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Research Article

# Clinical Profile of Type 2 Diabetes Mellitus in Bpkihs, Dharan, Nepal; A Hospital based Cross Sectional Study

**Robin Maskey[1]*, Mathew Abraham Amprayll[2], Poonam Lavaju[3], Bhupendra Shah[4], Bijay Bartaula[5], Manish Subedi[5] and Sanjib Kumar Sharma[6]**

[1]*Additional Professor, Department of Internal Medicine, BPKIHS, Dharan, Nepal*

[2]*Consultant, Department of Internal Medicine, Sunrise Hospital, India*

[3]*Professor, Department of Ophthalmology, BPKIHS, Dharan, Nepal*

[4]*Assistant Professor, Department of Internal Medicine, BPKIHS, Dharan, Nepal*

[5]*Ex Assistant Professor, Department of Internal Medicine, BPKIHS, Dharan, Nepal*

[6]*Professor, Department of Internal Medicine, BPKIHS, Dharan, Nepal*

***Corresponding Author:** Robin Maskey, Additional Professor, Department of Internal Medicine, BPKIHS, Dharan, Nepal.

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## Abstract

**Background and Aims:** The time of diagnosis, clinical spectrum and treatment pattern of diabetes mellitus in developing countries might be different from the developed countries. We conducted this study to determine the clinical spectrum, complications and treatment pattern of Nepalese diabetes patients.

**Methods:** This was a hospital-based cross-sectional study among patients with diabetes mellitus aged 30 years and above conducted for a period of one year at B.P. Koirala Institute of Health Sciences, Dharan, Nepal.

**Results:** Of 130 study population, the mean age of presentation was 53 years. Majority of them had sedentary life style (80%), smoker (57%), alcohol consumer (47%), and obese (34%). The mean fasting glucose, postprandial glucose and HbA1C level of the study population were 156 mg/dl (SD-5), 245 mg/dl (SD-89), and 7.67 (SD-1.88) respectively. Retinopathy (8%), dermatological complication (7%) followed Neuropathy (4%) were the common complication among study population.

**Conclusion:** Majority of diabetes mellitus patient were smoker and unachieved glycemic control. Retinopathy was the commonest complication. Nepalese diabetes patient required counselling regarding life style medication, monitoring of the glycemic control and complications in timely manner.

***Keywords:*** *Clinical Profile; Complications; Diabetes Mellitus; Nepal; Retinopathy*

## Introduction

Diabetes mellitus is characterized by impaired insulin secretion, insulin resistance, excessive hepatic glucose production, abnormal fat and protein metabolism and a constellation of chronic complications. It is a worldwide health crisis. Approximately 387 million people are living with diabetes worldwide with an estimated prevalence of 8.3% in 2014 and is expected to increase to 10% by 2030. The prevalence has risen dramatically over the past two decades [1].

Based on current trends more than 60% of the world's population of people with diabetes will be in Asia. The number of people with diabetes will exceed 123 million in 2035 [2]. The incidence of diabetes is showing an alarming rise in developing countries, particularly in Nepal. 60 - 80% of diabetics in developed countries are usually obese whereas in Nepal we find that the clinical profile of diabetes is different. Most of the patients attending our diabetic outpatient department are not obese as defined by existing parameters such as BMI.

When we compare the clinical profile in developed countries we find there is a remarkable difference in presentation, treatment and complications in obese and non-obese individuals in developing countries. In Nepal the proportion of non-obese diabetics is relatively more when compared to developed countries. Hence it is worth comparing the clinical and biochemical profile in non-obese and obese Type 2 diabetic patients in our population.

## Methodology

One hundred and thirty confirmed cases of adults age 30 years and above presenting in out patient and inpatient of department of internal medicine in BPKIHS, Dharan Nepal were enrolled in the study. Type 2 diabetes was defined as individuals without an episode of ketoacidosis, controlled on oral anti diabetic drugs for more than a year after diagnosis [3].

The study subjects were categorized as:

- Group A: BMI < 18.5 $kg/m^2$ (lean body weight type 2 DM)
- Group B: BMI ≥18.5 - 23 $kg/m^2$ (normal weight type2 DM)
- Group C: BMI ≥ 23 - 27.5 $kg/m^2$ (overweight type 2 DM)
- Group D BMI ≥ 27.5 $kg/m^2$ (obese type 2 DM).

The subjects with presence of active pulmonary tuberculosis history, presence of other chronic illnesses that could affect body weight like chronic liver or chronic kidney disease, type 2 DM patients with age of onset less than 30 years, patient with history of cancer and HIV were excluded from the study.

Weight was taken while the patient would stand on the weighing machine with minimum clothing, weight was measured to the accuracy of one Kg using the same machine for all patients. Height was taken while the subject would stand against the wall having a measuring scale. Patient would keep his feet together with occipital, back and heels touching the wall and neck slightly extended and face in the Frankfort plane.

Body mass index (BMI) was measured as weight in Kg ÷ Height in $m^2$.

Waist measurement was performed with a flexible measuring tape and measurement taken at midpoint between the costal margin and iliac crest with patient standing and measurements to the nearest 0.1 cm. taken at mid respiration; Hip measurements was taken at the maximum circumference of the hip; Waist hip ratio (WHR) was taken as the ratio of waist and hip measurements.

A detailed clinical examination was performed especially looking for possible complications of diabetes. These include:

1. Vitals included heart rate and blood pressure. Pulse was recorded for a period of one minute for rate, rhythm and any special character in addition to looking for consistency of the vessel wall. Blood pressure was measured in the lying down position with patient relaxed. A sphygmomanometer was used with an appropriate cuff size. Systolic pressure was taken at the time of the appearance of korotkoff sounds and diastolic pressure at the time of muffling of the sounds.

2. Detailed neurological examination was done to look for signs of peripheral neuropathy including presence of hypo or anaesthesia of a part or whole of the limb together with presence of muscle wasting if any and presence or absence of deep tendon jerks. 10g Monofilament, knee hammer and tuning fork was used for the neurological evaluation.
3. Vasculopathy including either feebleness or absence of peripheral pulses.
4. Fundus examination was done to look for signs of cataract, retinopathy including presence of micro-aneurysms, exudates, haemorrhages and maculopathy.
5. Signs of malnutrition included measurement of BMI.
6. Signs of insulin resistance like Acanthosis Nigricans.
7. Examination of foot was performed to look for presence of high risk feet or any other sign of foot involvement in diabetes and accordingly graded.

All the patients were subjected to a set of baseline investigations like Complete blood count (CBC), routine urine, liver, kidney examination and estimation of lipid profile, FBS, PPBS, HbA1c level, Urine for micro-albumin.

For HbA1c (Immunoinhibitor turbidometry method): Three ml of blood was drawn and centrifuged and serum (500 microml) collected from that and incubated with the reagent for 15 mins at $37^0$C. Later the readings was taken from the instrument COBAS C311.

For lipid profile: The parameters of cholesterol, HDL, LDL and Triglycerides were tested using the homogenous enzymatic colorimetric test on the COBAS C3 11.

Descriptive statistics such as frequency, percentage, mean, median, standard deviation, IQR was calculated for quantitative variables. Graphical representation of data using bar graphs, pie charts was prepared as per the need. For categorical data - frequency and proportion with graphical representation was made. Cross tabulation was done to find out the association between demographical, clinical and laboratory profile with type 2 diabetes mellitus. Chi-Square was used to examine the association between different variables under study. An independent sample t-test was used to compare the means of a normally distributed interval dependent variable for two independent groups. Mann Whitney, Wilcoxon rank sum test was used for skewed data. Statistical Analysis was performed with SPSS Version 16. Data was expressed as Mean and Standard Deviation for normally distributed data and as median and in Inter-Quartile Range for skewed data.

A p-value < 0.05 was considered as statistically significant for all.

## Results

The study was conducted from September 2017 to September 2018 at BPKIHS, a tertiary care centre of eastern Nepal. A total of 130 subjects were included. Out of 130 patients, 52 were males and 78 were females. The mean age of participants who were obese was 53.61 ± 15.20 years and those who were Non-Obese was 52.45 ± 10.97.

Family history of diabetes was present in 43 (33%) of which 11 (8%) were obese and 32 (25%) were non-obese. There were a total of 15 (11%) vegetarians and 115 (89%) non-vegetarians. There were a total of 62 (48%) who had low fiber and 68 (52%) who had good fiber content in their diet. The number of study subjects who had decreased appetite were 16 (12%) compared to 114 (88%) who had normal or increased appetite.

There were a total of 74 (60%) non-smokers and 56 (40%) smokers, 61 (47%) consumed alcohol and 69 (53%) did not consume alcohol. Only 30 (23%) individuals took part in regular physical activity and 100 (77%), were not regular with the physical activity. 18 (14%) individuals who were on Insulin therapy and 112 (86%) individuals were not on Insulin therapy (Table 1).

| Characteristics | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 52 | 40 |
| | Female | 78 | 60 |
| Age distribution (Years) | 30 - 39 | 18 | 14 |
| | 40 - 49 | 35 | 27 |
| | 50 - 59 | 33 | 25 |
| | 60 - 69 | 35 | 27 |
| | 70 - 79 | 8 | 6 |
| | ≥ 80 | 1 | 1 |
| Family History | Yes | 43 | 33 |
| | No | 87 | 67 |
| Diet | Vegetarian | 15 | 12 |
| | Non-vegetarian | 115 | 88 |
| Duration of Diabetes (Years) | < 5 | 56 | 43 |
| | 5 - 10 | 45 | 35 |
| | 10 - 15 | 19 | 15 |
| | 15 - 20 | 6 | 5 |
| | 20 - 25 | 2 | 2 |
| | 25 - 30 | 1 | 1 |
| | ≥ 30 | 1 | 1 |
| Fiber | Low | 62 | 48 |
| | Normal/high | 68 | 52 |
| Appetite | Decreased | 16 | 12 |
| | Normal/Increased | 114 | 88 |
| Smoking | Yes | 74 | 57 |
| | No | 56 | 43 |
| Alcohol | Yes | 61 | 47 |
| | No | 69 | 53 |
| Sleep | Normal | 128 | 98 |
| | Disturbed | 2 | 2 |
| Physical Activity | Regular | 30 | 20 |
| | Non-regular | 100 | 80 |
| Insulin | Yes | 18 | 14 |
| | No | 112 | 86 |
| Other medications | Yes | 79 | 61 |
| | No | 51 | 29 |
| Total | | 130 | 100 |

***Table 1:*** *Baseline characteristics of study population (n = 130).*

In our study among the 130 individuals with type 2 diabetes mellitus the mean fasting blood glucose was 156 ± 50 mg/dl and the mean Post prandial blood sugar was 245 ± 89 mg/dl, while the mean HbA1c was 7.67 ± 1.88%.

The mean cholesterol level in our study population was 186.31 ± 36 mg/dl whereas the mean LDL and HDL were 124.48 ± 42 mg/dl and 42.36 ± 9.39 mg/dl respectively. However, the mean triglyceride levels among the study population was 194 ± 89 mg/dl which was significant with a p value of 0.049 (Table 2).

| Characteristics | Mean ± SD | Range (min-max) | P-value | Remarks |
|---|---|---|---|---|
| Fasting blood sugar | 156.03 ± 50 | 72 - 338 | 0.50 | NS |
| Post-prandial blood sugar | 245 ± 89 | 120 - 552 | 0.51 | NS |
| HbA1c | 7.67 ± 1.88 | 4.1 - 15.5 | 0.50 | NS |
| Cholesterol | 186.31 ± 36 | 92 - 295 | 0.29 | NS |
| Triglycerides | 194.39 ± 89 | 48 - 647 | 0.049 | S |
| LDL | 124.48 ± 42 | 22 - 84 | 0.90 | NS |
| HDL | 42.36 ± 9.39 | 50 - 210 | 0.45 | NS |
| Creatinine | 0.94 ± 0.46 | 0.4 - 3.2 | 0.90 | NS |
| Urine micro-albumin | 9.76 ± 12.76 | 0.2 - 78 | 0.36 | NS |

***Table 2:*** *Baseline lab parameters of the study population (n = 130).*

In our study, among the 130 individuals with type 2 diabetes mellitus the number of obese patients were 44 (34%) and non-obese were 86 (66%) and among them the diabetic females were more obese than males with a significant p value of 0.03. The non-obese had a higher fiber content in their diet as compared to the obese with a statistically significant value of 0.026. The non-obese had a greater family history with more number of smokers and alcohol consumers (Table 3).

| Characteristics | Category | Obese | Non-obese | P values | Remarks |
|---|---|---|---|---|---|
| Gender | Male | 12 | 40 | 0.03 | S |
| | Female | 32 | 46 | | |
| Family History | Yes | 11 | 32 | 0.16 | NS |
| | No | 33 | 54 | | |
| Diet | Veg | 3 | 12 | 0.26 | NS |
| | Non-Veg | 41 | 74 | | |
| Fiber | Low | 27 | 35 | 0.026 | S |
| | Normal/High | 17 | 51 | | |
| Appetite | Decreased | 8 | 8 | 0.145 | NS |
| | Normal/Increased | 36 | 78 | | |
| Smoking | No | 27 | 47 | 0.294 | NS |
| | Yes | 17 | 39 | | |

| | | | | | |
|---|---|---|---|---|---|
| Alcohol | No | 22 | 47 | 0.615 | NS |
| | Yes | 22 | 39 | | |
| Sleep | Normal | 42 | 86 | 0.113 | NS |
| | Disturbed | 2 | 0 | | |
| Physical activity | Regular | 10 | 20 | 0.946 | NS |
| | Non-regular | 34 | 66 | | |
| On Insulin | Yes | 9 | 9 | 0.119 | NS |
| | No | 35 | 77 | | |
| On other medications | No | 14 | 37 | 0.216 | NS |
| | Yes | 30 | 49 | | |

***Table 3:*** *Comparison between obese and non-obese Type 2 diabetics in categorical variables (n = 130).*

In our study, there were more number of non-obese who engaged in regular physical activity however the p value was 0.946 and was statistically insignificant. There were more number of obese only on insulin 4 (9%) as compared to the non-obese 3 (3%). However, there were more number of non-obese on OHA alone 77 (90%). There were more number of obese on both OHA and insulin 9 (20%) as compared to the non-obese 9 (10%).

In our study among 130 individuals with type 2 diabetes mellitus the mean fasting blood glucose of obese patients was 160 ± 52 mg/dl which was more as compared to the mean fasting blood glucose in non-obese patients which was 153 ± 50 mg/dl. The mean Post prandial blood sugar among obese was 261 ± 95.33 mg/dl and non-obese was 237 ± 85 mg/dl while the mean HbA1c was 7.82 ± 1.6% for obese and 7.59 ± 1.8% for non-obese for which the p-value was insignificant. The mean cholesterol, HDL and LDL levels were statistically insignificant when comparing the two groups. However the mean triglyceride levels among the obese individuals was 216 ± 117 mg/dl and 183 ± 33 mg/dl in the non-obese group which was significant with a p value of 0.049 showing that the triglyceride levels were high among people who had type 2 diabetes.

The mean age among the two groups with type 2 diabetes who presented to our hospital was almost similar with a p value of 0.61 which was statistically insignificant. The mean duration of diabetes among the two groups were the same while the systolic, diastolic blood pressure and heart rate was comparable in the two groups and the p value was statistically insignificant (Table 4).

| Characteristics | Obese (Mean ± SD) | Non-obese (Mean ± SD) | P values | Remarks |
|---|---|---|---|---|
| FBS | 160 ± 52 | 153 ± 50 | 0.50 | NS |
| PPBS | 261 ± 95.33 | 237 ± 85 | 0.15 | NS |
| HbA1c | 7.82 ± 1.6 | 7.59 ± 1.8 | 0.50 | NS |
| Cholesterol | 191 ± 43 | 183 ± 66 | 0.29 | NS |
| Triglycerides | 216 ± 117 | 183 ± 33 | 0.049 | S |
| HDL | 42 ± 8.7 | 42 ± 9.7 | 0.90 | NS |
| LDL | 120 ± 44 | 126 ± 42 | 0.45 | NS |
| Creatinine | 0.93 ± 0.5 | 0.94 ± 0.4 | 0.90 | NS |
| Urine micro-albumin | 11 ± 13 | 9 ± 12 | 0.36 | NS |

| | | | | |
|---|---|---|---|---|
| Age | 53 ± 15 | 52 ± 10 | 0.61 | NS |
| Duration of Diabetes | 6.43 ± 7.61 | 6.16 ± 4.19 | 0.79 | NS |
| Systolic Blood Pressure | 125 ± 19 | 124 ± 16 | 0.85 | NS |
| Diastolic Blood Pressure | 78 ± 8.9 | 77 ± 6.6 | 0.46 | NS |
| Heart Rate | 82 ± 5.8 | 81 ± 5.3 | 0.73 | NS |
| Duration of OHA | 5 ± 6.9 | 5 ± 4.3 | 0.64 | NS |

***Table 4:*** *Comparison of clinic laboratory profile values between obese and non-obese type 2 diabetes mellitus (n = 130).*

| Complications | Category | Obese | Non-Obese | p-value | Remarks |
|---|---|---|---|---|---|
| Neuropathy | Yes | 4 | 1 | 0.045 | S |
| | No | 40 | 85 | | |
| Retinopathy | Yes | 4 | 7 | 0.546 | NS |
| | No | 40 | 79 | | |
| Nephropathy | Yes | 1 | 0 | 0.546 | NS |
| | No | 43 | 86 | | |
| Cardiovascular | Yes | 1 | 0 | 0.338 | NS |
| | No | 43 | 86 | | |
| Genito-urinary | Yes | 0 | 4 | 0.187 | NS |
| | No | 44 | 82 | | |
| Dermatological | Yes | 2 | 7 | 0.358 | NS |
| | No | 42 | 79 | | |

***Table 5:*** *Comparison of complications among obese and non-obese (n = 130).*

## Discussion

In our study among 130 adult patients with type 2 diabetes mellitus, majority of them were females (60%). Our data corroborates with the meta-analysis by Gyawali B., *et al*. which also showed the female predominance in type 2 diabetes mellitus was (58.5%) [4]. The female gender dominance might be due to sedentary life style, sub optimal maternal health, gestational diabetes and childhood obesity, poor access to care and fragmented system, unhealthy lifestyle, poverty and psychosocial stress among women in Nepal.

The mean age of our study population was 52.85 ± 12.52 years where as the mean age of the population was 42.9 in the study done by Lee Ji Won., *et al*. and 59.13 ± 8.73 years in the study done by Liu X., *et al.* [5,6]. Majority of the population in our study belonged to the age groups between 40 - 79 years (79%). In the meta-analysis done by Yang L., *et al*. showed that the majority of the patients belonged to the age groups between 35 to 75 years (46.1%) and the highest incidence was 14.1% in 65 - 74 years age group followed by 11.0% in the 55 - 64 years age group [7]. However, the highest incidence in our study was among the age groups 40 - 49 years (27%) and 60 - 69 (27%) years respectively. This could be due to patients seeking early medical care for either diabetes itself or various other conditions and diabetes could have been an incidental finding.

Family history of type 2 diabetes is recognized as an important risk factor of the disease. Individuals who have a family history of diabetes can have two to six times the risk of type 2 diabetes compared with individuals with no family history of the disease. In the study done by AM Annis., *et al*. it showed that 65.1% with Diabetes had a family history but in our study 33% had positive family history of Diabetes. This is because participants were asked whether any biological member of their family, living or deceased, had ever been told he/she had diabetes. Family history information was not very reliable because of participant refusal and lack of knowledge of family medical history. We defined family history as having a first-degree relative (parent and/or sibling) with diabetes. However more women reported a family history than men in our study which was 21%. This finding corroborates with the same study done by A Annis., *et al*. which showed higher prevalence of family history among women which was 30.9% [8].

In our study population the prevalence of non-vegetarians were 88% when compared to the vegetarians. This finding was similar to the study done by Pokharel D., *et al*. as the number of non-vegetarians was 92.8%. This higher percentage of type 2 diabetes among non-vegetarians is probably due to high intake of carbohydrates and fats, difficulty in procuring a healthy diet, difficulty in refraining from sweet tastes, several feasts and festivals. Food intake has been strongly linked with type 2 diabetes and not only related to the volume of food but also in terms of the composition and quality of diet. High intake of red meat, fried foods, contribute to the increased the risk of insulin resistance and type 2 diabetes mellitus [9].

The mean duration of type 2 diabetes mellitus in our study population was 6.25 ± 5.56 years. This data almost coincides with the study done by Pokharel D., *et al*. in which the mean duration of the population was 5.1 ± 3.8 years. This is probably due to more number of study subjects that has been recruited in their study as compared to ours.

In our study population among 130 adults with type 2 diabetes mellitus, 52% had higher fiber content in their diet specially the non-obese as compared to the obese with a statistically significant value of 0.026. In the study done by Meyer., *et al*. there was a 22% lower risk in developing diabetes among those who consumed fiber in their diet. There is a strong inverse association between incidence of diabetes and intake of total grains, whole grains, dietary fiber, cereal fiber and dietary magnesium. The relation between dietary fiber and diabetes has received much attention. Particularly soluble fiber has repeatedly been shown to decrease postprandial glucose and insulin concentrations both in persons with diabetes and in those without [10]. Dietary fiber ameliorates postprandial hyperglycemia by delaying digestion and absorption of carbohydrates and enhances satiety, which leads to a reduction in body weight. In insulin-resistant subjects, dietary fiber may enhance peripheral insulin sensitivity possibly via short-chain fatty acids produced by fermentation of fiber in the intestines. The recommended amount of dietary fiber in the general population is < 19 g/d for males and < 17 g/d for females in Japan and < 38 g/d for males and < 25 g/d for females in the US, although in our study dietary fiber intake was quantified by the intake of fruits, vegetables, cereals and legumes which was subjective.

In our study the prevalence of smokers among type 2 diabetes mellitus was 57%. However, Lee JWR., *et al*. in their study showed the prevalence of current smokers among Asian type 2 diabetes mellitus was 10%. This contrast in the prevalence of smokers among type 2 diabetes mellitus is due to the inclusion of both former and current smoker in our study. In the meta-analysis done by Akter S., *et al*. it showed that the risk of T2DM increased by 16% for each increment of 10 cigarettes smoked per day. In their study it showed that they estimated that 18.8% of T2DM cases in men and 5.4% of T2DM cases in women were attributable to smoking [11].

In our study the total percentage of alcohol consumers among the study population was 42%. This data is higher compared to a study done by Zhang S., *et al*. which showed 31.96% alcohol consumers who had type 2 diabetes mellitus of which 14.49% were newly diagnosed with T2DM and 29.94% with prediabetes [12]. This is due to the growing consensus of alcohol consumption daily in Nepal as alcohol is easily brewed even at homes. However, in their study they have concluded that alcohol consumption, heavy consumption in particular, is an independent risk factor for the development of prediabetes, but not for diabetes.

In our study the total percentage of study subjects who took part in regular physical activity was only 20%. In the study done by Zhang., *et al*. it showed that 68.34% non-drinkers and 61.44% drinkers took part in regular physical activity. When compared to a study done by Noh J., *et al*. the number of individuals who took part in regular physical activity was 58.3% which is still higher when compared to our study [13]. This is probably due to the sedentary lifestyle, lack of motivation, excessive alcohol consumption, depression and lack of effective medical counselling in Nepal.

In our study population there were 86% who were only on OHA and 14% on insulin therapy for type 2 diabetes mellitus. In the study conducted by Sapkota S., *et al*. in Nepal it showed that there were a total of 76.6% on OHA and 6.6% were on insulin [14]. Our study corroborates with the study done by Sapkota., *et al.* showing a higher percentage in the use of OHA. This could probably be due to initial hesitation to start medications (OHAs), having faith in the ability of conventional medications to manage hyperglycemia, general fear and reluctance toward using conventional OHA's and Insulin inconvenience of daily Insulin injections, unavailability of insulin in some areas of Nepal, lack of electricity and refrigeration at homes for storing insulin, appealing alternative treatment strategies that varied from the use of traditional home remedies (such as specific vegetables and spices) to herbs/herbal products, "Ayurvedic" medications, to finding complementary and health care approaches (such as Ceragem therapy- a Korean therapy) where patient is treated using an equipment that uses infrared light technology. However, in our study population 61% were on other medications along with medications for type 2 diabetes mellitus whereas in the same study conducted by Sapkota., *et al*. the percentage of study population taking other medications along with antidiabetic medications was 4.2%. This is because the number of patients enrolled in our study was much greater and apart from the considerable reluctance to take medicines, the preference to take as little as possible" have also been reported in other patients who suffer from chronic diseases in their study.

Among the 130 individuals who enrolled in our study, the mean fasting blood sugar and mean post-prandial blood sugar were 156.03 ± 50 mg/dl and 245 ± 89 mg/dl respectively whereas in an original research conducted in Chitwan, Nepal by Sapkota., *et al*. the mean fasting blood sugar and post-prandial blood sugar were 137.25 ± 39.9 mg/dl and 213.8 ± 59.6 mg/dl respectively. The mean HbA1c level in our study was 7.67 ± 1.88% and the mean HbA1c level in the similar study by Sapkota., *et al*. was 7.24 ± 1.1%. This data is almost comparable with the study done by Sapkota., *et al*. and the minor difference is probably due to the measurement in these values at different times of presentation to the hospital.

Dyslipidemia as a metabolic abnormality is strongly linked with type 2 DM. Its prevalence is variable, depending on the type and severity of diabetes, glycemic control, nutritional status, age and other factors. In our study population the mean cholesterol level, mean LDL level and the mean HDL level were 186.31 ± 36 mg/dl, 124.48 ± 42 mg/dl, 42.36 ± 9.39 mg/dl respectively. In the original research study done by Sapkota., *et al*. the mean cholesterol level, mean LDL level and the mean HDL levels were 206.0 ± 26.0 mg/dl, 123.3 ± 24.7 mg/dl, 46.1 ± 5.8 mg/dl respectively. This finding in our study is comparable with the study done by Sapkota., *et al*. The mean Triglyceride levels in our study population was 194.39 ± 89 mg/dl with a significant p value of 0.049. The mean triglyceride level in the previous mentioned study was 181.9 ± 45 mg/dl [15]. Our data almost coincides with the study done by Sapkota., *et al*. and many studies in the past have shown that insulin affects the liver apolipoprotein production and regulates the enzymatic activity of lipoprotein lipase and cholesterol ester transport protein, which causes dyslipidemia in diabetes mellitus. Hence insulin resistance is a key factor for the pathogenesis of type 2 DM and contributes to dyslipidemia.

In our study population among the type 2 diabetes the mean creatinine level was 0.94 ± 0.46 mg/dl and in the study done by Shah Kumar., *et al*. in Nepal showed a mean creatinine level of 1.64 ± 2.22 mg/dl [16]. This mean creatinine level was probably higher in their study as it included more patients with proteinuria and chronic kidney disease on dialysis. The mean creatinine level among patients without and with microalbuminuria in the previous study by Shah Kumar., *et al.* were 0.97 ± 0.16 mg/24hr urine and 1.90 ± 2.28 mg/24hr urine respectively. Increased creatinine levels in diabetics clearly indicate prolonged hyperglycemia which irreversibly causes damage the nephrons. Elevated serum creatinine has become firmly entrenched as fairly reliable indicators of kidney dysfunction.

In our study population, 6% had microalbuminuria and the mean Urine microalbumin level was 9.76 ± 12.76 mg/24hr urine. In the study done by Shah Kumar., *et al*. the prevalence of microalbuminuria was 26% whereas in another study done by BR Maharajan., *et al*.

in Nepal showed microalbuminuria was 35.89% in Jyapu and 37.73% in Brahmin which was higher as compared to our study [17]. This could be probably due to difference in ethnicity, inclusion of patients with renal failure, longer duration of diabetes. The p value was non-significant for microalbuminuria in their study which can be compared with our study.

In our study, among the 130 individuals with type 2 diabetes mellitus the number of obese patients were 44 (34%) and non-obese were 86 (66%). Among them the diabetic obese females were more than males with a significant p value of 0.03. Our study coincides with the original study done by Prando., *et al*. which showed that the percentage of obese females with type 2 diabetes mellitus was 68% and the obese males were 32% [18]. This is probably due the sedentary lifestyle, excess body fat, abdominal visceral fat and larger waist circumference, gestational diabetes, gaining weight during pregnancy and insulin resistance among the obese women with type 2 diabetes mellitus in Nepal.

In our study population, 61% of obese type 2 diabetics showed a lesser fiber content in their diet when compared to the non-Obese with a significant p-value of 0.026. In the study done by Hadrevi J., *et al*. there was a significant difference in dietary fiber intake between the obese and the normal-weight health care workers. Although dietary fiber intake was low for both groups in their study when compared to recommended daily fiber intake, the obese individuals had a significant lower dietary fiber intake compared to normal-weight [19]. This is probably due to health care workers typically have many small breaks in their daily work and this may tempt them to consume such quick snacks that are fat rich and unhealthy. Both studies signify that low fiber content in diet can lead to obesity. However, there is limited study comparing the obese and non obese type 2 diabetics.

In our study, among the 130 Obese and non obese type 2 diabetic patients, the mean triglyceride levels among the obese individuals was 216 ± 117 mg/dl and 183 ± 33 mg/dl in the non-obese group which was significant with a p value of 0.049 showing that the triglyceride levels were high among people who had type 2 diabetes. In a study done by Lukich A., *et al*. the mean triglyceride level for non-obese and obese type 2 diabetics was 144.3 ± 104.8 mg/dl and 166.0 ± 109.3 mg/dl respectively. Our study corroborates with this study, as in both the studies the mean triglyceride levels were higher in the obese type 2 diabetics. This could be explained by the body fat distribution as it is one of the major determinants of metabolic health. Visceral fat is metabolically active and is an important site for adipokines such as adiponectin and leptin, which plays an important role in insulin sensitivity, inflammation, lipid metabolism and athero-genesis. The most common pattern of dyslipidemia in type 2 diabetic patients is elevated TG levels and decreased HDL-C levels, which is also prevalent in the study done by Sapkota., *et al*. [5] and Pokharel D., *et al* [20].

In our study among the 130 diabetic individuals 9% of obese had neuropathy which was more as compared to the non-obese which was only 1% and the p value was 0.045 which was significant. Our study almost coincides with the study done by Khan SB., *et al*. the percentage of obese with neuropathy was 5% and non-obese was 6% with a non significant p value of 0.867 [21]. This minor difference could be due to the more number of study individuals in their study. Neuropathy in our study was confirmed by monofilament, tuning fork test and reflex testing.

In our study, the non-obese type 2 diabetics had a higher incidence of retinopathy which was 8% and this finding coincides with the study done by Khan SB., *et al*. which also showed a higher incidence of retinopathy among the non-obese type 2 diabetic patients which was 3%. Comparing both the studies the overall incidence of complications were higher in the non-obese type 2 diabetics which was 22% in our study and 79% in the study done by Khan SB., *et al*. when compared to the obese type 2 diabetics.

## Conclusion

Diabetes mellitus is a high burden disease in Nepal and continues to increase in significance and number as changing lifestyles lead to reduced physical activity and increased obesity. Female sex, obesity, high triglyceride levels were more commonly associated with diabetes in our study. Family history is significant but lifestyle modification like consumption of healthy high fiber diet, regular physical activity and weight loss could definitely impact the morbidity and mortality associated with diabetes.

## Bibliography

1. International Diabetes Federation. Diabetes atlas sixth edition poster update 2014, Brussels, Belgium (2014).

2. Guariguata L., *et al*. "Global estimates of diabetes prevalence for 2013 and projections for 2035". *Diabetes Research and Clinical Practice* 103.2 (2014): 137-149.

3. Akter S., *et al*. "Smoking and the risk of type 2 diabetes in Japan: A systematic review and meta-analysis". *Journal of Epidemiology* 27.12 (2017): 553-561.

4. BG Bishal Gyawali ., *et al*. "Prevalence of type 2 diabetes in Nepal: a systematic review and meta-analysis from 2000 to 2014". *Global Health Action* 1 (2015): 4-13.

5. Ji Won R., *et al*. "Trends in the Prevalence of Type 2 Diabetes in Asians Versus Whites". *Diabetes Care* 34 (2011): 353-357.

6. Xiaotian Liu., *et al*. "Prevalence, awareness, treatment, control of type 2 diabetes mellitus and risk factors in Chinese rural population: the Rural Diab study". *Scientific Reports* 6 (2016): 31426.

7. Yang L., *et al*. "Prevalence of type 2 diabetes mellitus among inland residents in China (2000-2014): A meta-analysis". *Journal of Diabetes Investigation* 7.6 (2016): 845-852.

8. Annis AM., *et al*. "Family History, Diabetes, and Other Demographic and Risk Factors Among Participants of the National Health and Nutrition Examination Survey 1999 - 2002". *Centers for Disease Control and Prevention* 2.2 (2005): 1-12.

9. Pokharel DR., *et al*. "Prevalence and pattern of dyslipidemia in Nepalese individuals with type 2 diabetes". *BMC Research Notes* 10.1 (2017): 1-11.

10. A Meyer K., *et al*. "Carbohydrates, dietary fiber, and incident type 2 diabetes in older". *The American Journal of Clinical Nutrition* 71 (2000): 921-930.

11. Akter S., *et al*. "Smoking and the risk of type 2 diabetes in Japan: A systematic review and meta-analysis". *Journal of Epidemiology* 27.12 (2017): 553-561.

12. Zhang S., *et al*. "The Relationship between Alcohol Consumption and Incidence of Glycometabolic Abnormality in Middle-Aged and Elderly Chinese Men". *International Journal of Endocrinology* (2016): 1-7.

13. Mehta KD., *et al*. "Hyperglycemia, glucose intolerance, hypertension and socioeconomic position in eastern Nepal". *The Southeast Asian Journal of Tropical Medicine and Public Health* 42 (2011): 197-207.

14. Sapkota S., *et al*. "Nepalese patients' perceptions of treatment modalities for type 2 diabetes". *Patient Prefer Adherence* 10 (2016): 1777-1786.

15. Sapkota LB., *et al*. "Correlation between glycemic parameters and lipid profile in type 2 diabetic patients attending tertiary care centre in central region of Nepal". *Jalgaon City Municipal Corporation* 7.1 (2017): 20-24.

16. Shah PK., *et al*. "Study of Renal Profile In Diabetic Patient at Nobel Medical College Teaching Hospital , Biratnagar". *Journal of Nobel Medical College* 5.2 (2016): 1-4.

17. BR M., *et al*. "Microalbuminuria and mortality in type 2 diabetes". *Journal of Nepal Health Research Council* 47.2 (1998): 89-90.

18. Prando R., *et al*. "Is type 2 diabetes a different disease in obese and nonobese patients?" *Diabetes Care* 21.10 (1998): 1680-1685.

19. Hadrévi J., *et al*. "Dietary Fiber Intake among Normal-Weight and Overweight Female Health Care Workers: An Exploratory Nested Case-Control Study within FINALE-Health". *Journal of Nutrition and Metabolism* (2017).

20. Pokharel DR., *et al*. "Prevalence and pattern of dyslipidemia in Nepalese individuals with type 2 diabetes". *BMC Res Notes* 10.1 (2017): 1-11.

21. Khan SB., *et al*. "Original Article Prevalence Of Diabetes Mellitus Among Obese And Non-Obese Patients With Coronary Artery Disease". *Journal of Ayub Medical College Abbottabad* 22.3 (2010): 64-67.

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