no bearing on the degree of actual DM management. The study stood out as an oddity among earlier research conducted in developing nations. [40]

A study in **Bangladesh**, a neighbour of India in South Asia, that involved 18,697 patients from various economic backgrounds came to the conclusion that targeted education efforts are needed for the country's 75% undereducated, rural, and destitute population. In terms of knowledge (65%), attitude (67%) and practice (72%), the sample showed intermediate ratings. A positive association between education and knowledge is implied by the fact that the people with low education had, for the most part, low knowledge scores.[41] The link between knowledge, attitude, and practice was negatively correlated with age, sex, education, living situation, and income. Thus, it was determined that there was an urgent need for education campaigns, particularly for the public that might be unaware of the disease. Another study in Bangladesh involved 425 patients and was done in Dhaka. Patients with a long history of illnesses and women scored higher on knowledge tests, but patients' attitudes toward disease was negative. Patients with strong socioeconomic standing had good KAP scores, and this conclusion was in line with research from Ethiopia.[42]

2.2.3 Middle East:

In 2017, a cross-sectional study with 856 participants was carried out at the Technical Institute of Karbala, **Iraq's** Al-Furat A-Awsat Technical University. The factors that contributed to diabetes were numerous and complex, and they included both modifiable (such as obesity, dietary habits, lifestyle, and socioeconomic class) and non-modifiable (such as genetic obesity-related genomic or genes determining lipid metabolism or polymorphism in the receptor and its coactivator, family history, and age) factors. The KAP scores of the patients were satisfactory (>50%). However, early community action is necessary given the disease's fast spread. Due to the fact that DM is a silent

disease and that many patients only become aware of it when it causes issues, it is imperative that residents in these nations receive knowledge, regardless of their disease status.[43]

A prospective study examined the impact of counselling on the KAP of patients with type 2 diabetes in **Jordan**. Participants were divided into intervention and control groups. The intervention group received individual counselling sessions focused on diabetes self-management, while the control group received standard care. The study demonstrated that counselling significantly improved participants' knowledge and attitudes towards diabetes management. Moreover, the intervention group exhibited better self-care practices compared to the control group. The findings underscored the effectiveness of counselling in enhancing KAP and highlighted its potential for improving diabetes outcomes. [44]

A study, conducted in **Iran**, examined the impact of clinical pharmacists' interventions on the detection and prevention of medication errors in a medical ward. While the study did not focus specifically on diabetes, medication management is a crucial aspect of diabetes care. The findings highlighted the positive role of clinical pharmacists in improving patients' knowledge, attitude, and practice regarding medication use and reducing medication errors. [45]

A cross-sectional study assessed the KAP of diabetic patients in **Saudi Arabia**. A self-administered questionnaire was used to collect data on participants' knowledge of diabetes, their attitudes towards the disease, and their self-care practices.[46] The study revealed gaps in participants' knowledge regarding diabetes complications and self-care practices. Attitudes towards diabetes management were generally positive, but adherence to recommended practices was suboptimal. The study emphasized the need for targeted educational programs to bridge the knowledge-practice gap and improve diabetes self-management. [47]

2.2.4 Europe

A meta-analysis and systemic review in **Europe** looked at people with type 2 diabetes who are not receiving insulin related knowledge, attitudes, and practices sessions surrounding self-monitoring of blood glucose (SMBG). The study found that although patients generally had a positive attitude towards SMBG, there was a lack of knowledge and adherence to recommended practices.

Education and counselling were identified as important factors in improving knowledge and adherence to SMBG.[48]

A systematic review examined studies conducted on KAP in diabetes patients from various **Eastern European** countries. The review analysed the findings of multiple studies to provide an overview of the existing research on KAP in diabetes mellitus. The review identified common themes across the studies, including inadequate knowledge about diabetes management, positive attitudes towards self-care, and suboptimal adherence to recommended practices. The review highlighted the importance of patient education programs that address the specific knowledge gaps and promote positive behavioural changes in diabetes management. [49]

2.2.5 Caribbean:

A cross-sectional study was carried out in 2019 between May and August. Setting: A self-administered questionnaire with details on 288 HCPs' sociodemographic characteristics, education, and knowledge of complementary and alternative medicine (CAM) practices was distributed to chronic illness clinics in **western Jamaica** that treat patients with HTN and T2DM. The study concluded that programs for training HCPs on knowledge are necessary to better serve patients. The percentage of HCPs in the research who indicated they knew little to nothing about CAM (78.0%) was comparable to the percentage who scored poorly or on average (81.0%) on the CAM knowledge exam. HCPs with significant knowledge claimed diet and exercise to be key CAM techniques. This may be due to the fact that diet and exercise have consistently been proved to be the best ways to maintain a healthy weight and ward off the onset of chronic illnesses like T2DM and cardiovascular conditions like HTN. The effectiveness and safety of other CAMs that are often used, such as herbal remedies, dietary supplements, and manual techniques, are not well supported by research, therefore HCPs tend to favour exercise and diet over these alternatives. Pharmacists were the largest percentage of responders who suggested CAM use in addition to prescription medication to patients. [50]

Multiple studies on KAP related to diabetes mellitus has been conducted in emerging countries and region. Knowledge achieved high degree relevance as it acted as the first step to control DM among the three variables. Age, socioeconomic position, and education all have a big impact on how many individuals in underdeveloped nations are knowledgeable about diseases. In order to

dispel myths and inaccurate information around the topic, educational awareness is crucial, according to past studies and their relevant outcomes.

2.3 KAP's Correlation with Diabetes

In one study, Brown et al. (2018) looked at the relationship between patients with T2DM and **knowledge** on glycaemic control. The results showed that patients with more knowledge about diabetes had better glycaemic control, demonstrating the value of education in enhancing self-management behaviours.[51] Similar findings were made by Zhang et al. (2019), who discovered that patients were more likely to stick to their drug regimens and lifestyle changes if they had a positive attitude towards their illness and treatment. [52]

The relationship between diabetes-related knowledge and health outcomes in European populations was investigated in a study by Müller et al. (2019). The results showed that people with more knowledge about managing their diabetes had better glycaemic control, a lower risk of complications, and greater quality of life. This demonstrates the value of educational initiatives in raising KAP among type 2 diabetes patients in Europe. [53]

The impact of patient **attitudes** towards self-care practices in type 2 diabetes was examined in a systematic review by Andersen et al. (2018). The review found that patients were more likely to attain better glycaemic control and enjoy better health outcomes if they had positive attitudes towards dietary changes, exercise, and medication adherence. This highlights the necessity of interventions that aim to alter attitudes in order to improve self-management behaviours. [49]

In terms of **practice**, Smith et al.'s (2017) study investigated the link between diabetes outcomes and self-care behaviours. The findings demonstrated that patients with better diabetes management and a lower risk of complications were those who exercised regularly, ate healthily, and monitored their blood glucose levels. This emphasises how important it is to incorporate healthy habits into the treatment of T2DM. [54]

KAP therapies have also been shown to be successful in enhancing diabetic self-management. For instance, Johnson et al. (2020) assessed the effects of a counselling programme on KAP and clinical outcomes in T2DM patients in a randomised controlled trial. Individualised counselling sessions were provided to the intervention group to address their knowledge gaps, attitudes, and

self-care routines.[55] In comparison to the control group, the results showed a significant improvement in KAP scores and better glycaemic management. [56]

A cross sectional study examined the practice patterns of European patients with type 2 diabetes in a cross-sectional survey. According to the survey, different European countries had variable levels of self-care practice adherence, with some regions having higher rates than others. Adoption of healthy behaviours was influenced by elements like socioeconomic position, cultural views, and access to healthcare resources.[57] This emphasises how crucial it is to take regional and cultural diversity into account when creating methodologies to enhance KAP for the treatment of diabetes.[58] Numerous studies have been conducted in Europe to examine how diabetic self-management education programmes affect KAP.[59] For instance, in a randomised controlled study, Akalu et al. (2017) examined the effectiveness of a structured education course in improving KAP and glycaemic control in people with type 2 diabetes. The results showed that people who took part in the education programme had much better knowledge, attitudes, and self-care habits than those in the control group. [60]

Studies conducted in Europe have also looked at how healthcare practitioners might support good KAP in the management of type 2 diabetes.[61] In a qualitative study, Karamanidou et al. (2019) investigated how healthcare professionals view patient assistance and education. In order to improve KAP, training healthcare personnel in patient-centred practices and culturally sensitive communication is crucial. [62] The study revealed both facilitators and barriers to successful communication and education delivery. Randomised controlled trials on self-management education courses for type 2 diabetes were examined in a systematic review. These programmes greatly enhanced patients' understanding, self-care practices, and glycaemic control, according to the research results. The evaluation emphasised the value of educating patients and supporting their self-management to improve their capacity to manage their diabetes. [63]

In a 2004 publication, Funnell et al. examined the idea of empowerment and how it relates to managing diabetes on one's own.[59,64] It was emphasised that effective diabetes care depends on providing patients with the knowledge, abilities, and confidence to take control of their disease.[65] In order to improve patients' capacity for self-management, the evaluation emphasised the necessity for healthcare practitioners to embrace patient-centred approaches and offer

specialised education and assistance. Hawthorne et al. (2006) conducted a comprehensive review that looked at the effects of culturally appropriate health education therapies for type 2 diabetes in ethnic minority communities. The review emphasised how important it is to include cultural customs, beliefs, and values while delivering diabetes education. [66,67] It was demonstrated that culturally appropriate interventions improved knowledge, self-care behaviours, and clinical outcomes in ethnic minority groups with type 2 diabetes. [68] A similar systematic review examined patients in Ghana for their knowledge, attitudes, and practices about diabetes. It exposed patients' subpar self-care behaviours and knowledge gaps around diabetes.[69] The evaluation emphasised the need for focused educational programmes to increase diabetes awareness among patients in Ghana and to foster positive attitudes and self-care behaviours. [70]

However, the multiple barriers to effective implementation of KAP improvement studies range from micro to macro level within populations and regions. For instance, cultural inclination towards alternate treatments in Asian countries, creates barriers to counselling around diabetes medications and lifestyles. Similarly social norms in Middle Eastern countries, wherein women are unable to seek sufficient help due to societal constructs. Financial barriers are another key deterrent, wherein patients are unable to avail care due to lack of funds. At micro level usually unsupportive families and interpersonal dilemmas create a challenge in seeking counselling. [33,43]

2.4 Expanding ill-impact of Diabetes: Escalating demand for Counselling

Diabetes does not operate in isolation; it can potentially contribute to the development of other chronic diseases. It increases the risk of early death and morbidity related to hypertension [71], and it can lead to cardiovascular illnesses (CVD) such as end-stage renal disease, stroke, and hypertension (HTN). Hypertension is the most common CVD-related cause of morbidity and mortality in people with type 2 diabetes [72]. Globally, the co-occurrence of diabetes mellitus and hypertension has significantly increased [73]. Diabetes and hypertension together increase the mortality risk by 7.2 times, with poorer nations reporting a higher death rate [74]. High blood pressure can cause peripheral arterial disease (PAD), heart attacks, strokes, renal failure, vision loss, and sexual dysfunction [75]. Signs of organ damage due to hypertension include elevated albumin excretion, left ventricular hypertrophy, and the presence of a left ventricular strain pattern on the ECG [76]. Approximately 80% of patients with diabetes die from cardiovascular diseases,

particularly hypertension and stroke [77]. Hypertension also accelerates the development of cardiovascular disease, diabetic renal disease, and diabetic cardiomyopathy [78].

Risk factors for hypertension in T2DM patients include obesity, advanced age, and severe atherosclerosis [79,80]. A study conducted in Iraq found that 89.6% of diabetes mellitus (DM) patients were affected by hypertension, with correlations to age, BMI, insulin use, and duration of diabetes [44]. Although hypertension is manageable, its asymptomatic nature leads many people to develop life-threatening problems [81], and it is often underdiagnosed in diabetes mellitus patients [82]. Poor healthcare practices such as smoking cigarettes exacerbate health issues [83]. Diabetic patients who smoke have a higher risk of developing hypertension due to the detrimental effects of nicotine and other tobacco products on blood vessels [84,85]. Age, current smoking habits, and a high body mass index are significantly associated with hypertension in non-diabetic patients [86,87], with a higher correlation observed in people with diabetes [88,89].

After the age of 70, when the relative risk of mortality is higher for the general population, the relative risk of mortality in the diabetes population is even higher overall (12%) [90,91]. As per previous studies, the average life expectancy for people without diabetes, those with Type 1 DM, and those with Type 2 DM were 75.8, 70.96, and 75.19 years, respectively [92]. The death rate in the non-diabetic population remained stable and lower (average—1.48%) from 2012 to 2015 compared to Type 1 DM (5.25%) and Type 2 DM (4.27%) [93]. Research studies show that life expectancy among diabetic patients declines with age and is shorter than that of the general population [94,95], with a longer disease duration leading to increased time spent in morbidity [96].

One of the most dangerous side effects of treating diabetes is hypoglycaemia [97], with older people being at greater risk [98]. Ageing and hypoglycaemia in type II diabetes are closely related.[99,100] According to estimates from Middle Eastern studies, the number of older individuals in Middle Eastern nations such as Jordan is expected to triple from 2017 to 2050, increasing the risk of type II diabetes and associated comorbidities in older adults [101].

2.5 Improving KAP is the Next Frontier

As reviewed in multiple research projects, counselling can be the next frontier for change. In the setting of diabetes care, pharmacist-led care interventions seem to be essential for glycaemic

management, enhancing self-care routines, ensuring medication adherence, enhancing quality of life, and lowering associated comorbidities. [102,103] To achieve glycaemic control, pharmacist-led care treatments can be tailored to each patient. [104] However, there can be a care gap, which may be caused by complex care procedures, delayed intervention, and subpar self-management, which are frequently brought on by a lack of timely information and an inadequate support system.[105]

Due to T2D's multifaceted character, an individualised strategy is required, with treatment goals and interventions catered to the patient's needs, co-morbidities taken into account, and the risks and rewards of rigorous therapy balanced.[106,107] Precision therapy for diabetes has finally arrived, attributed to personalised approach and current developments in genomic medicine. [108] Although medical advancements continue to raise the standard of care for chronic illnesses, it is up to patients to execute on counselling advice on a daily basis. [109] Unfortunately, patients are typically not taught the sophisticated techniques required to control their illness at home, at work, and in their communities.[110] Modern chronic illness care approaches therefore emphasise the significance of patient-centred self-management support.[111]

Many diabetic patients require assistance with problem-solving, creating attainable objectives, and gaining and applying practical knowledge to manage their disease in the context of their daily life. To guarantee that patients can comprehend and use self-management information, this support must also take into account the literacy and cultural backgrounds of the patients.[112] Additionally, taking into account patients' self-efficacy and motivation to carry out diabetes self-care activities is necessary to help them improve their self-management. [113] From practice aspect, studies have shown that the re-training of insulin injection technique and the empowerment of diabetes information have improved glycaemic control. [114] The standard of care for insulin injections includes adequate insulin storage, timing, rotation of injection sites, disposal of needles, treatment of hypoglycaemia, and adverse effects management. [115] The ITQ survey using UK data revealed that 75% of patients did not practice site rotation and half of patients reported having lip hypertrophy at some point in their lives, with 28% injecting into lip hypertrophy sites. Good technique includes correct site rotation as well as not injecting into lip hypertrophy areas. Many patients either do not recall receiving the information or do not remember ever receiving it.[116] When insulin is injected repeatedly in the same area, fat and scar tissue can build up.[117]

Ineffective insulin injection technique raises the risk of lipohypertrophy (LH), which therefore would result in unstable glycaemic management. [118]

The function of chemists has changed over time. In order to improve patients' health status, clinical outcomes, and quality of life, it is crucial for chemists to recognise patients' needs and collaborate with other members of the healthcare team. [119] The management of T2DM is aided by adherence to recommended oral hypoglycaemic agents (OHA). [120] The World Health Organisation (WHO) defines adherence as the degree to which an individual's behaviour takes medication, follows a diet, and/or implements lifestyle changes, with agreed-upon recommendations from a health care provider. [121]

As shown by several studies conducted in the past, patients' lack of understanding of their illness and treatment options can be blamed for their non-adherence to OHAs. However, taking the proper steps to improve their adherence would lead to better glycaemic control.[122] Medication adherence may be improved through patient education on the value of taking medications and their benefits, ongoing physician evaluation, simplification of the dosage schedule, and counselling of patients and their carers on the critical elements of adherence. Adopting a better, more customised approach is crucial since medication compliance is a crucial factor in the effectiveness of treatment for the diabetic population.[123] Better health outcomes are ultimately produced by education intervention initiatives to increase the level of adherence to anti-diabetic drugs.[124]

Counselling becomes all the more important, as it has been observed that there is no connection between the patients' educational background and their adherence behaviour.[125] Interestingly, similar outcomes were for the people with occupational background.[126] When compared to their counterparts, patients with high levels of medication adherence were shown to be substantially more prevalent in the group with greater than or equal to 10 yearly visits to the doctor's office.[127]

A very important aspect during counselling is cultural aspect too.[128] The importance of individualised and culturally competent T2DM teaching and counselling should be stressed by healthcare practitioners.[129] The burden of diabetes complications and functional impairment status can be decreased with regular monitoring of diabetes control and effective self-management behaviours. But, as per North American studies, African American patients are less likely to undergo the prescribed number of HbA1c tests annually, to have a retinal eye exam, and to have a

foot exam than non-Hispanic whites.[130] To help patients properly manage diabetes on their own, healthcare practitioners should emphasise the patient's responsibility in their treatment and offer resources like pillboxes, culturally appropriate classes, or information on food and exercise.[131] Participants also mentioned that joining live or online diabetes support groups had improved their diabetes self-management techniques. [132] To improve clinical outcomes, patients should make changes to their lifestyles. For the therapy and supervision of diabetic patients to enhance their QoL (quality of life), clinical chemists can be very helpful. [133] Recognized as a critical aspect of behaviour change and social advancement, improving KAP is essential for fostering sustainable progress in healthcare, education, environmental conservation, and beyond.[134] By augmenting knowledge, refining attitudes, and refining practices, societies can better address emerging challenges and capitalize on new opportunities.[135]

Elevating knowledge about diabetes, its risk factors, and preventive measures is fundamental to fostering early detection and intervention.[136] Educational campaigns that elucidate the importance of regular screenings, healthy lifestyle choices, and medication adherence can empower individuals to take proactive steps in managing their condition effectively.[137] Moreover, cultivating a deeper understanding of the physiological mechanisms underlying diabetes and its complications can facilitate informed decision-making and promote self-management skills among patients.[138]

Attitudes towards diabetes play a pivotal role in shaping treatment outcomes and quality of life. Addressing misconceptions and stigma associated with the condition is essential for fostering a supportive environment that encourages open dialogue and engagement in care.[139,140] By promoting positive attitudes towards self-care practices, dietary modifications, and physical activity, healthcare providers can inspire patients to embrace lifestyle changes that are conducive to diabetes management.[141]

Practices encompassing self-management behaviours and healthcare-seeking patterns significantly influence diabetes outcomes.[142] Empowering patients with practical skills, such as blood glucose monitoring, medication administration, and foot care, equips them to navigate daily challenges and make informed decisions about their health.[143] Additionally, promoting regular follow-up visits and facilitating access to specialized diabetes care services can enhance continuity

of care and prevent complications associated with uncontrolled diabetes.[144] Encouraging lifestyle modifications, such as balanced nutrition and regular physical activity, further supports optimal diabetes management. Incorporating mental health support and education on stress reduction techniques can also improve overall well-being. Community-based programs and peer support networks provide additional resources and motivation, fostering a supportive environment for sustainable health practices.

3. RESEARCH HYPOTHESIS AND OBJECTIVES

RESEARCH HYPOTHESIS AND OBJECTIVES:

3.1 Research Gap

Data related to rising cases of diabetics is threatening. The disease is not limited to selected areas/regions or countries but has become a global phenomenon. The generic attitude towards diabetes is being a chronic medical patient, who is meant to take insulin or similar remedies to maintain the proper insulin levels. However, the measures that can either prevent or reduce the ill-impact of the disease such as healthy attitude and practice are neither paid any attention nor promoted.

The lack of focus on healthy lifestyle including proper knowledge, attitude and practice demands the need of counselling for patients to help them lead a better life and serve as mediators or promoters of such lifestyle for other vulnerable people. There are ample studies around assessment of KAP scores of patients, but very few cater to the impact of counselling on patients and how it has a causal effect on post-counselling KAP scores and glycaemic levels.

The public health is seriously threatened by the diabetes epidemic that is spreading across the globe. Unfortunately, the general view of diabetes frequently centres around the idea of being a chronic patient for the rest of one's life, who depends on insulin or other prescriptions to control blood sugar levels. While the necessity of medical interventions cannot be disputed, prevention strategies and the adoption of a holistic strategy that incorporates knowledge, attitude, and practice (KAP) have generally been neglected and disregarded.

In order to fill this gap in diabetes management, a paradigm shift is required. The promotion of a thorough understanding of the disease and the empowerment of people to take control of their health depends heavily on patient and caregivers counselling. Counselling interventions can successfully provide patients with the methods and techniques required to live healthier lives by offering information, direction, and support. Additionally, when patients adopt healthy lifestyle changes, they act as change agents in their communities, educating others and encouraging healthy habits. While research have looked at how diabetes patients' KAP scores are assessed, only a small number have specifically explored the effects of counselling treatments on these scores. It is crucial to explore more deeply into the link between counselling and improved post-counselling impact.

We can better understand the transformative potential of counselling and how it affects patients' knowledge, attitudes, and practices linked to managing their diabetes by doing thorough study.

Investigating the long-term impacts of counselling therapies is just as important as evaluating the short-term results. This entails assessing the behaviour change's long-term viability after the counselling session and assessing the overall effect on patients' wellbeing. We can create interventions that encourage long-lasting behaviour changes and greatly enhance health outcomes for people with diabetes by studying the long-lasting impacts of counselling. Additionally, the value of patient counselling goes beyond the level of the individual. Patients who have attended counselling and seen improvements in their knowledge, attitude and practice become social ambassadors for healthy living. By encouraging and directing people towards better disease management techniques, they can act as role models. As a result, counselling has an impact that goes much beyond the individual patient, potentially influencing the attitudes and behaviours of the larger community with regard to diabetes care and prevention. Although, counselling interventions also come with challenge of accessibility, which is attributed to multiple factors ranging from social, economic, political, technological, and legal, however, if all these crucial factors are conducive, the counselling intervention can help improve well-being of patients and population as a whole.

The importance of patient counselling in the management of diabetes cannot be more emphasised. Along with counselling, multiple other modes such as education campaigns and programs or government policies have help accelerate the process of disease management and well-being. Fighting the diabetes epidemic necessitates addressing the lack of focus placed on healthy lifestyle variables, such as information, attitude, and behaviour. Focusing on counselling interventions allows to empower patients to actively participate in their own care, encouraging positive behavioural changes that reach beyond the level of the individual. The entire potential of counselling may be unlocked via thorough study, which opens the door to build strategies that lessen the burden of diabetes globally and enhance the lives of millions of people who are impacted by this chronic illness.

3.2 Rationale and Purpose of the Study

The goal of this study, "Impact of Patient Counselling on Knowledge, Attitude and Practice in the Management of Type 2 Diabetes Mellitus: A Prospective Study," is to provide information and

recommendations to people with diabetes, care givers and medical professionals located anywhere in the world. The focus of the research has been to demonstrate the beneficial effects of counselling for patients and their care givers in improving the well-being of patients and enriching them mentally and physically. The study was intended to realise the impact of counselling and educating patients and their caregivers to modify their mind-set and make efforts to control and reduce the implications of this metabolic disease. The patients were surveyed at different time intervals, before and after counselling, to evaluate the change in their levels of knowledge, attitude, and practice, and glycaemic (blood sugar) levels. In this study, no comparison with control group was established, and exclusively focused on impact of counselling rendered to the sample. The study will serve as a guiding principle for caregivers, physicians and pharmacists who directly deal with patients to help influence their mindset in a positive direction by enriching them with apt knowledge and persuading them to have a healthy attitude and lifestyle.

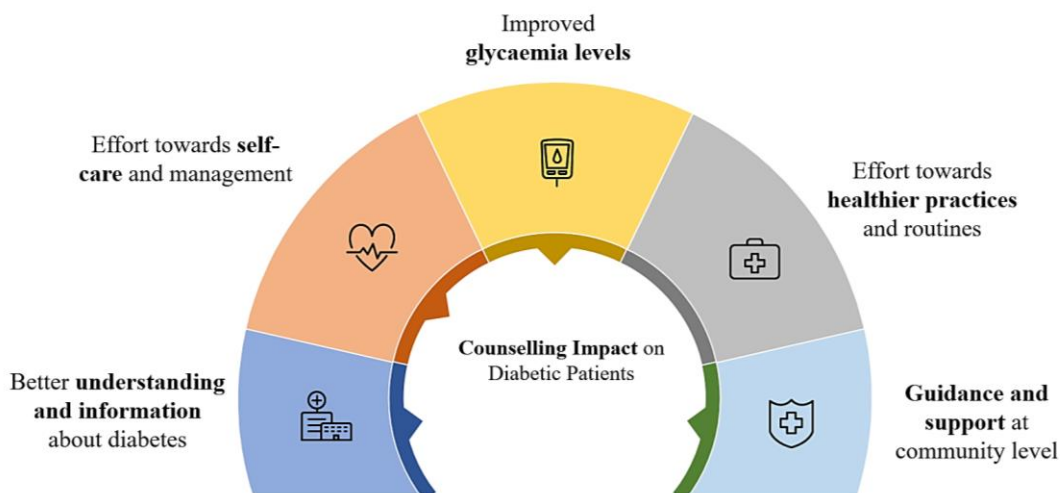


Figure 3: Impact of Counselling on Diabetic Patients

3.3 Hypothesis

Type 2 Diabetes mellitus is often associated as a chronic metabolic disorder, and patients given less emphasis on external efforts of self-care and management. Various studies in different regions of India have primarily emphasized on diabetic epidemiology, but studies pertaining to KAP survey in the field of diabetes are limited. [145,146]

The proposed study hypothesizes that patient counselling will help improve knowledge, attitude, and practice in the management of type 2 diabetes mellitus. Specifically, we predict the following:

1. The patients will demonstrate an improved KAP score after getting counselled.
2. The blood sugar levels (reported through fasting blood sugar (FBS), random blood sugar (RBS) and HbA1C) of patients will report improvement after getting counselled on the aspects of knowledge, attitude, and practice.

The caveats to these hypotheses include: no inclusion of confounding factors, bias in patient responses, variation in counselling interventions, and specificity of the study, may not be viable for generalization.

3.4 Aim

Evaluate the impact of patient counselling on knowledge, attitude, and practice in the management of type 2 diabetes mellitus.

3.5 Objectives

- 1) To access the demographic profile (gender, age, weight, literacy, income, occupation, marital status, physical activity, family history and duration of diabetes) of the patients suffering from diabetes mellitus
- 2) To evaluate the knowledge, attitude and practice levels of the patients suffering from diabetes mellitus
- 3) To counsel diabetic patients about their disease, medications, management, and lifestyle modifications, via individual and group sessions.
- 4) To evaluate the impact of counselling during the study period
- 5) To find out the key points that can benefit the patient knowledge.

4. MATERIAL AND METHODOLOGY

MATERIAL AND METHODOLOGY:

4.1 Material

4.1.1 Study Setting: The study was conducted in hospital of Punjab from 2020 to 2022 and the data for patients suffering from diabetes mellitus Type 2 was collected through in-person interviews and case sheets.

4.1.2 Survey Instrument: To collect the data pertaining to knowledge, attitude, and practice levels of patients, a KAP questionnaire (Annexure I) was developed by leveraging primary and secondary research sources. The questionnaire was validated by an expert committee of academicians (n = 2), and medical superintendent (n = 1). The Content and Face Validity Index by experts was obtained as 0.8 (>0.7), implying questionnaire is valid (Davis 1992).[147] The test the reliability of the KAP questionnaire, 2 interviews were conducted 15 days apart on same patients (n=53). The Cronbach's alpha value ≥ 0.70 was considered as reliable.

4.1.3 Patient Sample Size: 532 patients

Based on standard calculations, i.e. using software Statical Epiinfo¹, by CDC; Raosoft²; and manual calculation³ (Yamane et al 1967), the sample size was estimated to be 384 patients, but the data collected (of 384 patients) was positively skewed and did not provide a normal distribution to conduct analysis.[148] So, on increasing a sample size to 532, a normal distribution was obtained.

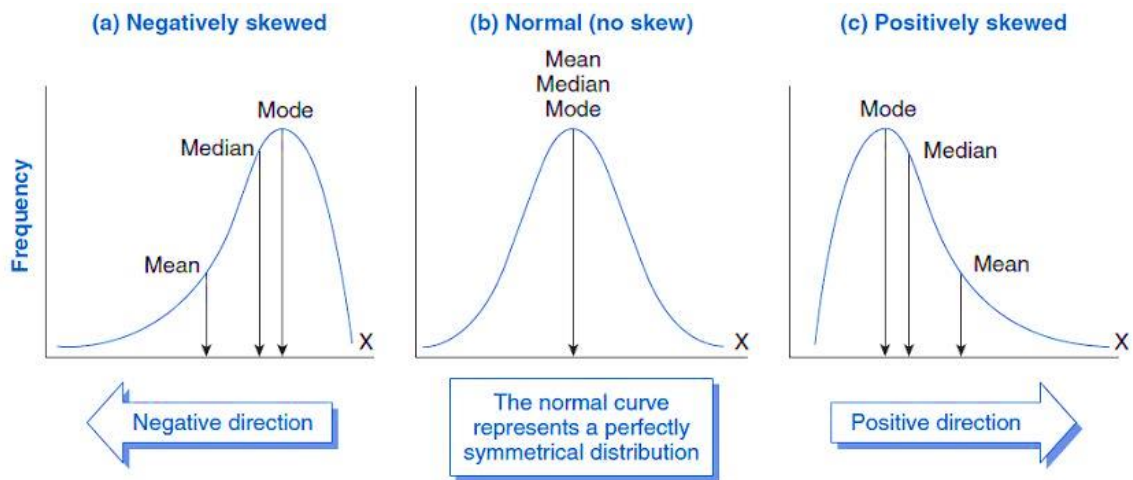


Figure 4: Normal Distribution vs Skewness

1. Sample size with Epiinfo: 384
2. Sample size with Raosoft: 323
3. Sample size by manual calculation: 400

4.1.4 Inclusion and Exclusion Criteria:

- 1) Inclusion Criteria: Patients who are diagnosed with Type 2 diabetes mellitus or referred from within and outside institute for treatment of diabetes mellitus; it includes type 2 diabetics irrespective of stage; comorbidities; sex; and must be adults (>18 years of age) who can respond to the KAP study's questions.
- 2) Exclusion Criteria: Expectant or nursing mothers were excluded because the certainty of them having type 2 diabetes mellitus (T2DM), or gestational diabetes was unclear, and significant hormonal changes could alter blood sugar levels. Additionally, patients who are mentally unfit were also excluded.

Before asking patients to fill the questionnaire a formal consent was taken (Annexure II, III and IV)

4.2 Methodology

Scale and KAP score categorization:

For the assessment of knowledge, attitude, and practice (KAP), three separate question sets were developed. The knowledge questions utilized a 3-point Likert scale with the options: 1 - Yes, 2 - No, and 3 - Don't Know. The attitude questions employed a 5-point Likert scale with the options: 1 - Strongly Disagree, 2 - Disagree, 3 - Maybe, 4 - Agree, and 5 - Strongly Agree. Similarly, the practice questions used a 5-point Likert scale, with options tailored to each question, ranging from negative to positive responses.

The categorization of KAP responses as good, average, or poor was based on patient responses. For knowledge questions, if a patient selected the correct option for 70% or more of the questions, the score was categorized as having 'good' knowledge. If the correct option was chosen for 50-69% of the questions, the score was categorized as 'average'. Less than 50% correct answers were categorized as 'poor'. For example, a question such as "Regular exercise will increase the need for insulin or other diabetic medication" requires the answer "No". Patients answering correctly would receive one mark, and a correct response rate of 70% or higher would categorize them as having a good knowledge score.

For attitude questions, if the patient selected relevant answers that fell on the same side of the midpoint value ('Maybe' in this case), were considered correct. Patients providing correct answers

for more than 70% of the questions were categorized as having a 'good' attitude, 50-69% as 'average', and less than 50% as 'poor'. For instance, a question such as "Do you help keep the habits of family members in control too?" would have "Agree" or "Strongly Agree" as the correct answers, both falling on one side of the midpoint. Selecting either of these would be considered a correct response.

Similarly, for practice questions, if the patient selected relevant answers that lay on one side of the midpoint value, these were considered correct. The same categorization rule applied: 70% or more correct answers for a 'good' score, 50-69% for 'average', and less than 50% for 'poor'. For example, the question "You never miss your medicine doses?" would require the answer "Agree" or "Strongly Agree," which fall on the same side of the midpoint and would be considered correct responses.

All analysis leveraged SPSS software. The missing values were filled as '999', to avoid outlying or insignificant results.

Confidence Interval: The confidence interval for the study was 95%. The two-sided 5% significance level (0.05) was used for all statistical tests. (Ab Rahman, 2015).[149]

The study's data analysis was split into two stages: descriptive and analytical.

- While the primary goal of descriptive statistics is to find the demographic divisions one by one, the primary goal of analytical statistics is to characterize the relationship between the independent variables and one or more dependent variables. (Altman et al., 1983).[150]
 - For numerical variable precision of the estimates, statistics such as the mean (μ) standard deviation (σX), standard error (SE), median (\bar{x}), were used. (Johnson & Karunakaran, 2014).[151]
- Parametric tests were performed during the study to test the hypothesis. (Rahman, 2015).[152]

Descriptive analysis was used to (1) access the demographic profile of the patients and to (2) assess the KAP levels of patients based on inputs to the questionnaire.

Analytical analysis (parametric tests) was conducted to determine the impact of independent variables (demographics) on blood sugar levels, to (3) determine the relevant counselling

techniques for different patient cohorts. Thereafter, (4) impact of counselling was evaluated using parametric tests to find the variation in KAP scores and blood sugar levels. (5) The tips used to educate and counsel patients were considered relevant and impactful, based on the results reaped by them.

Independent T Test (Kim et al 2019) [153]: To find out the difference between 2 groups such as gender (male, female) and dependent variable such as blood sugar levels (FBS, HBS, HbA1C). A statistical study using the Independent T-Test was performed in order to thoroughly analyse the links between demographic parameters and important numerical variables related to diabetes treatment. This approach was chosen to look at potential differences in blood sugar indicators such as Fasting Blood Sugar (FBS), Random Blood Sugar (RBS), and Haemoglobin A1C (HbA1C) across two distinct groups. This analysis was done to see if there were any statistically significant differences between the glycaemic profiles of the designated groups before counselling interventions.

The methodology's inclusion of the Independent T Test allowed for a careful analysis of how blood sugar levels can be affected by demographic factors. The investigation aimed to shed light on the potential impact of individualized instruction and counselling on closing gender-related glycaemic inequalities, if any, and emphasizing the importance of customized treatments in improving overall diabetes care results.

One-way ANOVA (Ostertagova et al, 2013)[154]: Wherein independent variables such as demographics (employment, income, etc.) and knowledge, attitude, and practice (with categories more than 2) and the dependent variable such as blood sugar levels (numerical and normally distributed) were evaluated.

A One-way Analysis of Variance (ANOVA) was used to fully evaluate the impact of independent multicategory variables on diabetes management. To examine potential mean differences among more than two categories of the independent variables, such as demographics and KAP scores, this statistical method was selected. According to the proposed assumptions, this analysis was performed on the dependent variable, which represented numerical and normally distributed data linked to the management of diabetes.

The study also looked into possible discrepancies between blood sugar levels that are impacted by independent variables including income, family history, and education. This allowed us to determine the approach of counselling while keeping the factors including family history, income, and education in mind, which may have significant implication on diabetes management.

This scientific approach deepens the understanding of the complex interactions among the numerous elements determining the results of diabetes management. For the variables that reported statistically significant difference in the means of blood sugar levels for different groups, a **univariate analysis** was conducted to calculate **R squared value** to find the difference in means and variances of the blood sugar levels factored by the independent variables (Canova et al 2017)[155].

Paired T-test (Ross et al 2017)[156]: To compare the means of KAP scores and blood sugar levels at 2 different time frames, before and after the counselling, to evaluate the impact of counselling on the said variables.

The goal of this analysis was to determine whether there was a statistically significant difference between the means of diabetes markers, which included HbA1C, Random Blood Sugar (RBS), and Fasting Blood Sugar (FBS), and also the KAP scores.

The goal was to determine whether counselling was successful in causing detectable changes in the aforementioned diabetes indicators by using the Paired T-Test. It sought to determine if the counselling interventions had a measurable effect on the participants' diabetes management results by comparing the means of these markers, before and after counselling. It was able to quantify and validate any statistically significant variations in the means using the Paired T-Test methodology, which gave a concrete proof of how well the intervention affected these diabetic markers.

The result of this investigation advances the knowledge of the practical advantages of counselling in the management of diabetes by demonstrating its potential to influence improvements in FBS, RBS, HbA1C indicators.

The integration of the Paired T-Test analysis allows for a thorough assessment of the effects of counselling interventions on diabetes indicators. This method makes it easier to identify statistically significant alterations by comparing means for the same set of data across time periods.

This methodology emphasizes the usefulness of counselling sessions in producing noticeable improvements in participants' diabetes-related health outcome. The significance in difference of results that are evaluated at different time frames give an insight in strong impact of the deployed counselling interventions.

5. RESULTS AND DISCUSSION

RESULTS AND DISCUSSION:

5.1 Demographic Profile of Patients

An initial component of the study was the demographic analysis of the patients, which gave important insights into the backgrounds and traits of the participants. Different demographic factors were examined using descriptive analysis, which provided a thorough insight of the sample population. To ascertain the representation of men and women in the study, the gender distribution of the patients was evaluated. This information aids in identifying any potential gender-based differences in diabetes management knowledge, attitudes, and practices. Another crucial demographic element that was taken into account in the study was age. To determine how the various age groups were distributed among the sample, the participants' age range was examined. This made it possible to investigate potential variations in KAP scores between age cohorts and find any patterns or trends that might be age-related.

Patients' weight, which is attributed to body mass index, was used in the demographic analysis to ascertain the prevalence of obesity or overweight in the sample. This knowledge is crucial because obesity is a significant risk factor for type 2 diabetes and impacts the condition's treatment and prognosis. To better understand the participants' educational backgrounds, the literacy status of the patients was evaluated. The level of formal education and its possible impact on knowledge acquisition and health literacy in relation to diabetes are shown by this demographic feature. Another crucial element taken into account in the demographic research was monthly income. The socio-economic standing of the subjects was ascertained, and any relationships between income levels and KAP scores were investigated. The availability of healthcare services, dietary preferences, and general health behaviours can all be influenced by socioeconomic variables.

To comprehend the participant's work-related features and potential implications on their lifestyle and disease management, the occupation type and job activity were investigated. To investigate any potential variations in social networks and support systems that might have an impact on diabetes self-care behaviours, marital status was evaluated. For the purpose of identifying participants who had a genetic propensity to the condition, family history of diabetes was taken into account as a demographic characteristic. Understanding the potential effects of family history on participants' knowledge, attitudes, and practices regarding diabetes treatment is made easier with the aid of this information. Finally, the patients' participation in exercise or regular physical

activity was evaluated using physical activity as a demographic characteristic. This information is crucial since exercise plays a crucial role in managing diabetes and has a big impact on how the condition turns out. A thorough grasp of the sample population was achieved through the thorough investigation of various demographic factors. This information not only helps to characterise the study participants but also identifies potential variables affecting KAP scores and directs focused diabetes management interventions.

5.1.1 Gender

53.4% of the patients who participated in the survey were female, while 46.6% were male, according to the gender distribution. This gender distribution offers important information about how men and women are represented in the sample population. The larger percentage of female participants in the study shows that women are more likely to take part in diabetes research. This result is in line with past studies that showed that women were more likely than men to have type 2 diabetes. There are a number of explanations for the gender difference in diabetes prevalence, including biological variations, hormonal impacts, and socio-cultural variables. Women might also be more proactive in seeking medical attention and taking part in research projects, which might explain why there are more of them in this sample. Overall, the gender distribution of the patients enrolled, which was 46.6% men and 53.4% women, emphasises the significance of taking gender into account as an important demographic element in the study of diabetes care. In addition to highlighting the necessity of gender-specific methods in healthcare interventions, it also highlights how crucial it is to raise diabetes awareness and educate both men and women about the disease.

Table 1: Frequency distribution of gender of patients

Gender-wise distribution of patients (n=532)

Gender	Frequency	Percent
Male	248	46.6
Female	284	53.4
Total	532	100.0

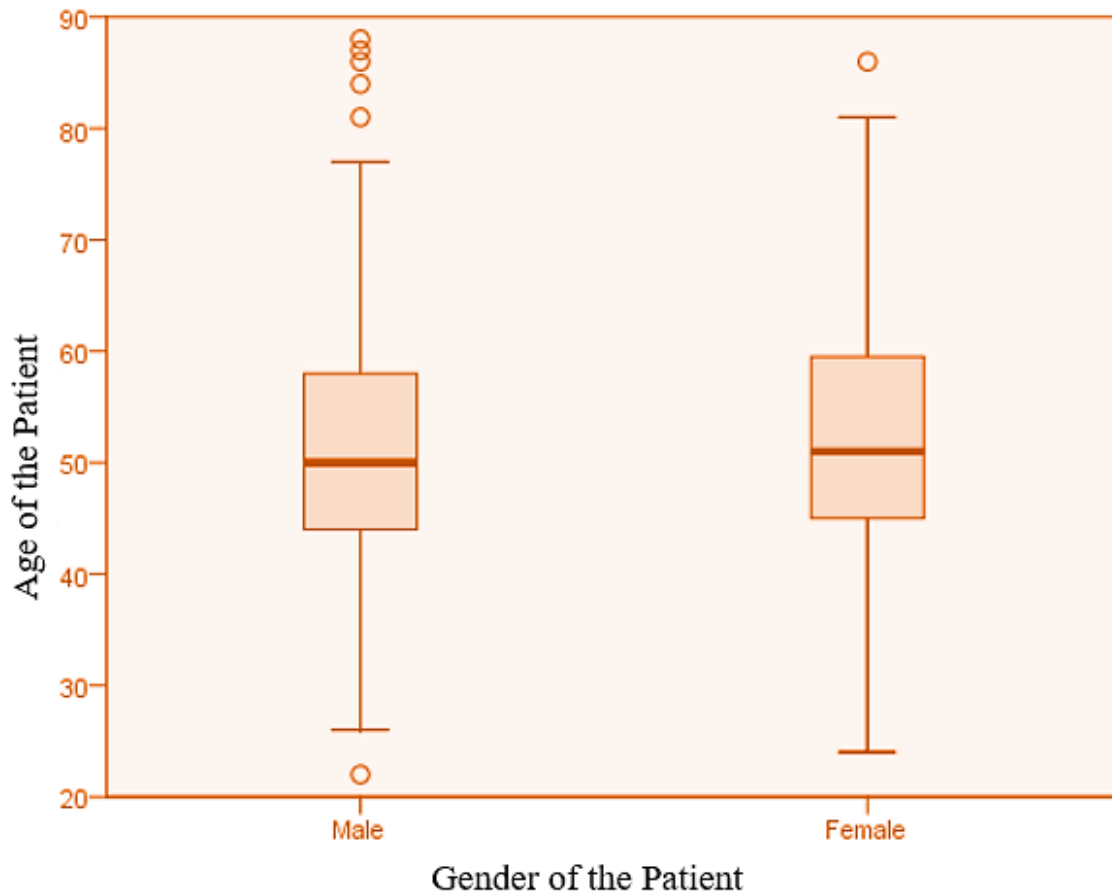


Figure 5: Simple box plot of the age of the patient and gender of the patient

5.1.2 Age

A sizable majority—roughly 66%—of the 532 individuals included in the study were between the ages of 41 and 60. The largest patient subset, accounting for 34% of the sample overall, was found to be between the ages of 41 and 50, according to further research. These results suggest that the disease has a greater impact on generation X individuals, who are typically between the ages of 41 and 60. The share of patients in the 41–60 age range emphasises the rising prevalence of diabetes among people in their middle years. This outcome is consistent with research by other authors, such as Patil et al. (2011) [157], who found that the prevalence of diabetes rises with age. In their study, Patil et al. found that the prevalence rate for people under the age of 60 was 44.8%, showing a significant impact of diabetes in this age range. Furthermore, they discovered a prevalence incidence of 23.3% in people aged 40 to 49, underscoring the rise of diabetes in the younger

generation. Numerous studies conducted around the world have noted a worrying trend: the incidence of diabetes is rising among younger people. This change in the age distribution of diabetes cases raises the possibility that risk factors and disease patterns could all evolve over time. The increasing prevalence of diabetes in this age range has been linked to elements including sedentary lifestyles, bad eating patterns, and rising obesity rates among younger people. Mean and standard deviation, SD, was found to be (Mean = 51.8 years and SD = 11.2 years), and the minimum and maximum age of patient to be years and years, respectively.

Table 2: Descriptive analysis of the age of patients

	N	Minimum	Maximum	Mean	Std. Deviation
Age of the patient	532	22	88	51.85	11.232

In summary, the study's analysis of the age distribution among the 532 patients showed that the majority of them (66%) belonged to the 41–60 age range, with the 41–50 age range comprising the largest subset. These results confirm the emerging understanding of diabetes' major effects on the generation X population. The prevalence of diabetes among younger people is rising, which necessitates aggressive actions to address the underlying risk factors and advance early intervention techniques. Healthcare practitioners can create focused strategies to lessen the burden of diabetes and enhance patient outcomes by studying the age distribution and changes in the prevalence of the disease.

Table 3: Frequency distribution of age of patients

Age-wise distribution of patients (n=532)

Age	Frequency	Percent
21-30	11	2.1
31-40	60	11.3
41-50	181	34.0
51-60	169	31.8
61-70	81	15.2
71-80	23	4.3
81-90	7	1.3
Total	532	100.0

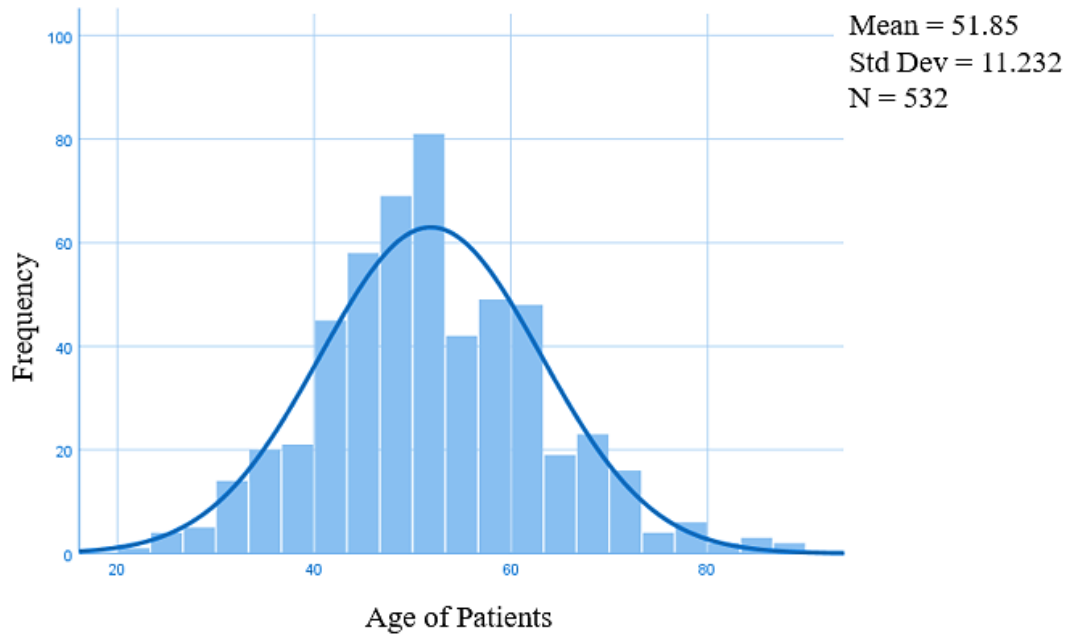


Figure 6: Distribution of the age of patients

The age data was normally distributed, depicting a bell curve in the histogram, and both the skewness and kurtosis was found to be within the normal range; viz. skewness (-1 to 1) and kurtosis (-1.96 to 1.96)

Table 4: Normality test of the age of patients

Test of age normality 1.1 (n=532)

Valid	532
Skewness	0.296
Std. Error of Skewness	0.106
Kurtosis	0.244
Std. Error of Kurtosis	0.211

Table 5: Shapiro-Wilk Normality test of the age of patients

Test of age normality 1.2 (n=532)

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age distribution of the patient	0.189	532	0.000	0.928	532	0.000

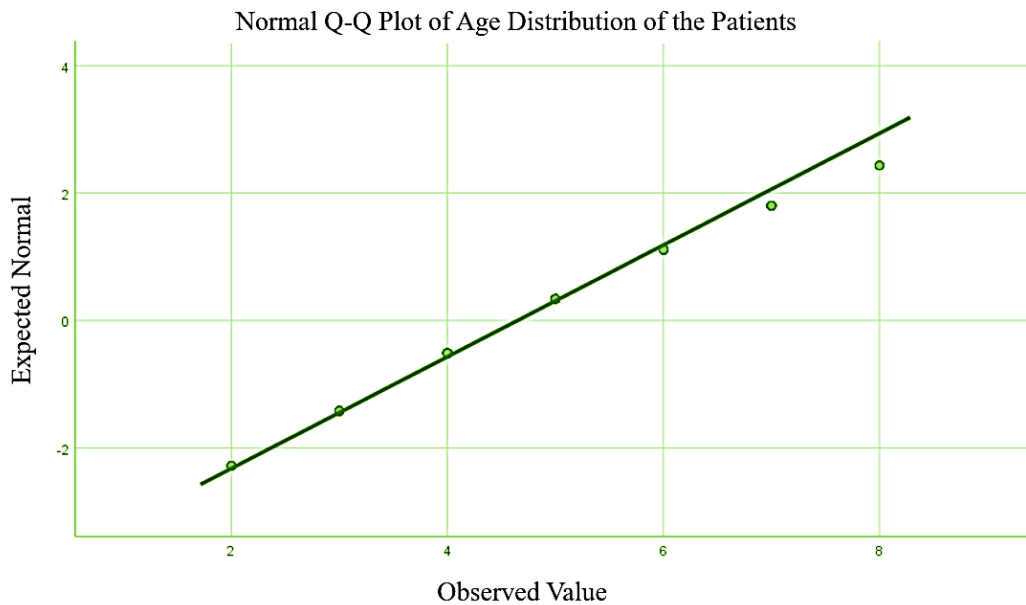


Figure 7: Normal Q-Q plot for age distribution

5.1.3 Weight

A thorough examination of the weight distribution of the 532 patients who were a part of the study uncovered some intriguing trends. The bulk of patients, or 34% of the entire sample, were in the 71–80 kg weight range. This amounted to 180 patients in all. 167 patients made up the 81-90 kg weight category, which was the next largest. The research on patient weight distribution demonstrates how common obesity and overweight are in people with diabetes mellitus. These findings highlight the importance of weight management in diabetes prevention and management as excess weight is a well-known risk factor for the onset of type 2 diabetes.

The significant percentage of patients who fall into the 71–80 kg weight range shows that many of the people with diabetes in the research population are overweight or somewhat obese. This is consistent with global trends showing an increase in overweight and obesity rates, especially among people with disorders like diabetes. As a result of the additional weight, the body's capacity to make and use insulin is put under higher stress, which leads to insulin resistance and hence the development of diabetes.

Table 6: Frequency distribution of weight of patients

Weight-wise distribution of patients (n=532)

Weight	Frequency	Percent
41-50	1	0.2
51-60	25	4.7
61-70	100	18.8
71-80	180	33.8
81-90	167	31.4
91-100	48	9.0
101-110	10	1.9
> 111 Kg	1	.2
Total	532	100.0

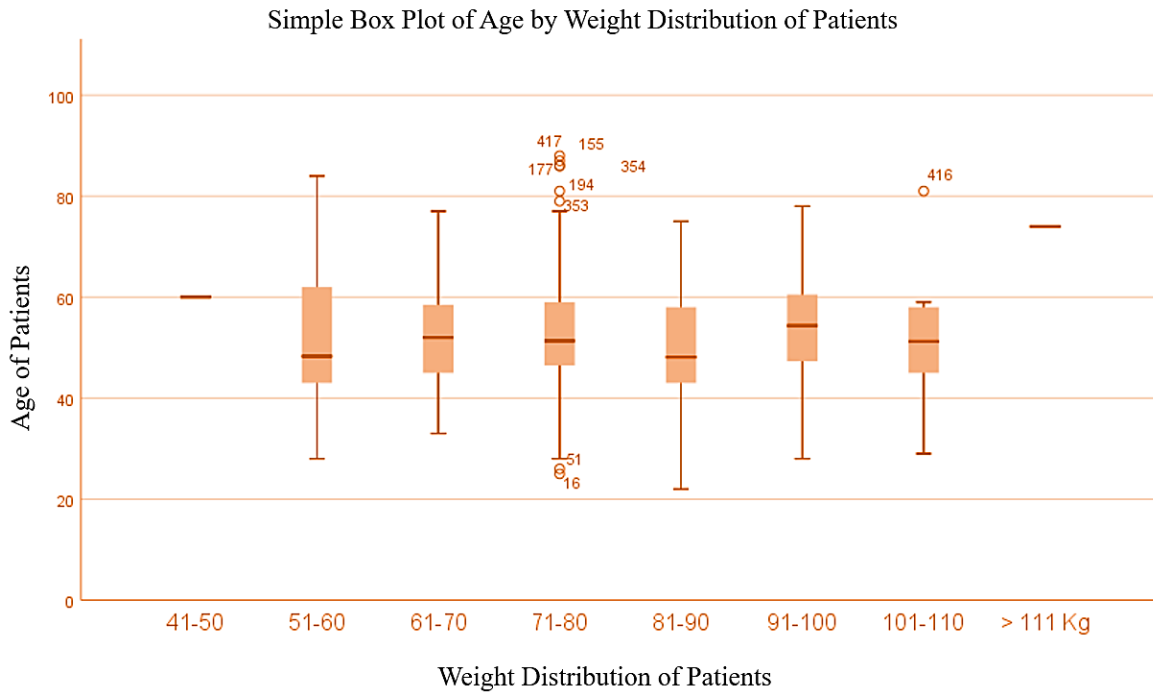


Figure 8: Box plot: weight vs age of patients

The weights of patients were normally distributed, and the Mean (μ) and SD were found to be (M = 78.14, SD = 10.5) kg with a minimum weight of 47 kg, and a maximum weight of 114 kg.

Table 7: Descriptive analysis of the weight of patients

Descriptive analysis of Weight of patients (n=532)

Mean	78.14
Median	78.00
Std. Deviation	10.508
Variance	110.428
Skewness	0.195
Std. Error of Skewness	0.106
Kurtosis	0.047
Std. Error of Kurtosis	0.211
Minimum	47
Maximum	114

Similar to the age of patients, the frequency distribution of weight depicted a bell curve in the histogram, and both the skewness and kurtosis was found to be within the normal range; viz. skewness (-1 to 1) and kurtosis (-1.96 to 1.96).

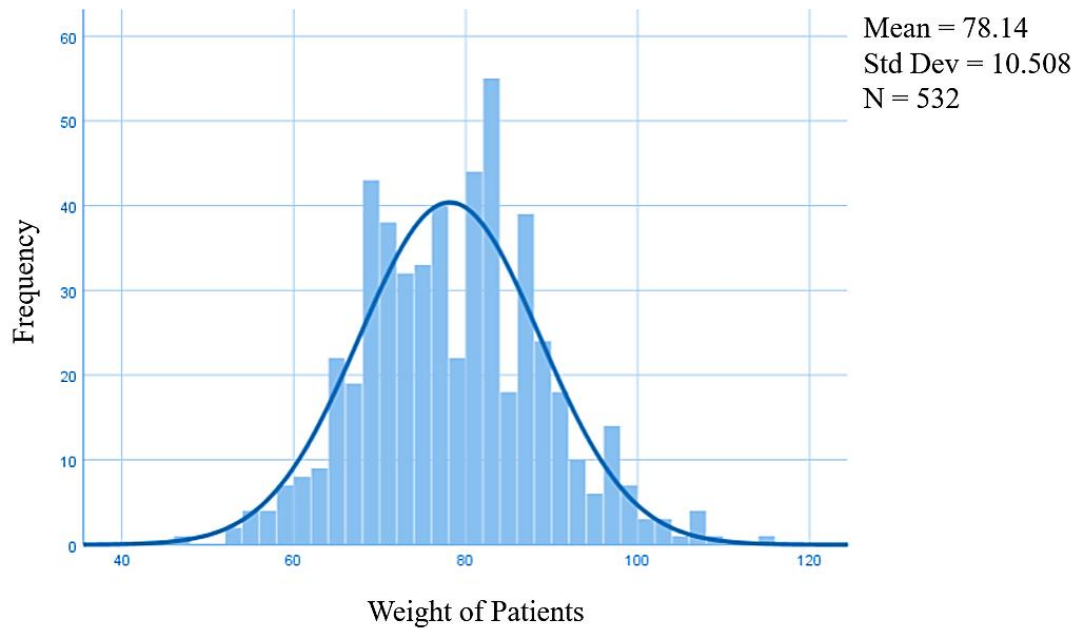


Figure 9: Distribution of the weight of patients

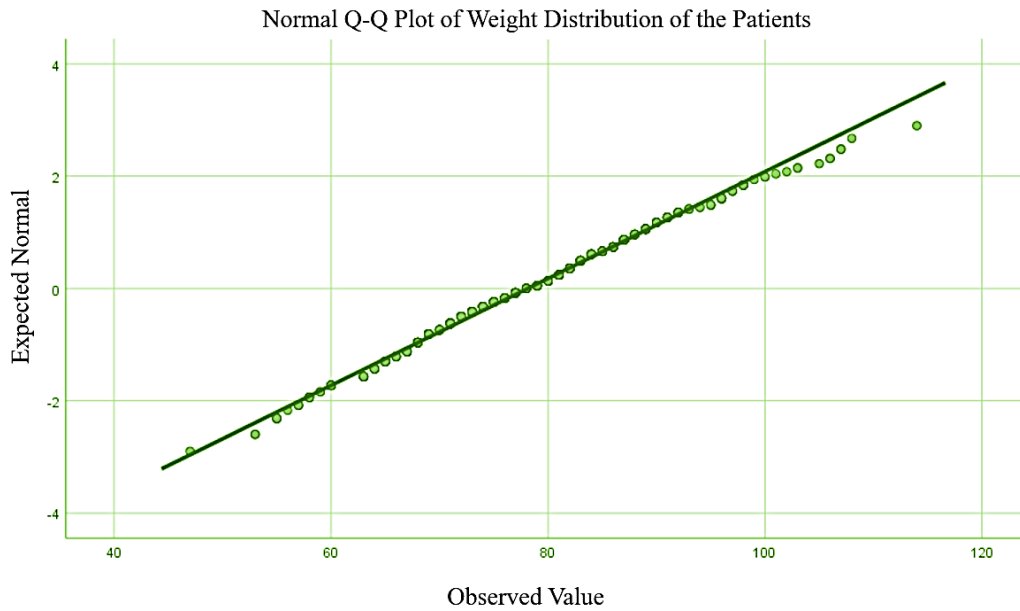


Figure 10: Normal Q-Q plot for weight distribution

Body Mass Index (BMI): The measurement of body weight in relation to body mass index (BMI) among the patient group produced a startling finding. 90% of the patients had BMIs that were higher above the acceptable ranges, which suggests that weight imbalance was a problem that affected the entire group. This result underlines the pressing requirement for efficient weight-management techniques in the treatment of diabetes. According to the patients' BMI assessments, 31% of them (166 people) were deemed overweight. This suggests that they were heavier than was healthy for their height and frame. Obese people have a higher chance of having heart disease, hypertension, and type 2 diabetes, among other health concerns.

Furthermore, according to their BMI ratings, an alarming 58% of the patients (311 people) were identified as obese. The excessive build-up of body fat that characterises obesity is a chronic disorder. Numerous health hazards are linked to it, including a higher risk of developing metabolic syndrome, insulin resistance, and cardiovascular illnesses. Due to the high prevalence of obesity among the patients, thorough weight management strategies are essential to address this crucial element of their general health.

The discovery that weight control was less of a priority for the patients is alarming because weight management is critical for managing diabetes and has a big impact on the course and results of the disease.

Table 8: Frequency distribution of BMI of patients

Descriptive analysis of BMI of patients (n=532)

Weight	Frequency	Percent
18.5 to 25 kg/m ² - Normal	55	10.3
25.1 to 30 kg/m ² - Overweight	166	31.2
> 30 kg/m ² - Obese	311	58.5
Total	532	100.0

5.1.4 Literacy Status

Intriguing data about the patients' literacy abilities was obtained through the examination of their educational backgrounds. About 40% of the people who were surveyed had finished their matriculation level of study. This suggests that a sizable proportion of the patient population had acquired a fundamental level of formal education, which may have helped or can help them understand and engage in self-management practices for diabetes.

About 27.4% of the patients were classed as illiterate, suggesting a lack of formal education, closely behind. This data points to a potential issue with this subgroup's health literacy and comprehension of diabetes-related information and instructions. Patients with low literacy levels may struggle to understand medical terms, decipher medical instructions, and take an active role in their own diabetes management. Additionally, compared to the illiterate group, 13.2% of the patients had completed their senior secondary education, showing a higher degree of educational attainment. This group of patients may have a better grasp of health-related information and may be more open to educational treatments tailored to enhance their awareness of diabetes and self-care routines. Furthermore, this sample had a considerably higher level of education as 16.4% of the patients had completed their degrees. Patients who have earned a degree may be more proactive in seeking out information and practising self-management techniques, as well as having a stronger capacity for health literacy.

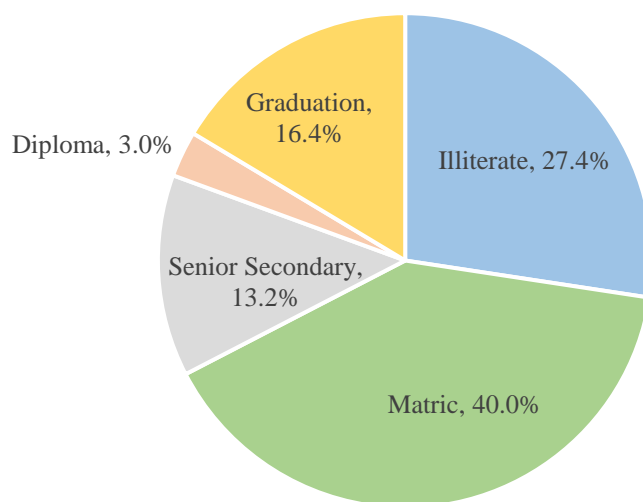


Figure 11: Literacy status distribution

Since a large chunk of patient population was less educated (<10th standard), it was likely that knowledge related to health/diabetes might be limited.

Table 9: Frequency distribution of literacy status of patients

Literacy status distribution of patients (n=532)

Literacy Status	Frequency	Percent
Illiterate	146	27.4
Tenth	211	39.7
Senior secondary	70	13.2
Diploma	18	3.4
Graduation	87	16.4
Total	532	100.0

5.1.5 Monthly Income

A sizable majority of the patients who participated in the survey—roughly 42.1%—reported having an average monthly income between 20,000 and 40,000 INR. With 224 patients, this income range comprised the majority of the population. It implies that a sizable proportion of patients had a modest economic level, which may have an impact on their access to medical services, drugs, and lifestyle changes.

Closely behind, 31% of the patients said their monthly income was between 10,000 and 20,000 INR. This group of 165 patients managed to take care of their fundamental necessities despite having a lesser income than those in the upper tier. Financial limitations in this group may limit their capacity to pay for expensive medications, frequent doctor visits, and better eating. In comparison, only a small percentage of patients, representing 5.5% of all patients, reported having a monthly income of more than 40,000 INR. Since they made up a smaller portion of the patient population, they may have had easier access to healthcare resources and more financial freedom to effectively manage their diabetes. The best diabetes care is not guaranteed by income alone, it is crucial to remember, since other elements like knowledge, attitude, and practice also play a big part.

Additionally, almost 21% of the patients said their monthly income was under 10,000 INR. This income range indicated a vulnerable group dealing with financial hardships that would limit their capacity to obtain high-quality medical treatment, pay for vital medications, and alter their way of life.

The mean income for patients fell in the range of 15,000 to 25,000 INR.

Table 10: Frequency distribution of monthly income of patients

Monthly Income distribution of patients (n=532)

Monthly income	Frequency	Percent
40,000 or more	29	5.5
20000-39999	224	42.1
10,000-19,999	165	31.0
Below 10000	114	21.4
Total	532	100.0

5.1.6 Occupation of Patients

Daily labourers made up the largest occupational group among the patients, accounting for almost 41% of the sample. Daily workers frequently perform physically taxing tasks, which could have an impact on how well they manage their diabetes. The nature of their profession, which frequently entails inconsistent working hours and restricted access to healthcare facilities, may make it difficult for them to follow a consistent schedule for medication adherence, dietary changes, and

routine medical exams. Following everyday workers, approximately 26.7% of the patients were self-employed people, including business owners. These patients could have greater control over their work schedules and possibly have better access to diabetes management tools. However, self-employed people may also have other difficulties, such as stress from their jobs, long hours, and irregular eating habits, which can affect their diabetes control. Farmers, workers in the public sector, and unemployed people made up a considerable portion of the patient population, accounting for roughly 16% of the sample. Farmers may experience physical strain and inconsistent working hours, much like normal labourers. Effective diabetes control may be hampered by the rigours of farming and the absence of healthcare resources in rural areas. Employees in the public sector, on the other hand, could have more stable working conditions and have access to employee healthcare benefits, both of which might help them better manage their diabetes. Unemployed people may experience additional difficulties with money issues and a lack of health insurance, which makes managing their diabetes more difficult.

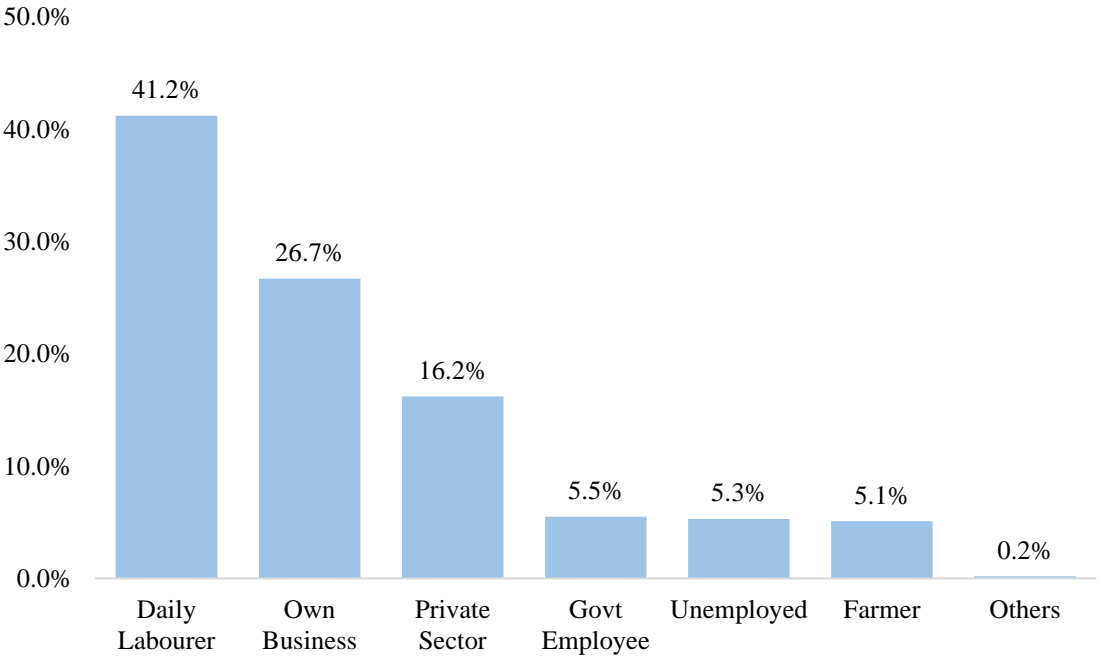


Figure 12: Occupation type of patients

Table 11: Frequency distribution of occupation of patients

Occupation type distribution of patients (n=532)

Occupation Type	Frequency	Percent
Government employee	29	5.5
Daily labour	219	41.2
Own business	142	26.7
Private Sector	86	16.2
Unemployed	28	5.3
Farmer	27	5.1
Others	1	0.2
Total	532	100.0

In relation to the occupation, nearly 31% patients were sedentary workers, whereas heavy and moderate activity workers accounted for 37% and 31% patients, respectively.

Table 12: Frequency distribution of employment type of patients

Employment type distribution of patients (n=532)

Employment Type	Frequency	Percent
Sedentary worker	166	31.2
Heavy worker	199	37.4
Moderate worker	167	31.4
Total	532	100.0

5.1.7 Marital Status

Married and unmarried patients accounted for 60% and 24%, respectively. The remaining sample included widow or divorced patients.

Table 13: Frequency distribution of marital status of patients

Marital status distribution of patients (n=532)

Marital Status	Frequency	Percent
Married	319	60.0
Unmarried	127	23.9
Widow	66	12.4
Divorced	20	3.8
Total	532	100.0

Marriage can provide various forms of support and assistance in diabetes management, while unmarried individuals may face distinct challenges related to self-management and social support. Healthcare providers should consider the influence of marital status on diabetes management and tailor interventions and support services accordingly. Understanding the role of marital status can contribute to more personalized and effective diabetes care, ultimately improving patient outcomes.

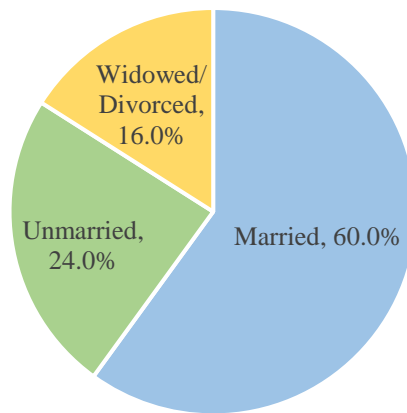


Figure 13: Marital status of patients

182 females in the patient sample were married, compared to 137 married males. The number of unmarried, widow and divorced patients nearly equalled each other, based on gender.

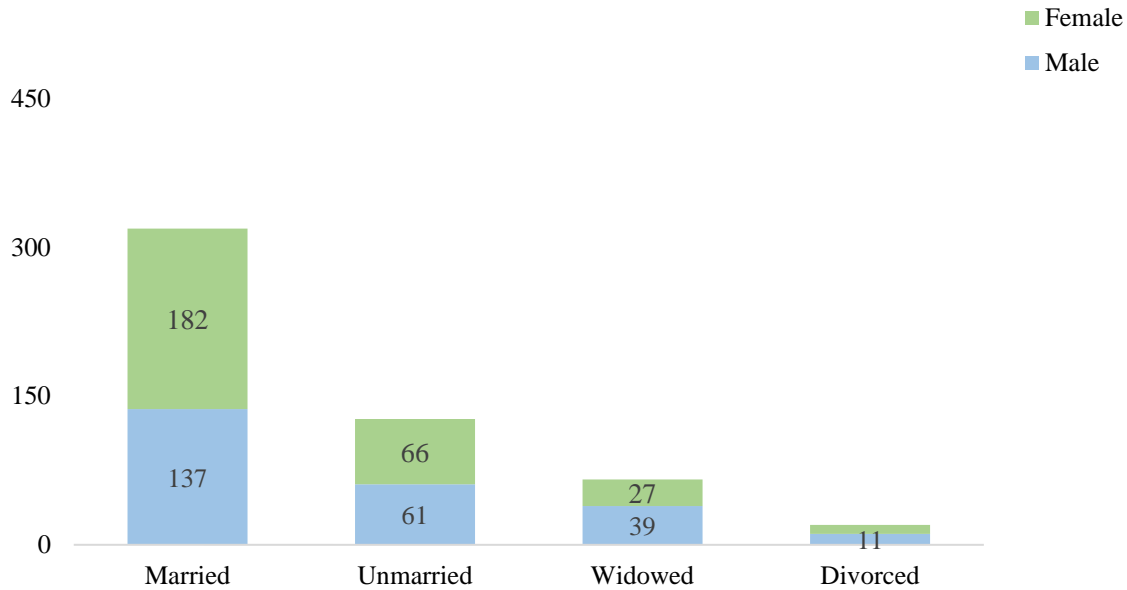


Figure 14: Marital status of patients w.r.t. gender

5.1.8 Physical activity

Nearly 92% of the patients in the study reported engaging in low to moderate physical activity, pointing to a lifestyle that is primarily sedentary. Concerns are raised regarding how this result would affect their ability to regulate their diabetes and general well-being. Weight gain, insulin resistance, and poor blood sugar control are just a few of the health problems that can be attributed to a sedentary lifestyle, which is characterised by a lack of regular exercise or physical activity. In order to improve insulin sensitivity, maintain a healthy weight, lower cardiovascular risks, and improve overall fitness levels, physical activity is essential for treating diabetes. Regular exercise has been shown to enhance overall quality of life, reduce the risk of complications, and control blood sugar levels in people with diabetes. It is alarming that just 8% of the patients claimed to engage in an active physical regimen. This low number suggests that a sizable portion of the patients could not be benefiting from regular exercise in controlling their diabetes. It emphasises the necessity of more knowledge and instruction regarding the value of physical activity in the management of diabetes.

Table 14: Frequency distribution of level of physical activity

Physical activity distribution of patients (n=532)

Level of physical activity	Frequency	Percent
Low	213	40.0
Moderate	278	52.3
High	41	7.7
Total	532	100.0

The ratio of males and females for different level of physical activity was approximately same. For high level of activity, the percentage of males and females was 7.3% and 8.1%, respectively. For moderate it was 52% and 53%, respectively, while for low activity it was 41% and 39%, respectively.

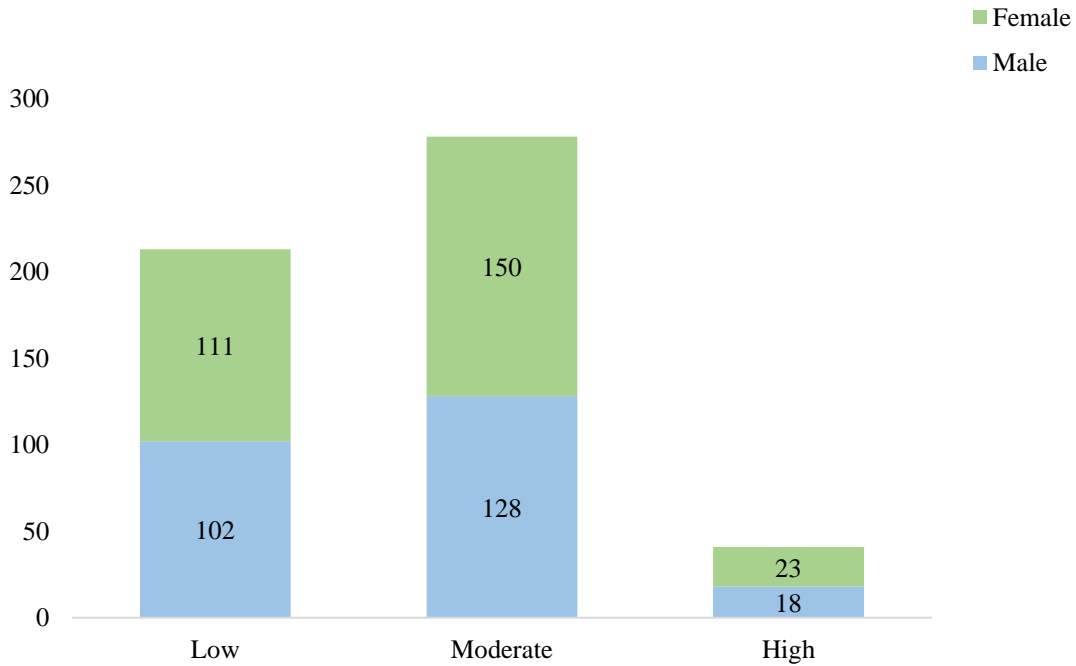


Figure 15: Physical activity w.r.t. gender

5.1.9 Calorie Intake

Another worrying result from the study was that approximately 60% of the patients had calorie intakes that were higher than the recommended dietary allowance (RDA), in addition to the sedentary lifestyle that was found among the patients. This suggests a high need for optimal calorie intake than is recommended for treating diabetes and maintaining a healthy weight. Optimal caloric intake is important for managing diabetes since too many calories can lead to weight gain, insulin resistance, and poor blood sugar control. It is crucial for people with diabetes to be aware of their calorie intake and make dietary decisions that support both diabetes management and overall health. Another concerning finding from the study was that nearly 40% of the patients had a calorie intake below the recommended dietary allowance (RDA). This indicates that these patients were consuming fewer calories than what is considered appropriate for meeting their nutritional needs and maintaining a healthy weight. Lack of calories can also have detrimental repercussions on the body, such as vitamin deficits, weakened immune system, and weight loss.

Table 15: Frequency distribution of the calorie intake

Calorie intake distribution of patients (n=532)

Calorie intake	Frequency	Percent
Below RDA	209	39.3
Above RDA	323	60.7
Total	532	100.0

5.1.10 Family History

A family history of either diabetes or both diabetes and hypertension was reported by almost 79% of the participants in the study. This research suggests that these disorders have a strong genetic component and that those with a family history may be more likely to develop diabetes or hypertension themselves. The treatment and management of a patient may be significantly impacted by a family history of diabetes or hypertension. It acts as a helpful indicator for medical practitioners to evaluate the patient's risk factors and implement the necessary preventive actions. In order to prevent or control the beginning of these illnesses in patients with a positive family history, more regular monitoring, lifestyle changes, and early therapies may be necessary.

Table 16: Frequency distribution of the family history for DM and Hypertension

Family history distribution of patients (n=532)

Family History	Frequency	Percent
Yes - Both	183	34.4
No - Both	5	.9
Only HTN	107	20.1
Only DM	237	44.5
Total	532	100.0

A person with diabetes has a twofold increased risk of developing high blood pressure compared to someone without the disease. High blood pressure can cause heart disease and stroke if it is not addressed. In fact, those with diabetes and high blood pressure are 4x more likely to develop heart disease than those without either of the conditions.[15] Numerous studies have been conducted on the impact of family history on the likelihood of having diabetes. Researchers examined the frequency of diabetes in children with various family history profiles in a study by Vishwanathan et al. (1996).[158] The results showed some intriguing patterns regarding how family history affects diabetes risk. The prevalence of diabetes was found to be 36% among children who had one parent with the disease, per the study. This shows that just having a parent with diabetes raises the risk of a child getting diabetes. However, when there was a family history of diabetes on the non-diabetic parent's side as well, the prevalence of diabetes increased dramatically. The frequency increased to 54% in these situations, where both the diabetic parent and the non-diabetic parent had a family history of the disease. This suggests that having a family history of diabetes on both sides of the family increases the likelihood that a child would develop the condition. The study also looked at the likelihood of developing diabetes if both parents did. In these situations, the prevalence rate increased even further to 62% when both parents had diabetes. This shows that the interaction of both parents' genetic risk factors significantly raises the risk of diabetes in kids. These results emphasise the critical role that a person's family history plays in the onset of diabetes. They contend that having a favourable family history greatly raises the risk of developing diabetes, particularly when it involves both parents and includes a family history on the side of the parent who does not have diabetes.

5.1.11 Duration of diabetes

Most of the patients, 60% of them, have had diabetes for less than five years, which is a rather brief amount of time. This shows that a sizable majority of the individuals had recently received a diabetes diagnosis or were just beginning to manage the condition. The comparatively high rate in this group could be a result of more people being diagnosed with diabetes recently or earlier detection and diagnosis of the disease. In addition, 28% of the patients said they had had diabetes for six to ten years. This suggests that the disease has been present in these people for a moderately long time and that they have been managing their condition for a sizable amount of time. Furthermore, 12% of the patients said they had had the disease for longer than 10 years. Those who have had diabetes for a considerable amount of time make up this subset of people. Managing diabetes for such a long time presents special difficulties because co-morbidities and long-term problems may develop. To improve the quality of life and reduce the dangers related to long-term diabetes, it is necessary to concentrate on comprehensive care, regular monitoring, and lifestyle changes.

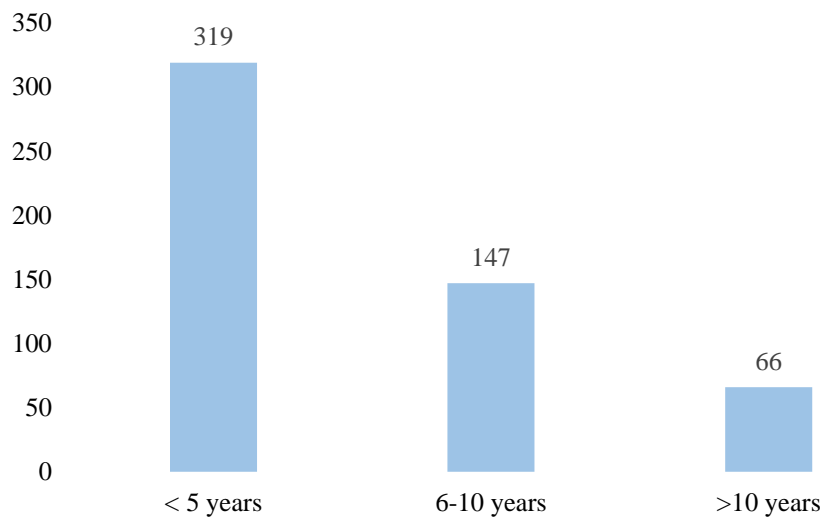


Figure 16: Duration of diabetes among patents

Results depicts recency in occurrence of diabetes among large proportion of patients.

Table 17: Frequency distribution of duration of DM diagnosis

Duration distribution of patients (n=532)

Duration since diagnosis	Frequency	Percent
< 5 yrs.	319	60.0
6-10 yrs.	147	27.6
>10 yrs.	66	12.4
Total	532	100.0

5.2 Status of KAP at the Inception of the Study

Based on the KAP survey the patients were categorized in good, average, and poor scores. The scoring was based on the answered selected on Likert scale.

The scoring is as follows.

- More than 70% questions correct (positive range) – Good (1)
- Between 50% to 69% questions correct (interim range) – Average (2)
- Below 50% questions correct (negative range) – Poor (3)

Patients' understanding of diabetes and how to manage it is vital for their capacity to effectively manage the condition and make wise health-related decisions. When the patients' knowledge was evaluated at the start of the investigation in the study, the results showed considerable gaps and misunderstandings.

Knowledge:

Only 31% of the patients showed a reasonable degree of knowledge of diabetes and its care at the start of the study. These people demonstrated a thorough knowledge of the illness, its aetiology, risk factors, symptoms, and available treatments. They demonstrated a strong foundation of knowledge by being able to give precise and knowledgeable answers to the questions posed. However, a sizable portion of the patients—nearly 50%—had inadequate awareness about diabetes. When questioned about the ailment, many gave unfavourable answers or showed a lack of comprehension. This raises questions about people's understanding and awareness of diabetes, its complications, and the necessary lifestyle changes needed for efficient care.

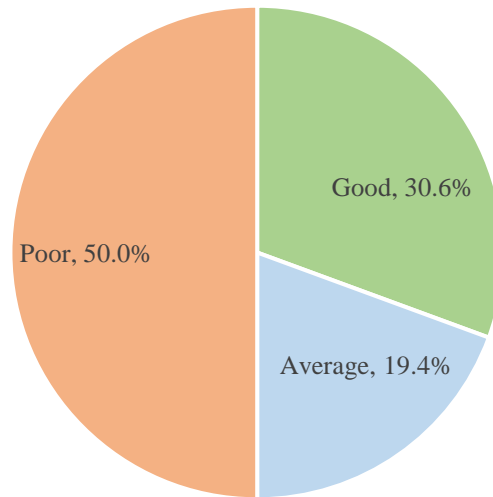


Figure 17: Knowledge scores of patients before counselling

The frequency of inadequate patient education or insufficient community awareness campaigns regarding diabetes is worrisome as it suggests a potential lack of access to reputable information sources and poor patient knowledge. These elements exacerbate the disease's misconceptions and lack of accurate information, making it more difficult for patients to take the necessary steps to manage their condition and avoid consequences.

Table 18: Frequency distribution of knowledge (inception) score

Knowledge level distribution of patients (n=532)

Knowledge level	Frequency	Percent
Good	163	30.6
Average	103	19.4
Poor	266	50.0
Total	532	100.0

The ratio of different knowledge level categories among males and females was similar (nearly 1:1 ratio), depicting that gender did not play any significant role in knowledge disparity.

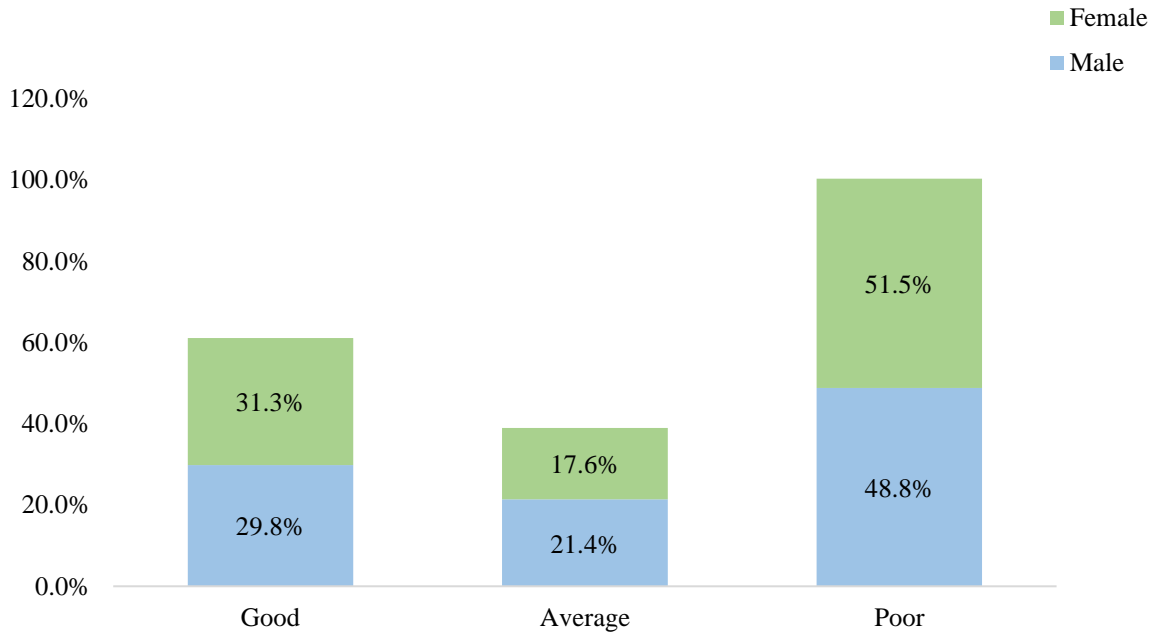


Figure 18: Knowledge scores of patients before counselling (by gender)

Attitude:

Likewise, for attitude also the scores of patients were less than 40%. Only about 39% of patients showed a positive attitude towards their diabetes management, which is a very low ratio. These people had a positive outlook, motivation, and a proactive attitude to controlling their sickness.

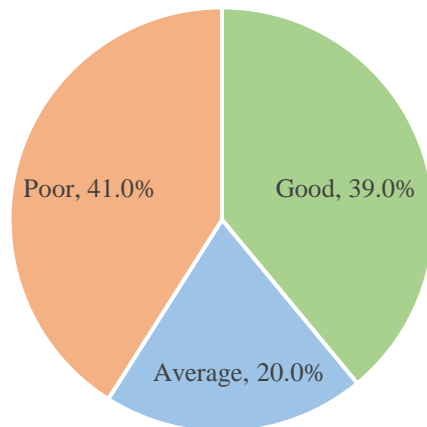


Figure 19: Attitude scores of patients before counselling

They were aware of the significance of following treatment regimens, changing their lifestyles, and actively taking part in their own care. On the other hand, a sizable portion of patients—roughly 61%—exhibited attitudes that need development. These people varied in their levels of resistance to making the necessary lifestyle adjustments or following the suggested treatment plans. They also varied in their levels of indifference or lack of enthusiasm. This suggests a potential knowledge gap on the significance of proactive self-care and the long-term effects of diabetes. Similar to knowledge levels, attitude scores also did not witness any disparity based on gender.

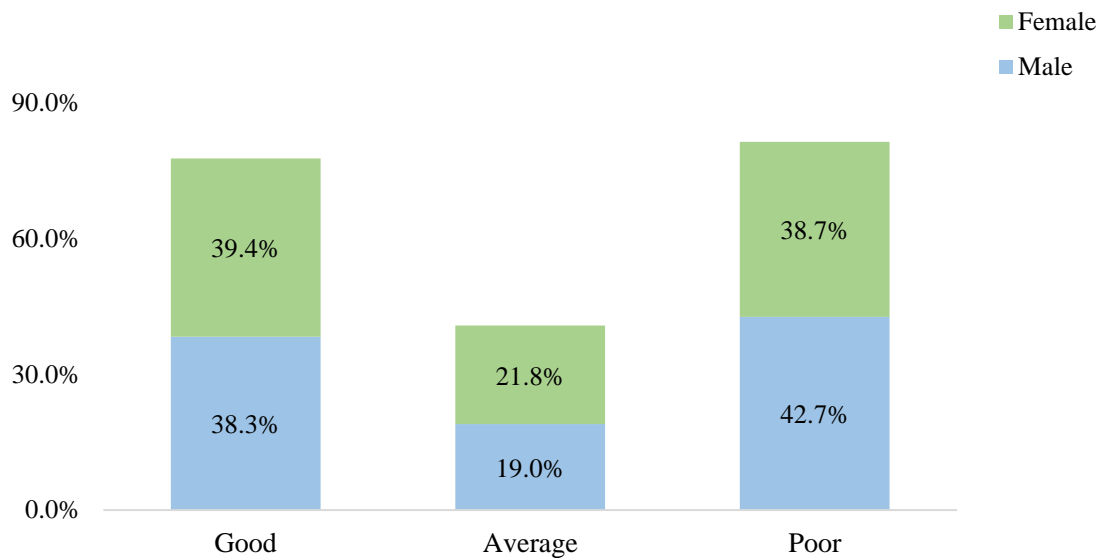


Figure 20: Attitude scores of patients before counselling (by gender)

Table 19: Frequency distribution of attitude (inception) score

Attitude type distribution of patients (n=532)

Attitude Type	Frequency	Percent
Good	207	38.9
Average	109	20.5
Poor	216	40.6
Total	532	100.0

Practice:

The results in terms of practice were likewise less than ideal, with just 37% of patients practising in accordance with advised criteria. This suggests that a significant majority of patients were not adhering to the food restrictions, exercise regimens, medication schedules, or self-monitoring procedures that were advised. These crucial components of managing diabetes if not be followed, which may result in uncontrolled blood glucose levels, an increased risk of complications, and generally unfavourable disease outcomes. Patients who were assessed, showed lower ratings in both attitude and practice, highlighting the need for focused interventions and educational initiatives aimed at enhancing patient participation and self-care behaviours. It is critical to address the obstacles and difficulties that prevent patients from forming optimistic opinions and putting sensible diabetes control practices into practice.

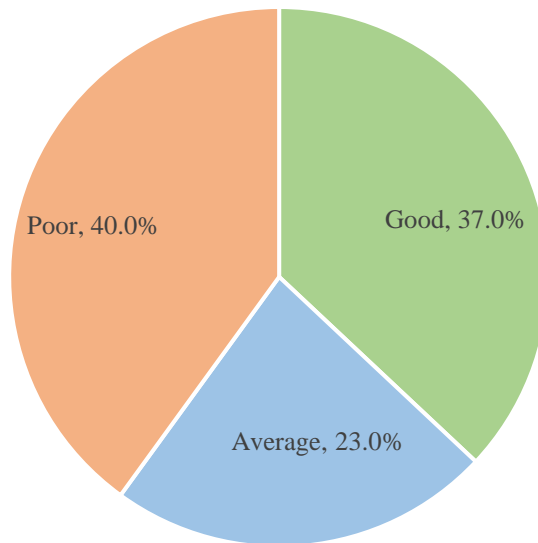


Figure 21: Practice scores of patients before counselling

Females were marginally better than males in keeping a (non) poor practice level, as 26% female reported an average score vs only 19% males.

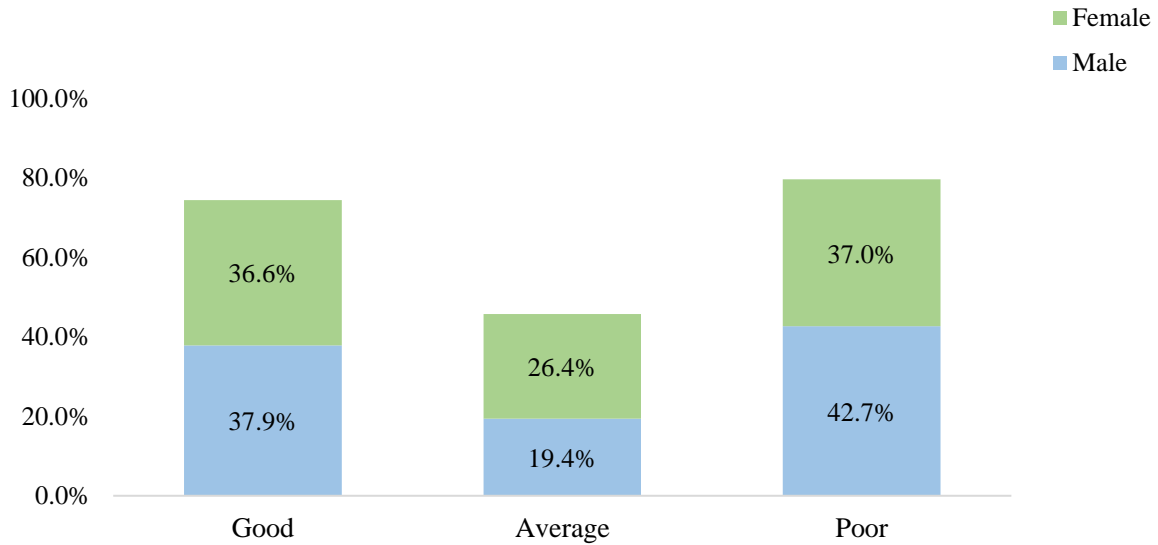


Figure 22: Practice scores of patients before counselling (by gender)

Likewise, 37% females had poor practice levels, compared to 43% males.

Table 20: Frequency distribution of practice (inception) score

Practice level distribution of patients (n=532)

Practice level	Frequency	Percent
Good	198	37.2
Average	123	23.1
Poor	211	39.7
Total	532	100.0

5.3 Difference in Blood Sugar Levels among Cohorts

To determine the significance of mean difference in blood sugar levels among different sample cohorts, independent T-test and one-way ANOVA were conducted.

5.3.1 Difference among Cohorts with different Gender Fasting Blood Sugar (FBS) - Gender

Male and female patients were found to have similar mean fasting blood sugar (FBS) levels, with an average value of ~277 mg/dL. This result indicates that there was no discernible gender-related implication in the fasting blood sugar levels in the study. It is crucial for one to note that the 277mg/dL mean FBS level found in this study implies poor glycaemic control. Patients with diabetes need to strive for lower fasting blood sugar levels, often between 80 and 130 mg/dL. The necessity for better diabetes management measures, such as medication modifications, lifestyle changes, and more frequent blood sugar testing, is highlighted by the raised FBS levels.

Table 21: Descriptive statistics of FBS by Gender

Gender statistics for FBS

	Gender of the patient	N	Mean	Std. Deviation	Std. Error Mean
Fasting blood sugar before counselling	Male	248	277.1774	13.69154	0.86941
	Female	284	277.2113	12.95048	0.76847

Based on independent T-test the p value was $p > 0.05$ (at 0.259) depicting that there was no significant difference in the mean FBS of both the genders.

Table 22: Independent T test – (gender; FBS)

Equality of Var (Levene's test)		Equality of Means (t test)							
F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
							Lower	Upper	
1.278	.259	-	530	0.977	-.03385	1.15599	-2.30473	2.23704	
		0.029							

Random Blood Sugar (RBS) - Gender

Both male and female patients' mean random blood sugar (RBS) levels were discovered to be similar, with an average value of about 320 mg/dL. This result indicates that there was no discernible gender-related variation in the random blood sugar levels in the study cohort. Regardless of when the last meal was eaten, random blood sugar levels offer a picture of the present blood glucose level at any given time. Elevated RBS levels may be a sign of uncontrolled diabetes as well as inadequate glycaemic control. It is significant to highlight that the study's average RBS result of 320 mg/dL suggests higher blood sugar levels. Patients with diabetes should aim to keep their random blood sugar levels below 200 mg/dL. The increased RBS levels found in the study sample point to the need for better blood sugar management by medication changes, lifestyle changes, and more frequent monitoring.

Table 23: Descriptive statistics of RBS by gender

Gender statistics for RBS

	Gender of the patient	N	Mean	Std. Deviation	Std. Error Mean
Random blood sugar before counselling	Male	248	320.8629	15.92459	1.01121
	Female	284	320.9437	15.08903	0.89537

Similar to FBS, based on independent T-test the p value was $p > 0.05$ (at 0.275) depicting that there was no significant difference in the mean RBS of both the genders.

Table 24: Independent T test – (gender; RBS)

Equality of Var (Levene's test)		Equality of Means (t test)						
F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
1.196	0.275	-	530	0.952	-0.08076	1.34572	-2.72436	2.56284
		0.060						

HbA1C - Gender

Both male and female patients had higher levels of HbA1c, an important indicator for maintaining long-term blood sugar control, with an average value of almost 8%. This shows that the study participants' total glycaemic management was poor and had HbA1C levels higher than the advised limit of 5.7%. The HbA1c test provides important information regarding a patient's long-term glucose control by reflecting the average blood glucose levels over the previous two to three months. Higher HbA1c values reflect poor glycaemic control, which is linked to a higher risk of complications from diabetes.

Table 25: Descriptive statistics of HbA1C by gender

Gender statistics for HbA1C

		Gender of the patient	N	Mean	Std. Deviation	Std. Error Mean
HbA1c measurement of patient on admission	Male		248	8.0198	0.93889	0.05962
	Female		284	7.9736	0.93009	0.05519

Similar to FBS and RBS there was no significant difference ($p > 0.05$; 0.912) in the mean HbA1C of either gender.

Table 26: Independent T test – (gender; HbA1C)

Equality of Var (Levene's test)		Equality of Means (t test)							
F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Interval Difference Lower	Confidence of the Upper	
0.012	0.912	0.569	530	0.570	0.04617	0.08119	-0.11333	0.20566	

5.3.2 Difference among Cohorts with different Calorie Intake

Fasting Blood Sugar (FBS) – Calorie Intake

It was discovered that patients with calorie intake over the recommended dietary allowance (RDA) had greater FBS levels than those with intakes below the cap. According to other research reports, patients who consumed more calories than the RDA had an average FBS level of about 280 mg/dL. This suggests that these people may have worse glycaemic control and higher blood glucose levels when they are fasting. Increased FBS levels are concerning because they may be a factor for long-term complications of diabetes, including heart disease, renal issues, and nerve damage. Patients who consumed fewer calories than the RDA, on the other hand, had relatively lower FBS levels, with an average of about 272 mg/dL. It is crucial to remember that overall diabetes treatment depends heavily on calorie consumption. Overeating can result in weight gain, insulin resistance, and trouble managing blood sugar levels. On the other hand, eating less calories than necessary can lead to vitamin shortages and low energy. The results of the study emphasise the need for using a customised and balanced approach to food management in diabetes.

Table 27: Descriptive statistics of FBS in cohorts with different calorie intake

Calorie statistics for FBS

	Calorie Intake	N	Mean	Std. Deviation	Std. Error Mean
Fasting blood sugar before counselling	Below RDA	209	272.3732	13.31224	0.92083
	Above RDA	323	280.3158	12.32326	0.68568

There was a significant difference ($p < 0.05$; 0.22) in the FBS of cohorts with higher calorie intake and ones with lower.

Table 28: Independent T test – (calorie intake; FBS)

Equality of Var (Levene's test)		Equality of Means (t test)						
F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
5.278	0.022	-7.034	530	0.000	-7.94258	1.12924	10.16093	5.72424

Random Blood Sugar (RBS) – Calorie Intake

Similar to FBS, RBS for patients with higher calorie intake was higher (324 mg/dL) than the ones with lower intake (315 mg/dL).

Table 29: Descriptive statistics of RBS in cohorts with different calorie intake

Calorie statistics for RBS

	Calorie intake status	N	Mean	Std. Deviation	Std. Error Mean
Random blood sugar before counselling	Below RDA	209	315.3158	15.50917	1.07279
	Above RDA	323	324.5232	14.34735	.79831

The difference in RBS among cohorts was significant with $p=0.019$ ($p<0.05$).

Table 30: Independent T test – (calorie intake; RBS)

Equality of Var (Levene's test)		Equality of Means (t test)						
F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
5.500	0.019	-7.001	530	0.000	-9.20743	1.31510	11.79088	6.62398

HbA1C – Calorie Intake

Interestingly, the study's results showed that, when comparing the two groups' HbA1C levels, there was no discernible variation in calorie intake. The absence of variation in HbA1C levels implies that over time, the effect of caloric intake on glycaemic control may have been balanced or

rationalised. The HbA1C test does not measure an immediate response to calorie consumption; rather, it measures the cumulative impact of blood sugar levels over time. It provides a more complete picture of total glycaemic control by accounting for the variations in blood sugar levels that take place throughout the course of the day. As a result, even if there were brief differences in fasting blood sugar levels based on calorie consumption, these variations may have levelled out over the course of several months, resulting in comparable HbA1C levels in both cohorts.

The effect of caloric consumption on HbA1C levels may be mitigated or justified by a number of factors. First off, it's crucial to understand that a variety of factors, such as medication adherence, physical activity, stress levels, and general eating patterns, affect glycaemic control. Although calories consumed play a significant role in diet management, HbA1C levels are not only determined by calorie intake.

The impact of calorie consumption on HbA1C levels can potentially be moderated by individual differences in metabolism and insulin sensitivity. While some people may have inherent insulin resistance, rendering them more prone to blood sugar variations, others may be more effective at metabolising and using glucose.

Table 31: Descriptive statistics of HbA1C in cohorts with different calorie intake

Calorie statistics for HbA1C

	Calorie intake status	N	Mean	Std. Deviation	Std. Error Mean
HbA1c measurement of patient before counselling	Below RDA	209	7.3057	0.83985	0.05809
	Above RDA	323	8.4412	0.68824	0.03829

No statistical difference in the HbA1C means, as p value was 0.953 ($p > 0.05$).

Table 32: Independent T test – (calorie intake; HbA1C)

Equality of Var (Levene's test)		Equality of Means (t test)						
F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
0.004	0.953	-17.022	530	0.000	-1.13543	0.06670	-1.26647	-1.00440

5.3.3 Difference among Cohorts with different Literacy Status

Fasting Blood Sugar (FBS) – Literacy Status

One-way ANOVA was used, followed by univariate analysis to determine the difference in variances in blood sugar levels, followed by the impact of independent variable in determining the blood sugar levels.

The literacy status of patients was divided into 5 categories – illiterate, 10th, senior secondary, diploma, graduate or more.

Table 33: Frequency distribution of Literacy Status

Literacy levels

		Category	N
Literacy status of the patient	1	Illiterate	146
	2	Tenth	211
	3	Senior secondary	70
	4	Diploma	18
	5	Graduation	87

Based on one-way ANOVA there was a significant difference in the variance of FBS for all the cohorts (p=0.000; i.e., <0.05). Also, the Welch and Brown-Forsythe test bolstered the conclusion by reporting a significant difference (p=0.000).

Table 34: One-way ANOVA (literacy status, FBS)

ANOVA: Fasting blood sugar (FBS)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24351.684	4	6087.921	46.220	0.000
Within Groups	69413.985	527	131.715		
Total	93765.669	531			

Table 35: Welch and Brown-Forsythe test (literacy status, FBS)

Robust Tests of Equality of Means: Fasting blood sugar (FBS)

	Statistic^a	df1	df2	Sig.
Welch	44.277	4	96.572	0.000
Brown-Forsythe	34.606	4	110.617	0.000

a. Asymptotically F distributed.

There was a difference in means of FBS for illiterate and ones with higher education qualification. The ones who were more educated has a lesser FBS compared to ones who held less education.

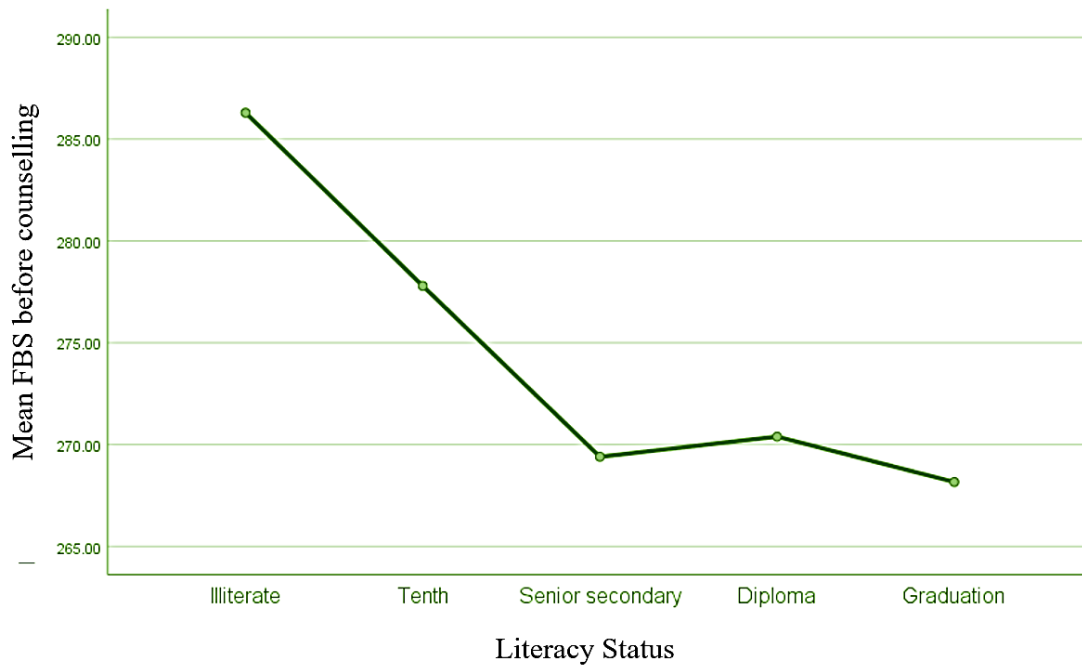


Figure 23: Mean FBS of patients with different literacy status

However, the one-way ANOVA test does not give insight on the internal mean differences (among cohorts), neither does it explain the level of impact of independent variable (literacy status in this case) in determining the dependent variable (FBS).

By leveraging the univariate analysis, we determined the percentage impact of literacy status (LS) in determining FBS. The partial Eta squared provided a value of 0.26, explaining the 26% impact of LS on FBS value.

Table 36: Univariate analysis (literacy status, FBS)

Tests of Between-Subjects Effects: Dependent Variable - FBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	24351.684 ^a	4	6087.921	46.220	0.000	0.260
Intercept	20258261.6	1	20258261.6	153803.35	0.000	0.997
LS	24351.684	4	6087.921	46.220	0.000	0.260
Error	69413.985	527	131.715			
Total	40971230.0	532				
Corrected Total	93765.669	531				

a. R Squared = 0.260 (Adjusted R Squared = 0.254)

Random Blood Sugar (RBS) – Literacy Status

Similar to FBS, there was a significant difference in the variance of RBS for all the cohorts ($p=0.000$; which is <0.05). Also, the Welch and Brown-Forsythe test (for equality of means) bolstered the conclusion by reporting a significant difference ($p=0.000$).

Table 37: One-way ANOVA (literacy status, RBS)

ANOVA: Random Blood Sugar (RBS)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	33043.729	4	8260.932	46.300	0.000
Within Groups	94027.572	527	178.420		
Total	127071.301	531			

Table 38: Welch and Brown-Forsythe test (literacy status, RBS)

Robust Tests of Equality of Means: RBS

	Statistic^a	df1	df2	Sig.
Welch	44.377	4	96.514	0.000
Brown-Forsythe	34.439	4	108.772	0.000

a. Asymptotically F distributed.

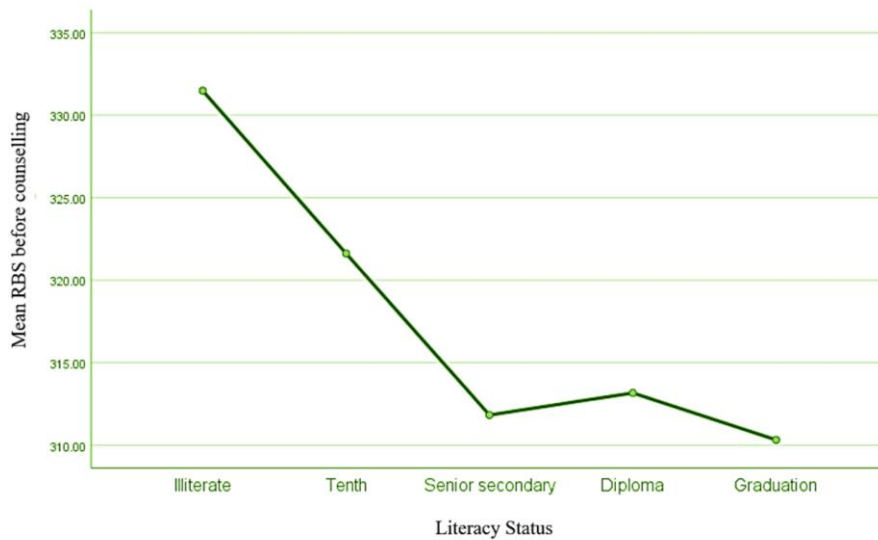


Figure 24: Mean RBS of patients with different literacy status

Based on the univariate analysis, the partial eta squared was reported as 0.26, similar to FBS, explaining the literacy status has 26% impact in determining the RBS of patients.

Table 39: Univariate analysis (literacy status, RBS)

Tests of Between-Subjects Effects: RBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	33043.729 ^a	4	8260.932	46.300	0.000	0.260
Intercept	27152154.531	1	27152154.531	152180.739	0.000	0.997
LS	33043.729	4	8260.932	46.300	0.000	0.260
Error	94027.572	527	178.420			
Total	54912788.000	532				
Corrected Total	127071.301	531				

a. R Squared = 0.260 (Adjusted R Squared = 0.254)

HbA1C – Literacy Status

Difference in the variance of people of different literacy status was significant; however, the impact of literacy status on HbA1C was limited (partial eta squared 0.037) at 3.7%.

Table 40: One-way ANOVA (literacy status, HbA1C)

ANOVA: HbA1c measurement of patient on admission

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	17.315	4	4.329	5.121	0.000
Within Groups	445.512	527	0.845		
Total	462.827	531			

Table 41: Univariate analysis (literacy status, HbA1C)*Tests of Between-Subjects Effects: HbA1C*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17.315 ^a	4	4.329	5.121	0.000	0.037
Intercept	16815.092	1	16815.092	19890.704	0.000	0.974
LS	17.315	4	4.329	5.121	0.000	0.037
Error	445.512	527	0.845			
Total	34469.240	532				
Corrected Total	462.827	531				

a. R Squared = 0.037 (Adjusted R Squared = 0.030)

5.3.4 Difference among Cohorts with different Monthly Income

Monthly income was grouped into 4 categories – ranging from below 10,000 INR to above 40,000 INR.

Table 42: Frequency distribution of Monthly Income*Monthly income categories*

Monthly Income	Frequency	Percent
40,000 or more	29	5.5
20000-39999	224	42.1
10,000-19,999	165	31.0
Below 10000	114	21.4
Total	532	100.0

FBS and RBS – Monthly Income

For both FBS and RBS, we found a significant difference in variances; also, the impact of monthly income on the two parameters was nearly 8.6%. This implies that values for biomarker varied for some set of categories based on income.

Table 43: One-way ANOVA (monthly income, FBS and RBS)

ANOVA: Fasting blood sugar (FBS and RBS)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8023.541	3	2674.514	16.470	0.000
Between Groups	10935.196	3	3645.065	16.572	0.000

Table 44: Welch and Brown-Forsythe test (monthly income, FBS and RBS)

Robust Tests of Equality of Means: FBS and RBS

	Sig. FBS	Sig. RBS
Welch	.000	.000
Brown-Forsythe	.000	.000

Table 45: Univariate analysis (monthly income, FBS)

Tests of Between-Subjects Effects: FBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8023.541 ^a	3	2674.514	16.470	0.000	0.086
Intercept	22474826.913	1	22474826.913	138399.978	0.000	0.996
Income	8023.541	3	2674.514	16.470	0.000	0.086
Error	85742.128	528	162.390			
Total	40971230.000	532				
Corrected Total	93765.669	531				

a. R Squared = 0.086 (Adjusted R Squared = 0.080)

Table 46: Univariate analysis (monthly income, RBS)

Tests of Between-Subjects Effects: RBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	10935.196 ^a	3	3645.065	16.572	0.000	0.086
Intercept	30112492.729	1	30112492.729	136903.130	0.000	0.996
Income	10935.196	3	3645.065	16.572	0.000	0.086
Error	116136.104	528	219.955			
Total	54912788.000	532				
Corrected Total	127071.301	531				

a. R Squared = 0.086 (Adjusted R Squared = 0.081)

HbA1C – Monthly Income

In case of HbA1C, a significant difference in variances and means of HbA1C, when factored by monthly income. The level of significant for both one way ANOVA and Welch and Brown-Forsythe test was less than 0.05 ($p < 0.05$).

Table 47: One-way ANOVA (monthly income, HbA1C)

ANOVA: HbA1C

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	321.739	3	107.246	401.354	0.000
Within Groups	141.088	528	0.267		
Total	462.827	531			

Table 48: Welch and Brown-Forsythe test (monthly income, HbA1C)

Robust Tests of Equality of Means: HbA1C

	Statistic^a	df1	df2	Sig.
Welch	517.457	3	124.760	0.000
Brown-Forsythe	401.021	3	271.269	0.000

a. Asymptotically F distributed.

The most significant parameter of determining the impact of monthly income on HbA1C was partial eta squared. As per univariate analysis, the monthly income had a 69.5% impact on the HbA1C of patients.

Table 49: Univariate analysis (Monthly income, HbA1C)

Tests of Between-Subjects Effects: HbA1C

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	321.739 ^a	3	107.246	401.354	0.000	0.695
Intercept	17887.537	1	17887.537	66941.399	0.000	0.992
Income	321.739	3	107.246	401.354	0.000	0.695
Error	141.088	528	.267			
Total	34469.240	532				
Corrected Total	462.827	531				

a. R Squared = 0.695 (Adjusted R Squared = 0.693)

Lower the income higher was the HbA1C.

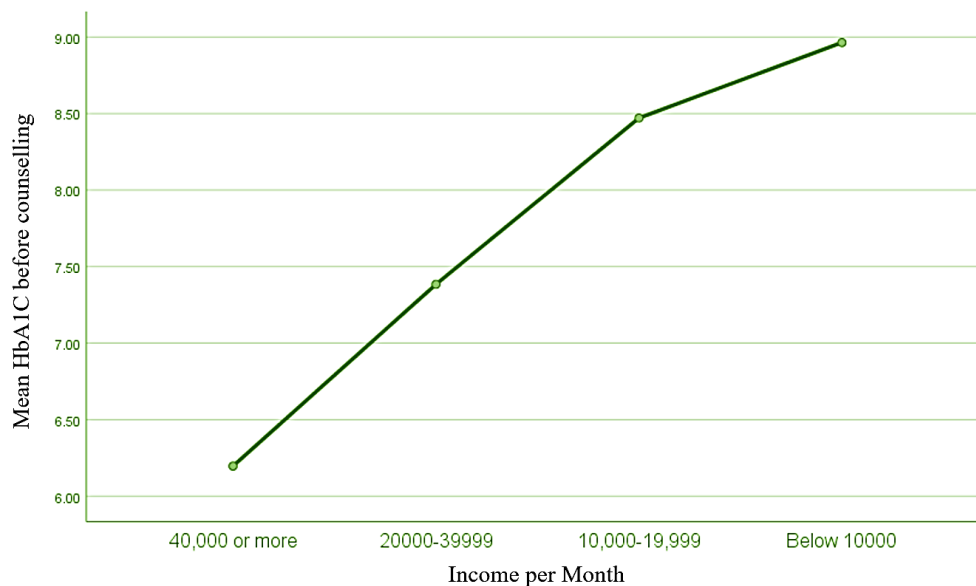


Figure 25: Relationship of monthly income on HbA1C

5.3.5 Difference among Cohorts with different level of Physical Activity

Physical activity was categorized into low, moderate, and high based on the duration of their exercise (<15 min: low; 15-60 min: moderate; >60 min: high). Adults are advised to engage in at least 150-300 minutes per week of moderate-intensity physical activity, at least 75-150 minutes per week of vigorous intensity physical activity, or at least 150 minutes per week of MVPA (moderate-to-vigorous-intensity physical activity) according to the WHO 2020 guidelines on physical activity.

Table 50: Frequency distribution of Physical Activity

Physical activity distribution

Physical activity status	Frequency	Percent
Low	213	40.0
Moderate	278	52.3
High	41	7.7
Total	532	100.0

FBS and RBS – Physical Activity

For both FBS and RBS, a significant difference in variances was found ($p < 0.05$); also, the impact of physical activity on the two parameters was nearly 9.6%.

Table 51: One-way ANOVA (physical activity, FBS and RBS)

ANOVA: FBS and RBS

		Sum of Squares	df	Mean Square	F	Sig.
Between	Groups	9006.151	2	4503.076	28.105	0.000
FBS						
Between	Groups	12235.585	2	6117.793	28.182	0.000
RBS						

Table 52: Welch and Brown-Forsythe test (physical activity, FBS and RBS)

Robust Tests of Equality of Means: FBS and RBS

	Sig. FBS	Sig. RBS
Welch	0.000	0.000
Brown-Forsythe	0.000	0.000

a. Asymptotically F distributed.

Table 53: Univariate analysis (physical activity, FBS)

Tests of Between-Subjects Effects: FBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9006.151 ^a	2	4503.076	28.105	0.000	0.096
Intercept	20780901.310	1	20780901.310	129697.491	0.000	0.996
Phy. Act.	9006.151	2	4503.076	28.105	0.000	0.096
Error	84759.518	529	160.226			
Total	40971230.000	532				
Corrected Total	93765.669	531				

a. R Squared = 0.096 (Adjusted R Squared = 0.093)

Table 54: Univariate analysis (Physical activity, RBS)*Tests of Between-Subjects Effects: RBS*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12235.585 ^a	2	6117.793	28.182	0.000	0.096
Intercept	27842066.614	1	27842066.614	128256.729	0.000	0.996
Phy. Act.	12235.585	2	6117.793	28.182	0.000	0.096
Error	114835.716	529	217.081			
Total	54912788.000	532				
Corrected Total	127071.301	531				

a. R Squared = 0.096 (Adjusted R Squared = 0.093)

HbA1C - Physical Activity

Similar to monthly income, the physical activity level also had a significant impact (of 64.5%) on HbA1C of patients. The differences in variances and means of HbA1C for different categories of patients was also significant ($p < 0.05$).

Table 55: One-way ANOVA (physical activity, HbA1c)*ANOVA: HbA1C*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	298.451	2	149.226	480.244	0.000
Within Groups	164.376	529	0.311		
Total	462.827	531			

Table 56: Welch and Brown-Forsythe test (Physical activity, HbA1C)*Robust Tests of Equality of Means: HbA1C*

	Statistic ^a	df1	df2	Sig.
Welch	486.601	2	101.884	0.000
Brown-Forsythe	253.593	2	67.126	0.000

a. Asymptotically F distributed.

Table 57: Univariate analysis (physical activity, HbA1C)

Tests of Between-Subjects Effects: HbA1C

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	298.451 ^a	2	149.226	480.244	0.000	0.645
Intercept	16332.977	1	16332.977	52563.362	0.000	0.990
Phy. Act.	298.451	2	149.226	480.244	0.000	0.645
Error	164.376	529	0.311			
Total	34469.240	532				
Corrected Total	462.827	531				

a. R Squared = 0.645 (Adjusted R Squared = 0.644)

5.3.6 Difference among Cohorts with different Family Histories

Patients were divided in cohorts based on their family history for diabetes and hypertension.

Table 58: Frequency distribution of Family History

Family history of DM and HTN

Category	Frequency	Percent
Yes- Both	183	34.4
No- Both	5	0.9
Only HTN	107	20.1
Only DM	237	44.5
Total	532	100.0

Fasting Blood Sugar (FBS) – Family History

Study observed a significant difference in means and variances of FBS of patients who fall in different groups based on family history. The impact of family history on FBS was however limited to 6%.

Table 59: One-way ANOVA (family history, FBS)

ANOVA: FBS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5649.188	3	1883.063	11.283	0.000
Within Groups	88116.481	528	166.887		
Total	93765.669	531			

Table 60: Welch and Brown-Forsythe test (family history, FBS)

Robust Tests of Equality of Means: FBS

	Statistic^a	df1	df2	Sig.
Welch	10.295	3	19.761	0.000
Brown-Forsythe	12.745	3	52.810	0.000

a. Asymptotically F distributed.

Table 61: Univariate analysis (family History, FBS)

Tests of Between-Subjects Effects: FBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5649.188 ^a	3	1883.063	11.283	0.000	0.060
Intercept	5548826.749	1	5548826.749	33248.951	0.000	0.984
Family History	5649.188	3	1883.063	11.283	0.000	0.060
Error	88116.481	528	166.887			
Total	40971230.000	532				
Corrected Total	93765.669	531				

a. R Squared = 0.060 (Adjusted R Squared = 0.055)

Random Blood Sugar (RBS) – Family History

Same results, as FBS, were reported for RBS. The Study observed a significant difference in means and variances of RBS of patients ($p < 0.05$). The impact of family history on RBS was limited to 6%.

HbA1C – Family History

Similar to previous independent variables such as monthly income, family history also had a significant impact on HbA1C. One-way ANOVA highlighted significant difference in the variances of the groups; and based on univariate analysis it was deduced that family history had a significant impact of ~48%.

Table 62: One-way ANOVA (family history, HbA1C)

ANOVA: HbA1C

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	221.909	3	73.970	162.113	0.000
Within Groups	240.918	528	0.456		
Total	462.827	531			

Table 63: Welch and Brown-Forsythe test (family history, HbA1C)

Robust Tests of Equality of Means: HbA1C

	Statistic ^a	df1	df2	Sig.
Welch	154.970	3	19.369	0.000
Brown-Forsythe	82.865	3	8.646	0.000

a. Asymptotically F distributed.

Table 64: Univariate analysis (family History, HbA1C)

Tests of Between-Subjects Effects: HbA1C

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected M	221.909 ^a	3	73.970	162.113	0.000	0.479
Intercept	4155.617	1	4155.617	9107.512	0.000	0.945
Family History	221.909	3	73.970	162.113	0.000	0.479
Error	240.918	528	0.456			
Total	34469.240	532				
Corrected T	462.827	531				

a. R Squared = 0.479 (Adjusted R Squared = 0.477)

The patients who have no family history in diabetes or hypertension, has better HbA1C levels, indicating influence of history on blood sugar levels.

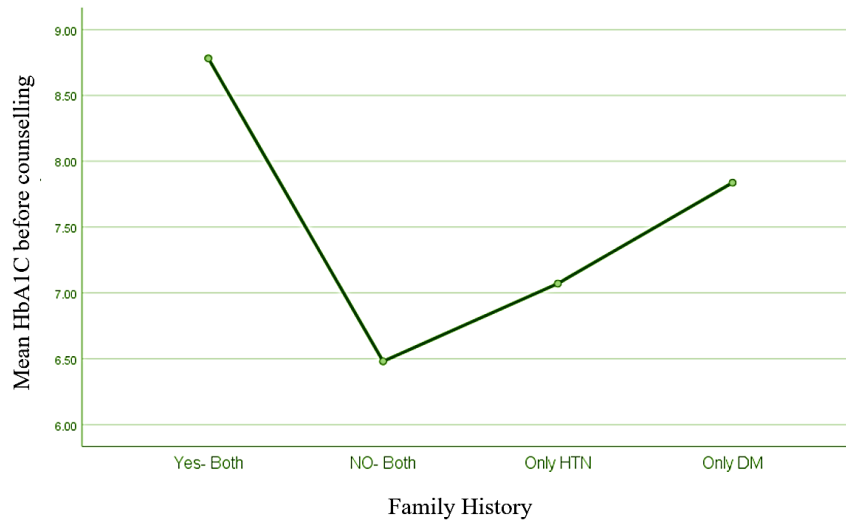


Figure 26: Mean of HbA1C relative to family history

5.3.7 Difference among Cohorts with different Duration of Diabetes

Patients were divided into 3 categories based on their duration of diabetes.

Table 65: Frequency Distribution based on Diabetes Duration

Duration	Frequency	Percent
< 5 yrs.	319	60.0
6-10 yrs.	147	27.6
>10 yrs.	66	12.4
Total	532	100.0

FBS and RBS – Diabetes Duration

Similar to previous trend, duration of disease had a limited impact on FBS and RBS. The difference in means and variances of the biomarkers were significant; however, the impact of the independent variable (duration) was limited to 1.8%.

Table 66: One-way ANOVA (duration, FBS and RBS)

ANOVA: FBS and RBS

		Sum of Squares	df	Mean Square	F	Sig.
Between FBS	Groups	1718.137	2	859.068	4.937	0.008
Between RBS	Groups	2347.391	2	1173.696	4.978	0.007

Table 67: Welch and Brown-Forsythe test (duration, FBS and RBS)

Robust Tests of Equality of Means: FBS and RBS

	Sig. FBS	Sig. RBS
Welch	0.010	0.010
Brown-Forsythe	0.011	0.011

Table 68: Univariate analysis (duration, FBS)

Tests of Between-Subjects Effects: FBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1718.137 ^a	2	859.068	4.937	0.008	0.018
Intercept	27339854.443	1	27339854.443	157122.984	0.000	0.997
Duration	1718.137	2	859.068	4.937	0.008	0.018
Error	92047.532	529	174.003			
Total	40971230.000	532				
Corrected Total	93765.669	531				

a. R Squared = 0.018 (Adjusted R Squared = 0.015)

Table 69: Univariate analysis (duration, RBS)

Tests of Between-Subjects Effects: RBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2347.391 ^a	2	1173.696	4.978	0.007	0.018
Intercept	36639428.873	1	36639428.873	155401.302	0.000	0.997
Duration	2347.391	2	1173.696	4.978	0.007	0.018
Error	124723.909	529	235.773			
Total	54912788.000	532				
Corrected Total	127071.301	531				

a. R Squared = 0.018 (Adjusted R Squared = 0.015)

HbA1C – Diabetes Duration

Unlike all the previous cases, duration of disease had no impact on the HbA1C levels of patients. The significance value was much higher (0.329) than the expected level of $p < 0.05$.

Table 70: One-way ANOVA (duration, HbA1C)

ANOVA: HbA1C

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.943	2	0.972	1.115	0.329
Within Groups	460.884	529	0.871		
Total	462.827	531			

Table 71: Welch and Brown-Forsythe test (duration, HbA1C)

Robust Tests of Equality of Means: HbA1C

	Statistic^a	df1	df2	Sig.
Welch	0.973	2	164.075	0.380
Brown-Forsythe	1.058	2	224.205	0.349

a. Asymptotically F distributed.

5.3.8 Difference among Cohorts based on KAP Scores

All 3 parameters – knowledge, practice, and attitude – scores were divided into 3 categories – ‘good’, ‘average’ and ‘poor’.

Table 72: Frequency distribution of Knowledge scores

Knowledge Before Counselling

Category	Frequency	Percent
Good	163	30.6
Average	103	19.4
Poor	266	50.0
Total	532	100.0

Table 73: Frequency distribution of Attitude scores

Attitude Before Counselling

Category	Frequency	Percent
Good	207	38.9
Average	109	20.5
Poor	216	40.6
Total	532	100.0

Table 74: Frequency distribution of Practice scores

Practice Before Counselling

Category	Frequency	Percent
Good	198	37.2
Average	123	23.1
Poor	211	39.7
Total	532	100.0

FBS, RBS and HbA1C - Knowledge

Among the 3 scores – knowledge, attitude, and practice – only knowledge reported significant difference in means of the 3 cohorts, whereas the attitude and practice had no impact.

While the impact of knowledge on the blood sugar levels was very miniscule, it reported a significant level of difference in the means of 3 group (with good, average, or poor knowledge).

Table 75: One way ANOVA (Knowledge; FBS)

ANOVA: FBS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1403.629	2	701.814	4.020	0.019
Within Groups	92362.040	529	174.597		
Total	93765.669	531			

Table 76: Welch and Brown-Forsythe test Knowledge; FBS)

Robust Tests of Equality of Means: FBS

	Statistic^a	df1	df2	Sig.
Welch	3.943	2	252.884	0.021
Brown-Forsythe	3.897	2	377.448	0.021

a. Asymptotically F distributed.

Impact of knowledge on FBS was reported as a mere 1.5%.

Table 77: Univariate analysis (Knowledge, FBS)

Tests of Between-Subjects Effects: FBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1403.629 ^a	2	701.814	4.020	0.019	0.015
Intercept	35170718.987	1	35170718.987	201438.927	0.000	0.997
KnowB	1403.629	2	701.814	4.020	0.019	0.015
Error	92362.040	529	174.597			
Total	40971230.000	532				
Corrected Total	93765.669	531				

a. R Squared = 0.015 (Adjusted R Squared = 0.011)

Likewise, for RBS similar values were reported (1.5%), and for HbA1C there was significant level of difference in means and the level of impact was marginally higher at 1.9%.

FBS, RBS, and HbA1C – Attitude and Practice

Unlike knowledge, the attitude and practice parameters depicted no significant difference $p=0.875$ and $p=0.860$ ($p>0.05$), respectively, in the means and variances of blood sugar levels among groups.

Table 78: One way ANOVA (Attitude; FBS)

Attitude: ANOVA: FBS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	47.384	2	23.692	0.134	0.875
Within Groups	93718.285	529	177.161		
Total	93765.669	531			

Table 79: One way ANOVA (Practice; FBS)

Practice: ANOVA: FBS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	53.352	2	26.676	0.151	0.860
Within Groups	93712.317	529	177.150		
Total	93765.669	531			

5.4 Impact of counselling on KAP and Blood Sugar levels of patients

Paired T-test was used to determine the difference in biomarker data (blood sugar - FBS, RBS and HbA1C) and KAP scores post the patients' counselling.

5.4.1 Fasting Blood Sugar (FBS)

The mean FBS before and after the counselling dropped from 277.2 mg/dL to 140.2 mg/dL, highlighting a significant dip ($p<0.05$). The intervention had a good effect on patients' glycaemic control, as seen by the considerable decrease in mean FBS levels following counselling. It highlights the value of counselling in enabling patients to take control of their diabetes treatment

and make healthy lifestyle changes. The individuals' glycaemic control was significantly improved by the counselling intervention. The counselling sessions enabled patients to make knowledgeable decisions about their dietary choices, medication adherence, physical exercise, and general self-care by offering instruction, guidance, and support.

Table 80: Paired Sample Statistics (FBS)

Paired T - FBS

		Mean	N	Std. Deviation	Std. Error Mean
Pair	Fasting blood sugar before counselling	277.1955	532	13.28846	0.57613
	Fasting blood sugar after counselling	140.2105	532	9.01311	0.39077

Table 81: Paired Sample Correlation (FBS)

Paired Sample Correlation - FBS

		N	Correlation	Sig.
Pair	Fasting blood sugar before counselling & Fasting blood sugar after counselling	532	0.874	0.000

Table 82: Paired differences (FBS)

Paired Differences - FBS

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
FBS before and after counselling	136.98496	6.95911	0.30172	136.3922	137.577	454.020	531	0.000

5.4.2 Random Blood Sugar (RBS)

Similar to FBS, RBS also reported a significant dip of 131 mg/dL, with RBS dropping from 320 mg/dL before counselling to 189 mg/dL after counselling. The intervention's beneficial effects on patients' glycaemic management are evidenced by the considerable decrease ($p < 0.05$) in mean RBS levels following counselling. Counselling assisted patients in gaining greater control over their blood sugar levels by addressing several facets of diabetes care and encouraging behaviour change.

Table 83: Paired Sample Statistics (RBS)

Paired T - RBS

		Mean	N	Std. Deviation	Std. Error Mean
Pair	Random blood sugar before counselling	320.9060	532	15.46951	0.67069
	Random blood sugar after counselling	189.8026	532	9.32932	0.40448

Table 84: Paired Sample Correlations (RBS)

Paired Sample Correlation - RBS

		N	Correlation	Sig.
Pair	Random blood sugar before counselling & Random blood sugar after counselling	532	0.914	0.000

5.4.3 HbA1C

HbA1C dipped by nearly 0.5% from 7.99% to 7.5% after the counselling ($p < 0.05$). The decrease in HbA1C values among the patients who received counselling points to improved long-term glycaemic control. An individual's average blood sugar levels over the previous two to three months are reflected by the useful marker HbA1C. It can be assured that the counselling

intervention had a good impact on the participants' overall blood glucose management because it decreased HbA1C.

Patients learned about the significance of HbA1C as a gauge of their diabetes control throughout the counselling sessions. They developed a better grasp of how persistently elevated blood sugar levels can contribute to diabetes-related problems. With this information at hand, patients were inspired to actively participate in self-care activities and make the necessary lifestyle changes to improve glycaemic control.

Table 85: Paired Sample Statistics (HbA1C)

Paired T – HbA1C

		Mean	N	Std. Deviation	Std. Error Mean
Pair	HbA1c measurement of patient on admission	7.9951	532	0.93360	0.04048
	HbA1c measurement of patient after counselling	7.5203	532	0.90462	0.03922

Table 86: Paired Sample Correlations (HbA1C)

Paired Sample Correlation – HbA1C

		N	Correlation	Sig.
Pair	HbA1c measurement of patient on admission & HbA1c measurement of patient after counselling	532	0.966	0.000

5.4.4 KAP Scores

Interesting findings on the effect of counselling on patients' management of their diabetes were revealed by the assessment of knowledge, attitude, and practice (KAP) scores. All three domains improved, although the practice score was the only one to indicate a statistically significant shift.

Knowledge scores, after counselling, were good, average, and poor for 43%, 44% and 13% sample, respectively; compared to 31%, 19%, and 50% sample, respectively, before counselling.

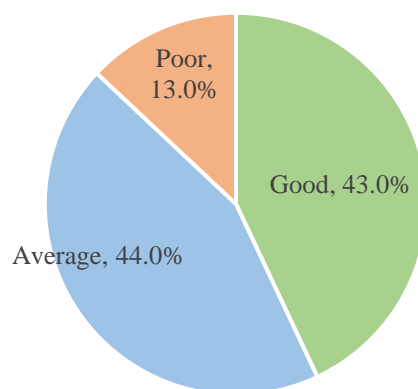


Figure 27: Distribution of Knowledge scores after counselling

After the counselling intervention, individuals showed a slight improvement in knowledge of 0.5 index points. This shows that during the counselling sessions, individuals were able to learn more about managing their diabetes. They learned about subjects like the necessity of blood sugar monitoring, adherence to medication, dietary adjustments, and the function of physical activity in the management of diabetes. Even though the increase in knowledge was not statistically significant ($p>0.05$), it is nevertheless interesting since it shows that patients are becoming more conscious of and knowledgeable about their disease.

Table 87: Knowledge (before and after counselling)

Knowledge (before, after)	Mean	P Value (paired T test)
Knowledge before counselling	2.1443±0.01360 (average)	0.134 ($p>0.05$)
Knowledge after counselling	1.5223±0.00410 (good)	

Attitude scores, after counselling, were good, average, and poor for 44%, 42% and 14% sample, respectively; compared to 39%, 20%, and 41% sample, respectively, before counselling.

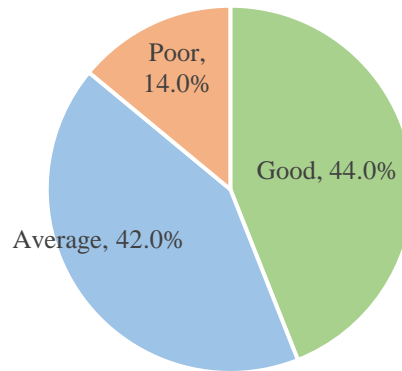


Figure 28: Distribution of Attitude scores after counselling

Similar to knowledge, the attitude score improved slightly after counselling by 0.3 index points. This shows that following the counselling sessions, the patients' attitudes towards managing their diabetes changed for the better. They might now feel more accountable for their own health and have a more upbeat attitude on controlling their disease. Even though this improvement was not statistically significant ($p > 0.05$), it nonetheless shows that patients' perspectives on their diabetes have improved. Despite the lack of statistical significance in the knowledge and attitude scores, it is significant to remember that even a small improvement might have significant effects on patients' overall diabetes care. Increased self-efficacy, motivation, and empowerment in self-care practices can be attributed to incremental improvements in knowledge and attitude.

Table 88: Attitude (before and after counselling)

Attitude (before, after)	Mean	P Value (paired T test)
Attitude before counselling	2.5103±0.01360 (average)	0.678 ($p > 0.05$)
Attitude after counselling	2.2010±0.00410 (average)	

Practice scores, after counselling, were good, average and poor for 45%, 41% and 14% sample, respectively; compared to 37%, 23%, and 40% sample, respectively, before counselling.

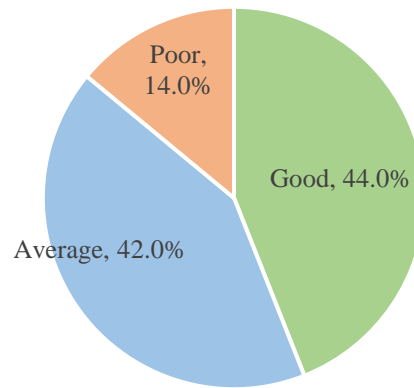


Figure 29: Distribution of Practice scores after counselling

However, the practice score showed a considerable improvement after counselling. Patients' practical implementation of diabetes control techniques and self-care practices demonstrated a discernible improvement. This may indicate that the counselling intervention was successful in converting information and empowering attitudes into concrete actions and behaviour modification. Patients had higher rates of adherence to medication schedules, dietary recommendations, frequent physical activity, and other healthy lifestyle choices. The considerable increase in practice ratings illustrates how effective counselling is at encouraging and facilitating good improvements in patients' day-to-day diabetes care.

Based on paired T-test, a p value of 0.001 ($p < 0.05$) was retrieved, implying that the difference in practice scores of patients was statistically significant.

Table 89: Paired Sample Statistics (Practice)

Paired T – Practice

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Practice Before	2.0244	532	0.87730	0.03804
	Practice After	1.7011	532	0.70974	0.03077

Table 90: Paired Sample Correlations (Practice)

Paired Sample Correlation – Practice

		N	Correlation	Sig.
Pair 1	Practice Before & Practice After Counselling	532	-0.146	0.001

The statistically significant difference in the practice levels ensures that healthy practice can be attributed to the management of blood sugar levels in diabetic patients. The relevant counselling, based on qualitative and quantitative assessment of patient audience, helped improve KAP and blood sugar levels depicting positive results.

6. CONCLUSION

CONCLUSION:

The result of the study offers strong proof that patients who have higher Knowledge, Attitude, and Practice (KAP) ratings demonstrate much successful diabetes control. Through rigorous analysis and thorough assessments, it has shown a substantial association between higher KAP scores and better diabetes self-care. Notably, those who received counselling interventions showed a notable improvement in their KAP scores during subsequent assessments, highlighting the critical importance of education and counselling in improving patients' comprehension and strategy for managing their diabetes. The findings of this study not only support the value of KAP evaluation as a predictor of effective diabetes care, but they also highlight the potential advantages of targeted counselling interventions in improving patients' overall management of their diabetic condition.

Since diabetes is a chronic condition, people must have the KAP needed for efficient self-management and control. However, studies show that a sizeable portion of diabetics lack the necessary knowledge, optimistic attitudes, and useful abilities. With an emphasis on how counselling might help close these gaps, this in-depth study tried to analyse the body of knowledge on KAP in diabetes treatment. With a rising prevalence, diabetes is a worldwide health concern that requires a multifaceted strategy to care. Knowledge of the condition, attitudes towards adopting healthy behaviours, and the ability to put those behaviours into practice are all necessary for effective diabetes treatment. However, research has consistently demonstrated that many diabetic patients lack the essential information, have a poor attitude, and find it difficult to make the necessary lifestyle modifications.

The **lack of knowledge** about the significance of crucial elements including food, exercise, and blood sugar control is one of the major issues seen in the management of diabetes. Many people make improper dietary choices and have inconsistent blood sugar management because they don't understand what a good diet is. Additionally, there is a general lack of knowledge on the long-term effects of diabetes, which can lower motivation to follow the right self-management techniques.

The capacity of a patient to effectively control their diabetes can be substantially impacted by **negative attitudes** and emotions. Some people could have overwhelmed or hopeless feelings, which might make them feel resigned about their circumstance. These unfavourable attitudes can

prevent proactive self-care participation and contribute to ineffective disease treatment. It is essential to remove these mental obstacles in order to improve patient outcomes.

Implementing information and a pro-active mindset is an important part of managing diabetes. But many patients have **trouble sticking to their (practice)** exercise schedules, food restrictions, and prescription schedules. Poor adherence can be caused by a number of things, including forgetfulness, a lack of enthusiasm, and social pressures. This results in insufficient blood sugar management and a higher risk of problems. Improving diabetes outcomes requires finding practical methods to increase adherence.

This research results depicted that majority population lacked necessary KAP, which is required to self-manage and control the impact of diabetes. One common issue, that was witnessed in research, is a lack of understanding about the importance of diet, physical activity, and controlled blood sugar levels. Some patients also struggled with adherence to medication regimens, dietary restrictions, or exercise plans. Negative attitudes, such as a sense of hopelessness or resignation about their condition, can also make it difficult for patients to take an active role in their diabetes management. More than 90% of patients in the research had rare to limited physical activity routine, along with excessive calorie intake (beyond the recommended levels), highlighting poor attitude towards disease control and healthy lifestyle. Since nearly 80% of the patients had a family history, so not having control on the planning and execution part of healthy lifestyle is expected to amplify the impact significantly.

Impactful counselling: The counselling included all necessary guidance from sharing knowledge fundamentals on diabetes to motivating patients to include healthy routine in their lifestyle. Consistency, over efficiency, was time and again highlighted, so that even if incremental and marginal, patients maintain consistency in following simple yet healthy practices. The tone of counselling sessions was motivational and optimistic, so that negative mindset can be modified.

The counselling had a significant impact on patients, as the KAP scores reported to change positively after the counselling journey, practice being the most impacted parameter. Although counselling takes significant time and effort, it allows healthcare professionals to connect with patients on a personal level, assess their needs and concerns, and provide personalized advice and support. Effective counselling requires active listening, empathy, and the ability to communicate

complex medical information in a way that is understandable to the patient. It can improve patient outcomes by increasing their knowledge and understanding of their health conditions, promoting adherence to treatment plans, and addressing emotional and psychological issues that may impact their overall health.

In order to close the KAP gaps seen in diabetes individuals, counselling is essential. Healthcare practitioners can offer patients individualised counsel, instruction, and support by developing a friendly and reliable alliance. Active listening, empathy, and the capacity to convey complex medical facts in a clear and intelligible way are all necessary for effective counselling. Through counselling, patients can better understand their condition, discover useful self-management techniques, and cultivate a positive outlook on diabetes care.

The thorough evaluation emphasises how important it is to close the KAP gaps in diabetes care. Obtaining ideal results is significantly hampered by ignorance, unfavourable attitudes, and inadequate self-care behaviour. In order to close these gaps and give patients the tools they need to actively participate in their diabetes treatment, counselling interventions have shown promise. Counselling can aid in better diabetes control, fewer complications, and increased overall well-being for people with diabetes by resolving information gaps, encouraging optimistic attitudes, and enhancing adherence to self-care practices. In order to further improve patient outcomes in the management of diabetes, future research should keep investigating novel counselling ways and strategies.

The use of Knowledge, Attitude, and Practice (KAP) surveys for diabetes can provide valuable information about the understanding, beliefs, and behaviours of individuals regarding diabetes management. The results of KAP surveys can help healthcare professionals and organizations to identify areas of strength and weakness in diabetes education and management, and to design targeted interventions to improve diabetes care. Some common findings from the KAP survey included:

- **Limited knowledge:** Many individuals with diabetes have a limited understanding of the condition and its causes, risk factors, and complications.
- **Positive attitudes:** People with diabetes tend to have positive attitudes towards self-management, but they may also feel overwhelmed or discouraged by the challenges faced.

- **Inadequate practices:** Despite having positive attitudes, individuals with diabetes may not consistently follow recommended practices for self-management, such as monitoring blood glucose levels, taking medications, and following a healthy diet and routine.
- **Barriers to care:** Participants in KAP surveys often report various barriers to accessing and adhering to care, such as cost, lack of access to healthcare, and conflicting advice from different healthcare providers.

Although the study may have some limitations such as patient biases and confounding factors; however, the research results can serve as a driver to develop targeted education and awareness campaigns to improve knowledge and attitudes and to support individuals in adopting healthy behaviours for diabetes management. It can provide valuable information for healthcare providers, public health researchers, and policymakers to better understand the needs and challenges for diabetes. The survey's findings offer important new information about the precise areas in which people with diabetes lack sufficient knowledge and have unfavourable attitudes about their condition.

A motivational tone of counselling, where counsellor guides patients from fundamentals of diabetes to simple yet effective changes in lifestyle, can reap beneficial results. Designing educational interventions that specifically target these areas of insufficiency can be done using this knowledge. Healthcare practitioners can effectively improve diabetes-related knowledge and attitudes among patients by adjusting the content and delivery of **educational programmes** to the identified needs of the target group. The survey results can also help in the creation of measures to encourage people to adopt healthy behaviours for the treatment of diabetes. Healthcare professionals can create interventions that explicitly target the difficulties people have sticking to medication regimes, food restrictions, and activity plans by understanding the hurdles and challenges these people have. To assist people in overcoming these obstacles and forming sustainable lifestyle habits, this may entail offering them helpful advice, materials, and continuing support.

There were a few limitations to the study that can be modified, improved, and taken care of in future research such as:

- a. Patients churn rate during the study – in this study, initially more than six hundred patients were surveyed for the study, but some churned out due to hospital/ doctor change, and we had a net surveyed data of 532 patients, before and after counselling.
- b. Instead of RBS, postprandial blood sugar (PPBS) could have been a better and uniform metric for analysing sugar levels after meal.
- c. Sometimes patients did not follow counsellors' statements in the expected manner at once.

However, the knowledge obtained from this study is useful for public health academics as well as policymakers and healthcare professionals. These results can be used by researchers to do **additional research** on the variables affecting knowledge, attitudes, and practices related to diabetes management. This may help in the creation of evidence-based programmes and regulations that attempt to enhance diabetes outcomes on a bigger scale. Especially, an advanced study which measures the impact of counselling interventions in improving KAP levels over long term will be tangibly beneficial for healthcare system and society.

The results can also be used by decision-makers to guide the creation of **public health programmes** and regulations that support diabetes prevention and management. Policymakers can effectively allocate resources and create initiatives that address these obstacles at a systemic level by having a thorough grasp of the particular difficulties experienced by people with diabetes. This could involve actions like expanding access to diabetes education programmes, putting in place regulations to encourage settings with healthy food options, and encouraging physical exercise in local communities.

Positive counselling can have a significant impact on diabetes patients by improving their emotional well-being, self-management skills, and overall health outcomes. Prior studies have also shown that positive counselling can help patients to better cope with the challenges of diabetes, leading to improved glycaemic control, increased physical activity, and better adherence to medication and dietary recommendations. Additionally, positive counselling can improve patients'

self-efficacy and confidence in managing their diabetes, which can lead to long-term improvements in their health and quality of life.

Diabetes patients might benefit greatly from the education provided by medical professionals and pharmacists. Healthcare professionals that specialise in diabetes, such as physicians and nurses can enlighten patients about the condition, its signs and symptoms, and available treatments. Additionally, they can assist patients in acquiring self-management skills like controlling blood sugar levels, taking medications, and leading a healthy lifestyle. By giving patients information about their drugs, including how to take them, possible side effects, and drug interactions, pharmacists play a crucial part in diabetes education. Additionally, they can offer advice on over-the-counter medicines and dietary supplements that might affect blood sugar levels.

Together, healthcare professionals and pharmacists may offer **comprehensive diabetes education and guidance** that encourages patients to actively participate in the management of their condition.

The interaction of chemists and medical professionals' results in a thorough method of diabetes counselling. Together, they make certain that patients are given correct information regarding their illness and course of therapy. Patients benefit from this cooperative effort because they have access to a team of skilled specialists who are committed to their well-being, which promotes a sense of trust and confidence in them. Patients are encouraged to actively participate in the management of their illness via comprehensive diabetes education provided by medical experts and chemists. By providing motivational counselling and guiding people, gives them the power to decide what is best for their health. This has proven to show results in better treatment compliance, better diabetic management, and a lower risk of complications.

7. BIBLIOGRAPHY

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Annexures

Annexure I

QUESTIONNAIRE

Age: _____

Gender: _____

Weight: _____

Height: _____

Income pm: _____

Occupation: _____

Level of education: _____

Marital status: _____

Patient history of diabetes (in years): _____

Family history: Y/N __

Sugar (FBS) mg/dl: _____

RBS mg/dl: _____

HbA1c: _____

HDL: _____

LDL: _____

TG: _____

Knowledge-based questions:

1. Eating too much sugar and other sweet foods is a cause of diabetes.
(Yes/No/Don't Know)
2. The usual cause of diabetes is lack of effective insulin in the body.
(Yes/No/Don't Know)
3. Kidneys produce insulin.
(Yes/No/Don't Know)
4. In untreated diabetes, the amount of sugar in the blood usually increases.
(Yes/No/Don't Know)
5. If I am diabetic, my children have a higher chance of being diabetic.
(Yes/No/Don't Know)
6. Diabetes can be cured.
(Yes/No/Don't Know)
7. A fasting blood sugar level of 210 is too high.
(Yes/No/Don't Know)
8. The best way to check my diabetes is by testing my urine.
(Yes/No/Don't Know)
9. Regular exercise will increase the need for insulin or other diabetic medication.
(Yes/No/Don't Know)
10. Medication is more important than diet and exercise to control my diabetes.
(Yes/No/Don't Know)
11. Cuts and abrasions on diabetes heal more slowly.
(Yes/No/Don't Know)
12. The way I prepare my food is as important as the foods I eat.
(Yes/No/Don't Know)

13. Diabetes can cause loss of feeling in my hands, fingers, and feet.

(Yes/No/Don't Know)

14. Shaking and sweating are signs of high blood sugar.

(Yes/No/Don't Know)

15. Frequent urination and thirst are signs of low blood sugar.

(Yes/No/Don't Know)

16. A diabetic diet consists mostly of special foods.

(Yes/No/Don't Know)

Attitude-based questions:

1. There is not much use in trying to have good blood sugar control because the complications of diabetes will happen anyway.

(Strongly disagree, disagree, may be, agree, strongly agree)

2. Almost everyone with diabetes should do whatever it takes to keep their blood sugar close to normal.

(Strongly disagree, disagree, may be, agree, strongly agree)

3. Diabetes is hard because you never get a break from it.

(Strongly disagree, disagree, may be, agree, strongly agree)

4. People with diabetes should learn a lot about the disease so that they can oversee their own diabetes care.

(Strongly disagree, disagree, may be, agree, strongly agree)

5. What the patient does has more effect on the outcome of diabetes care than anything a health professional does.

(Strongly disagree, disagree, may be, agree, strongly agree)

6. It is frustrating for people with diabetes to take care of their disease.

(Strongly disagree, disagree, may be, agree, strongly agree)

7. People with diabetes have the right not to take good care of their diabetes.

(Strongly disagree, disagree, may be, agree, strongly agree)

8. Do you consider your diet to be controlled one?

(Strongly disagree, disagree, may be, agree, strongly agree)

9. Do you help keep the habits of family members in control too?

(Strongly disagree, disagree, may be, agree, strongly agree)

10. There is not much use in trying to have good blood sugar control because the complications of diabetes will happen anyway.

(Strongly disagree, disagree, may be, agree, strongly agree)

11. People with diabetes should have the final say in setting their blood glucose goals.

(Strongly disagree, disagree, may be, agree, strongly agree)

12. The important decisions regarding daily diabetes care should be made by the person with diabetes.

(Strongly disagree, disagree, may be, agree, strongly agree)

13. Type II diabetes is a very serious disease.

(Strongly disagree, disagree, may be, agree, strongly agree)

14. People who have Type II diabetes will probably not get much payoff from tight control of their blood sugars.

(Strongly disagree, disagree, may be, agree, strongly agree)

Practice-based questions:

1. Frequency of contact with your doctor.

Yearly, Extended months; Half-yearly; Few months; Monthly

2. How often do you exercise?

Never, rarely, sometimes, frequently, regularly

3. Do you keep a strict diet check?

Strongly disagree, disagree, may be, agree, strongly agree.

4. You take prescribed medication as said by doctor.

Strongly disagree, disagree, may be, agree, strongly agree.

5. You strictly follow the dietary recommendations given by doctor.

Strongly disagree, disagree, may be, agree, strongly agree.

6. Frequency of your blood sugar checks?

Extended months; Few months; Monthly; Weekly; Daily

7. Frequency of your blood pressure checks?

Extended months; Few months; Monthly; Weekly; Daily

8. Frequency of your eye-check up?

Yearly, Extended months; Half-yearly; Few months; Monthly

9. Frequency of your urine test?

Yearly, Extended months; Half-yearly; Few months; Monthly

10. Frequency of your lipid test?

Yearly, Extended months; Half-yearly; Few months; Monthly

11. You never miss your medicine doses?

Strongly disagree, disagree, may be, agree, strongly agree.

12. You keep a control on urges for sugary food?

Strongly disagree, disagree, may be, agree, strongly agree.

Annexure II

INFORMED CONSENT FORM

Name of the patient:

Name of the patient parent / guardian:

Age:

Gender:

Hospital IP / O.P No:

I.....here by give my consent to take part in the study entitled **“Impact of Patient Counselling on Knowledge, Attitude and Practice in the Management of Type 2 Diabetes Mellitus: A Prospective Study”**. I have been clearly explained about the objectives of the study and I know about my rights to withdraw the patient from the study at any point of time.

Signature of Patient / Attendant

Signature of the Investigator

Annexure III

अनुबंध द्वितीय

सूचित सहमति प्रपत्र

रोगी का नाम:

रोगी के माता-पिता/अभिभावक का नाम:

आयु:

लिंग:

अस्पताल आईपी / ओ.पी नंबर:

मैंयहां“**Impact of Patient Counselling on Knowledge, Attitude and Practice in the Management of Type 2 Diabetes Mellitus: A Prospective Study**” शीर्षक वाले अध्ययन में भाग लेने के लिए अपनी सहमति देता हूं।

मुझे अध्ययन के उद्देश्यों के बारे में स्पष्ट रूप से समझाया गया है और मैं किसी भी समय रोगी को अध्ययन से वापस लेने के अपने अधिकारों के बारे में जानता हूं।

रोगी/परिचारक के हस्ताक्षर

अन्वेषक के हस्ताक्षर

Annexure IV

ਅਨੁਬੰਧ-III

ਸੂਚਿਤ ਸਹਿਮਤੀ ਫਾਰਮ

ਮਰੀਜ਼ ਦਾ ਨਾਮ:

ਮਰੀਜ਼ ਦੇ ਮਾਤਾ-ਪਿਤਾ/ਸਰਪ੍ਰਸਤ ਦਾ ਨਾਮ:

ਉਮਰ:

ਲਿੰਗ:

ਹਸਪਤਾਲ IP / O.P ਨੰਬਰ:

ਮੈਂ ਇੱਥੇ **“Impact of Patient Counselling on Knowledge, Attitude and Practice in the Management of Type 2 Diabetes Mellitus: A Prospective Study”** ਸਿਰਲੇਖ ਵਾਲੇ ਅਧਿਐਨ ਵਿੱਚ ਭਾਗ ਲੈਣ ਲਈ ਆਪਣੀ ਸਹਿਮਤੀ ਦਿੰਦਾ ਹਾਂ।

ਮੈਨੂੰ ਅਧਿਐਨ ਦੇ ਉਦੇਸ਼ਾਂ ਬਾਰੇ ਸਪਸ਼ਟ ਤੌਰ 'ਤੇ ਸਮਝਾਇਆ ਗਿਆ ਹੈ ਅਤੇ ਮੈਂ ਕਿਸੇ ਵੀ ਸਮੇਂ ਮਰੀਜ਼ ਨੂੰ ਅਧਿਐਨ ਤੋਂ ਵਾਪਸ ਲੈਣ ਦੇ ਆਪਣੇ ਅਧਿਕਾਰਾਂ ਬਾਰੇ ਜਾਣਦਾ ਹਾਂ।

ਜਾਂਚਕਰਤਾ ਦੇ ਮਰੀਜ਼

ਅਟੈਂਡੈਂਟ ਦੇ ਦਸਤਖਤ



Impact of Knowledge, Attitude and Practice on the Management of Type 2 Diabetes Mellitus in Developing Countries: A Review



Sanjeev Kumar Gautam¹ and Vivek Gupta^{1,*}

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Abstract: Background: Diabetes is a major metabolic aggressive disease that has exponentially increased around the globe, including both developed and developing countries. The significant change in the lifestyle of people, attributed to the fast-paced living style and dietary conditions, are a few of the core reasons behind the disease. Multiple studies conducted in various developing countries conclude that patient education, along with adhered practices and attitudinal outlook, can significantly help in deterring the ill effects of diabetes mellitus.

Objective: The review aimed at understanding the impact of KAP on the management of diabetes mellitus in emerging economies.

Methods: Multi-central analytical cross-sectional and prospective studies were conducted for research in multiple countries with median per capita income of ~\$4,000 (developing countries - Ethiopia, Bangladesh, Iraq, Iran, Nigeria, etc.), wherein significant difference was witnessed in the outlook of patients and related stakeholders, who had a decent score of KAP relative to ones with lower scores, towards type 2 diabetes mellitus.

Results: Among all the three variables that are capable of managing diabetes - knowledge, attitude and practice (KAP) - knowledge attained a high degree of importance as it served as the initial step to control DM. In developing countries, the ratio of people with knowledge - relating to disease - is significantly dependent on age, socio-economic status and education. As per the previous studies and their corresponding results, educational awareness is of utmost importance in order to eradicate myths and wrong information around the same.

Conclusion: The review concludes the importance of patient counseling to modify their KAP towards the disease will be highly effective in countries like India, where the count of diabetes mellitus patients is increasing aggressively. Investment in patient counselling to improve their KAP score will significantly help in palliating the effect of this disease.

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Keywords: Type-2 diabetes mellitus, KAP score, patient counselling, morbidity, mortality, developing countries, per capita income.

1. INTRODUCTION

The impact of patient counseling on knowledge, attitude and practice in the management of metabolic diseases such as Type-2 diabetes mellitus, has been a key area of study to manage and deter its ill effects. Since the spread of the disease is accelerating, propelled by sedentary life style and unhealthy living practices, the role of KAP has become vital in managing it. Diabetes is regarded as the most common chronic conditions in mankind. It is a major public health concern worldwide. Progression of DM in most cases results

in complications, lowering patients' life quality and increasing their morbidity and mortality. It is not only a threat to humankind but also to the health economy of any country [1, 2].

Despite significant growth in medicine, with the advancement in DM controlling methods ranging from drugs to medical devices, the psychological gap still prevents the improvement of the lifestyle of patients. Patients typically lack accurate knowledge related to the disease and show a lack of adherence. Minimal levels of a positive outlook are witnessed among patients.

In this review, the studies conducted in various developing countries and regions on the impact and status of KAP on diabetes mellitus has been covered. Cross-sectional and prospective studies were conducted on patients over a signifi-

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High HbA1c in diabetes patients propelled by the synergetic impact of the sedentary profession and family history

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ABSTRACT

Aims/hypothesis: We investigated associations between family history and active lifestyle, separately and in combination, to diabetes indicators HbA1c, fasting blood sugar (FBS) and resting blood sugar (RBS).

Subjects and methods: This cross-sectional study comprised 532 patients, aged 22–88 years, with 53.4% women and 28% having a family history in diabetes. Information on lifestyle factors was obtained by questionnaire, and diabetes indicators through case sheets.

Results: The cohort with family history in diabetes had higher values of diabetes indicators, similarly the patients who led a less-active lifestyle had significantly higher values. The factors attributed significantly to the values of HbA1c, FBS and RBS. Among the 3, HbA1c had a higher impact of lifestyle, and its synergy along with family history amplified the impact. HbA1c values ranged from 6.8% to 9%, for patients with no history and relatively active lifestyle, to ones with family history and sedentary lifestyle, respectively.

Conclusions/interpretation: Our analysis suggested a synergetic impact of lifestyle and family history on diabetes patients. While both family history of diabetes and lifestyle risk factors had effects on type 2 diabetes, irrespective of sex, lifestyle attributed to more pronounced impact. Among the 2, lifestyle is a more manageable factor and can be improved with regular counselling, motivation, education, and awareness.

Key words: family history of diabetes, synergy, lifestyle, physical activity, sedentary lifestyle, diabetes

1. INTRODUCTION

Diabetes is among the top 10 causes for global mortality, which contributed to 6.7 million deaths in 2021. As per International Diabetes Federation, 537 million people were suffering from diabetes globally, and the numbers are expected to reach 643 million by 2030 (growing at a CAGR of 2.02% during the period 2021-2030).¹ It incurred a global healthcare expenditure worth USD 966 billion in 2021 and is estimated to reach more than USD 1 trillion by 2030.²

After China (141 million), India (74 million) has the second-highest number of diabetics worldwide. In India, there are an additional 40 million persons who have impaired glucose tolerance, which puts them at a high risk of becoming type 2 diabetes. The country has more than half (53.1%) of diabetics who are undiagnosed. Diabetes can result in serious and sometimes fatal consequences such heart attack, stroke, kidney failure, blindness, and lower limb amputation if it is not recognized or treated properly.³

It is categorized under metabolic disorder and is primarily propelled by unhealthy lifestyles, obesity, and genetics. Amalgamation of these factors tend to have a much worse impact on patients – implying that patients who have a family history of diabetes and are leading a sedentary lifestyle are much more vulnerable than the ones who try to maintain an active lifestyle.



Protein Tyrosine Phosphatase 1B (PTP1B): A critical molecular target for treatment and management of related complications in Type-II Diabetes and obesity

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KEYWORDS

PTP1B;
Diabetes
mellitus;
Obesity;
Insulin;
insulin-to-
insulin
receptor

ABSTRACT:

One of our society's biggest health challenges is type 2 diabetes mellitus. In order to control this chronic condition and its associated problems, novel therapies are being developed despite the wide range of alternatives available for existing medication treatments. Since protein tyrosine phosphatase 1B (PTP1B) is an essential component of a negative regulator in the insulin and leptin signaling pathways, it is a promising therapeutic target for a number of human disorders, including type 2 diabetes (T2DM) and obesity. PTP1B inhibitors improve insulin receptor sensitivity and can treat illnesses linked to insulin resistance. Type 2 diabetes mellitus and the group of cardiovascular risk factors known as the "metabolic" syndrome are strongly linked to resistance to the cellular action of insulin, a fundamental pathophysiological defect that accompanies the global obesity epidemic. The creation of new pharmaceuticals that lessen insulin resistance may be crucial for treating and preventing diabetes as well as lowering the cardiovascular risk profile that goes along with it. Research on the function of protein-tyrosine phosphatase PTP1B in the cell has now demonstrated unequivocally that it is a crucial negative regulator of the tyrosine phosphorylation cascade, which is essential to the insulin signaling pathway. In over nourished situations, PTP1B inhibition also decreases the amount of triglycerides stored in adipose tissue and is not linked to any apparent harm. In general, these investigations have cleared the path for the commercialization of PTP1B inhibitors, which could potentially function as an innovative kind of "insulin sensitizer" for the treatment of type 2 diabetes and the metabolic syndrome.

1. Introduction

Globally, the prevalence of diabetes mellitus (DM), a chronic multifactorial illness, is rising [1]. According to the American Diabetes Association's classification published in 2021, diabetes mellitus (DM) can be broadly classified into four categories: type 1 DM, type 2 DM, gestational DM, and specialized kinds of DM resulting from various causes. Of those, type 2 diabetes accounts for 90-95% of all instances of the disease [2]. It is the most common kind of diabetes. This kind of diabetes usually has a history of insulin resistance and gradually decreased pancreatic β cell insulin production. Hyperglycemia, or persistent blood glucose levels, is the result of these anomalies [3, 4]. Biguanides, sulfonylureas, thiazolidinediones (TZD), meglitinides, dipeptidyl peptidase 4 (DPP-4) inhibitors, α -glucosidase

licensed for the treatment of type 2 diabetes [5]. In spite of the large number of type 2 DM medications that are already licensed, over 7,000 clinical trials are filed to explore novel formulations [6]. Even if the number of therapeutic choices has increased over the past few decades, the therapies that are currently available have shown limitations and downsides. Even though metformin is the medication most frequently administered to people with type 2 diabetes, little is known about how it works. Additionally, using it is linked to adverse gastrointestinal consequences [7]. Other now licensed medications for the treatment of type 2 diabetes also have a number of drawbacks, such as hypoglycemia, changes in body weight, an increased risk of cardiovascular disease, and urinary tract infections [5]. Furthermore, 4.2 million deaths

Negative Impact of Climate Crisis on Diabetic Patients

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Abstract: Global research has highlighted the ill-impact of climate change on mankind, making it one of the serious issues to be tackled for a sustainable life ahead. Recent studies have also laid emphasis on the impact of climate change on diabetes, which is a global health problem. Evidence have suggested that extreme temperatures are impacting the vulnerable diabetic patients significantly. The growth in level of incidence and prevalence is attributed to climate change to some extent. The review aims at comprehensively describing the relation and substantial instances of the former. The rise in temperature is leading to mild to severe cardiac events, obesity, more hospitalization, decrease in insulin sensitivity and other nutritional problems in patients, and dip in temperatures is leading to problems such as hypoglycemic complications, increased HbA1c and cardiac issues. Making substantial policies that aim at managing climate change, especially with the lens of diabetes healthcare is the need of the hour.

Key words: Climate Change, Diabetes, Brown Adipose Tissue, Cardiac Events, HbA1c, Critically Rising/Dipping Temperatures, Healthcare Policies

INTRODUCTION

Diabetes is among the top 10 causes for global mortality, which contributed to 6.7 million deaths in 2021. As per International Diabetes Federation, 537 million people were suffering from diabetes globally, and the numbers are expected to reach 643 million by 2030 (growing at a CAGR of 2.02% during the period 2021-2030).¹ It incurred a global healthcare expenditure worth USD 966 billion in 2021 and is estimated to reach more than USD 1 trillion by 2030.² Changing lifestyles, obesity, genetics remain the top causes for diabetes, however, a new entrant – climate change – is also developing a correlation with the disease. The earth has witnessed a minimum rise of 1.1 °C temperature since the early 20th century, which has impacted the biodiversity in a substantial manner – It is estimated that one-third of bio species may get extinct by 2070. Despite setting a goal to limit global warming to below 2°C, relative to pre-industrial levels (in IPCC Paris Agreement, 2015) not much has been done in the space, which led to easing the target to 1.5°C.

This noteworthy change in climate has both directly and indirectly impacted the lives of healthy and unhealthy humans alike. The destructive change has targeted every human segment ranging from infants to elderly. The diabetes incidence has increased by 0.31% with each degree rise in global temperatures.³ The environmental complications created by temperature rise adversely affect the glucose metabolism, especially in patients. Higher temperatures are posing a greater risk of hospitalization and morbidity in patients suffering from type 2 diabetes mellitus.^{4,5} On the other side, dipping temperatures, due to climate change, are posing a risk of hyperthermia.^{4,6} The adverse impact on food and industrial production may also become a headwind for life-saving drugs supply, such as insulin, which will be a setback for global health system.⁷ Studies have also reflected that increase in obesity and diabetes-occurrence go in tandem, which are propelled by climate effects. Gestational diabetes is also on rise, wherein pregnant mothers are much more vulnerable to climate-related dangers leading to occurrence of diabetes. Climate change and diabetes are following the same trajectory and are among the core issues impacting a large share of population worldwide. This review aims at explaining the relationship between these two threats (climate change and diabetes) to mankind and exploring the possible suggestive measures that can be implemented to cushion the adverse impact.

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21 February 2024 14:16:57

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Dashboard (International Journal Of Preventive Medicine) Tuesday, April 9, 2024

0 Manuscripts Requiring Technical Modification

0 Manuscript In Withdrawal Request

0 Manuscripts Requiring Revision

0 Manuscripts For Proofing / Checking

0 Incomplete Submissions

0 Payment Required

Submitted Manuscripts

Manuscript ID	Manuscript Title	Manuscript Type	Submitted On	Status	Request for withdrawal
ijpvm_356_23	Dynamics of dairy product consumption, confounding factors, and their influence on the risk of type 2 diabetes	Review Article	December 25, 2023	In Production	

Items per page: 10 1 - 1 of 1

DYNAMICS OF DAIRY PRODUCT CONSUMPTION, CONFOUNDING FACTORS, AND THEIR INFLUENCE ON THE RISK OF TYPE 2 DIABETES

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Abstract:

Background: Several studies have looked into the possible link between consumption of dairy products and the risk of type 2 diabetes and are largely skewed towards inverse impact.

Objective: We carried out a revised systematic review on the association between consumption of dairy products and type 2 diabetes risk. In order to draw conclusions and look for uniformity in results across geographies, we looked through research articles from reliable sources.

Conclusions: After controlling for confounding variables, this review indicates that the relationship between the incidence of type 2 diabetes and consumption of dairy products is context dependent. While majority studies show an inverse relationship in incidence risk and dairy consumption, particularly low-fat dairy products, the results are not uniform across regions. More targeted research, though, with critical review of instruments, confounders and biomarker metrics may drive some consistency or logical variance in outcomes.

Key words: dairy consumption, milkfat, nutrition, dietary impact, confounders

INTRODUCTION

As per CDC latest research, 2023, nearly 39 million people worldwide are suffering diabetes, wherein only 30 million have been diagnosed, and a budding population of nearly 98 million have prediabetes. [1] While diet and exercise are considered as key constituents to prevent and manage diabetes, the awareness of the right type and time of diet and exercise is still haywire. Healthcare practitioners round the world have inconsistent opinions of diet and physical activity plans, making it an intuitive practice at patients end. High-fat fermented dairy, whole cheese, and high-fat cheese were linked to a decreased incidence of prediabetes in the Hoorn trials (6.4 years of follow-up). [2] However, total dairy and other dairy products did not appear to be linked to pre-diabetes. Conversely, high-fat milk and yogurt consumption was strongly

linked to a decreased risk of prediabetes in the Rotterdam investigations (11.4 years of follow-up), but low-fat dairy products and low-fat milk consumption were linked to a higher risk of prediabetes. [3]

The relatively recent studies that were focused on diet intake and their impact of patients or prospects have shown some similar mixed results. While fats have a reputation of having ill effect on patients' health, some studies have shown that milk products with fat content have been reducing the risk of type 2 diabetes and are managing the levels in patients, while some have shown ill or no effect. As per International Dairy Federation, world's per capita consumption of dairy products rose dramatically between 2006 and 2019. Dairy products are seeing considerable growth in markets in Asia, Africa, and Latin America. [4] As per the




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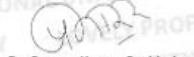
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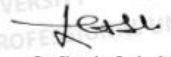
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Title of Graphical abstract: Impact of effective counselling in improving the knowledge, attitude, and practice levels of diabetic patients, thus leading to better glycemic control

Authors name: Sanjeev Kumar Gautam and Dr. Bimlesh Kumar

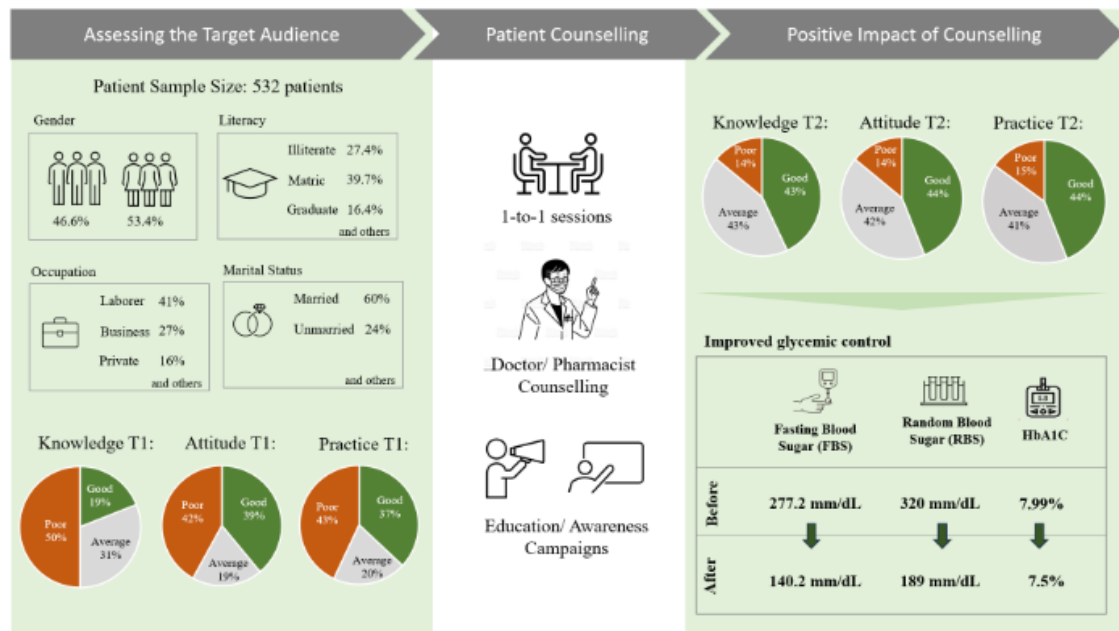
Name of Scholar: Sanjeev Kumar Gautam **Registration Number:** 41800471

Program Name: Ph.D. (Pharmacology) [Part Time]

Name/ UID of Supervisor: Dr. Bimlesh Kumar (12474)

Summary of graphical abstract: The abstract represents the impact of counselling on patients in improving their KAP – knowledge pertaining to diabetes, attitude pertaining to its supervision, and practice pertaining to its management. The KAP levels when assessed at initial stages of patient interaction provided a non-satisfactory index; however, over the course of time, with proper awareness and education, patients were able to improve their KAP levels and better manage their diabetes. This improvement was evident with the significant dip in their biomarker data for fasting blood sugar (FBS), random blood sugar (RBS) and HbA1C.

Graphical Abstract:



Improved Knowledge, Attitude, and Practice levels of patients Enhance Diabetes Management