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Research Article

The Dietary Practices Among the Type 2 Diabetic Subjects in Nepal

Om Prakash Sah, Madan Pandey and Kritee Niroula*

[1]*M. Sc. Clinical Nutrition and Dietetics, Biratnagar, Nepal*

[2]*BSc Nutrition and Dietetics, Tribhuvan University, Nepal*

***Corresponding Author:** Kritee Niroula, BSc Nutrition and Dietetics, Tribhuvan University, Nepal.

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Abstract

Background: Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose. The study aim is to evaluate the relationship between biochemical parameters with dietary habits and physical activities of participants.

Methods: Data collection took participants' age, sex, anthropometric measurement, lifestyle factors, dietary habits, and prevalence of diabetes-related complications.

Results: The study showed significant differences in triglyceride and HDL across low-fat milk, yogurt intakes, fruits, and green leafy vegetables and HbA1c, Creatinine, FBG, and PP blood glucose levels across cereal consumption.

Conclusions: It showed significant differences between frequency of food intake and nutritional status, physical activity, and biochemical parameters.

Keywords: Dietary Practices; Type 2 Diabetes; Postprandial Blood Glucose; Fasting Blood Glucose; Nepal

Abbreviations

T2DM: Type 2 Diabetes Mellitus; BMI: Body Mass Index; SPSS: Statistical Package for Social Sciences; HbA1c: Hemoglobin A1c; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; FBG: Fasting Blood Glucose; PP: Post Prandial

Introduction

The term diabetes describes a group of metabolic disorders characterized and identified by the presence of hyperglycemia in the absence of treatment. The heterogeneous aetio-pathology includes defects in insulin secretion, insulin action, or both, and disturbances of the carbohydrate, fat, and protein metabolism [1]. Blood glucose rises because it cannot be metabolized in the cells, due to a lack of insulin production by the pancreas or the inability of the cells to effectively use the insulin that is being produced [2].

Most people with Type 2 Diabetes Mellitus (T2DM) are overweight or obese, which either causes or aggravates insulin resistance [3]. Many of those who are not obese by Body Mass Index (BMI) criteria have a higher proportion of body fat distributed predominantly in the abdominal region, indicating visceral adiposity compared to people without diabetes [4]. However, in some populations, such as Asians, β-cell dysfunction appears to be more notable and prominent than in populations of European descent [5]. This is also observed in thinner people from low- and middle-income countries such as India, and among people of Indian descent living in high-income countries [6].

The prevalence of diabetes for all age groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. For developing countries, urbanization was used as a proxy measure of the increased risk of diabetes associated with altered diet, obesity, decreased physical activity, and other factors such as stress, which are assumed to differ between urban and rural populations [7].

In Nepal, T2DM is the third most common non-communicable disease among hospitalized patients. With an estimated prevalence of 6.3%–25.9% among the general population. An unhealthy diet and physical inactivity are important modifiable risk factors for T2DM [8].

Though the dietary practice is culture and context-specific, there is limited research on the dietary practice of T2DM subjects in the study area. Therefore, this study was designed to assess the dietary practice and its effects among selected T2DM subjects of Eastern Nepal who came to the Endocrine Clinic.

Objectives

- To assess the dietary habits and lifestyle patterns of selected subjects.
- To evaluate the relationship between biochemical parameters with dietary habits and physical activities.
- To highlight the importance of nutrition education among diabetic patients.

Material and Methods

A cross-sectional study was conducted among diabetic subjects selected via simple random sampling from those who attended the Endocrine Clinic in Biratnagar of Nepal having the age group 18–70 years.

Sample size

The sample size was determined by using a simple proportional formula assuming the rate of prevalence of malnutrition to be 6.3%, the prevalence of diabetes in Eastern Nepal [9] and a margin of error of 5%. The confidence interval was taken at 95% with a non-response rate of 5%.

Mathematically,
Sample size (n_0) = $Z^2 \times p\ (1\text{-}p)/\ d^2$
Source: Kothari (2004); Singh, M.L. (2005)

Here, n_0 is the sample size for an infinite population; z is the critical value at a given level of confidence; p is the estimated prevalence of malnutrition; q = 1–p; e = margin of error.
So, Sample size = $1.96^2 \times 0.063\ (1 - 0.063)/\ (0.05)^2 = 90.7$
Sample Size = 91

Selection of study subjects

The study was conducted by random sampling of identified diabetic subjects, who were attending the Endocrine Clinic. Permission was obtained from the administration and the doctor of the Endocrine clinic. Verbal consent from the caretaker and participants was obtained, and the objective of the study was explained to them. Privacy and confidentiality of collected information were ensured at all levels.

Inclusion criteria

- Subjects with T2DM attending the Endocrine clinic.
- Subjects between 18-70 years of age.
- Subjects who were interested and provided verbal consent.

Exclusion criteria

- Subjects with severe medical and surgical complications.
- Pregnant women.
- Subjects who were illiterate and unable to understand.

Data collection

The close-ended interview consisting of general information about age, sex, anthropometric measurement, lifestyle factors, dietary habits, the prevalence of diabetes-related complications, and medication was used for data collection. The biochemical parameters were taken from their clinical reports.

Statistical analysis

Statistical analysis of the data was performed using the Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive analysis was done to find the mean, standard deviation, frequency, and percentage of all biochemical parameters and food frequency values. Chi-square and ANOVA tests were used to identify existing differences in biochemical parameters across different levels of dietary practices.

Results

Demographic characteristics of subjects

The study shows that the percentages of subjects were 3%, 47%, 44% and 6% from age categories of 19-30, 31-50, 51-70, and > 70, respectively. Study shows that a high percentage fell in the age groups of 31-50 and 51-70 years. The mean age was 51.7±12.51 years old. Out of 100 participants, 65 were male, and 35 were female.

Nutritional status of the subjects

In the study, it was found that 58% of participants were overweight. Among them 39% were male and 19% female. About 15% were obese, among which 8% were male and 7% were female.

Physical activity of the subjects

The study shows that only 33% of participants were involved in physical activity for more than 30 minutes, 50% for less than 30 minutes and 17% were not doing any physical activity.

Food pattern of the diabetic subjects

In the study, it was found that 54% of participants were taking meals five times a day which included two heavy meals and three light meals, while 19% and 20% of were taking meals three and four times respectively.

Eating pattern of cereals and cereals product

Figure 1 shows that 60% of the participants were taking rice once a day and only 40% 2-3 times a day. Similarly, 48% of participants consumed wheat flour chapati once a day. About 12%, 11%, and 3% were taking chapati 2-4 times a day, 2-3 times a day, and 1-2 times a month respectively. Noodles were not so common, 31% and 17% of participants ate noodles 2-4 times per week and 1-2 times per month.

Consumption pattern of milk and milk products

About 50% of the participants had daily consumption of low-fat milk, 2-3 times per week by 7%, and 43% were not taking milk at all. Similarly, whole milk was consumed daily by 28% of the participants, and 24% and 7% consumed milk 2-4 times a week and 1-2 times per month respectively. In the case of yogurt, none consumed it on daily basis, while 74% were taking yogurt 2-4 times a week, and 8% and 6% were taking it 1-2 times per month and once a week respectively. These results can be seen in figure 2.

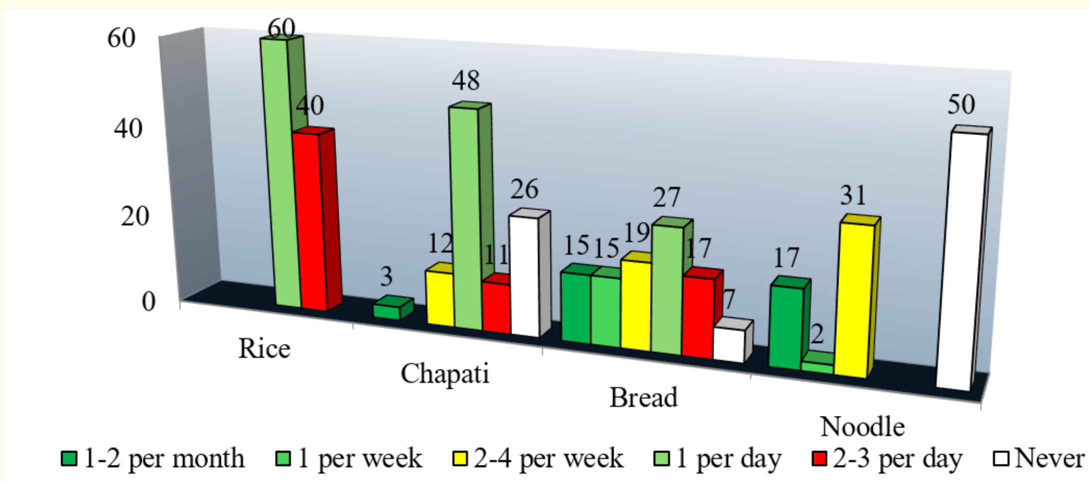

Figure 1: Bar diagram of frequency of participants taking cereals and cereals product.

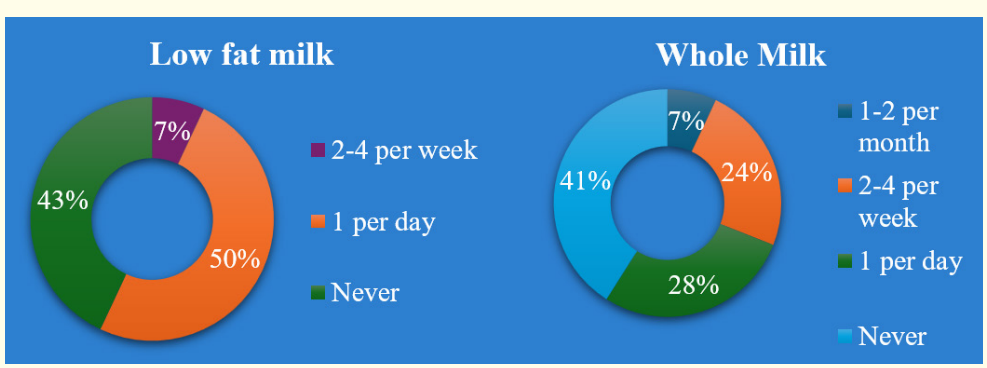

Figure 2: Doughnut representation of the frequency of taking milk and milk product.

Consumption pattern of roots and tubers

Figure 3 show a pie chart of roots and tubers consumption. Only 16% were used to consuming roots and tubers in their daily diet, 9% took 2-4 times a week, and 68% ate once or twice a month.

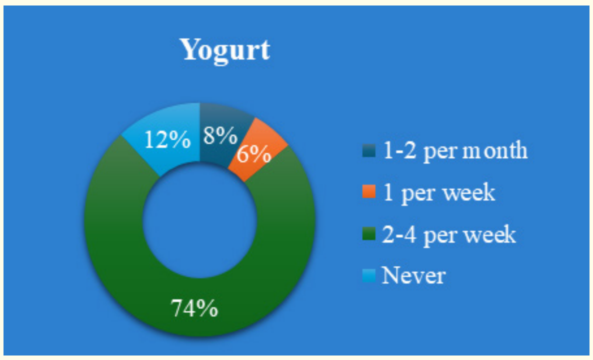

Figure 3

Consumption pattern of fruits and vegetables

Figure 4 shows that 42%, 25%, and 58% of participants consumed fruits, green leafy vegetables, and other vegetables daily respectively. It was found that 33% and 25% of participants consumed fruits 2-4 times a week and 1-2 times a month respectively. Among the participants, 7%, 57%, 8%, and 3% consumed green leafy vegetables 2-3 times a day, 2-4 times a week, once a week, and 1-2 times a month respectively. 15%, 19%, and 8% of the selected subjects consumed other vegetables 2-4 times a week, once a week, and 1-2 times a month respectively.

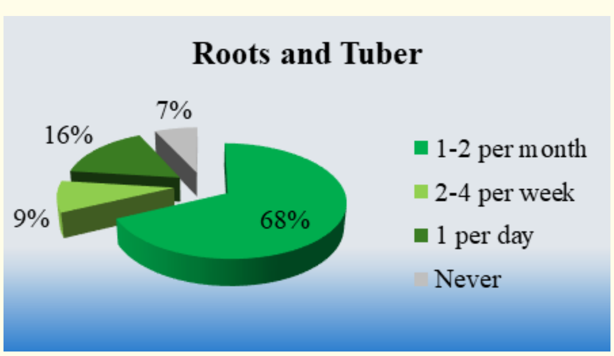

Figure 4

Consumption pattern of Nuts, seeds, and oil

The study shows that 51%, 3%, and 19% of the participants consumed nuts and seeds 1-2 times per month, once a week, and 2-4 times a week respectively and 27% were not consuming nuts and seeds. The percentage of participants who ate fried foods 1-2 times a month, one per week, and 2-4 times per week were 55%, 3%, and 38% respectively and 4% were not taking fried foods.

Medication

Among the participants, 63% were using oral medication, 15% were under insulin, 6% were using alternative drugs and 16% were under diet control.

Descriptive statistics of biochemical parameters

The study shows that the mean and standard deviation of the HbA1c of participants were 8.16 ± 2.03 and maximum and minimum values were 13.2% and 5.1% respectively. The mean and standard deviation of High-Density Lipoprotein (HDL) of participants were 39.11 ± 5.82 and the maximum and minimum values were 57 mg/dl and 30 mg/dl respectively. Similarly, the mean and standard deviation of Low-Density Lipoprotein (LDL) of participants were 87.01 ± 13.39 and maximum and minimum values were 133 mg/dl and 57 mg/dl respectively. The mean and standard deviation of the triglyceride levels were 187.21 ± 66.31 and maximum and minimum values were 520 mg/dl and 98 mg/dl respectively. The mean and standard deviation of creatinine, FBG, and Post Prandial (PP) blood glucose of participants were 0.95 ± 0.24, 163.55 ± 64.62, and 260.61 ± 97.14 respectively.

Distribution of subjects according to biochemical parameters

The study showed that 23% of participants had PP blood glucose range between 140-200mg/dl, and 77% had PP blood glucose than >200mg/dl. Similarly, 11%, 27%, and 62% of participants had fasting blood glucose levels of 70-100mg/dl, 100-125mg/dl, and >126mg/dl respectively. The study shows that 88% of participants had normal LDL (<100mg/dl), 11% had moderate LDL (100-129mg/dl), and 1% had a risk level of HDL (>129mg/dl). Creatinine levels in the normal range were in 72% of participants, 13% had a high range and 15% had in the low range.

Association between nutritional status and biochemical parameters

The study was conducted to identify if there exist differences in biochemical parameters across different levels of dietary food patterns, nutritional status, lifestyle, and medication of participants with changes in biochemical parameters. To find a significant difference between these variables non-parametric Chi-square and Kruskal-Wallis tests were used.

The study found that there was a significant association between BMI with HbA1c (p-value = 0.026). The cohort study conducted in the US between 2012-2019 on adults identified with T2DM found that there was an association between an increase in BMI and mean HbA1c [10]. In this study, the mean HbA1c increased with an increase in BMI. This study also shows a significant association (p-value = 0.00) BMI with participants' PP blood glucose and Fasting Blood Glucose (FBG) respectively. The study conducted on elderly persons from an area in southern Estonia found that blood glucose level was positively correlated with BMI [11].

The study shows that weight change has a significant association (p-value = 0.03) with HbA1c, FBG, and PP blood glucose. In diabetic subjects, due to insufficient insulin, glucose isn't used as energy, so the body starts burning fat and muscle for energy, resulting in weight loss [12]. These results can be seen in Table 1.

Biochemical parameters	BMI	N	Mean ± SD	p-value
HbA1c	Normal	27	5.93± 0.42	0.00**
	Overweight	58	8.39 ± 1.36	
	Obese	15	11.28 ± 0.95	
Fasting blood glucose	Normal	27	138.52 ± 41.16	0.00**
	Overweight	58	159.16 ± 63.32	
	Obese	15	225.60 ± 68.12	
Postprandial blood glucose	Normal	27	281.48 ± 95.76	0.00**
	Overweight	58	242.52 ± 98.49	
	Obese	15	293 ± 82.91	
Biochemical parameters	**Change in weight**	**N**	**Mean ± SD**	**p-value**
HbA1c	Loss	33	9.18 ± 2.18	.003*
	Gain	2	6.06 ± 0.5	
	No	65	7.72 ± 1.77	
Fasting blood glucose	Loss	33	187.39 ± 70.16	0.033*
	Gain	2	147.5 ± 3.54	
	No	65	151.94 ± 59.66	
Post Prandial blood glucose	Loss	33	299.12 ± 106.23	0.035*
	Gain	2	220 ± 14.14	
	No	65	242.31 ± 88.29	

Table 1: Association between nutritional status and biochemical parameters.

Note: * Statistically significant (p < 0.05).

Association between lifestyle factors and biochemical parameters

The test revealed significant differences (p-value = 0.00) in the HbA1c based on the intensity and duration of exercise (< 30 min, n = 50; > 30 min, n = 33; no exercise = 17). The study shows that the mean HbA1c of participants was increasing with decreasing intensity of exercise. The study also revealed a highly significant difference in FBG (p-value = 0.00), and PP blood glucose based on the duration of exercise. In Harvard Health Publishing, it was mentioned that exercise lowers blood glucose levels and boosts your body's sensitivity to insulin, countering insulin resistance.[13] The study discloses significant differences (p-value = 0.045) in the creatinine for 2 levels of smoking (yes, n = 11; never, n = 89). In the American Journal of Nephrology, one study shows that smoking was independently associated with an increase in serum creatinine for every 5 cigarettes per day, resulting in a 0.3mg/dl rise in serum creatinine [14]. These results can be seen in Table 2.

Biochemical parameters	Duration of Exercise	N	Mean ± SD	p-value
HbA1c	< 30 min	50	8.4 ± 1.53	0.00**
	> 30 min	33	6.72 ± 1.54	
	No exercise	17	10.29 ± 2.07	
Fasting blood glucose	< 30 min	50	156.14 ± 51.09	0.00**
	> 30 min	33	124.48 ± 33.5	
	No exercise	17	261.18 ± 46.35	
Post Prandial blood glucose	< 30 min	50	256.9 ± 68.9	0.00**
	> 30 min	33	204.94 ± 77.74	
	No exercise	17	379.59 ± 101.4	
Biochemical parameters	**Smoking**	**N**	**Mean ± SD**	**p-value**
Creatinine	Yes	11	1.03 ± .22	0.045*
	Never	89	0.94 ± .24	

Table 2: Association between lifestyle factors and biochemical parameters.

Note: * Statistically significant (p < 0.05).

Association between frequency of diet, diet followed by subjects, dairy products, fruits, and vegetables with biochemical parameters

To evaluate the difference across four levels of frequency of meals to different biochemical parameters Kruskal Wallis test was used. The test found highly significant differences (p-value = 0.01) in the HDL for four levels of frequency of meal. Similarly, the study revealed significant differences (p-value = 0.03) in the PP blood glucose for two levels of diets (self, n = 86; and modified, n = 14). Research conducted on the Thai population having the risk of type 2 diabetes found that the effect of dietary modification on 2-hour postprandial blood glucose in the experimental group had improved [15]. The study showed that low-fat milk and yogurt intakes were significantly different with triglyceride (p-value = 0.014) and HDL (p-value = 0.006) respectively. In this study, the level of triglyceride was increased with an increase in intake of dairy products and HDL was decreased with a high intake of the dairy product. A study found that the intake of dairy-fermented milk was positively associated with triglycerides and indirectly associated with HDL [16].

In evaluating the difference across five levels of fruit and green leafy vegetable intake to different biochemical parameters, the test revealed a significant difference between the frequencies of fruits (p-value = 0.001) and green leafy vegetables (p-value = 0.012) with triglyceride levels. The frequency of intake of other vegetables had a significant difference with HDL (p-value = 0.042), Triglyceride (p-value = 0.00), and PP blood glucose (p-value = 0.033) respectively. A similar study done in Iran found that intakes of fruits and vegetables are inversely proportional to the lipid profile of diabetic subjects [17]. These results can be seen in Table 3.

Biochemical parameters	Frequency of meal	N	Mean ± SD	p-value
HDL	2(2 meals)	7	34.86 ± 2.27	0.01*
	3 (2 meals, 1 snacks)	19	41.74 ± 6.37	
	4(2 meals, 2 snacks)	20	40.1 ± 7.1	
	5(2meals, 3 snacks)	54	38.37 ± 5.01	
Biochemical parameters	Diet follow	N	Mean ± SD	p-value
Postprandial blood glucose	Self	86	268.26 ± 96.31	0.03*
	Modified	14	213.64 ± 91.89	
Biochemical parameters	Low fat milk	N	Mean ± SD	p-value

Triglyceride	2-4 per week	7	178.16 ± 73.05	0.014*
	1 per day	50	201.77 ± 60.24	
	Never	43	162.43 ± 25.45	
Biochemical parameters	Yogurt	N	Mean ± SD	p-value
HDL	1-2 per month	8	41.63 ± 6.88	0.00**
	1 per week	6	46.66 ± 6.95	
	2-4 per week	74	38.08 ± 5.16	
	Never	12	40.00 ± 5.70	
Biochemical parameters	Fruit	N	Mean ± SD	p-value
Triglyceride	1-2 per month	24	260.92 ± 79.79	0.00**
	1 per week	1	234	
	2-4 per week	32	184.16 ± 36.81	
	1 per day	43	147.66 ± 33.16	
Biochemical parameters	Green leafy vegetables	N	Mean ± SD	p-value
Triglyceride	1-2 per month	3	295.33 ± 31.77	0.012*
	1 per week	8	244.75 ± 127.55	
	2-4 per week	57	184.47 ± 53.72	
	1 per day	25	164.46 ± 44.93	
	2-3 per day	7	177 ± 77.88	
Biochemical parameters	Other vegetables	N	Mean ± SD	p-value
HDL	1 per week	8	45.25 ± 9.22	0.042*
	2-4 per week	19	38.26 ± 5.1	
	1 per day	15	36.47 ± 3.97	
	2-3 per day	58	39.22 ± 5.37	
Triglyceride	1 per week	8	312 ± 100	0.00**
	2-4 per week	19	240.16 ± 52.43	
	1 per day	15	181.6 ± 32.82	
	2-3 per day	58	154.10 ± 31.98	
Postprandial blood glucose	1 per week	8	314 ± 45.12	0.033*
	2-4 per week	19	284.63 ± 77.36	
	1 per day	15	249 ± 85.51	
	2-3 per day	58	248.38 ± 108	

Table 3: Association between frequency of meal, diet followed by subjects, dairy products, fruits, and vegetables with biochemical parameters.

Note: * Statistically significant ($p < 0.05$).

Association between Carbohydrate-rich foods and biochemical parameters

Kruskal Wallis test was conducted to reveal the difference in several biochemical parameters to the intake of carbohydrate-rich foods. The test shows that significant differences were found among five categories (1-2 per month, 1 per week, 2-4 per week, 1 per day, 2-3 per day, and never) of white bread intake with HbA1c (p-value = 0.00), Creatinine (p-value = 0.019), FBG (p-value = 0.00), and PP blood glucose levels (Sig. = 0.00). Similarly, the test shows that significant differences were found among three categories (2-4 per week, 1 per day, 2-3 per day) of rice intake with HbA1c (p-value = 0.00), Creatinine (p-value = 0.04), FBG (p-value = 0.00), and PP blood glucose levels (p-value = 0.00).

The study shows that significant differences were found among five categories (1-2 per month, 1 per week, 2-4 per week, 1 per day, 2-3 per day, and never) of chapati intake with HbA1c (p-value = 0.01), and FBG (p-value = 0.011). A review study published by the American Diabetes Association states that carbohydrates in food influence blood glucose levels. The total amount of carbohydrates consumed is a strong predictor of glycemic response [18]. These results can be seen in Table 4.

Biochemical parameters	White bread	N	Mean ± SD	p-value
HbA1c	1-2 per month	15	6.13 ± 0.68	0.00**
	1 per week	15	6.78 ± 0.75	
	2-4 per week	19	7.81 ± 1.03	
	1 per day	27	9.32 ± 1.53	
	2-3 per day	17	10.64 ± 1.65	
	Never	7	6.03 ± 0.90	
Creatinine	1-2 per month	15	0.84 ± 0.28	0.019*
	1 per week	15	0.87 ± 0.24	
	2-4 per week	19	5.04 ± 0.17.67	
	1 per day	27	1.03 ± 0.19	
	2-3 per day	17	1.01 ± 0.17	
	Never	7	0.88 ± 0.42	
Fasting blood glucose	1-2 per month	15	129.07 ± 38.45	0.00**
	1 per week	15	136.87 ± 43.72	
	2-4 per week	19	144.63 ± 42.10	
	1 per day	27	179.52 ± 65.20	
	2-3 per day	17	229.71 ± 74.99	
	Never	7	123.71 ± 30.77	
Postprandial blood glucose	1-2 per month	15	202.33 ± 75.89	0.00**
	1 per week	15	227.8 ± 67.85	
	2-4 per week	19	252 ± 57.71	
	1 per day	27	285.52 ± 79.89	
	2-3 per day	17	339.24 ± 136.88	
	Never	7	192.14 ± 81.91	
Biochemical parameters	Rice	N	Mean ± SD	p-value
HbA1c	2-4 per week	1	5.70	0.00**
	1 per day	59	7.07 ± 1.19	
	2-3 per day	40	9.84 ± 1.88	
Creatinine	2-4 per week	1	0.7	0.04*
	1 per day	59	2.22 ± 10.04	
	2-3 per day	40	1.02 ± 0.17	
Fasting blood glucose	2-4 per week	1	145	0.00**
	1 per day	59	138.24 ± 41.12	
	2-3 per day	40	201.35 ± 75.10	

Postprandial blood glucose	2-4 per week	1	230	0.00**
	1 per day	59	226.68 ± 69.36	
	2-3 per day	40	311.43 ± 111.28	
Biochemical parameters	**Chapati**	**N**	**Mean ± SD**	**p-value**
HbA1c	1-2 per month	3	5.93 ± 0.12	0.01*
	2-4 per week	12	9.57 ± 2.05	
	1 per day	48	7.81 ± 1.85	
	2-3 per day	11	7.44 ± 2.00	
	Never	26	8.75 ± 2.02	
Fasting blood glucose	1-2 per month	3	179 ± 49.11	0.011*
	2-4 per week	12	235.75 ± 90.19	
	1 per day	48	150.917 ± 47.85	
	2-3 per day	11	133 ± 57.70	
	Never	26	164.69 ± 62.26	

Table 4: Association between Carbohydrate-rich foods and biochemical parameters.

Note: * Statistically significant ($p < 0.05$).

Association between carbonated beverages and biochemical parameters

While testing for the differences in 4 categories (1-2 per month, 1 per week, 2-4 per week, 1 per day, and never) of carbonated drink intake with biochemical parameters, the study found a significant difference with FBG (p-value = 0.00), and PP blood glucose (p-value. = 0.023) respectively. The study showed that the increased intake of carbonated drinks leads to increased blood glucose levels. Researchers reported that an increase in the consumption of sugar-sweetened beverages increases PP blood glucose levels and decreases insulin sensitivity [19].

Association between medications and biochemical parameter

The study shows the significant difference between two categories (Yes, and Never) of taking oral anti-hyperglycemic agents with three biochemical parameters namely, HbA1c (p-value = 0.01), FBG (p-value = 0.00), and PP blood glucose (p-value = 0.01) respectively. A systematic review of the comparative effectiveness and safety of oral medication for type 2 diabetes revealed that most oral agents (thiazolidinediones, metformin, and repaglinide) improved glycemic control to the same degree as sulfonylureas (absolute decrease in HbA1c level of about 1 percentage point) [20].

Conclusions

Conclusively, this study has assessed the dietary patterns and their effects among T2DM subjects of Eastern Nepal who had to follow up at the endocrine clinic. It was not explored before, and findings are important to understand the dietary pattern and their association with participants' biochemical parameters. The study has revealed that more than half of the total subjects include rice and other vegetables in their diet daily. Less than one-fifth of the total subjects are taking roots and tubers. This study has shown a significant difference between the frequency of food intake with nutritional status, physical activity, and biochemical parameters. Nutritional education about diabetic diet was given to all subjects. The limitation of the study includes changes in blood lipid and glucose may also be the result of other factors such as physical activity or genetics which have not been addressed in this study. The applicability of this study is to intervene in awareness programs about the diabetic diet and physical exercise among diabetic subjects to maintain biochemical parameters.

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