International Journal of Neurolinguistics & Gestalt Psychology (ISSN No. 2582-9270) 2023. Vol. 3 Issue No. 1
DOI https://doi.org/10.52522/ijngp.v3i1.4

A Quantitative Study to Understand Diabetes and Behaviour; Hereditary and Beyond

Dr. Rajkumar Arunachalam
MBBS, NLP Practitioner,
Diploma in Relationship & Marriage Counselling,
Certificate in Clinical Psychology.
Life Coach ACC, ICF accomplished
Chennai, India

Introduction

Diabetes is a group of chronic conditions characterized by high levels of glucose (sugar) in the blood. The hallmark of Diabetes Mellitus, which is mostly brought on by people's daily routines, is considered a chronic disease. Here, habits mostly refer to those that steer a person away from active lifestyle choices and towards a sedentary routine with little to no activities. Modern life is built on the goal to make our lives easy, relaxing, and less tiring hence the concept of sitting down or; 'couch-potato behaviour' and doing things at a slow pace triggered the onset of several lifestyle diseases with Type-2 Diabetes being the most common and popular in our Indian societies.

As an autoimmune illness, type 1 diabetes occurs when the body's immune system unintentionally targets and kills the cells in the pancreas that make insulin. Despite being age-neutral, it is typically diagnosed in children and young adults. Increased thirst, frequent urination, impaired vision, exhaustion, and unintentional weight loss are all signs of type 1 diabetes. Regular insulin injections or the use of an insulin pump to supplement the lost insulin are common forms of treatment.

---

*This Research paper is on **'Diabetes and Behaviour'** and has been authored by **Dr. Rajkumar Arunachalam***

*This paper has been assisted by **Madhumita Dutta** who supported in the writing, analysing, editing and referencing of the research manuscript, she is part of the **Global Internship Research Program (GIRP).***

*This paper has been mentored by **Anil Thomas**, a Certified NLP Master Practitioner and Gestalt Therapist.*

*This paper has been critically reviewed and proofread by **Kainaz Bharucha** a Certified Counselor and completed her Master's in Clinical Psychology*

Correspondence concerning this article should be addressed to office@ijngp.com

To control their illness and lower the risk of complications, people with type 1 diabetes must also closely check their blood sugar levels, eat a balanced diet, and exercise frequently. The major source of energy for your cells is glucose, which is processed by the body differently as a result of type 2 diabetes. Insulin, a hormone that facilitates glucose uptake into cells, develops a resistance in type 2 diabetes patients' bodies. As a result, glucose doesn't get utilized for energy by the corresponding cells and instead accumulates in the blood. This study focuses solely on Type 2 Diabetes.

Type 2 diabetes has a strong genetic component and most patients have a first-degree relative with diabetes. Studies have showcased that first-degree relatives with type 2 diabetes are three times more likely to develop it than individuals without any positive familial historical genograms. Much progress has been made in our understanding of the genetics of this disease. Whereas monogenic forms of diabetes result from rare genetic mutations with large effects, such as those seen in maturity-onset diabetes of young people, most cases of type 2 diabetes are thought to be due to genetic variations that are more common but exert less effect. Most genetic variants associated with type 2 diabetes seem to be related to insulin secretion rather than insulin resistance, and several of the risk alleles are associated with reduced islet-cell function.

Blood glucose levels that are higher than usual but not high enough to be labelled as type 2 diabetes are referred to as pre-diabetes. When the blood glucose levels are specifically between 100 and 125 mg/dL on a fasting blood glucose test or between 140 and 199 mg/dL on an oral glucose tolerance test, pre-diabetes is identified. Pre-diabetics are more likely to acquire type 2 diabetes, but it is possible to avoid or delay the onset of type 2 diabetes by making lifestyle changes such eating a nutritious diet, getting more exercise, and decreasing weight. Many family and twin studies have shown that Type-2 diabetes can be inherited up to 80% of the time. (Poulsen P, 1992) Studies also demonstrate a whopping chance of 70 percent of developing diabetes if both parents are affected, and a chance of 40 percent if only one parent is affected

(Tillil H, 1987). Heritability rates are high when coupled with obesity and other health morbidities.

Given the high prevalence of diabetes in both this cohort and the current population, it is also regarded as the primary cause of death worldwide. Years of ongoing research into diabetes, linkage analysis, candidate gene methodology, large-scale association studies, and genome-wide association studies (GWAS) have yielded profitable hints that numerous genes contribute to the vulnerability to Type 2 Diabetes. In several studies, meta-analyses of these loci, such as the creation of genetic risk scores, significantly contributed to the prediction of this disease and facilitated the adoption of early diagnosis and preventative strategies to manage this expanding disease burden globally in order to prevent or delay the onset. (J. B. Meigs, 2008) (V. Lyssenko, 2008).

The International federation of Diabetes states that one among three young people in India are suffering from lifestyle diseases. Diabetes being the most common lifestyle disease is becoming more prevalent among all age groups. Type 2 diabetes is most commonly diagnosed in older adults, but is increasingly seen in children, adolescents and younger adults too. Research findings are accumulating that the onset type 2 diabetes in adolescents and young adults seems to have a more aggressive disease reaction, resulting in several medical complications, quality of life that have long-term outcomes, raising the possibility of a medical catastrophe. The reason for this is due to rising levels of obesity, physical inactivity and poor dietary plans. The environment in which genes are expressed may have changed due to industrialization, which could have an impact on the human genome. The industrialising emerging nations' increased reliance on chemicals caused widespread nutritional insufficiency and genome abnormalities, at least doubling the risk of genome instability. These nations frequently experience environmental toxins such as polychlorobiphenyls, metal vapours, and fly ash. (Anetor J. I, 2010). This could have led to genetic changes that make people more susceptible to diabetes.

The association linked throughout the genesis of the disease is created by the interplay of genetic and non-genetic variables with genetic factors. Lifestyle choices, dietary patterns, and consumables contaminated with poisons are examples of such factors. Alcoholism, smoking, a lax attitude towards daily tasks, tension, sleeplessness, and other such behaviours. The hypothalamic-pituitary-adrenal axis is activated by stress, which alters glucose metabolism and causes insulin resistance and beta cell dysfunction. Lack of sleep also causes an increase in hunger, which can induce weight gain if calorie- and sugar-rich foods are consumed during the sleepless period. Moreover, this may result in elevated blood pressure and sympathetic nervous system activity.

A rising body of research points to a connection between industrialization and diabetes. Cite the research. An agrarian or rural civilization is transformed into an industrial one through the process of industrialization, which is characterised by the employment of machinery and technology to boost productivity. When cultures become more industrialised, people frequently modify their eating and exercise habits and are exposed to additional environmental contaminants. Urbanization brought upon by industrialization frequently results in changes to nutrition and lifestyle. When urbanisation carries with it other socioeconomic issues including migration, subpar housing conditions, and a lack of fundamental social, economic, and political resources, it is also linked to an increased risk of diabetes. An elevated risk of diabetes has been associated with these alterations. The rapid rise in diabetes among developing countries is most often attributed to the impact of food processing, agricultural system changes, significant changes in physical activity patterns on diet trends, and urban marketing systems. (Mazza, 2020)

Exposure to environmental toxins such as heavy metals and pesticides due to rapid industrialisation and expansion of agriculture and manufacturing industries, have been linked to an increased risk of diabetes. Toxins are chemicals or substances that can harm the body's normal functions and cause adverse health effects. There are several ways in which exposure to toxins can increase the risk of diabetes:

- **Insulin resistance**: Toxins can prevent the body from using insulin, a hormone that controls blood sugar levels, as it should. Increased blood sugar levels and an increased risk of type 2 diabetes result from the body developing insulin resistance.
- **Pancreatic damage**: Toxins can damage the pancreas, an organ that produces insulin. Damage to the pancreas can lead to a decrease in insulin production, which can cause diabetes.
- **Obesity**: Toxin exposure, particularly in the early stages of life, can impair the growth of fat cells and increase their number and size, which can result in obesity. A significant risk factor for type 2 diabetes is obesity.

- **Oxidative stress**: Oxidative stress is a condition that develops when there is an imbalance between the body's capacity to neutralise free radicals and the generation of free radicals. Toxins can create this condition. Oxidative stress can cause tissue and cell damage, inflammation, and cell death, all of which can hasten the onset of diabetes.

Examples of toxins that have been linked to diabetes include: Persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs) and dioxins. Heavy metals, such as lead and cadmium. Pesticides, such as organochlorines and organophosphates. Bisphenol A (BPA), a chemical used in the production of plastic. Overall, exposure to toxins can increase the risk of diabetes by disrupting normal physiological functions in the body.

Reducing exposure to toxins and adopting a healthy lifestyle, such as regular exercise and a balanced diet, can help reduce the risk of developing diabetes. Eating habits have significantly altered due to the fast-paced livelihood that both adolescents and adults have chosen. Concentration on packaged and fast food has created a lifestyle where healthy eating habits have become a rare phenomenon. Type 2 Diabetes has an association with dietary habits where red meat, processed meat, carbohydrates, and sugar-based synthetic beverages are used in amounts that are not appropriate for a healthy human body.

Active bodily function seemed almost minimal as the current job prospects require long hours of desk jobs than manual services with industrialization and machinery evolution making our lives easier and lazier in the spotlight. This results in letting the body acquire an awkward seating position resulting in cramped muscles, neck and back pain, and other posture-related issues. This, later on, results in insulin resistance and increased activity of the sympathetic nervous system. Individuals mostly are seen to get themselves involved indoors and in educational institutions with electronic gadgets that are beneficial to complete assignments and other leisure activities attaining sedentary lifestyles.

There is limited research on the relationship between thought alteration and diabetes. However, it is known that stress and mental health can impact physical health, including blood sugar control in people with diabetes. Stress can cause changes in hormones that can impact blood sugar levels. People with diabetes who experience depression, anxiety, or other mental health conditions may struggle with following a healthy lifestyle and managing their diabetes, which can lead to fluctuations in blood sugar levels and an increased risk of complications. On the other hand, some studies suggest that mindfulness-based interventions, such as meditation and yoga, may help improve blood sugar control and reduce stress levels in people with diabetes. It's important for people with diabetes to seek support for their mental health, whether it's through therapy, support groups, or other resources. A healthcare provider can also provide recommendations for managing stress and improving mental health in people with diabetes.

Habits and beliefs also constitute a major proportion in the onset of the disease. Positive attitude towards life in general and having optimal self-esteem and self-concept enables individuals to inculcate livelihoods that are considered appropriate for growth and development holistically. This will proportionately reduce the type 2 diabetes caused by sedentary and poor lifestyle. It can take years for Type 2 Diabetes symptoms to become apparent. Some individuals don't even pick up on symptoms. Despite the fact that more and more children and teenagers are developing it, symptoms typically appear as people get older. Knowing the risk factors for Type 2 Diabetes is crucial because the symptoms are subtle. But, it can also cause tingling, discomfort, or numbness in the hands or feet. Chronic type 2 diabetes has an impact on the body's ability to metabolise blood sugar (glucose). Changes in lifestyle can be extremely helpful in controlling and even reversing the consequences of type 2 diabetes. Some of the recommended lifestyle changes include:

- **Eating a healthy diet**: A balanced diet that includes lots of fruits, vegetables, whole grains, and lean proteins should be your main priority. Avoid consuming sugary beverages and foods that are high in saturated and trans fats.
- **Maintaining a healthy weight**: Excess weight can contribute to insulin resistance and make it harder to manage blood sugar levels. Losing weight through diet and exercise can help improve blood sugar control.
- **Physical activity**: Regular physical activity, such as brisk walking, jogging, cycling, swimming or dancing, can help improve insulin sensitivity, lower blood sugar levels, and promote weight loss. Aim for at least 30 minutes of moderate physical activity most days of the week.
- **Quitting smoking**: Smoking can harm blood vessels and raise a diabetic's risk of heart disease and other issues.
- **Stress management**: Changes in hormones brought on by stress may have an effect on blood sugar levels. Stress levels can be controlled by partaking in stress-relieving exercises like yoga, meditation, or deep breathing.

- **Getting enough sleep**: The hormones that control appetite and metabolism can be upset by a lack of sleep, which can result in weight gain and insulin resistance. Sleep for 7-9 hours every night.

By making these changes, people with type 2 diabetes can improve their overall health, reduce the risk of complications, and better manage their blood sugar levels. However, it's important to remember that everyone is different and the approach that works best for one person may not work for another. It's always best to work with a healthcare provider to develop a personalised treatment plan.

Behavioral patterns can be observed across a wide range of domains, including social, cognitive, and emotional behavior. Identifying and understanding behavioral patterns can be useful for personal growth and development, as well as for improving communication and relationships with others. In some cases, these patterns may be problematic and require professional intervention, such as therapy or counseling. The present study aims to understand the behavioural patterns surmounting dietary choices and exercise motivation.
IT also further studies the relationship between exercise motivation and satisfaction in life among individuals diagnosed with Type 2 diabetes or who are pre diabetics aged between 12-70 years residing in major Indian states.

Review of Literature

The rigid challenges when it comes to managing diabetes contain within cognitive fusion and experiential avoidance in adolescents. The extensive use of psychosocial intervention becomes so necessary because medication taps the surfaces not the depth of a lifestyle disease. The genetic inheritance coupled with environmental factors needs to be highlighted because the choices made are at our disposal and the management can benefit a great deal. The role of Acceptance-Commitment Therapy rests on the foundational ground of contextual behavioural science. Avoidance of the suffering will only accentuate the risk factors and decline the prognosis of it. The Acceptance Commitment Therapy, therefore, focuses on using mindfulness and acceptance, reducing the impact of thoughts and self-conceptualization of behaviour to manage T2D among adolescents. (Katherine Hadlandsmyth, 2013)

Although managing diabetes is difficult and tiring, the results are better. Clinical data points to individual and social behavioural elements that will produce the best behavioural alteration necessary to control diabetes and both delay and prevent its occurrence. Many co-occurring eating and mental disorders, community infrastructure, familial support, and health literacy are among the many contributing factors. To improve peer, family, and community communication and integrate behavioural modification techniques into clinical and community contacts to improve health welfare, probable recommendations are enabled. (Korey K Hood, 2015)

The efficacy of the activity monitor that displays the exercise intensity and steps was compared with that of the pedometer fused with exercise therapy. The participants were subjected into the activity monitor group of 92 participants in total and the pedometer group of 95 participants. The main goal was the improvement of Haemoglobin A1c. A significant difference was observed in terms of the decrease in HbA1c level between the two groups at a period of 2 months. The findings highlighted that deploying the activity level monitor which displays information on exercise intensity, along with the number of steps, is crucial in exercise therapy in the process that promotes the lowering of HbA1c in diabetic patients. (Masaaki Miyauchi, 2016)

The effectiveness of lifestyle interventions supported by dietary modifications and cardiovascular fitness on glycemic control in young people with type 2 diabetes who are overweight is not fully understood. The results of a clinical trial cohort from 15 US centres that looked at the Treatment Options for Type 2 Diabetes in Teens and Youth with Type 2 Diabetes 2 Years and Body Mass Index revealed that 33% of men and 5% of women increased cardiovascular fitness. This was associated with a lower percentage of men developing glycemic failure (HbA1c 8%; P =.007) and a lower HbA1c (P =.001) in men.
Females who consumed less saturated fat and/or more fibre at month 24 had lower HbA1cs (P =.01 and P =.007, respectively). (Andrea Kriska, April, 2017)

Cognitive challenges such as learning about a new disease and debunking the myths associated with and managing the youth knowledge and superficial knowledge gained from unreliable sources create several roadblocks in the treatment and management of diabetes. Behavioural challenges like maintaining positive youth health behaviour and adherence to the regimen outlined seem difficult because of the several stimuli encouraging unhealthy lifestyles because they tend to be the prerequisite for an easy lifestyle. Psychological challenges include managing youth emotions surrounding the concept of diabetes and navigating social relationships with peers and family members around disclosing the diagnosis of T2D in the adolescent. Enhancing the knowledge of parents

with regard to symptomatology, aetiology, and treatment or management of prediabetes and diabetes among adolescents helps in better prognosis and remission. (Sara M. St. George, 2017)

A prospective cohort research included 867 patients newly diagnosed with Type-2 Diabetes, aged between 40 and 69 years, from the Addition-Cambridge Study assessed the relationship between behaviour modification and weight loss in Type 2 diabetes as well as the remission of diabetes at 5 year follow-up. At baseline and a year after diagnosis, participants had evaluations regarding their weight change, physical activity (EPAQ2 questionnaire), diet (plasma vitamin C and self-report), and alcohol usage (self-report). HbA1c levels were used to evaluate remission five years following diabetes diagnosis. The study's final finding was that early in the disease trajectory, weight reduction of less than or equal to 10% appeared to be related with an enhanced risk of remission at five years. (H. Dambha-Miller, 2019). Diabetes is described as a condition characterised by persistently elevated blood sugar levels. Many health issues, such as hyperosmolar hyperglycemia, diabetic ketoacidosis, or even mortality, can arise if it is not treated and managed. Chronic kidney disease, foot ulcers, eye damage, cardiovascular disease, and stroke are some more long-term health issues. In the process of preventing or managing type 2 diabetes, it is seen useful to maintain a healthy diet, low-fat diet, low-calorie diet, palaeolithic diet, very low carbohydrate diet, raw food intake, and/or ketogenic diet. (Chinaza Godswill Awuchi, Feb 2020)

Selective lifestyle changes are hindered by financial and material resources that prevent access to nutritious diets, physical activity, and competing daily responsibilities. Diabetes prevention programmes must provide adolescents and their parents with straightforward interactive, hands-on learning experiences that combine a feeling of fun, play, and community. In order to support diabetes prevention programmes for teenagers using human-centered design methodologies, healthy lifestyles need to be intrinsically motivated, aligning with important values and identity, and contain opportunities to try new behaviours in a supportive environment with associated incentives and rewards. (Julie M Pike, 2020)

Cognitive Behavioural Therapy and health education showed better outcomes among adolescents at risk of T2D. A year later the adolescent girls reported greater depression and insulin resistance when CBT was coupled with mindfulness. Cognitive restructuring and thought alteration encircling the risk involved with T2D and life-long severity and comorbidities can have a better success outcome. (Pinhas-Hamiel O, 2020)

The incidence of childhood and adolescent diabetes hailing from different states of India varied significantly from 3-29% and the highest incidence of diabetes mellitus was 2.55/1000 among Indian adolescents. (WHO, 2010). A study in Chennai showcased that the majority of adolescents had average risk for lifestyle and moderate risk for diabetes mellitus for the poor lifestyle choices adopted and pressure from educational institutions and family. This study demonstrated a positive correlation between lifestyle and risk for diabetes mellitus. Though the risk for diabetes mellitus is equal in boys and girls, it can be noted from the study that boys are physically more active than girls hence there is a significant difference in physical activity at 1% level of significance. (S Gayathri Chellam, 2020). A quasi-experimental design and follow-up evaluations on the experimental and control groups were used to examine the short-term effectiveness of brief group cognitive behavioural therapy (BG-CBT) in reducing diabetes-related distress (DRD), lowering haemoglobin A1c (HbA1c), improving food consumption behaviour, enhancing physical activity, and improving medication adherence behaviour. The Diabetes Mellitus Clinic at Hang Dong Hospital in Chiang Mai, Thailand, was used to gather 56 participants who were either diagnosed with type 2 diabetes or who had moderate to severe diabetes-related distress. Participants were then randomly assigned to either the brief CBT group or the control group. The control group received standard care while the CBT group underwent six quick weekly sessions of cognitive behavioural group therapy. Participants' baseline information was gathered from them at weeks 0 and 6. (Tunsuchart, Lerttrakarnnon, Srithanaviboonchai, Likhitsathian, & Skulphan, 2020)

Having type 2 diabetes is a serious health calamity. Diabetes management necessitates paying strict attention to food decisions and regular intake. The decision-making processes underlying dietary behaviour modification were examined using a qualitative methodology incorporating semi-structured telephonic interviews. This analysis revealed numerous themes relating to better health outcomes for people with T2D. Together with the volitional process (understanding one's limit, learning about how one's body responds to food, forming plans to achieve the goals), implicit processes, such as the desire to improve health status, ability, and responsibility to make a change in dietary intakes, are essential (unlearning habits and limitation of the availability). The study also discusses a number of

individual variations and feelings that are equally important in the management procedures of diabetes that have long-term benefits. (Roshan R. Rigby, 2022)

Persons with diabetes mellitus have experienced many lifestyle changes. These experiences cause several physical and psychological reactions. Anxiety, stress, low self-esteem, a support system, and less physical activity can restrict one's growth and decline the management pursuits for T2D. (Sri Sumartini, 2022) The effectiveness of a 12-week cognitive behavioural therapy programme using an app with supervision from a therapist in reducing the symptoms of depression and anxiety in individuals with chronic physical conditions like obesity and Type 2 Diabetes was investigated. For the study, a total of 1512 people with moderate depression levels were enrolled. The treatment cohort consisted of 831 patients who successfully completed the follow-up exams. The 12-week treatment programme included weekly one-on-one video counselling sessions with a professional therapist, followed by monthly sessions. The planned lesson plans included exercises and activities. The participants were given the Generalized Anxiety Disorder scale (GAD-7) and the Patient Health Questionnaire (PHQ-8) to gauge their levels of anxiety and depression, respectively. The results showcased clinical significant improvement in depressive symptoms by 74% clinically after 12 weeks. An exploratory analysis of changes in body weight at a multilevel, mixed-effect model showcased that reliable improvement in depressive symptoms at follow-up was associated with significantly greater weight loss at 9 months and better management of diabetic symptoms. (Venkatesan A, 2022)

The correlations between physical behaviours and type 2 diabetes mellitus (T2DM) risk markers were investigated in a cross-sectional study involving middle-aged South African men and women. Combining the signals from two triaxial accelerometers worn simultaneously on the hip and thigh, we were able to determine the total movement volume and time in minutes spent across different physical activities—even while awake or sitting/lying, standing, light intensity physical activity (LPA), and moderate-to-vigorous intensity of physical activity (MVPA). The findings showed that the total movement volume was inversely associated with measures of fasting and 2-hour glucose and directly associated with insulin sensitivity, basal insulin clearance, and beta-cell function, but these associations were not independent of fat mass, except for basal insulin clearance in women. In conclusion, moderate-to-vigorous intensity of physical activity is essential to reduce the risk of Type 2 diabetes in men and women, however light intensity physical activity seems to be more important for women to manage Type 2 diabetes. (Venkatesan A, 2022)

Methods

Objective of the study- The study aims to understand the behavioural patterns surmounting dietary choices and exercise motivation among individuals diagnosed with Type 2 diabetes or who are pre-diabetic aged between 12-70 years residing in major Indian states using The UK Diet and Diabetes Questionnaire (Clare Y England, 2017) and The Exercise Motivation Inventory-2 (EMI) (Markland, 1997). The study also aims to study the relationship between exercise motivation and satisfaction in life using The Satisfaction in Life Scale (Diener, 1985) of the participants recruited in the study with the above said medical diagnosis.

Research Hypothesis-

There is a positive relationship between the exercise motivation of individuals diagnosed with Type-2 Diabetes or who are pre-diabetic and life satisfaction.

Variables -

Independent Variable - Exercise Motivation
Dependent Variable - Satisfaction in Life

Sample - A purposive sample consisting of individuals in the age group of 12-70 years diagnosed with Type 2 Diabetes or are pre-diabetics hailing from different states in India have been recruited for the study.

Sample Inclusion Criteria - Individuals hailing from India and are diagnosed with Type 2 Diabetes or are pre-diabetics.

Sample Exclusion Criteria -

- No other diagnosed or undiagnosed major health comorbidities.
- No diagnosed psychological disorders such as depression, anxiety, affective disorders, personality disorders, etc.
- No significant negative life events in the past 6 months.
- No history of addiction involving alcohol or psychoactive substances by the participant.

Instruments used-

- The UK Diet and Diabetes Questionnaire (Clare Y England, 2017)
- The Exercise Motivation Inventory-2 (EMI) (Markland, 1997)
- The Satisfaction in Life Scale (Diener, 1985)

Research Design - This study utilizes a descriptive quantitative research approach. The behavioural patterns of individuals diagnosed with Type 2 Diabetes will be documented with a survey involving relevant scales to understand their diet, exercise preferences, and satisfaction in life.

Statistical Analysis

Correlation is used to determine if there is a positive correlation between exercise motivation and satisfaction in life among the participants. Chi-square was employed to understand the relationship between the several edible substances constituting the dietary choices of individuals being studied using the UK Diet and Diabetes Questionnaire. Descriptive statistics like mean and standard deviations were employed to describe the various aspects of the sample.

Results

The data for the study was obtained from 220 participants; 109 female participants and 111 male participants. The participants hailed from different states in India. A total of 207 participants were medically diagnosed with Type 2 Diabetes and 13 participants were pre diabetics. The mean age of the participants recruited was found to be 44.223 years.

Table 1:
Showing the mean, and standard deviation of the Exercise Motivations Inventory - 2 (EMI-2) and Life Satisfaction Scale and the correlation between the 2 scales.

	Exercise Motivation Inventory 2	Life Satisfaction Scale
Mean	177.595	12.818
Standard deviation	58.599	6.647
Correlation between the 2 scales	0.282933	

The r-value was calculated to be 0.282933 which is a low positive positive correlation between the exercise motivation and life satisfaction among the participants diagnosed with Type-2 diabetes and who are pre-diabetic.

Table 2:
Showing the total raw score and mean score of the 14 dimensions under the Exercise Motivation Inventory-2.

Dimensions	Total Raw Score	Mean Score
Stress Management	2875	13.068
Revitalization	2256	10.254
Enjoyment	2942	13.273
Challenge	3339	15.177
Social Recognition	3033	13.786
Affiliation	2820	12.818
Competition	3294	14.972
Health Pressures	2220	10.091
Ill- Health Avoidance	2305	10.477
Positive Health	2340	10.636
Weight Management	3115	14.159
Appearance	2930	13.318
Strength & Endurance	3483	15.832
Nimbleness	2119	9.632

Table 3:
Showing the scores of healthy, less healthy, and unhealthy dietary dimensions and chi-square value as well as p-value on the UK Diet and Diabetes Questionnaire.

Dimensions	Healthy Dietary Choices	Less Healthy Dietary Choices	Unhealthy Dietary Choices	Chi-square	p-value
Vegetables	91	113	16	4.54752E-05	4.74513E-16
Fruits	82	111	27	4.54752E-05	1.63951E-11
Cakes & Biscuits	148	62	10	132.533	1.66273E-29
Sweets & Chocolates	156	59	5	4.54752E-05	2.05923E-3
Sugary Drinks	143	50	27	4.54752E-05	4.45993E-23
Full Fat Spread	160	53	7	4.54752E-05	3.08205E-37
Cheese	163	52	5	4.54752E-05	1.00089E-39
Processed meat	105	103	12	4.54752E-05	1.89659E-17
Crips & Salty Snacks	97	66	57	4.54752E-05	0.002460726
Pastries	129	70	21	4.54752E-05	4.71666E-18
Fast Foods	134	83	3	4.54752E-05	1.46383E-26
Pudding	126	87	7	4.54752E-05	8.26522E-22
Alcohol	178	38	4	4.54752E-05	4.04409E-51

Oily Fish	100	115	5	4.54752E-05	8.26522E-22
Regular Meals	71	80	69	4.54752E-05	0.625992141
Breakfast	104	55	61	4.54752E-05	5.85657E-05
Snacking	98	49	73	4.54752E-05	0.000277384
High-Fibre Bread	156	62	2	4.54752E-05	1.99779E-36

Choice of all the edibles listed above except regular meals by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)

Discussions

A correlation was determined between the scores of the Exercise Motivations Inventory - 2 (EMI-2) and Life Satisfaction Scale using Pearson's Product Moment Correlation. This was done to determine if there is any correlation between exercise motivation and satisfaction in life in the group as a whole. The r-value was calculated to be 0.282933 which is a low positive positive correlation between the exercise motivation and life satisfaction among the participants diagnosed with Type-2 diabetes and who are pre-diabetic. This indicates that regular exercises have been linked to increased life satisfaction and overall well-being. Exercise can help improve mood, reduce stress, anxiety and boost self-esteem, all of which can contribute to an overall sense of well-being and satisfaction in life holistically.

Reluctance to exercise and maintaining a healthy regime to indulge in several physical activities stems from the inability to find an enjoyable exercise activity. Efforts to find an effective exercise regime with essential aerobic challenges and at the same is considered enjoyable encompasses the challenge further. However, numerous reports and studies focused on the importance of exercise in the management and treatment of diabetes frame a positive picture and the most beneficial and organic way to combat any lifestyle-related diseases. Recent studies are rigorously evaluating the impact of exercise and vitamin D supplementation and their interplay with diabetic peripheral neuropathy and ulceration. Hence the coagulation of research findings has shown a remarkable benefit from exercise and physical activities in ameliorating the symptoms of diabetes and delaying the onset of it. (David W. Jenkins, 2017)

The total raw score obtained by the sample group under the Exercise Motivation Inventory-2 was found to be 39071 and the corresponding mean, as well as standard deviation, was 177.595 and 58.599 respectively. This inventory has 14 dimensions which are discussed below concerning the data obtained from the sample.

- **Stress Management** - Stress management is the process of identifying and reducing or coping with the negative effects of stress on a person's physical, emotional, and mental well-being. It involves the use of various strategies, techniques, and activities to help individuals better understand and manage their stress levels. The sample had a total score of 2875 and a corresponding mean of 13.068 under stress management.
- **Revitalisation**- Revitalization refers to the process of bringing new life or energy into something that has become stagnant or inactive. It involves efforts to restore vitality, strength, or vigor to an individual, organization, community, or system that has experienced decline or stagnation. The sample had a total score of 2256 and a corresponding mean of 10.254 under this dimension of revitalization.
- **Enjoyment**- Enjoyment is a feeling of pleasure or satisfaction that comes from engaging in an activity or experiencing something. It is a subjective experience that varies from person to person, and can be influenced by a variety of factors, such as personal preferences, cultural background, mood, and context. The group had a total score of 2942 and a mean of 13.273 under the dimension of enjoyment.
- **Challenge**- A challenge is a task or goal that requires effort, skill, or determination to accomplish. It is something that tests a person's abilities, knowledge, or resources, and may be difficult or even impossible to achieve without overcoming obstacles or facing adversity. Challenges can come in different forms, such as physical, intellectual, emotional, or social, and can be experienced in various domains of life, such as work, education, relationships, or personal growth. They can be perceived as opportunities for growth and learning, as well as sources of stress and frustration, depending on how they are approached and managed. Overall, a challenge can provide motivation and a sense of accomplishment when successfully overcome. The group had a total score of 3339 and a mean score of 15.177 under challenge.
- **Social Recognition**- Social recognition refers to the acknowledgement and appreciation of a person's contributions or achievements by others in their social circle or community. The group had

a total score of 3033 and a mean score of 13.786 under the dimension of social recognition.

- **Affiliation**- Affiliation refers to the desire or tendency to form social connections and maintain relationships with others. It is a basic human need and an important aspect of social behavior. Affiliation can involve seeking out social contact, joining groups or communities, and engaging in social activities or events. The group had a total score of 2820 and a mean score of 12.818 under this dimension of affiliation.
- **Competition**- Competition refers to a situation in which individuals or groups strive to outperform each other in order to achieve a desired outcome, such as winning a prize, gaining recognition, or obtaining a limited resource. It involves a struggle for superiority, often based on a set of rules or criteria that define the parameters of the competition. The group had a total score of 3294 and a mean score of 14.972 under competition.
- **Health Pressures** - It typically refers to a responsibility or duty that an individual has to maintain their own physical, mental, and emotional well-being. This can include behaviors and practices that promote health, such as regular exercise, healthy eating, stress management, and preventative care. The group had a total score of 2220 and a mean score of 10.091 under health pressures.
- **Ill-Health Avoidance** - "Ill health avoidance" refers to the proactive steps that individuals take to prevent the onset of physical or mental health problems. This can include a wide range of behaviors and practices, such as getting regular medical check-ups, engaging in regular exercise, eating a healthy diet, getting enough sleep, reducing stress, and avoiding risky behaviors such as smoking or substance abuse. The group had a total score of 2305 and a mean score of 10.477 under this dimension.
- **Positive Health** - Positive health refers to a state of physical, mental, and social well-being that goes beyond the mere absence of disease or infirmity. It is a holistic and positive approach to health that emphasizes the capacity of individuals to lead fulfilling and productive lives. The group had a total score of 2340 and a mean score of 10.636 under positive health.
- **Weight Management -** Weight management refers to the process of achieving and maintaining healthy body weight through a combination of diet, exercise, and other lifestyle changes. It involves managing the balance between the number of calories consumed and the number of calories burned, to achieve a healthy weight and body composition. The group had a total score of 3115 and a mean score of 14.159 under weight management.
- **Appearance** - Appearance refers to the way a person or thing looks or presents itself to others. It encompasses various physical attributes such as height, weight, skin color, hair type, facial features, and clothing, as well as the way these attributes are combined and presented. Appearance can also include non-physical aspects such as posture, body language, grooming habits, and personal style. The group had a total score of 2930 and a mean score of 13.318 under appearance.
- **Strength & Endurance** - Strength refers to the ability of the muscles to generate force or resistance against a load. Endurance, on the other hand, refers to the ability of the body to sustain physical activity for an extended period of time without fatigue. The group had a total score of 3483 and a mean score of 15.832 under strength and endurance.
- **Nimbleness** - Nimbleness, also known as agility, refers to the ability to move quickly and easily with coordination and balance. It involves a combination of physical attributes, such as speed, balance, flexibility, and coordination, as well as mental attributes such as quick decision-making and reaction time. The group had a total score of 2119 and a mean score of 9.632 under nimbleness,

Life satisfaction is a multidimensional construct that can be measured using a variety of self-report measures, such as the Satisfaction with Life Scale. These measures typically assess a person's overall evaluation of their life, as well as their satisfaction with specific domains such as work, family, and leisure. Overall, life satisfaction is an important concept in psychology as it reflects an individual's overall sense of well-being and can have important implications for their mental and physical health, as well as their ability to cope with stress and adversity.

The group obtained a total score of 5720 and a corresponding mean score of 6.386 on The Life Satisfaction Scale. This indicates that the group on the whole is satisfied in their life. 70 participants are extremely satisfied in their life, 47 participants are satisfied, 52 participants are slightly satisfied, 34 participants are neutral, 14 of them are slightly dissatisfied, 7 participants are dissatisfied and 3 participants are extremely dissatisfied in their life.

Life satisfaction is a psychological concept that refers to a person's overall evaluation of their life. It is a subjective assessment of one's own life that takes into

account a range of factors such as achievements, relationships, and general happiness. Life satisfaction can be influenced by a variety of factors, including individual characteristics such as personality, social and economic factors, and life events such as career success, relationships, and health. Individuals with high levels of life satisfaction tend to have a positive view of themselves, their relationships, and their lives in general. They may experience higher levels of happiness, positive emotions, and overall well-being, and they may also be more resilient in the face of stress or adversity. On the other hand, individuals with low levels of life satisfaction may experience negative emotions such as sadness, anxiety, or depression, and may be more vulnerable to stress and adversity. They may also be more prone to engaging in unhealthy behaviors, such as substance abuse, overeating, or social withdrawal.

Factors such as age, income, personality, number of comorbidities, body mass index, smoking habits, physical activity, and life satisfaction (were examined for interaction with diabetes type. The interaction of age and diabetes type was significant for HRQL (β = 0.05, $p < 0.05$, ɧ2 = 0.016), Aging was associated with increased health-related quality of life in the Type 2 diabetes group, while age was inversely associated with health-related quality of life in the Type 1 diabetes group. There seemed no significant interactions between the identified determinants and diabetes type in life satisfaction. (Ikuyo Imayama, 2011)

Maintaining a healthy diet is crucial for overall health and well-being. A balanced and nutritious diet provides the body with the necessary nutrients, vitamins, and minerals it needs to function optimally. It can boost energy levels and improve stamina, allowing you to perform daily activities with ease. The foods we eat can have a significant impact on our mood and mental health. Eating a healthy diet can help improve mood, reduce stress, and prevent depression.

The UK Diet and Diabetes Questionnaire (Clare Y England, 2017) targets foods and habits important in diabetes prevention and management. The questionnaire was administered to the sample group and statistical analysis of chi-square was done to understand their dietary dynamism and to confirm whether the observed results are in line with the expected outcome due to chance or is it because of the relationship between different variables considered in this study. The results are elaborated below.

- **Vegetables**- Vegetables are an essential part of a healthy and balanced diet. They are low in calories, high in fiber, and packed with vitamins, minerals, and other beneficial nutrients that are important for maintaining good health. Under this dimension, 91 participants have healthy dietary choices, 113 participants have less healthy dietary choices encircling vegetables and 16 participants have unhealthy dietary choices wherein they only include vegetables rarely or once a week. The chi-square value is 4.54752E-05 and the p-value is 4.74513E-16 indicating that the choice of vegetables by participants diagnosed with Type-2 diabetes and being healthy is statistically significant. ($p<0.05$)
- **Fruits**- Fruits are rich in essential nutrients, such as vitamin C, potassium, folate, and fiber, which are important for maintaining good health. They are a good source of dietary fiber, which promotes healthy digestion, reduces the risk of heart disease, and helps regulate blood sugar levels. Under this dimension, 82 participants have healthy dietary choices, 111 participants have less healthy dietary choices encircling fruits and 27 participants have unhealthy dietary choices wherein they only include fruits rarely or once a week. The chi-square value is 4.54752E-05 and the p-value is 1.63951E-11 indicating that the choice of fruits by participants diagnosed with Type-2 diabetes and being healthy is statistically significant. ($p<0.05$)
- **Cakes & Biscuits**- Cakes and biscuits are typically high in sugar, refined carbohydrates, and unhealthy fats. While they may be enjoyable to eat in moderation, consuming them regularly in large amounts can have negative health consequences. Under this dimension, 148 participants have healthy dietary choices, 62 participants have less healthy dietary choices encircling fruits and 10 participants have unhealthy dietary choices wherein they only include fruits rarely or once a week. The chi-square value is 132.533 and the p-value is 1.66273E-29 indicating that the choice of cakes and high-sugar biscuits by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Sweets & Chocolates**- Under this dimension, 156 participants have healthy dietary choices, 59 participants have less healthy dietary choices encircling fruits and 5 participants have unhealthy dietary choices wherein they only include sweets and chocolates 1-3 times a day or more. The chi-square value is 4.54752E-05 and the p-value is 2.05923E-3 indicating that the choice of sweets and chocolate by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)

- **Sugary Drinks**- Under this dimension, 143 participants have healthy dietary choices, 50 participants have less healthy dietary choices encircling drinks high in sugar and 27 participants have unhealthy dietary choices wherein they include sugary drinks 1-3 times a day or more. The chi-square value is 4.54752E-05 and the p-value is 4.45993E-23 indicating that the choice of sugary drinks by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Full Fat Spread**- Under this dimension, 160 participants have healthy dietary choices, 53 participants have less healthy dietary choices encircling full fat spread and 7 participants have unhealthy dietary choices wherein they include full fat spreads 1-3 times a day or more. The chi-square value is 4.54752E-05 and the p-value is 3.08205E-37 indicating that the choice of full fat spread by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Cheese**- Under this dimension, 5 participants have healthy dietary choices, 52 participants have less healthy dietary choices encircling cheese and 163 participants have unhealthy dietary choices wherein they include cheese spreads daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 1.00089E-39 indicating that the choice of cheese by participants diagnosed with Type-2 diabetes and being unhealthy or healthy is statistically significant. ($p<0.05$)
- **Processed meat**- Under this dimension, 105 participants have healthy dietary choices, 103 participants have less healthy dietary choices encircling processed meat and 12 participants have unhealthy dietary choices wherein they include processed meat daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 1.89659E-17 indicating that the processed meat by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Crisps and salty snacks**- Under this dimension, 97 participants have healthy dietary choices, 66 participants have less healthy dietary choices encircling Crisps and salty snacks and 57 participants have unhealthy dietary choices wherein they include chips spread daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 0.002460726 indicating that the choice of Crisps and salty snacks by participants diagnosed with Type-2 diabetes and being unhealthy is statistically significant. ($p<0.05$)
- **Pastries**- Under this dimension, 129 participants have healthy dietary choices, 70 participants have less healthy dietary choices encircling pastries and 21 participants have unhealthy dietary choices wherein they include them daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 4.71666E-18 indicating that the choice of pies, pasties and savory pastries by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Fast Foods**- Under this dimension, 134 participants have healthy dietary choices, 83 participants have less healthy dietary choices encircling fast food and 3 participants have unhealthy dietary choices wherein they include them daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 1.46383E-26 indicating that the choice of fast food by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Pudding**- Under this dimension, 126 participants have healthy dietary choices, 87 participants have less healthy dietary choices encircling pudding and 7 participants have unhealthy dietary choices wherein they include them daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 8.26522E-22 indicating that the choice of pudding by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Alcohol**- Under this dimension, 178 participants have healthy dietary choices, 38 participants have less healthy dietary choices encircling liquor and 4 participants have unhealthy dietary choices wherein they include them daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 4.04409E-51 indicating that the choice of liquor by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Oily Fish**- Under this dimension, 100 participants have healthy dietary choices, 115 participants have less healthy dietary choices encircling oily fish and 5 participants have unhealthy dietary choices wherein they include them daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 8.26522E-22 indicating that the choice of oily fish by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Regular Meals**- Under this dimension, 71 participants have healthy dietary choices, 80 participants have less healthy dietary choices

encircling a proper healthy balanced diet and 71 participants have unhealthy dietary choices wherein they include them rarely or less than once a week. The chi-square value is 4.54752E-05 and the p-value is 0.625992141 indicating that the choice of regular meals by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is not statistically significant. ($p>0.05$)

- **Breakfast**- Under this dimension, 104 participants have healthy dietary choices, 55 participants have less healthy dietary choices encircling breakfast and 61 participants have unhealthy dietary choices wherein they include them rarely or less than once a week. The chi-square value is 4.54752E-05 and the p-value is 5.85657E-05 indicating that the choice of breakfast by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **Snacking**- Under this dimension, 73 participants have healthy dietary choices, 49 participants have less healthy dietary choices encircling snacking and 98 participants have unhealthy dietary choices wherein they include them 5-6 times a week or everyday. The chi-square value is 4.54752E-05 and the p-value is 0.000277384 indicating that the choice of snacking by participants diagnosed with Type-2 diabetes and being unhealthy and healthy is statistically significant. ($p<0.05$)
- **High-Fibre Breads**- Under this dimension, 156 participants have healthy dietary choices, 62 participants have less healthy dietary choices encircling high-fiber breads and 2 participants have unhealthy dietary choices wherein they include them daily or twice or more a day. The chi-square value is 4.54752E-05 and the p-value is 1.99779E-36 indicating that the choice of high-fiber breads by participants diagnosed with Type-2 diabetes and being unhealthy is statistically significant. ($p<0.05$)

Diet is a crucial component of managing diabetes, as it can help control blood sugar levels and prevent complications. Eating regularly and in moderate amounts is important as it helps to prevent blood sugar spikes and crashes. Complex carbohydrates, such as whole grains, fruits, and vegetables, are better for people with diabetes than simple carbohydrates, such as sugar, and refined grains are required as carbohydrates have the most significant effect on blood sugar levels. Eating lean proteins such as chicken, fish, and legumes, which are good sources of protein without added fat, and consuming healthy fats that include unsaturated fats found in nuts, seeds, and vegetable oils are considered crucial. Avoiding processed foods that can be high in added sugars, sodium, and unhealthy fats is beneficial in the management of the disease.

Conclusions

The present study demonstrates the positive relationship between exercise motivation and satisfaction in life among the participants diagnosed with Type-2 diabetes and who are pre-diabetics. This implies that participants have good insights encompassing the need to monitor their physical activities in order to keep their blood sugar level at a level that is considered appropriate and healthy based on their subsequent age and body mass index.

Exercise can have significant benefits for people with diabetes, including helping to enhance blood sugar control. It can also decrease insulin resistance, which means that the body needs less insulin to transport glucose into the cells. This can also lead to lower blood sugar levels. It increases glucose uptake by the muscles, even in the absence of insulin. This means that muscles can use glucose for energy even if insulin is not available. People with diabetes need to talk to their healthcare provider before starting an exercise program. They may need to adjust their medication or insulin dosages before and after exercise to prevent low blood sugar (hypoglycemia). They may also need to monitor their blood sugar levels before, during, and after exercise to make sure they stay within a safe range.

Diabetes is a growing health problem in India. According to the International Diabetes Federation, India had an estimated 77 million adults living with diabetes in 2019, and this number is expected to rise to 101 million by 2030. Several factors contribute to the high prevalence of diabetes in India, including changing lifestyles, unhealthy diets, lack of physical activity, and genetic predisposition. Additionally, there are also challenges in diabetes diagnosis and management, including poor access to healthcare in some areas and low awareness of the condition.

The Indian government and healthcare organizations have taken steps to address the diabetes epidemic, including launching national programs to promote awareness, early diagnosis, and management of diabetes. These initiatives aim to improve access to diabetes care, promote healthy lifestyles, and increase awareness among the public.

- National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke (NPCDCS): The NPCDCS is a national program launched by the Ministry of Health and Family Welfare in 2010. The program aims to prevent and control non-communicable diseases, including diabetes, by promoting healthy

lifestyles and early diagnosis and management of the conditions.

- Eat Right India: In 2018, the government launched the Eat Right India initiative to promote healthy eating habits and reduce the prevalence of non-communicable diseases, including diabetes. The program includes initiatives such as the Food Safety and Standards Authority of India's Eat Right Challenge, which encourages citizens to make healthy food choices.
- National Diabetes and Diabetic Retinopathy Survey: The government conducted a national survey on diabetes and diabetic retinopathy in 2015-2019. The survey aimed to estimate the prevalence of diabetes in the country and assess the burden of diabetic retinopathy, a complication of diabetes that can lead to blindness.
- Jan Aushadhi Scheme: The Jan Aushadhi Scheme is a government initiative to provide affordable medicines to citizens. The scheme includes several medicines for diabetes management, which are available at low cost in Jan Aushadhi stores across the country.

These initiatives are important steps in addressing the diabetes epidemic in India. However, there is still a need for continued action and investment in diabetes prevention, early diagnosis, and management to improve the health and well-being of people living with diabetes in India. The future direction of research on diabetes needs to be focused on the correlation between psychological variables along with physiological variables on a longitudinal basis to understand different cohorts. It will help to shape appropriate intervention strategies involving psychotherapeutic measures and medication to manage the disease onset holistically promoting future physical and psychological well-being.

References

Andrea Kriska, L. E. (April, 2017). Impact of lifestyle behavior change on glycemic control in youth with type 2 diabetes. Pediatric Diabetes, 19(2).

Anetor J. I. (2010). Industrialization and the increasing risk of genome instability in developing countries: nutrigenomics as a promising antidote. African journal of medicine and medical sciences, 39 Suppl, 7–20.

Chinaza Godswill Awuchi, C. K. (Feb 2020). Diabetes and the Nutrition and Diets for Its Prevention and Treatment: A Systematic Review and Dietetic Perspective. A Systematic Review and Dietetic Perspective, 6. 5-19.

Clare Y England, J. L. (2017). Development of a brief, reliable and valid diet assessment tool for impaired glucose tolerance and diabetes: the UK Diabetes and Diet Questionnaire. Public health nutrition, 20(2), 191–199.

Clement N Kufe1, J. (2022). Physical behaviors and their association with type 2 diabetes mellitus risk markers in urban South African middle-aged adults: an isotemporal substitutionapproach. BMJ Open Diabetes Research & Care , 10(4).

Diener, E. E. (1985). The Satisfaction with Life scale. Journal of Personality Assessment, 49, 71-75.

H. Dambha-Miller, A. J. (2019). Behaviour change, weight loss and remission of Type 2 diabetes: a community-based prospective cohort study. Diabetic Medicine.

Ikuyo Imayama, R. C. (2011). Determinants of quality of life in adults with type 1 and type 2 diabetes. Health and Quality of Life Outcomes.

J. B. Meigs, P. S. (2008). Genotype score in addition to common risk factors for prediction of type 2 diabetes. The New England Journal of Medicine, vol. 359, no. 21, pp. 2208–2219.

Julie M Pike, C. M.-P. (2020). Diabetes Prevention in Adolescents: Co-design Study Using Human-Centered Design Methodologies. J Particip Med, Vol 13 , No 1 (2021) :Jan-Mar.

Katherine Hadlandsmyth, K. S. (2013). Proposing an Acceptance and Commitment Therapy. International Journal Of Behavioral Consultation And Therapy, Vol. 7, NO. 4.

Korey K Hood, M. H.-L. (2015). Effective strategies for encouraging behavior change in people with diabetes. Diabetes Manag (Lond), 5(6):499-510. PMID: 30100925; PMCID: PMC6086609.

Markland, D. (1997). The Exercise Motivation Inventory-2. University of Wales. Masaaki Miyauchi, M. T. (2016). Exercise Therapy for Management of Type 2

Diabetes Mellitus: Superior Efficacy of Activity Monitors over Pedometers. Journal of Diabetes Research.

Mazza, S. (2020). Does Urbanization or Industrialization Have More Impact on the Increasing. Physician Assistant Studies Augsburg University.

Pinhas-Hamiel O, H. D. (2020). Cognitive Behavioral Therapy and Mindfulness-Based Cognitive Therapy in Children and Adolescents with Type 2 Diabetes. Current Diabetes Reports, 20(10):55.

Poulsen P, K. K.-N. (1992). Heritability of type II (non-insulin-dependent) diabetes mellitus and abnormal glucose tolerance--a population-based twin study. . Diabetologia., 42:139–145.

Roshan R. Rigby, L. T. (2022). Understanding dietary behaviour change after a diagnosis of diabetes: A qualitative investigation of adults with type 2 diabetes. PLOS ONE.

S Gayathri Chellam, R. C. (2020). Assessment of the lifestyle and risk for diabetes mellitus among adolescents in the age group of 14-17 years at selected schools in Chennai. International Journal of Research in Paediatric Nursing, 2(2): 99-101.

Sara M. St. George, E. R. (2017). A Qualitative Study of Cognitive, Behavioral, and Psychosocial Challenges Associated With Pediatric Type 2 Diabetes in Ethnic Minority Parents and Adolescents. The Diabetes Educator, 43(2):180-189.

Sri Sumartini, S. T. (2022). Physical Activity and Psychosocial of Adolescents with Diabetes Mellitus Type 2: A Qualitative Study. Malaysian Journal of Medicine and Health Sciences.

Tillil H, K. J. (1987). Age-corrected empirical genetic risk estimates for first-degree relatives of IDDM patients. Diabetes.

Tunsuchart, K., Lerttrakarnnon, P., Srithanaviboonchai, K., Likhitsathian, S., & Skulphan, S. (2020). Benefits of Brief Group Cognitive Behavioral Therapy in Reducing Diabetes-Related Distress and HbA1c in Uncontrolled Type 2 Diabetes Mellitus Patients in Thailand. Int. J. Environ. Res. Public Health, 17, 5564.

Venkatesan A, F. B. (2022). Improvements in Depression Outcomes Following a Digital Cognitive Behavioral Therapy Intervention in a Polychronic Population: Retrospective Study. JMIR Form Res, Vol 6 , No 7

V. Lyssenko, A. J. (2008). Clinical risk factors, DNA variants, and the development of type 2 diabetes. The New England Journal of Medicine, vol. 359, no. 21, pp. 2220–2232.