*IOSR Journal Of Pharmacy www.iosrphr.org*
*(e)-ISSN: 2250-3013, (p)-ISSN: 2319-4219*
*Volume 8, Issue 7 Version. I (July 2018), PP. 27-35*

# Study of Life Style Pattern and Glycosylated Haemoglobin (Hba1c) Complications Of Diabetic Subjects

Chegi Soundarya Reddy &Archana Prabhat
*Alva's Centre for PG studies and Research, Department of Food science and Nutrition, Moodbidri-574227*
*Mangalore University*
**Corresponding Author:Archana Prabhat*

**Abstract:**

Diabetes mellitus (DM) is worldwide public health problem, its incidence and prevalence has increased in recent years both in developing and developed countries. DM is a heterogeneous, etiologic and pathogenic syndrome, characterized by chronic Hyperglycaemia. Glycosylated haemoglobin (HbA1c) is the golden standard for monitoring glycaemic control and its assay provides a measure of chronic glycaemic levels which correlates with the risk of diabetes complications. There is a strong correlation between HbA1c value and risk of chronic complications of DM. **Objective:** To study the lifestyle pattern and glycosylated haemoglobin complications of diabetic subjects. **Methodology:** A hospital based observational study was carried out among 90 diabetic subjects, required data was collected referring the patient's case record. Interviewed was done using a structural questionnaire to elicit the data collection. Demographic details were taken along with the anthropometric measurements. **Result:** Sex and family history plays a great role in developing of diabetes. An increased prevalence of Hypertension was seen in diabetic subjects although they occur independently and known to exacerbate each other. Majority of subjects showed extremely significance in biochemical parameters along with blood lipid profile and few with highly significance and significant levels which result in positive impact of diet on biochemical parameters. Also the prevalence of chronic complications with an elevated level of HbA1c value leads to severity. Interestingly they experience a higher prevalence of sleep disorder with an exerting detrimental influence on glycaemic control. Mean intake of calories, carbohydrates and fat were slightly higher than recommended dietary allowance and average of intake of protein was found to be less in both males and females. **Conclusion**: Frequent monitoring of blood sugar levels and lipid profiles have been found to be effective in reducing risk of developing type 2 DM and this is essential in the prevention and management of DM. Hence, type 2 DM is strongly linked with lifestyle, dietary pattern and HbA1c range.

**Key words:** Diabetes mellitus, Glycosylated hemoglobin, Lifestyle pattern

---

Date of Submission: 22-06-2018 Date of acceptance: 05-07-2018

---

## I. INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by chronic hyperglycaemia and disturbances of carbohydrate, fat and protein metabolism which is due to absolute or relative deficiency of insulin secretion or action[1]. Glycosylated haemoglobin is the golden standard for monitoring glycaemic control in patients with DM.In 2010, the International Expert Committee and the American Diabetes Association proposed diagnostic criteria for diabetes and prediabetes based on HbA1c levels. These are HbA1c ≥6.5% (≥48 mmol/mol) to diagnose diabetes mellitus and between 5.7–6.4% (39–46 mmol/mol) for prediabetes and normal range varies from 4-6%[2].

***Prevalence***

The global burden of DM is enormous with an estimated 366 million people living with DM worldwide. According to National Urban Diabetes Survey (2018), the age standardized prevalence of diabetes and Impaired Glucose Test were 12.1 and 14% respectively with no gender difference and that the prevalence of diabetes is uniformly high in all urban cities of India (Chennai 13.5%, Bangalore 12.4%, Hyderabad 16.6%, Calcutta 11.7%, Mumbai 9.3% and New Delhi 11.6%) but higher in Southern cities [3].

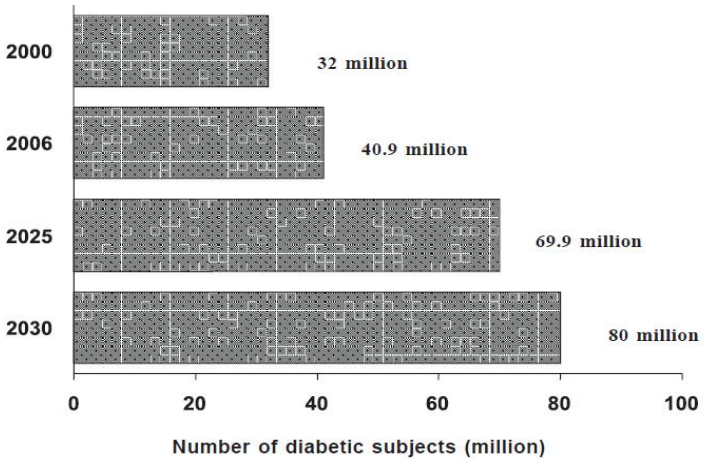


Figure 1: Estimated number of diabetic subjects in India [4].

***Complications***

- **Macro vascular** complications include Ischemic heart disease, Stroke, Peripheral vascular disease
- **Micro vascular** complications include Diabetic Retinopathy, Diabetic Nephropathy, Diabetic Neuropathy [5].

***Diagnosis***

The following are the test used for diagnosing DM

- **Casual Plasma (Blood) Glucose Test**
- **Oral Glucose Tolerance Test**
- **Fasting Plasma Glucose (FPG) Test**
- **Postprandial Blood Glucose Test**
- **Glycosylated hemoglobin Test**

***Treatment***

The major components of the treatment of diabetes are
A) Drug Treatment for Diabetes
B) Non Drug Treatment for Diabetes [6].

***Management***

The management of DM is important to control and prevent complications by maintaining normal blood glucose levels through strategies such as diet , exercise, stress management and levels of blood pressure, cholesterol [7] .

***The main objectives of this research paper are***

i) To assess the pre and post biochemical parameters of diabetic subjects
ii) To evaluate the chronic complications of diabetic subjects by HbA1c range
iii) To study the lifestyle characteristics and dietary pattern of the diabetic subjects

***Role of dietary fiber***

Intake of dietary fiber was associated with reduced prevalence of abdominal obesity, hypertension and metabolic syndrome and also with lower prevalence of albuminuria, low estimated glomerular filtration rate and chronic kidney disease after adjustments in protein intake[8].

***Quality of life***

The relationship between DM and depression, anxiety and stress symptoms are associated with poor glycaemic control. Diabetes depression and stress has been found to be significantly associated with HbA1c level. It is obvious from statistical analysis that the co-existence of diabetes and depression, anxiety and stress are highly prevalent thereby affecting glycaemic HbA1c control. As DM is very complex disease and it management requires significant self-control and increasing access to psychological support [9].

***Tobacco and smoking***

Tobacco smoke and tobacco products contain potentially harmful constituents that affects organ system and physiological processes. Smoking is a cause of type 2 diabetes and it increases with more consumption. It is shown that tobacco is associated with subclinical markers of atherosclerosis and no independent association between tobacco use and insulin resistance, but smoking plays a cause for diabetes with more incidence of complications[10].

***Physical activity and obesity***

The effect of daily routine physical activities such as occupational, household and daily lifestyle activities and obesity on the prevalence of type 2 diabetes in high-risk population has been associated with a reduced risk of type 2 diabetes [11].

***Sleep quality***

Good sleep quality plays an important role in maintaining effective glycaemic control and also improves the quality life of diabetics. Evidence had showed that there was 1.1% elevation of HbA1c due to lack of 3 hours sleep in one single night [12].

## II. METHODS

***Research design***

It is a clinical based observational study.

***Sampling method***

90 subjects of each 45 males and females were selected who were diagnosed with DM. Data was collected from subjects who had different background with various complications. The basic and clinical information was taken from profiles of the subjects and other details were taken by one to one direct interview.

***Study method and tools and techniques***

1. Demographic details:

A questionnaire was developed and used to collect general information which consisted of identification number, religion, age, sex, marital status, type of family, number of family members, place of residence, occupation and qualification.

2. Anthropometric measurements:

The Height and weight of the subjects were noted and Ideal body weight was calculated. BMI was also calculated and the samples were categorized into Underweight, Normal and Overweight or Obese based on WHO standards.

3 Biochemical Parameters:

Biochemical parameters such as haemoglobin, blood glucose levels, and other reports as per a condition were noted.

4. Clinical:

Subject's clinical history, present problem, diagnosis, treatment plan and the duration of the disease were taken. The medications prescribed for the subjects were also taken.

5. Diet Recall:

Diet recall of minimum 3 days was taken and total calories, Carbohydrates, Proteins and Fat were all calculated using Microsoft Excel. Food allergy and dietary type, lifestyle habits were also noted. Samples were counselled and dietary guidelines were suggested based on the conditions.

6. Statistical analysis of Data:

The individual data obtained were made into data sheet using SPSS software for statistical analysis of the data. SPSS (v 16.0) software was used.

## III. RESULTS AND DISCUSSION

The table has a record of anthropometric measurements of the indices such as height, weight, Ideal Body Weight (IBWI and Body Mass Index (BMI) . Height and Weight of an individual plays an important role in decrypting the external appearance. Particular weight for height must be maintained for a fit body structure. IBW gives the ideal body weight that needs to be maintained for the particular height. BMI increases and such

subjects are known to be overweight or obese but if the weight is very low related to the height BMI decreases showing the subjects as underweight. It is seen that the subjects belonging to the weight range 61-80kgs are more prone to diabetes and IBW showed that their weight must have been between the range of 41-60kgs. Subjects belonged to range 25-30 of BMI which indicates the more of subjects were overweight. Hence it can be seen that weight is one among the triggering factor leading to the diseased condition [3]

**Table 1: Frequency of Anthropometric measurements**

| Variables | Characteristics | Males n=45 n (%) | Females n=45 n (%) | Males Mean ±S.D | Females Mean ±S.D |
|---|---|---|---|---|---|
| **Height(cms)** | 141-150 | 0 (0) | 2 (4) | 1.64 ±0.08 | 1.62 ±0.08 |
| | 151-160 | 16 (35) | 18 (40) | | |
| | 161-170 | 22 (48) | 16 (35) | | |
| | >171 | 7 (15) | 9 (20) | | |
| **Weight(kgs)** | 41-60 | 3 (6) | 8 (17) | 79.43 ±14.0 | 72.73 ±9.90 |
| | 61-80 | 23 (51) | 26 (57) | | |
| | 81-100 | 16 (35) | 8 (17) | | |
| | >100 | 3 (6) | 3 (6) | | |
| **IBW(kgs)** | 41-60 | 37 (82) | 43 (95) | 54.32 ±5.55 | 52.84 ±5.44 |
| | 61-80 | 8 (17) | 2 (4) | | |
| **BMI(kg/m$^2$)** | <18 | 0 (0) | 0 (0) | 29.36 ±5.07 | 27.59 ±3.24 |
| | 18-24.9 | 10 (22) | 10 (22) | | |
| | 25-30 | 20 (44) | 27 (6) | | |
| | >30 | 15 (33) | 8 (17) | | |

The table 2 presents the mean value for the biochemical parameters recorded during the admission and discharge of the diabetic subjects. Biochemical parameter gives the estimation of the severity of the disease. The difference in the biochemical parameters shows the impact of prescribed diet on diabetes.From obtained results of both males and females, it is seen that blood chemical parameters exhibited extreme significance level. This indicates that there was a strong association of the diet to biochemical parameters. Therefore, the continuation of the of the prescribed diet helps in recovery.

**Table 2: Mean biochemical parameters (pre and post)**

| Biochemical parameter | Reference range | | Males Mean ± S.D | Females Mean ± S.D | p value |
|---|---|---|---|---|---|
| **Haemoglobin** | Male- 14-18 g/dL Female- 12-16 g/dl | Pre | 11.97 ±1.65 | 10.52 ±2.26 | $0.000^{***}$ |
| | | Post | 13.00 ±1.44 | 11.49 ±2.12 | |
| **Sodium** | 136.0-144.0 mEq/L | Pre | 144.77 ±5.47 | 144.04 ±4.87 | |
| | | Post | 140.44 ±4.41 | 138.68 ±4.75 | |
| **Potassium** | 3.6-5.1 mEq/L | Pre | 3.78 ±0.58 | 4.04 ±4.87 | |
| | | Post | 3.47 ±0.43 | 3.62 ±0.37 | |
| **Uric acid** | Male-4-8.5mg/dL Female-3-7mg/dL | Pre | 6.35 ±1.35 | 6.79 ±1.43 | |
| | | Post | 5.90 ±1.22 | 5.82 ±0.94 | |
| **Protein** | 6-8.3g/dL | Pre | 7.06 ±1.19 | 7.35 ±1.14 | |
| | | Post | 6.20 ±0.83 | 6.82 ±0.87 | |
| **Blood glucose** | FBS-80-110mg/dL | Pre | 230.35 ±63.28 | 228.64 ±76.62 | |

| | | | | | |
|---|---|---|---|---|---|
| **levels** | | Post | 182.46 ±46.04 | 184.97 ±72.35 | |
| | PPBS-110-140mg/dL | Pre | 335.22 ±82.37 | 324.22 ±81.08 | |
| | | Post | 279.28 ±67.23 | 271.8 ±96.02 | |

NS- Non significant,***- Extremely significant,**- Highly significant,* - Significant
FBS- Fasting Blood Sugar; PPBS: Post Prandial Blood Sugar

Mean blood lipid profile is presented in the following table 3. Over weight is associated with a higher LDL level and lower HDL level[13]. Males and females exhibited extremely significance level in all forms of fat i.e., TC,HDL, LDL, VLDL, TG, Cholesterol/HDL ratio Lifestyle habits likely play a role in the increased risk in diabetic subjects developing dyslipidemia prior to a diagnosis of type 2 diabetes. Therefore it is important to manage lipid profile for controlling blood sugar levels and HbA1c value [14].

**Table 3 : Mean Blood Lipid profile**

| **Parameters** | **Reference range** | | **Males Mean ±S.D** | **Females Mean ±S.D** | **p value** |
|---|---|---|---|---|---|
| **TC (mg/dl)** | <200 mg/dL | Pre | 240.31 ±28.47 | 245.6 ±24.42 | |
| | | Post | 236.73 ±30.51 | 226.24 ±28.09 | |
| **HDL (mg/dl)** | 30-60 mg/dL | Pre | 32.2 ±3.29 | 33.04 ±3.58 | |
| | | Post | 33.77 ±3.46 | 36.57 ±4.36 | |
| **LDL (mg/dl)** | <130 mg/dL | Pre | 152.28 ±19.06 | 153.53 ±17.43 | $0.000^{**}$ |
| | | Post | 150.77 ±19.63 | 141.82 ±16.24 | |
| **VLDL (mg/dl)** | 2-30 mg/dL | Pre | 37.2 ±7.05 | 36.04 ±7.853 | |
| | | Post | 36.51 ±7.43 | 33.46 ±8.44 | |
| **TG (mg/dl)** | <150 mg/dL | Pre | 157.71 ±11.75 | 152.24 ±14.42 | |
| | | Post | 156.11 ±11.84 | 149.64 ±14.26 | |
| **Cholesterol/ HDL Ratio** | Upto 4.5 | Pre | 7.56 ±1.42 | 7.54 ±1.26 | |

NS- Non significant;*** - Extremely significant;** - Highly significant; *- Significant

The table 4 presents frequency of clinical data such as diagnosis, treatment plan and duration of diabetes. About 58% of subjects were diagnosed with HTN, 28%, CAD and CABG 22%[15]. Depending upon the diagnosis treatment plan is done and carried out as per the condition. The diet modification and physical exercise treatment plan in diabetic subjects was found to be 28%. About 38% subjects had >10 years of diabetes (duration). As DM is metabolic disorder and chronic disease it cannot be cured completely but can be managed with healthy lifestyle to control blood sugar levels and lowering HbA1c's level.

**Table 4 : Frequency of clinical data**

| **Variables** | **Characteristics** | **Frequency** |
|---|---|---|
| **Diagnosis** | HTN | 52 (57) |
| | Cholelithiasis | 14 (15) |
| | COPD | 18 (20) |
| | Hypothyroidism | 10 (11) |

| | | |
|---|---|---|
| | CABG | 20 (22) |
| | Oligoastrocytoma | 14 (15) |
| | CAD | 25 (27) |
| | RTA | 17 (18) |
| | Myelofibrosis | 12 (13) |
| | CSOM | 15 (16) |
| | UTI | 16 (17) |
| **Treatment plan** | Physical exercise | 13 (14) |
| | Diet modification | 17 (18) |
| | Insulin | 11 (12) |
| | Medication | 13 (14) |
| | Diet modification +physical exercise | 25 (27) |
| | Diet modification + medication | 11 (12) |
| **Duration of Diabetes (years)** | 1-5 | 27 (30) |
| | 6-10 | 28 (31) |
| | >10 | 35 (38) |

Analysing different intervals of HbA1c in table 5, it is observed that the lower percentage of chronic complications of DM in the group with HbA1c values were lower than 6%. It was also found that their number increases with HbA1c, with a rise HbA1c between 7 and 7.9% compared to those 6 and 6.9%.These chronic DM complications can be improved by glycaemic control and the HbA1c level can be reduced by maintaining the target recommended by ADA(American Diabetes Association):HbA1c <7 %[16].

**Table 5 : Chronic complications according to HbA1c group (N=90)**

| **HbA1c (%)** | **<6 n(%)** | **6-6.9 n(%)** | **7-7.9 n(%)** | **8-8.9 n(%)** | **≥9 n(%)** |
|---|---|---|---|---|---|
| **Diabetic Retinopathy** | 6 (6) | 6 (6.0) | 8 (8) | 12 (13) | 27(30) |
| **Diabetic Nephropathy** | 3 (3) | 2 (2) | 7 (7) | 14 (15) | 33(36) |
| **Diabetic Neuropathy** | 4 (4) | 2 (2) | 9 (10) | 12 (13) | 26(28) |
| **Ischemic heart disease** | 2 (2) | 3 (3) | 7 (7) | 9 (10) | 38(42) |
| **Peripheral artery disease** | 3 (3) | 4 (4) | 2 (2) | 12 (13) | 27(30) |
| **Cerebrovascular disease** | 2 (2) | 4 (4) | 8 (8) | 13 (14) | 30(33) |

A perusal of table 6 represents results for the Lifestyle characteristics of diabetic subjects. Prevalence of smoking in males is higher than compared to females, which it (smoking) leads to aggravates glucose homeostasis [10]. Intake of alcohol is found to be higher in males than females, as excessive consumption alcohol can reduce effectiveness of insulin which results in elevated blood sugar levels [17]. Physical activity is a cornerstone of type 2 diabetes prevention and treatment; it is observed that males and females had lack of physical activity. Interestingly, duration of sleep hours is found be to less both in male and female subjects which it result to raise high blood sugars and insulin resistance [12]. Majority of males and females had sedentary lifestyle which it is a triggering factor for development of diabetes. Higher percent of males (80%) and females (75%) had stress due to their occupation, resulting in impairment of glucose tolerance and elevated blood sugar levels . Females (64%) showed high risk of grade 1 obesity when compared to males (44%)[18]. Majority of the enrolled subjects had lack of diabetes education which they were unaware of prevention and treatment.

**Table 6 : Frequency of lifestyle characteristics**

| Variables | | Males (n=45) n (%) | Females (n=45) n (%) |
|---|---|---|---|
| • **Smoking status** | | | |
| | Current smokers | 28 (62) | 8 (17) |
| | Past smokers | 11 (24) | 8 (17) |
| | Never smokers | 6 (13) | 29 (64) |
| • **Alcohol consumption** | | | |
| | Once in a week | 17 (37) | 12 (26) |
| | Twice in a week | 23 (51) | 5 (11) |
| | Occasionally | 5 (11) | 14 (31) |
| | Never | 0 (0) | 14 (31) |
| • **Physical Activity** | | | |
| | Yes | 11 (24) | 14 (31) |
| | No | 25 (55) | 21 (46) |
| | Rare | 9 (20) | 10 (22) |
| **Hours of sleep (Mean±S.D)** | | 5.35±1.06 | 5.04±0.90 |
| • **Kind of work** | | | |
| | Sedentary | 25 (55) | 31 (68) |
| | Moderate | 15 (33) | 10 (22) |
| | Heavy | 5 (11) | 4 (8) |
| • **Stress** | | | |
| | Yes | 36 (80) | 34 (75) |
| | No | 9 (20) | 11 (24) |
| • **Body mass index (BMI)** | | | |
| | Underweight | 0 (0) | 0 (0) |
| | Normal | 2 (4) | 0 (0) |
| | Overweight | 7 (15) | 8 (17) |
| | Grade 1 obesity | 20 (44) | 29 (64) |
| | Grade 2 obesity | 14 (31) | 8 (17) |
| | Grade 3 obesity | 2 (4) | 0 (0) |
| • **Diabetes education** | | | |
| | Yes | 13 (28) | 16 (35) |
| | No | 32 (71) | 29 (64) |

It is observed in the table 7 that of all the food groups, cereals (mainly rice) was their staple diet with considerable to be the appreciable intake of 57% which includes different carbohydrates (refined) causing a surge in blood glucose levels resulting in unstable blood glucose profile. About 41 and 44% of diabetic subjects respectively never consumed pulses and green leafy vegetables. There was very low intake of fruits in their diet. Milk & milk products intake was considerably good. Intake of flesh food and fat was extremely higher than normal allowance. Excessive consumption of saturated fat in diet rises high levels of LDL which invariably increases the risk of CVD in diabetic subjects. It has been observed that diabetic subjects had often lack of sufficient knowledge about importance of food groups[8].

**Table 7: Frequency of food group consumption**

| Food groups | Number of time a day | | | Number of time a week | | | Occasionally | Never Consumed |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 | | |
| | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) |
| Cereals | 10(11.0) | 29(32.0) | 51 (56.0) | - | - | - | - | - |
| Pulses | 2(2.0) | - | - | 26 (28.0) | 17 (18.0) | 2 (2.0) | 6 (6.0) | 37 (41.0) |
| Green Leafy Vegetables | - | - | - | 28 (31.0) | 11 (12.0) | - | 11 (12.0) | 40 (44.0) |
| R & T | 18(20) | 5(5.0) | 2(2.0) | 23 (25.0) | 16 (17.0) | 19(21.0) | - | 7 (7.0) |
| OV | 20(22.0) | 10(11.0) | - | 24 (26.0) | 7 (7.0) | - | 9 (10) | 20 (22.0) |
| Fruits | 8(8.0) | 6(6.0) | - | 24 (26.0) | 10 (11.0) | - | 9 (10) | 33 (36.0) |
| Flesh food | 12(13.0) | 1(1.0) | - | 19 (21.0) | 22 (24.0) | 16(17.0) | 4 (4.0) | 16 (17.0) |
| Milk & Milk Products | 32(35.0) | 30(33.0) | 5(5.0) | 9 (10) | 4 (4.0) | - | - | 10 (11.0) |
| Fat | 29(32.0) | 14(15.0) | 9(10) | 6 (6.0) | 23 (25.0) | 5(5.0) | 3 (3.0) | 1 (1.0) |

It was considered imperative to assess nutrient intake of subject having vegetarian and non-vegetarian diet. The mean adequacy of nutrient intake shown in the table 8 differs in actual intake from RDA. Adequacy table gives the clear differences between the recommended nutrient and actual intake. The overall energy intake of female subjects is higher than the male raw counterparts difference of 7%. 80-83% of carbohydrate intake; protein intake was considerable low in both subjects (22-25%). The carbohydrate intake was almost 83% in males and 80% in females. The intake of fat was observed more in males than females which shows the difference 7%.

**Table 8: Mean adequacy of nutrient intake**

| Nutrients | Actual Intake Mean ±S.D | | RDAderived Mean ±S.D | | % Adequacy | |
|---|---|---|---|---|---|---|
| | Males | Females | Males | Female | Males | Females |
| Energy(Kcals) | 1305.70 ±108.21 | 1309.29 ±197.81 | 1086.46 ±111.06 | 1056.85 ±108.97 | 84 | 91 |
| Carbohydrate (gms ) | 230.23 ±24.11 | 236.15 ±30.54 | 190.49 ±20.83 | 186.34 ±19.10 | 83 | 80 |
| Protein (gms ) | 25.58 ±7.01 | 27.45 ±4.98 | 51.95 ±7.99 | 53.27 ±5.51 | 22 | 25 |
| Fat (gms ) | 32.22 ±8.53 | 38.46 ±7.86 | 11.99 ±1.34 | 11.88 ±1.26 | 40 | 33 |

## CONCLUSION

Frequent monitoring of blood sugar levels and lipid profiles have been found to be effective in reducing risk of developing type 2 DM and this is essential in the prevention and management of DM. Hence, type 2 DM is strongly linked with Lifestyle, Dietary pattern and HbA1c range.

## IV. FUTURE SCOPE OF RESEARCH

In future research, a more rigorous sampling method can be introduced to improve the generalization of the results. And to improve depth understanding of type 2 Diabetes which will enable the design of better strategies of treatment and medications for diabetics in the future.

## REFERENCE

[1]. Gunjan kumar Mandal, Jyothrimayi D. "COMPARATIVE STUDY OF MICROALBUMINURIA AND GLYCATED HEMOGLOBIN." Asian J Pharm Clin Res 9, no. 2 (2016): 356-360.

[2]. Michela Incani, Federica Sentinelli, Laura Perra, Maria Grazia Pani, Marta Porcu, Andrea Lenzi, Maria Gisella Cavallo. "Glycated hemoglobin for the diagnosis of diabetes and prediabetes: Diagnostic impact on obese and lean subjects, and phenotypic." J Diabetes Invest 6, no. 1 (2015): 44-50.

[3]. Tirupathi Reddy, M.D., Dr. B. Suryanarayana, M.D. , Dr. R. Siddeswari, M.D. , Dr. B. Sudarsi, M.D., Dr. S. Manohar, M.D.,Dr. S. Manohar, M.D. "A Study of Correlation of Body Mass Index, Waist Hip Ratio and Lipid Profile in Type II Diabetes Mellitus Subjects." International Journal of Scientific and Research Publications 5, no. 4 (2015): 1-4.

[4]. Mohan V, S. Sandeep, R. Deepa, B. Shah & C. Varghese. "Epidemiology of type 2 diabetes: Indian scenario." Indian J Med Res, 2007: 217-230.
[5]. Dattatreya Adapa, Sarangi TK. "A Review on Diabetes Mellitus: Complications, Management and Treatment Modalities." Journal of Medical and Health Sciences 4, no. 3 (2015): 1-16.
[6]. Harikumar, B. Kishore Kumar, G.J.Hemalatha, M.Bharath Kumar, Steven Fransis Saky Lado. "A Review on Diabetes Mellitus." INTERNATIONAL JOURNAL OF NOVEL TRENDS IN PHARMACEUTICAL SCIENCES 5, no. 3 (2014): 201-217.
[7]. Mangrue, L Roper and T Chung. "Assessment of weight loss in the management of patient with Type 2 Diabetes Mellitus in primary care in Trinidad ." Journal of Diabetes metabolism, 2011: 115-120.
[8]. Hiroki Fujii, Masanori Iwase, Toshiaki Ohkuma, Shinako Ogata-Kaizu, Hitoshi Ide, Yohei Kikuchi,Yasuhiro Idewaki, Tamaki Joudai, Yoichiro Hirakawa, Kazuhiro Uchida, Satoshi Sasaki, Udai Nakamura,and Takanari Kitazono. "Impact of dietary fiber intake on glycemic control,cardiovascular risk factors and chronic kidney disease in Japanese patients with type 2 diabetes mellitus: the Fukuoka Diabetes Registry." Nutrition Journal 12, no. 159 (2013): 1-8.
[9]. Abdulbari Bener, Mustafa Ozturk and Erol Yildirim. "Association between Depression, Anxiety and Stress Symptoms and Glycemic Control in Diabetes Mellitus Patients." International Journal of Clinical Endocrinology, 2017: 001-007.
[10]. Rachel J. Keith, Mahmoud Al Rifai, Christopher Carruba, Natasha De Jarnett. "Tobacco Use, Insulin Resistance, and Risk of Type 2 Diabetes: Results from the Multi- Ethnic Study of Atherosclerosis." PLoS ONE 11, no. 6 (2016): 1-15.
[11]. Ansari, Rashid M. "Effect of Physical Activity and Obesity on Type 2 Diabetes in a Middle-Aged Population." Journal of Environmental and Public Health, 2009: 1-5.
[12]. Bing-Qian Zhu, Xiao-Mei Li, Dan Wang, Xing-Feng Yu. "Sleep quality and its impact on glycaemic control in patients with type 2 diabetes mellitus." i n t e r n a t i o n a l journal o f nurs i n g s c i e n c e s 1 (2014): 260-265.
[13]. Manoj Kumar Yadav, Tapan Kumar Mohapatra, Rabindra Kumar Mohapatra, Ketki Khandhadiya, Kazi Ashique Firdoush, Kedar Prasad Yadav. "Study on Glycated hemoglobin and Lipid Profile in Type-2 Diabetes Mellitus." International Journal of Science and Research 4, no. 6 (2015): 1917-1919.
[14]. Bhambhani GD, Rutu G. Bhambhani, Nilesh Chandradityasinh Thakor. "Lipid profile of patients with diabetes mellitus: a cross sectional study." International Journal of Research in Medical Sciences 3, no. 11 (2015): 3292-3295.
[15]. Afzal, Ahsana Shah and Mohammad. "Prevalence of diabetes and hypertension and association with various risk factors among different Muslim populations of Manipur, India." Journal of Diabetes & Metabolic Disorders 12, no. 52 (2013): 1-10.
[16]. Ufuoma Chukwuani, Kester A. Digban, Godwin D. Yovwin, Ngozi J. Chukwuebuni. "Prevalence of chronic complications of type 2 diabetes mellitus in a secondary health centre in Niger Delta, Nigeria." International Journal of Research in Medical Sciences 4, no. 4 (2016): 1080-1085.
[17]. Wannamethee SG, Shaper AG, Perry IJ, K G M M Alberti. "Alcohol consumption and the incidence of type II diabetes." J Epidemiol Community Health 56 (2002): 542–548.
[18]. Yaturu, Subhashini. "Obesity and type 2 diabetes." Journal of Diabetes Mellitus 1, no. 4 (2011): 79-95.