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A Study of Prevalence of Co-Morbidities, Self- Management and Awareness in Type II Multifactorial Diabetes Mellitus Patients: A Cross Sectional Study Conducted in The Darjeeling Hills Region of West Bengal, India

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Abstract

Background: *The study is aimed to analyze and assess the perception, awareness, management and knowledge of the Type II Diabetes mellitus patients in the sample population. The objective is to gather pioneer data at the ground level and to analyze age of diagnosis, complication related to Type II diabetes, co-morbidities, physical and physiological parameters of the diabetic patients.* ***Methods:*** *A cross-sectional study was conducted in the Darjeeling Himalayan region through interviews and structured questionnaires. Data was analyzed using spss-16 and excel-2019.* ***Results:*** *A total of 243 (n=243) type II diabetes patients participated, 126 (51.9%) females and 117 (48.1%) males. Rural area: (n=159) (65.40%); Urban area: (n=84) (34.6%). The age of diagnosis of type II diabetes were highest in the age group of 46-55 years (39.51%). Significantly higher percentage of people with family history of diabetes were diagnosed at an early age, 26-35 years (9.38%) and 36-45 years (28.13%. Diabetic retinopathy 64.20% and hypertension 59.30% were highest among the patients of Darjeeling. In the study 96 patients (60.49%) self-monitored by using Glycometer and 147 patients (39.51%) did not self-monitor and 34.69% of patients who did not have self-monitoring facility recorded high blood glucose level as compared to only 21.8% patients having such facilities at home. In the survey, 76.53% of the patients had high current blood glucose level, change in food habits has not benefited the patients. Almost 75% of the people with diabetes have higher BMI of obese or overweight category. Metformin was prescribed (72.82%) followed by glimepiride (51.85%).* ***Conclusion:*** *In our study we have found very poor self-management of people towards diabetes. People should rather focus more on exercise, weight management and self -monitoring to maintain healthy blood glucose level and avoid diabetic co-morbidities which invariably brings physically, mentally and economically burden to the patients.*

Keywords: *Diabetes mellitus; Age of diagnosis; Diabetic co-morbidity: Self-monitoring activities; Glycaemic control; Darjeeling region*

1. Introduction

Diabetes mellitus is a major public health issue affecting more than 400 million people worldwide.[1] Diabetes mellitus are classified into two types, type I and type II. The main difference between the type 1 and type 2 diabetes is that type 1 diabetes is a genetic condition that often shows up in the early ages and type 2 is genetic as well as lifestyle-related disorder which develops over time. More than 95% of people with diabetes have type 2 diabetes [2]. symptoms of the type I diabetes include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision changes, and fatigue. These symptoms may occur suddenly. In type II diabetes, symptoms may be similar to those of type 1 diabetes but are often less marked. As a result, the disease may be diagnosed several years after onset, after complications have already arisen. Type 2 diabetes (formerly called non-insulin-dependent, or adult-onset) results from the body's ineffective use of insulin. More than 95% of people with diabetes

have type 2 diabetes. This type of diabetes is largely the result of excess body weight and physical inactivity. Symptoms may be similar to those of type 1 diabetes but are often less marked. As a result, the disease may be diagnosed several years after onset, after complications have already arisen. Until recently, this type of diabetes was seen only in adults but it is now also occurring increasingly frequently in children.

This study is a pilot project which aims to study and discuss about the perception, awareness, management and knowledge of the Type II Diabetes mellitus patients in the sample population. (In Darjeeling Hill region). The main objective of the research is to gather pioneer data at the ground level. To analyze age of diagnosis, complication related to Type II diabetes, co-morbidities, physical and physiological parameters of the diabetic patients. The study aims to study about relation between the life style such as food habits, profession, family history and self- monitoring practices, the type of medicines used and its impact of Type II diabetes mellitus patients. The data may be used to design a suitable program for awareness drive, management and to enhance future research works to be undertaken which would eventually help Type II Diabetes mellitus patients of not only region but also all around.

2. Materials And Methods

Study Area:

The study was conducted in the Darjeeling hill station in the state of west Bengal, India located at the latitude and the longitude of (27.0410° N, 88.2663° E). and the altitude of approximately 2,045m from the sea level. Darjeeling is a small town with the literacy rate of about 75%. About 80 percent of people of this are Gorkhas of Mongolian origin like Rai, Gurung, manger etc and Gorkhas of Indo-Aryan communities like Chhetri, Bahun, Kami, Sarki etc. and other communities like Lepchas and Bhutias.

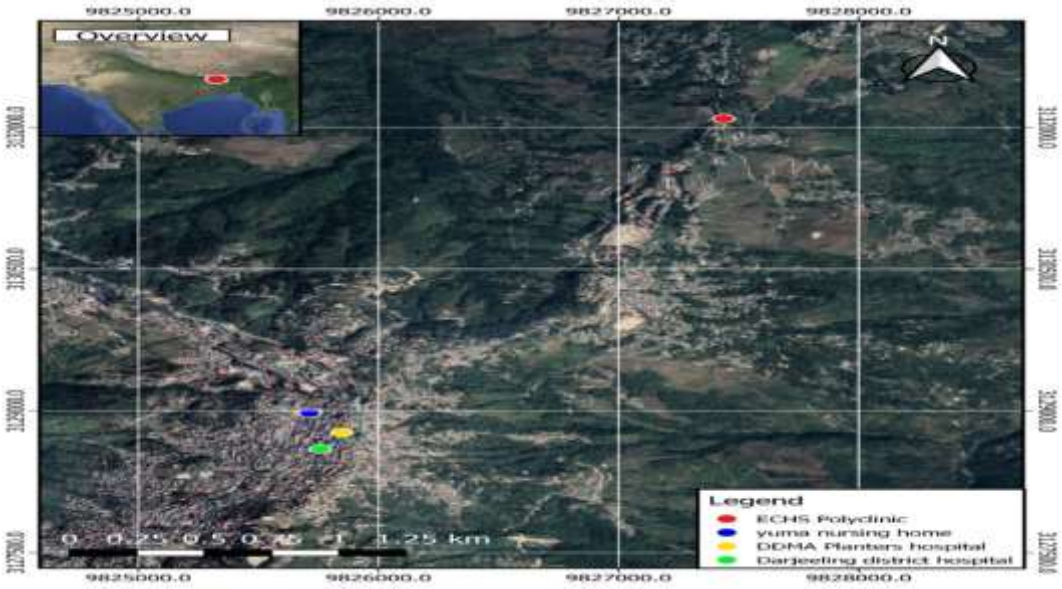
Study Design

A questionnaire-based interaction was conducted with the type II diabetic patients admitted or visited different hospitals of Darjeeling for their regular check-ups. The data were collected after acquiring relevant permission from the respective authority. All the subjects participated voluntarily participate in survey signing a consent form after which they were asked to fill up a questionnaire. The four different hospitals of Darjeeling where study was conducted were:

- ECHS polyclinic (Lebong Army hospital)
- YUMA nursing home
- DDMA planters' hospital
- Darjeeling district hospital.

Map of The Study Area

Fig 1: Satellite map of the study area was prepared using QGIS version 3.22.11.



Sample Size

Interaction was done with total 243 diabetic patients (117 males and 126 females). The subjects participated from each hospital are as follows:

Table 01: Sample size

Sl no	HOSPITAL	INDIVIDUALS		TOTAL
		MALE	FEMALE	
01	ECHS polyclinic	34	37	71
02	YUMA nursing home	18	19	37
03	DDMA planters' hospital	23	26	49
04	Darjeeling district hospital.	42	44	86

Age Groups

Considering the occurrence of type II diabetes in the later age, age of patients was classified into six age groups. (From 26 years to 85 years in the class width of 10 years). Present age was also recorded in the same format.

Educational Qualification

Educational status of the subjects was classified into 7 groups; The subjects who cannot read and write at all were considered as 'illiterate'. 'Primary' for the subjects who at least can read and write and have passed or appeared class 4^{th} standard according to the Indian education system. 'pre- metric' was considered for the subjects who have cleared 8^{th} standard. Those who have passed 10^{th} and 12^{th} board exams were considered as 'metric' and 'post metric' respectively and college degree holder subjects were considered as graduate and patients who have cleared higher education master's degree were considered as 'post graduate'.

Address And Profession

Address of the patients were classified into rural and urban. Profession of the subjects were categorized into eight groups according to the common profession status of the Darjeeling hills; government employee, housewife, farmer, tea garden worker, self -employed, retired government employee, businessmen and ex -military serviceman.

Food Habits

Patients were asked whether they take special diet and other nutrition along with the normal regular diet or not, and recorded in the yes/No form. They were asked whether they consume alcohol or not and was recorded yes/no and if yes, regularly or occasionally. Their tobacco smocking or chewing habits were recorded in the yes/no form. Their regular food habits or the normal three times meal were categorized into six groups and are recorded as:

Table 02: Pattern of food habits

Abbreviation	Breakfast	Lunch	Dinner
RSC	Rice	Snacks /biscuits	Chapati/oats/porridge
SRC	Snacks /biscuits	rice	Chapati/oats/porridge
RSR	Rice	Snacks /biscuits	Rice
CSR	Chapati/oats/porridge	Snacks /biscuits	Rice
CRC	Chapati/oats/porridge	rice	Chapati/oats/porridge
CCC	Chapati/oats/porridge	Chapati/oats/porridge	Chapati/oats/porridge

Physical And Physiological Parameters

Patients were asked if they have or had any stress or depression and recorded in yes/no form. They were asked their blood group according to the ABO blood grouping system. Patients were asked about their exercise habits and recorded in the yes/no form. Height and weight and weight of the patients were measured and are converted to body mass index BMI (kg/m2). Both the approaches for BMI, World health organization classification and the Asia- pacific approach of WHO [4,5] was taken into consideration for the better result. The Asia pacific approach is considered better in predicting some co-morbidities [6]. The BMI range taken for both the approaches are:

Table 03: BMI reference chart.

CLASSIFICATION	WHO	Asia-Pacific
Underweight	<18.5	<18.5
Normal	18.5–24.9	18.5–22.9
Overweight	25–29.9	23–24.9
Obese	≥30	≥25

Type II Diabetes Related Comorbidities

Subjects were asked whether they have been diagnosed with other comorbidities or not. Out of the different diabetic comorbidities, seven common comorbidities were taken into account they are cardiovascular, neuropathy, retinopathy, nephropathy, skin problems, oral and dental problems and hypertension.

Medications

Type of oral hypoglycemic agents or other medicines were analyzed by examining their medical reports and medicine prescription and after proper consulting with the pharmacist of the respective hospitals. Composition of the medicines for diabetes in the prescription of the patients were observed and recorded after categorizing them according to the types of different medicines for type II diabetes currently available in India [3].

Blood Glucose Level

Patients were asked to produce their latest blood glucose level (mg/dl) done in the random sugar test. The range for the blood sugar level in the random test [3] were categorized as:

Table 04: Blood glucose reference chart

Categories	Blood glucose level(mg/dl)
Normal	79-140
High	140-200
Very high	>200

Other Parameters

Other parameters in the questionnaires set were; subjects were asked whether they monitor their diabetes with glucometer or not and recorded in yes/no form. Total tests per month done by the patients were also recorded. They were asked whether they have family history for type II diabetes or not and were recorded in yes/no form.

Data Management and Statistical Analysis:

Data was collected on a pre-designed document and finally transferred from data sheets into a computer software programme; Statistical Package for the social sciences (SPSS). All the statistical analysis of the different variables and factors was done using SPSS (software version 16) significance relationship between two variables were checked using one way ANOVA test and two tailed Pearson's correlation was also done for the continuous variables. p- value 0.05 and less were considered significant for ANOVA and Pearson's correlation as well. All the tables for the primary data and simple frequency distribution were prepared using SPSS itself and final table and graphs were prepared using MS excel version 2019.

3. Results and Discussion

A population based cross sectional study was conducted in the Darjeeling Hill regions, a total of 243 (n=243) type II diabetes patients participated in the study, out of which 126 (51.9%) were females and 117 (48.1%) males. Rural area: (n=159) (65.40%); Urban area: (n=84) (34.6%). In the study conducted it was found that 37% (90) patients were in the age group of 56-65 years, which was highest in the group followed by 25.90% (63) patients in the age group of 66-75 years. In the study sample the prevalence of type II diabetes was found be more in averagely qualified patients (matriculate/secondary level 33.30% (81) and pre-metric 22.20% (54). (Table 05) In considering the profession of the patients it was found that housewives were significantly affected 45.70% (111). A population based cross sectional study was conducted in China for Sex-based differences in diabetes prevalence and risk factors [7] There was no significant sex-based difference in DM prevalence.

Table 05: The General Information Of The Patients

		Frequency	Percentage
Gender	Male	117	48.10%
	Female	126	51.90%
Age	26-35	3	1.20%
	36-45	30	12.30%
	46-55	51	21%
	56-65	90	37%
	66-75	63	25.90%
	76-85	6	2.50%
Address	Rural	159	65.40%
	Urban	84	34.60%
Edu.Q	Illiterate	36	14.80%
	Primary	48	19.80%
	pre metric	54	22.20%
	Metric	81	33.30%
	post metric	9	3.70%
	Graduation	12	4.90%
	Postgraduation	3	1.20%
Profession	Housewife	111	45.70%
	Government employee	3	1.20%
	Farmer	6	2.50%
	Tea garden worker	12	4.90%
	Self employed	21	8.60%
	Retired govt employee	21	8.60%
	military ex serviceman	69	28.40%

(I) Age Of Diagnosis of Type II Diabetes Mellitus Patients.

The age of diagnosis of type II diabetes in the study sample were found to be highest in people of the age group between 46-55 years (39.51%) followed by the age group of 56-65 years (27.16%) and 36-45 years (18.52%). Significantly lower percentage of incidences of the disease was seen in people of age group 26-35 years (6.17%) and 66-75 years (8.64%) [Table:06].

Table 06: Frequency of the Age of diagnosis.

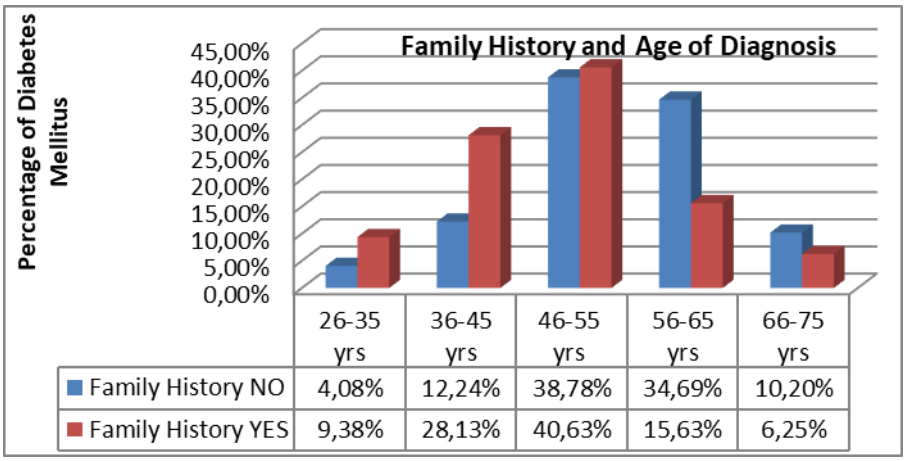
Age of diagnosis (Years)	Frequency	Percentage
15-25	0	0.00%
26-35	15	6.17%
36-45	45	18.52%
46-55	96	39.51%
56-65	66	27.16%
66-75	21	8.64%

Both the male (38.46%) and the females (40.48%) were diagnosed with type II diabetes mellitus at the age of 46-55 years. However, these differences in gender are not statistically significant. Significant age of onset difference is not found among gender. (Table 07). In the current study it was found that the family history of the type II diabetes had a significant impact on the age of diagnosis of the disease. It was found that significantly higher percentage of people were affected with family history in the age group of 26-35 years (9.38%) and in the age group of 36-45 years (28.13%)as compared to people without family history in the age group of 26-35 years(4.08%) and 36-45 years(12.24%). Further it was found that family history did not have significant impact on the age of diagnosis at later age group of 56-65 years and 66-75 years. (Fig 2) The more cases of diabetes found in a family, younger the age of onset of type 2 diabetes. There is no significant difference of occurrence of the disease based on the address.

TABLE 07: Age of Diagnosis and Gender/Address/Family History.

		AGE OF DIAGNOSIS (years)				
		26-35	36-45	46-55	56-65	66-75
Gender	Male	5.13%	15.38%	38.46%	30.77%	10.26%
	Female	7.14%	21.43%	40.48%	23.81%	7.14%
Address	Rural	5.66%	18.87%	41.51%	24.53%	9.43%
	Urban	7.14%	17.86%	35.71%	32.14%	7.14%
Family history	Yes	4.08%	12.24%	38.78%	34.69%	10.20%
	No	9.38%	28.13%	40.63%	15.63%	6.25%

Fig 2: Age of diagnosis and family history of Type II diabetes

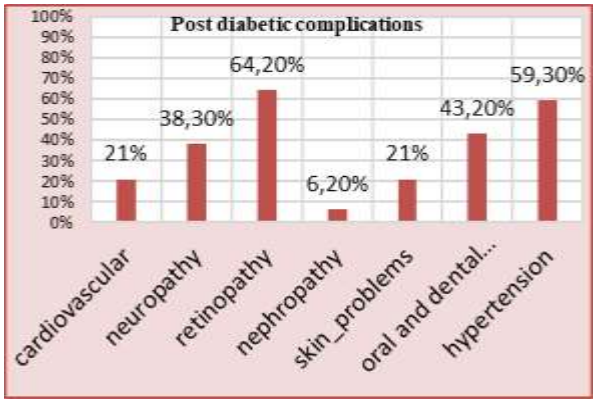


(ii) Post Diabetic Complications:

Out of the different co morbidities of the type II diabetes, diabetic retinopathy and the hypertension were found to be highest among the patients of Darjeeling 64.20% and 59.30% respectively. (Fig 3) It was seen that 43.20% of the patients suffered from some kind of oral and dental problems followed by neuropathy (38.30%), cardiovascular disease and Skin related problem (21%). In the sample survey the association with nephropathy related disease was seen at 6.20%. (Table 08)

Table 08: Frequency of the post diabetic complications Fig 3: Post diabetic complications

Post Diabetic Complications	frequency	Percentage
Cardiovascular	51	21%
Neuropathy	93	38.30%
Retinopathy	156	64.20%
Nephropathy	15	6.20%
Skin problems	51	21%
Oral and dental problems	105	43.20%
Hypertension	144	59.30%



From the study sample, males showed relatively higher percentage of post diabetic complications as compared to females, cardiovascular (males 25.64% and females 16.67%), neuropathy (males 41.03% and females 35.71%,), oral and dental problems (males 48.72% and 38.10%, females) and hypertension (males 66.67% and 52.38% females)(Table).However females showed higher percentage of post diabetic complications in retinopathy (69.05%), nephropathy (9.52%) and skin problems (26.19%) compared to 58.97%, 2.56% and (15.38%) in males respectively.

The patients of the upper age group 56-65, 66-75 and 66-75 years were found to be diagnosed with greater prevalence of post diabetic complications like cardiovascular, neuropathy, retinopathy, skin problems, oral and dental problems, and hypertension compared to the people of the lower age group. [Table: 09]. Cardiovascular disease was a common complication seen in both rural and urban population

20.75% and 21.43% respectively. Neuropathy, nephropathy, skin problems, oral and dental problems and hypertension are found in 41.51%, 7.55%, 24.53%, 47.17% and 62.26% of the rural people respectively. Which is higher compared to 32.14%, 3.57%, 14.29%, 35.71% and 53.57% of the urban people having above complications respectively. Retinopathy is found higher (71.43%) among the urban people than in rural people. Post diabetic complications shows a significant relation with retinopathy skin problem and hypertension (p value 0.017,0.008 and 0.000 respectively) less prevalence of retinopathy and skin problems are seen in the patients involved in regular exercise. Less percentage of People with normal BMI are found to have hypertension, oral and dental problems, skin problems, nephropathy and retinopathy than people of obese and overweight category however BMI is only statistically significant for retinopathy, skin problem, oral and dental problems (p value 0.007,0.004,0.023) respectively. (Table 14)

Table 09: - Post Diabetic Complications.

		Cardio vascular	Neuropathy	Retinopathy	Nephropathy	Skin problems	Oral and dental problems	Hyper tension
GENDER	Male	25.64%	41.03%	58.97%	2.56%	15.38%	48.72%	66.67%
	female	16.67%	35.71%	69.05%	9.52%	26.19%	38.10%	52.38%
AGE	26-35	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	36-45	10.00%	30.00%	40.00%	10.00%	10.00%	0.00%	30.00%
	46-55	5.88%	35.29%	47.06%	5.88%	5.88%	23.53%	35.29%
	56-65	26.67%	33.33%	80.00%	10.00%	36.67%	63.33%	73.33%
	66-75	33.33%	52.38%	66.67%	0.00%	14.29%	57.14%	76.19%
	76-85	0.00%	50.00%	100.00%	0.00%	50.00%	0.00%	50.00%
ADDRESS	Rural	20.75%	41.51%	60.38%	7.55%	24.53%	47.17%	62.26%
	Urban	21.43%	32.14%	71.43%	3.57%	14.29%	35.71%	53.57%
STRESS	NO	21.88%	39.06%	65.63%	6.25%	21.88%	43.75%	57.81%
	YES	17.65%	35.29%	58.82%	5.88%	17.65%	41.18%	64.71%
EXERCISE	NO	20.51%	33.33%	71.79%	7.69%	28.21%	38.46%	46.15%
	YES	21.43%	42.86%	57.14%	4.76%	14.29%	47.62%	71.43%
BMI WHO	UNDER WEIGHT	16.67%	16.67%	33.33%	0.00%	0.00%	33.33%	33.33%
	NORMAL	22.22%	44.44%	63.89%	8.33%	22.22%	44.44%	61.11%
	OVER WEIGHT	23.33%	33.33%	66.67%	3.33%	20.00%	53.33%	63.33%
	OBESE	11.11%	44.44%	77.78%	11.11%	33.33%	11.11%	55.56%

(iii) SELF- MONITORING PRACTICE:

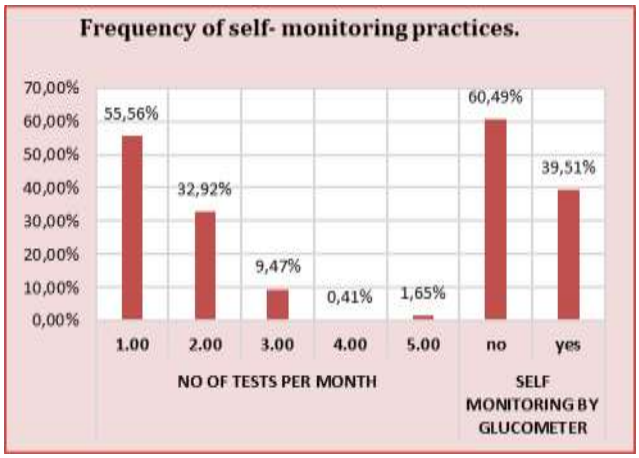
The study explores the self -monitoring practice of checking blood glucose level by glucometer at home, it is to be noted that no such researches or the cross-sectional surveys has been done to monitor the percentage of people practicing self -care habits. Economical- status of the people also affects these kinds of self- care and management of type II diabetes. It was found that out of the total number (n=243), 96 patients (60.49%) self-monitored by using Glycometer and 147 patients (39.51%) did not self-monitor. (Fig 4) Out of the total patients under study, 55.56% checked their blood glucose level at least once a month; 32.92% percent check twice a month and 9.47% thrice a month. [Table: 10].

The majority of patients with diabetes in this study could not accurately estimate their blood glucose levels indicating that home testing may be a necessary part of diabetes self- care. Home testing may also function as a form of biofeedback to facilitate an improved ability to estimate blood glucose level.

Table 10: **Self-monitoring practice in patients**

	Freq.	Patients	Percentage	Normal	High	Very High
No Of Tests Per Month	1.00	135	55.56%	20.00%	44.44%	35.56 %
	2.00	80	32.92%	25.00%	56.25%	18.75 %
	3.00	23	9.47%	39.13%	39.13%	22.74 %
	4.00	1	0.41%	0.00%	0.00%	0.00%
	5.00	4	1.65%	25.00%	0.00%	75.00 %
Self-Monitoring By Glucometer	No	147	60.49%	18.37%	46.94%	34.69 %
	Yes	96	39.51%	31.25%	46.88%	21.88 %

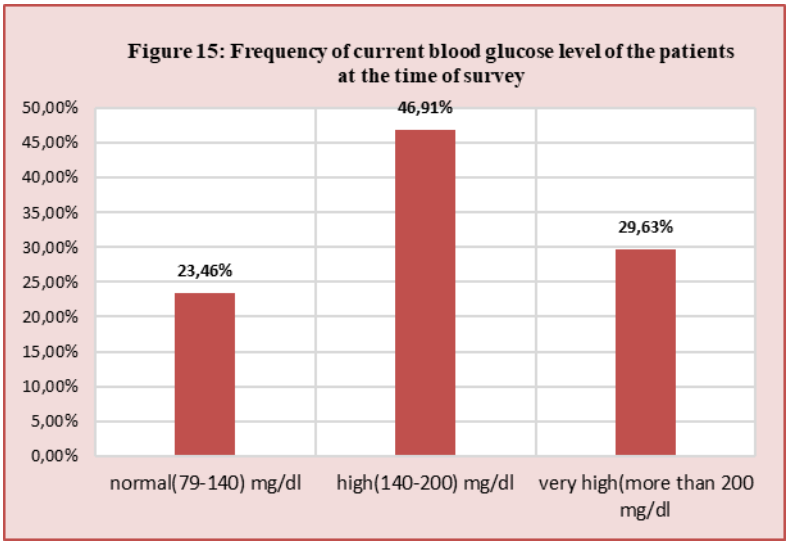
Fig 4: Frequency of Self-monitoring practice



In the study current blood glucose level of the patients was taken at the time of survey, [Fig: 5], 46% patients had the high blood level and 29.63% patients had very high blood glucose level compared to the 23.4% patients having normal blood glucose level. Out of the total number of patients under study, it was found that 76.53% are still having high current blood glucose level, which is suggestive that in spite of the medical supervision and change in food habits has not benefited the patients under survey.

There are no significant differences found between number of tests per month and the blood glucose level but 31% of the patients having blood glucose level monitoring habit using glucometer at home have normal blood glucose level than 18% of the people who don't have self- monitoring facility at home. It was seen that 34.69% of the people who don't have such facility have high blood glucose level compared to only 21.8% patients having such facilities at home. It is statistically significant at level of 0.05 (p value 0.025.(Table 14)

Fig 5: Current blood glucose level at the time of the survey



(iv) Food Habits:

Out of the total sample, regular food habit pattern CRC is followed by 46.91% of the diabetic patients i.e., two times chapati in their regular meal and one meal of rice. Only 3.70% of the patients responded to take special diet regularly. Out of the total sample, 30.86% of the patients consume alcohol occasionally and 4.94% people were found to consume alcohol regularly. In the sample population 9.88% of the people were found to chew or smoke tobacco. [Table 11]

Table 11: Food habits of patients.

Regular Food Habits		Frequency	Percentage
Rice-Snack-Chapati	Rsc	9	3.70%
Snack-Rice-Chapati	Src	57	23.46%
Rice-Snack-Rice	Rsr	51	20.99%
Chapati-Snack-Rice	Csr	9	3.70%
Chapati-Rice-Chapati	Crc	114	46.91%
Chapati-Chapati-Chapati	Ccc	3	1.23%
Special Diet	No	234	96.30%
	Yes	9	3.70%
Alcohol	Yes Regularly	12	4.94%
	Yes Occasionally	75	30.86%
Tobacco		24	9.88%

People with the habit of consuming rice at dinner were found to have high blood glucose level. 52.94% and 66.67% of the people following RSR and CSR pattern were found to have high blood glucose level. (Table 12). The level of glucose remains relatively higher than the people following other food patterns. However, it is not statistically significant because there no significant difference in glycemic index between rice and wheat.[21] The patients with the habit of regular alcohol consumption were found to have high or very high blood glucose level (56%) than the non-frequent alcohol consumers (32%). This is statistically significant at the level of 0.01 with the p value 0.024.(Table:14)

Table 12: Food habit and current blood glucose level.

		Normal	High	Very High
REGULAR FOOD HABITS	RSC	66.67%	33.33%	0.00%
	SRC	26.32%	36.84%	36.84%
	RSR	23.53%	52.94%	23.53%
	CSR	0.00%	66.67%	33.33%
	CRC	21.05%	47.37%	31.58%
SPECIAL DIET	No	20.51%	48.72%	30.77%
	Yes	100.00%	0.00%	0.00%
ALCOHOL	Yes Regularly	0.00%	50.00%	50.00%
	Yes Occasionally	12.00%	56.00%	32.00%
TOBACCO		25.00%	62.50%	12.50%

(v) FREQUENCY OF THE DIFFERENT MEDICINES USED.

In the population based cross sectional study it was found that oral anti diabetic drug Metformin belonging to Biguaide class were prescribed to majority of the patients (72.82%), as a monotherapy or by combining with other medicines. (Fig 6) Glimipride (51.85%) Class Sulfonamides were second most used oral anti diabetic drug followed by pioglitazone (16%) which is the only Thiazolidinediones used in India [7]. Other hypoglycaemic agents like vildagliptin, teneligliptin, sitagliptin, linagliptin,dapagliflozin and voglibose were found to be less frequently used as oral anti diabetic drug by the patients [Table:13]. In January 2022, the Food and Drug Administration announced a voluntary recall of metformin. People with type 2 diabetes use metformin to control their blood sugar alongside a healthy diet and exercise. Concerns over higher-than-acceptable levels of the probable cancer-causing contaminant N-nitrosodimethylamine (NDMA) prompted the recall.

From the total sample, only 6.1% have ever used insulin. It was found that GLP-1antigonists and meglitinides were not found to be prescribed by any medical practitioner or hospitals to the patients residing in the Darjeeling Hill Region

Table 13: Frequency of the different medicines used for type II diabetes.

Drug Class	*Oral Anti-Diabetic Drug*	*Frequency*	*Percentage*
Biguanide	*Metformin*	*177*	*72.84%*
Sulfonamides	*Gliclazide*	*0*	*0.00%*
	Glipizide	*0*	*0.00%*
	Glimepride	*126*	*51.85%*
Meglitinides	*Repaglinide*	*0*	*0.00%*
	Nateglinide	*0*	*0.00%*
Thiazolidinediones	*Pioglitazone*	*39*	*16.05%*
	Rosiglitazone	*0*	*0.00%*
GLP1 agonists	*Exenatide*	*0*	*0.00%*
	Lixisenatide	*0*	*0.00%*
	Liraglutide	*0*	*0.00%*
	Albiglutide	*0*	*0.00%*
	Dulaglutide	*0*	*0.00%*
DPP4 inhibitors	*Vidagliptin*	*3*	*1.23%*
	Teneligliptin	*21*	*8.64%*
	Alogliptin	*0*	*0.00%*
	Sitagliptin	*6*	*2.47%*
	Linagliptin	*9*	*3.70%*
SGLT2 inhibitors	*Canagliflozin*	*0*	*0.00%*
	Dapagliflozin	*6*	*2.47%*
Alpha glucosidase inhibitors	*Acarbose*	*0*	*0.00%*
	Miglitol	*0*	*0.00%*
	Voglibose	*12*	*4.94%*
Insulin		*15*	*6.17%*

Fig 6: Frequency of the type of medicines prescribed to the patients

Table 14. Statistical Analysis Of Data.

One way ANOVA test of the variables				
Variables	**Factors**	**f value**	**p value**	**Df**
	Exercise habits	55.949	0.000**	1
Gender	Nephropathy	5.368	0.021*	1
	Skin problems	4.312	0.039*	1
	Hypertension	5.196	0.024*	1
	Total tests per month	8.472	0.000**	4
	Self- monitoring by glucometer	13.725	0.000**	1
	Cardiovascular	10.369	0.001**	1
	Neuropathy	6.369	0.012*	1
	Retinopathy	20.608	0.000**	1

Present age		Skin problems	5.269	0.023*	1
		Oral and dental problems	31.134	0.000**	1
		Hypertension	33.775	0.000**	1
		Total tests per month	10.761	0.000**	4
		Self- monitoring by glucometer	24.884	0.000**	1
Edu. Q		Cardiovascular	6.627	0.013*	1
		Neuropathy	3.914	0.049*	1
		Nephropathy	12.844	0.000**	1
		Total tests per month	8.872	0.000**	4
		Self- monitoring by glucometer	17.875	0.000**	1
Profession		Cardiovascular	6.052	0.015*	1
		Age of diagnosis	3.042	0.018*	4
		Total tests per month	7.084	0.000**	4
		Self- monitoring by glucometer	18.091	0.000**	1
Exercise habits		Retinopathy	5.754	0.017*	1
		Skin problems	7.241	0.008**	1
		Hypertension	17.046	0.000**	1
BMI	WHO	Retinopathy	6.722	0.010*	1
	Asia pacific	Retinopathy	7.530	0.007**	1
		Skin problems	8.244	0.004**	1
		Oral and dental problems	5.204	0.023*	1
Alcohol		Oral and dental problems	10.957	0.001**	1
		Current blood glucose level	5.691	0.004**	2
Age of diagnosis		Cardiovascular	13.418	0.000**	1
		Neuropathy	5.256	0.024*	1
		Retinopathy	34.417	0.000**	1
		Oral and dental problems	60.414	0.000**	1
		Hypertension	25.416	0.000**	1
Family history		Age of diagnosis	5.168	0.01*	4
Self- monitoring by glucometer		Current blood glucose level	3.732	0.025*	2

Discussion:

Among the diabetic peoples of Darjeeling, the of type II diabetes the total sample (n=243), more females (51.9%) of the females are found to have type II diabetes than 48.1% males. [Table 05]. A population based cross sectional study was conducted in China for Sex-based differences in diabetes prevalence and risk factors, there was no significant sex-based difference in DM prevalence. [3] In the study rural population (n=159) (65.40%) were found to be affected relatively more with type II diabetes mellitus than urban population (n=84) (34.6%). [Table 05]. Similar study was conducted in Yangon Region of Myanmar, urban and rural areas and the prevalence of DM was 12.1% in urban and 7.1% in rural areas. [8] The reason may be due to lack of awareness (early detection), minimum physical works and poor diet. Almost all rural people are found to have less knowledge about diabetic management; as a result, there was no significant change in food habits and regular exercise. Beside medications no special care has been observed. In the study males and females were found to have onset of diabetes at the age of 46-55 years. Onset ages of diabetes were found to be almost same for male and female. A descriptive cross-sectional study at Noble OPD center from November 2019 to January 2020, which included 321 type2 diabetic patients (119 males, 202 females) the mean age was found to be 53.86 ± 11.54 years. [17] The newly diagnosed T2DM patients admitted to the diabetes identification center of Tianjin 4th Central Hospital (TJ4thch) from October 2017 to June 2020 were registered. The T2DM-diagnosed age in males was lower than in females.[16]

Prevalence of diabetes is found to be more in the averagely qualified patients and early onset is found in the government employees. Work load and stress is also can be one of the factors of the multifactorial diabetes [3]. And also working for hours sitting in a single place and lack of exercise habits worsen it.

Out of the total sample, 39.5% of the patients have the known family history for the type II diabetes mellitus. Highest number of the patients (48.63%) who have the family history of type II diabetes were diagnosed at the age of 46-55 year and this data is statistically significant (p- value-0.01).(Table 14) Early onset of diabetes at the age of 26-35 years and 36-45 years of age are found to have impact of family history. But diagnosis at the later ages 56-65 years and 66-75 years of age have less impact of family history. [Fig. 7]. In one of the studies data on family history of diabetes and age of diabetes onset were prospectively collected on 5193 subjects. Family members were deemed to include grandparents, parents, siblings, aunts/uncles and children. The more cases of diabetes found in a family, the younger the age of onset of type 2 diabetes. [18] Genetic factors may cause early onset of type II diabetes than other factors and later diagnosis may be due to other multi- factors less than the genetic. A study was done to check the impact of family history on the onset of type II diabetes at baseline, individuals with a family history of diabetes (FH+) had approximately a twofold increase in the prevalence of type 2 diabetes compared with individuals without a family history of the disease (FH−) (18.0% vs. 9.9%; $P = 1.3 \times 10^{-31}$).[10]

Diabetic retinopathy and the hypertension were found to be highest co-morbidities among the patients of Darjeeling 64.20% and 59.30% respectively. [Table 08] People with the higher age group are found to have more than one co-morbidities related to diabetes than in the diabetic patients of the lower age group. A cross sectional survey carried out on 912 type 2 diabetes patients attending different urban primary health care facilities at Bhubaneswar, the number of co morbidities was highest in the age group > = 60 across both sexes. Age was found to be a strong independent predictor for diabetes co morbidity.[15] It is obvious to generate other complications with poor management of diabetes. Self - monitoring practice is one of the important measures to control diabetes which automatically makes people conscious about their blood glucose level and helps to prevent long term impact of diabetes and co-morbidity. Type II Diabetes related Co-morbidity means additional burden on the family which has a greater impact on the economical weaker section. Males were found to check their blood glucose level more than one time per month (45%), than females (12%). More males 51.28% are found to monitor their blood glucose level using glucometer at their home than female (28.57%). This may be the reason that fewer diabetic males are found compared to females. [Table 10]

Out of the total patients, 55.56% of the patients check their blood glucose level at least once a month and 32.92% percent check twice a month. And only few monitored their blood glucose level twice or more a month. Only 39.51% people had glucometer kit at their home. Economical- status of the people also affects these kinds of self- care and management of type II diabetes.

According to the current blood glucose level report of the patients at the time of survey, 46% patients had the high blood level and 29.63% patients had very high blood glucose level compared to the 23.4% patients having normal blood glucose level. [Fig. 5] Out of the total number of patients under study, it was found that 76.53% are still having high current blood glucose level, which is suggestive that in spite of the medical supervision and change in food habits has not benefited the patients under survey.It was revealed that 31% of the patients having blood glucose level monitoring habit using glucometer at home had normal blood glucose level than people who don't have self- monitoring facility at home. Further, 34.69% of the people who did not have such facility recorded high blood glucose level as compared to only 21.8% patients having such facilities at home. It is statistically significant at level of 0.05 (p value 0.025).[Table 14] To explore whether people with diabetes can accurately estimate their blood glucose levels and to assess which factors explain variability was done in Stuart Frankum, in the study it was found that home testing may also function as a form of biofeedback to facilitate an improved ability to estimate blood glucose levels. [14]

From the total sample, higher percentages of males are found to have post diabetic complications; cardiovascular neuropathy oral and dental problems and hypertension compared female. Female patients were found to have higher percentage of retinopathy and skin problems as compared to males. Out of the total sample of different blood groups the prevalence of type II diabetes is found to be more in people of blood group A+(39.9%).

In the study 46.9% of the patients were in the obese and 25.9% percent in the overweight category. Almost 75% of the people with diabetes had higher BMI. Less percentage of People with normal BMI are found to have hypertension, oral and dental problems, skin problems, nephropathy and retinopathy than people of obese and overweight category however BMI is only statistically significant for retinopathy, skin problem, oral and dental problems respectively. (Table 09) So, it can be suggested that by maintaining body weight not only we can manage diabetes but we can also reduce the risk of other co-morbidities of diabetes.

In a population-scale cohort study made in the UK Biobank, it was found that lower BMI was consistently associated with reduced diabetes risk across BMI, family history, and genetic risk categories, suggesting all individuals can substantially reduce their diabetes risk through weight loss. Results of the study support the broad deployment of weight loss interventions to individuals at all levels of diabetes risk [9].

In the study of dietary habits of the patient it was found that no significant impact could be seen in controlling Type II diabetes in people following Rice and Chapati diet. (Table 11) In one of the studies conducted in part of North India, glycemic responses of 2 mixed meals were compared with reference meal (glucose). The GI of test meal 1 (85.5 ± 11.8%) and test meal 2 (83.6 ± 11.4%) was not significantly different (P = 0.7095). The present study found no differences in glycemic index of wheat chapatti and rice based mixed meals [12]. But people of the region still of the view that chapati is good for the maintaining the GI. According to the American Dietetic Association, "appropriately planned vegetarian diets including vegan diets are healthful, nutritionally adequate, and may provide health benefits in the prevention and treatment of certain diseases" [11]. Alcohol consumers are found to have cardiovascular neuropathy and retinopathy respectively, then the non-alcoholic patients and these differences are statistically significant at the level of 0.01 for cardiovascular and retinopathy and at level of (0.05 p value 0.024) for neuropathy. Alcohol intake was inversely associated with serum insulin and positively associated with HDL-cholesterol.[13]

Out of the total sample highest number of people (39.51%) were diagnosed with type II diabetes in the age of 46-55 years. This is the average age of diagnosis of type II diabetes shown by many research works. Higher percentage of the patients with onset of diabetes at the later ages (56-65 years and 66-75) are found to have hypertension and the oral and the dental problems. Overall comorbidities are found to be less when diabetes is detected earlier [Table-17] It is generally accepted that the early detection of type 2 diabetes mellitus (T2DM) is important to prevent the development of complications and comorbidities, as well as premature death. [19]

In the study, only 6.1% have ever used insulin. None of the any type of the alpha glucosidase inhibitors, GLP-1antigonists and meglitinides are found to be prescribed by any hospitals Metformin is prescribed to most of the patients, (72.82%) as a monotherapy or by combining with other medicines followed by glimipride(51.85%) pioglitazone(16%) which is the only Thiazolidinediones used in India. [3] Other hypoglycaemic agents like vildagliptin, teneligliptin, sitagliptin, linagliptin, dapagliflozin and voglibose are found very less in the combined diabetic medicines of the patients.

Although it is not easy to achieve behavioral modifications through structured DM education, in addition to therapeutic interventions in Type II diabetic patients but nevertheless it is important to bring awareness about glycemic control. One example of an effective DM education programme in China consisted of theoretical and practical courses [20]. There is evidence that a number of metabolic and congenital disorders can be appropriately managed by dietary and pharmacological approaches [21,22].

4. Conclusion

Considering many other researches on type II diabetes mellitus, it can be concluded that many factors may be the cause for the type II diabetes like obesity, genetic factor, lack of body exercise etc. In our research we have found very poor self-management of people towards diabetes. People should rather focus more on exercise, weight management and self -monitoring to maintain their blood glucose level and avoid having other diabetic co-morbidities which invariably brings physically, mentally and economically burden to the patients. Despite of taking regular hypo-glycaemic drugs, most of the people have high or very high blood glucose level this may be due to lack of self- management. People with the family history of diabetes need to take early precaution to avoid to develop post diabetic complications later or earlier. Blood glucose monitoring habit using glucometer at home have maintained a normal blood glucose level than the people who do not have such facility. Diabetes is not a curse. There are so many diseases which is even worse than this. However, people need to be very cautious once they encounter with the so-called type II diabetes. Not only medications but lifestyle of the patients also plays an important role in its management.

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References:

1. Padhi, S., Nayak, A.K. and Behera, A., 2020. Type II diabetes mellitus: a review on recent drug based therapeutics. Biomedicine & Pharmacotherapy, 131, p.110708.
2. World health organisation (WHO) on diabetes https://www.who.int/news-room/fact-sheets/detail/diabetes.
3. ICMR guidelines for management of type 2 diabetes 2018-Indian Council of Medical Research, Ansari Nagar, New Delhi – 110 029
4. Lim, J.U., Lee, J.H., Kim, J.S., Hwang, Y.I., Kim, T.H., Lim, S.Y., Yoo, K.H., Jung, K.S., Kim, Y.K. and Rhee, C.K., 2017. Comparison of World Health Organization and Asia-Pacific body mass index classifications in COPD patients. International journal of chronic obstructive pulmonary disease, pp.2465-2475.
5. The Asia-Pacific perspective : redefining obesity and its treatment.orld Health Organization. Regional Office for the Western Pacific. (2000). The Asia-Pacific perspective : redefining obesity andits treatment. Sydney : Health Communications Australia. https://apps.who.int/iris/handle/10665/206936
6. Verma, Madhur[1,]; Rajput, Meena[2]; Kishore, Kamal[3]; Kathirvel, Soundappan[4] Journal of Family Medicine and Primary Care: June 2019 - Volume 8 - Issue 6 - p 2095-2100doi: 10.4103/jfmpc.jfmpc_257_19
7. Zhang, H., Ni, J., Yu, C., Wu, Y., Li, J., Liu, J., Tu, J., Ning, X., He, Q. and Wang, J., 2019. Sex-based differences in diabetes prevalence and risk factors: a population-based cross-sectional study among low-income adults in China. Frontiers in endocrinology, 10, p.658.
8. Aung, W.P., Htet, A.S., Bjertness, E., Stigum, H., Chongsuvivatwong, V. and Kjøllesdal, M.K.R., 2018. Urban–rural differences in the prevalence of diabetes mellitus among 25–74 year-old adults of the Yangon Region, Myanmar: Two cross-sectional studies. BMJ open, 8(3), p.e020406.
9. Wainberg, M., Mahajan, A., Kundaje, A., McCarthy, M.I., Ingelsson, E., Sinnott-Armstrong, N. and Rivas, M.A., 2019. Homogeneity in the association of body mass index with type 2 diabetes across the UK Biobank: a Mendelian randomization study. PLoS medicine, 16(12), p.e1002982.
10. Cederberg, H., Stančáková, A., Kuusisto, J., Laakso, M. and Smith, U., 2015. Family history of type 2 diabetes increases the risk of both obesity and its complications: is type 2 diabetes a disease of inappropriate lipid storage?. Journal of internal medicine, 277(5), pp.540-551.
11. Adeva-Andany, M.M., Rañal-Muíño, E., Vila-Altesor, M., Fernández-Fernández, C., Funcasta-Calderón, R. and Castro-Quintela, E., 2019. Dietary habits contribute to define the risk of type 2 diabetes in humans. Clinical Nutrition ESPEN, 34, pp.8-17.
12. Nayar, S. and Madhu, S.V., 2020. Glycemic index of wheat and rice are similar when consumed as part of a north indian mixed meal. Indian Journal of Endocrinology and Metabolism, 24(3), p.251.
13. Wannamethee, S.G., Shaper, A.G., Perry, I.J. and Alberti, K.G.M.M., 2002. Alcohol consumption and the incidence of type II diabetes. Journal of Epidemiology & Community Health, 56(7), pp.542-548.
14. Frankum, S. and Ogden, J., 2005. Estimation of blood glucose levels by people with diabetes: a cross-sectional study. British Journal of General Practice, 55(521), pp.944-948.
15. Pati, S. and Schellevis, F.G., 2017. Prevalence and pattern of co morbidity among type2 diabetics attending urban primary healthcare centers at Bhubaneswar (India). PloS one, 12(8), p.e0181661.
16. Hao, Z., Huang, X., Liu, X., He, F. and Shao, H., 2022. Association Analysis Between Different Diabetic Family History and Gender with Diagnosed Age of Type 2 Diabetes Mellitus: A Cross-Sectional Study in Tianjin, China. INQUIRY: The Journal of Health Care Organization, Provision, and Financing, 59, p.00469580221086364.
17. Naseri, M.W., Esmat, H.A. and Bahee, M.D., 2022. Prevalence of hypertension in Type-2 diabetes mellitus. Annals of Medicine and Surgery, 78, p.103758.
18. Molyneaux, L., Constantino, M. and Yue, D., 2004. Strong family history predicts a younger age of onset for subjects diagnosed with type 2 diabetes. Diabetes, Obesity and metabolism, 6(3), pp.187-194.
19. Impact of Genetic Factors on the Age of Onset for Type 2 Diabetes Mellitus in Addition to the Conventional Risk Factors Peter Piko,[1] Nardos Abebe Werissa,[1,2] Szilvia Fiatal,[3] Janos Sandor,[3] and Roza Adany[1,3,*] doi: 10.3390/jpm11010006
20. Zheng, F.; Liu, S.; Liu, Y.; Deng, L. Effects of an outpatient diabetes self-management education on patients with type 2 diabetes in China: A randomized controlled trial. J. Diabetes Res. 2019, 2019, 1073131. [Google Scholar] [CrossRef]
21. Jurca, C.; Bembea, M.; Pallag, A.; Mureșan, M.; Szilagyi, A.; Balmoș, A.; Pop, O.; Jurca, A.; Dobjanschi, L. Pharmacotherapeutical considerations in the treatment and management of neonatal hyperammonaemia. Farmacia 2018, 66, 216–222. [Google Scholar]
22. Nitescu, M.; Furtunescu, F.L.; Otelea, M.; Rafila, A.; Streinu-Cercel, A. Prevalence of metabolic syndrome parameters in a Romanian population of young adults. Rom. Rev. Lab. Med. 2012, 20, 21–28. [Google Scholar]