Research article

Prevalence of target organ disease and its relation with HbA1c at the point of detection of type 2 diabetes mellitus – A cross sectional study from a tertiary care hospital in Odisha

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ABSTRACT

Introduction and Aim: HbA1c is not only a valid indicator of chronic hyperglycaemia but also coincides with the increased risk of diabetic complications in the long term. This study focuses on the prevalence of target organ disease (TOD) and its relation with HbA1c at the point of detecting Type 2 Diabetes Mellitus(T_2DM).

Materials and Methods: This is a single-centre cross-sectional study done in the Department of General medicine at IMS and SUM Hospital, Odisha, between November 2020 and June 2022, including all newly diagnosed Type-2 Diabetes Mellitus patients aged > 30 years. Besides all the biochemical parameters, the demographic profile was noted in an excel sheet, and later on, using SPSS version 26, the data was analysed categorically.

Results: 148 newly diagnosed Type 2 DM patients were enrolled in the study with male predominance (54.72%). The mean age was found as 52.49±9.40 years. There were 29 (19.5%) cases of diabetic retinopathy, 39 (26.3%) diabetic neuropathy, 32(21.6%) diabetic nephropathy and 23(15.54%) left ventricular diastolic dysfunction, with a minimal number of RWMA [7 (4.72%)], Concentric left ventricular hypertrophy [9 (6.08%)] and Ischemic DCM [1(0.67%)] found as complications of newly diagnosed Diabetes mellitus patients. The prevalence of coronary artery disease (CAD) is higher in our study than in other diabetic complications, i.e., 40 (27.02%). A statistically significant ($p<0.05$) correlation exists between newly diagnosed Diabetes patients with higher $HbA1_C$ and serum creatinine, serum urea, microalbuminuria, and positive monofilament test.

Conclusion: This study underscores the significance of assessing target organ damage (TOD) prevalence for Type 2 Diabetes Mellitus (T2DM) detection, highlighting the utility of HbA1c testing. HbA1c, a rapid and precise diagnostic tool, holds promise, especially in resource-limited settings, aiding in timely T2DM diagnosis and improved patient care amid the global diabetes epidemic.

Keywords: Diabetes; HbA1c; target organ disease (TOD); diabetic complications.

INTRODUCTION

Diabetes-related morbidity and mortality are increasing as the prevalence of T_2DM rises globally (1,2). HbA1c blood level gives us information on the patient's average blood glucose levels during the previous 2-3 months, which is the approximate of red blood cells (RBCs; 3). The HbA1c level is currently suggested as a standard of care (SOC) for evaluating and observing T_2DM individuals. HbA1c is a solid gauge of long-standing hyperglycaemia. It corresponds well with the increased risk of diabetic problems in the long run, making it the investigation of choice for long-term T_2DM monitoring (4). On the other hand, as the Action to Control Cardiovascular Risk in Diabetes (ACCORD) study reported the potentially dangerous outcomes of extensive HbA1c level targeted therapy, the aptness of general glycaemic targets for individuals with T_2DM had been debated with raising eloquence (5).

In patients with T_2DM and paroxysmal atrial fibrillation following catheter ablation, high HbA1c levels were related to an increased risk of recurrence of atrial tachyarrhythmia (6). Those with diabetes with a 1% increase in HbA1c concentration had a 30% rise overall and a 40% rise in cardiovascular mortality (7, 8). Whereas lowering HbA1c by 0.2% could reduce mortality by 10%. Recent research has linked the progression of renal damage and the prevalence of cardiovascular disease to HbA1c variability, which is unrelated to the mean HbA1c level (9). One of the studies done in Korea found that HbA1c variability, in addition to the mean HbA1c level, was not a sovereign interpreter of carotid intima-media thickness (10). Similarly, in Renal Insufficiency and Cardiovascular Events (RIACE), a multicentre study in Italy found that HbA1c fluctuation did not affect macrovascular consequences (11). Furthermore, population-based information on correlations between exact alterations in HbA1c levels and the death rate is limited among patients with T_2DM (12).

This study aims to determine the prevalence of macrovascular and microvascular problems in newly detected T_2DM patients, as well as their relationship with HbA1c levels. This emphasizes the importance of

viewing for diabetic complications at the initial stages of diabetes detection, regardless of the existence or lack of clinical features of those problems. Early discovery and appropriate action will decrease the disabilities and death owing to diabetic complications and even provides an opportunity to reverse those complications (13).

MATERIALS AND METHODS

This is a single-centre cross-sectional study done in the Department of General medicine at IMS and SUM Hospital, Odisha, between November 2020 and June 2022.

Inclusion criteria

All patients with newly diagnosed Type-2 Diabetes mellitus in outpatient/inpatient meeting the following criteria were included those

- aged >30 years
- having blood pressure of <130/80 mm Hg
- Without the presence of known eye disease, kidney disease, ischemic heart disease and
- mentally and physically fit.

Exclusion criteria

- Those with any substance abuse or mental illness.
- Those with cardiomyopathy, valvular heart disease, heart failure, chronic pulmonary illness, severe anemia, and hemoglobinopathies.
- Blood pressure >130/80 mmHg.

A total of 148 newly diagnosed T_2DM patients were enrolled in the study. Using the purposive non-probability sampling technique, data collection was done after receiving the informed consent. A well-framed questionnaire was prepared for the demographic data of age, sex, socio-economic status, and urban/rural origin. Individuals' height and weight were measured and recorded. A detailed clinical and personal history, including addictions and habits, was taken from each participant. Fasting and Postprandial Plasma glucose (FPG and PPG) – HbA1c, Electrocardiography (ECG), Chest X-ray, and 2D Echocardiography were performed. In selected cases, USG KUB was done.

Ethical concern

This study was conducted from the data collected from investigating reports of the samples received in the haematology laboratory as part of the diagnostic workup. Data on X-ray chest, USG KUB, and Echocardiography were collected from radiology department reports after obtaining informed consent from the patient according to hospital protocol. This study did not directly deal with the study participants, and there was no research-related risk to the participants. No monetary benefits were offered to the participants. The subject's identity wasn't disclosed and was kept anonymous. All the relevant patient data was kept confidential.

Statistical analysis

The data were collected manually. A big excel sheet was made, and after the necessary coding, the data were analysed using IBM SPSS Statistics software version 26. Descriptive statistics were expressed as frequencies (percentages), mean, median, and standard deviations. Chi-square test and Correlation analysis were done where applicable. P value ≤ 0.05 was taken as statistically significant.

RESULTS

Out of 148, there were 67 (45.3%) female and 81 (54.7%) male diabetics present in our study. The mean age was 52.49±9.40 years, ranging from a minimum of 30 to a maximum of 70 years (Fig.1). The BMI distribution shows most of the patients, 89(60.13%) had overweight followed by 37 (25%), obese, and only 3(2.02%) had underweight (Fig.2). The descriptive analysis of all continuous parameters was assessed by mean and standard deviation (Table 1).

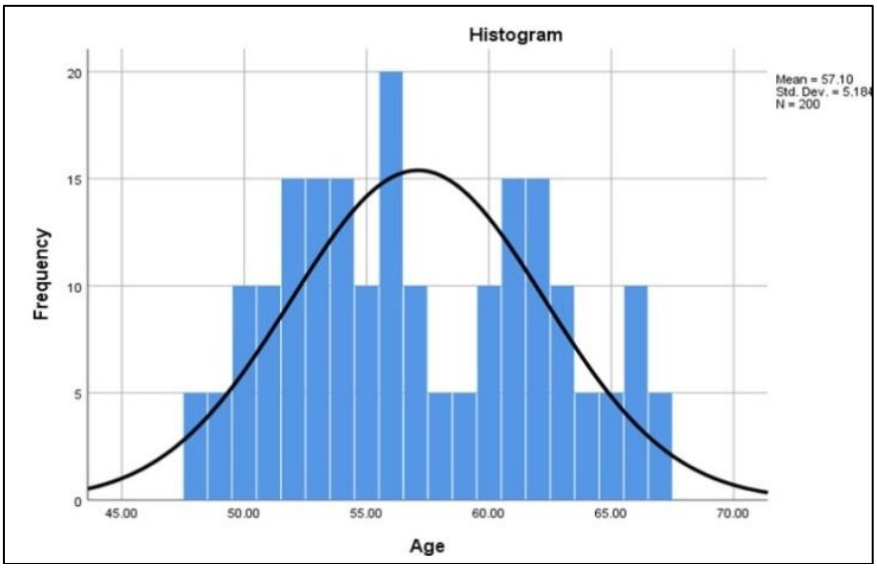

Fig.1: Histogram showing normal distribution of age of patients

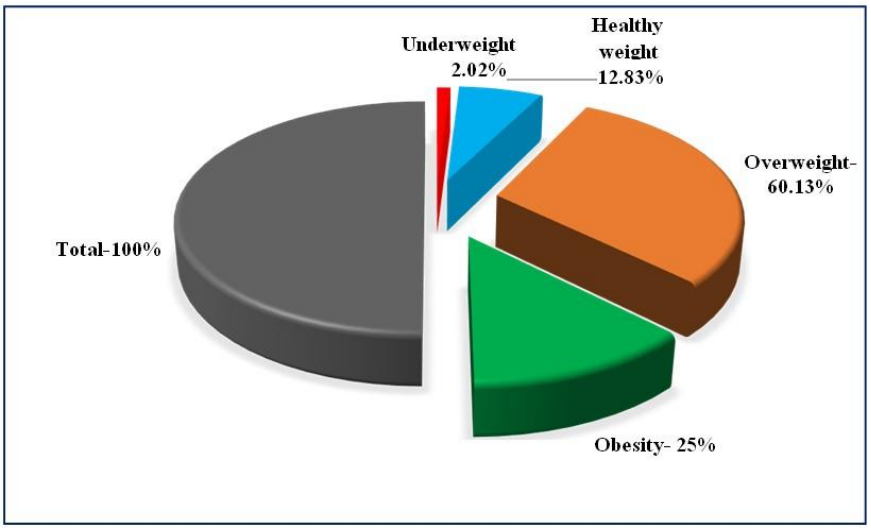

Fig. 2: BMI classification of all patients

Table 1: Descriptive analysis of various continuous parameters

Parameter	Mean (μ)	Standard deviation (SD)
FBS (mg/dL)	228.78	56.21
2 Hour PPBS (mg/dL)	356.32	65.45
HbA_1C%	10.63	1.85
S. Creatinine (mg/dL)	1.22	0.52
S. Urea (mg/dL)	24.66	10.47
Total cholesterol (mg/dL)	261.32	27.48

Around 32 patients out of 148 diabetes patients had microalbuminuria. Of 148 patients, 23 (15.5%) patients had Non-proliferative Diabetic Retinopathy, and 6 (4.1%) patients had Proliferative Diabetic Retinopathy. The prevalence of Diabetic Neuropathy was assessed through a monofilament test. There were 39 (26.3%) patients who had diabetic neuropathy. On ECG examination of all patients, only 3(2%) cases had left ventricular hypertrophy. There were a maximum of 17(11.48%) subjects who had T wave inversion, followed by 12 (8.1%) cases that had ST depression and 3(2.02%) cases which contributed to ST elevation as well as pathological Q wave. The 2-D Echo examination shows 23 (15.54%) cases had left ventricular diastolic dysfunction, 9 (6.08%) had concentric LVH, 7 (4.72%) cases found with RWMA, and a single case (0.67%) of Ischemic DCM found in the present study.

The prevalence of incidentally detected T_2DM among patients with other diseases and those with various signs and symptoms suggestive of T_2DM are depicted in the table below (Table 2).

We observed there was a significantly positive correlation between HbA1c and serum Creatinine (a marker for Diabetic Nephropathy; Fig.3), serum Urea, Microalbuminuria (Fig.4), Monofilament test (a marker for Diabetic Neuropathy) with p-value <0.05. In our study, no significant correlation was found between HbA_1C and Diabetic Retinopathy and Cardiovascular complications (P value >0.05). The correlation between HbA_1C with other indicators of diabetes complications is depicted in Table 3.

Table 2: Prevalence of incidentally detected T_2DM

	Male	Female
Patients presenting with other diseases		
Pneumonia	13(16.04%)	7(10.44%)
Sepsis	4(4.93%)	3(4.47%)
UTI	10(12.34%)	14(20.89%)
Fever underEvaluation	17(20.98%)	11(16.41%)
RTA	7(8.64%)	5(7.46%)
Acutegastritis	23(28.39%)	24(35.82%)
Diarrhoea	6(7.40%)	2(2.98%)
Others	1(1.23%)	1(1.49%)
Patients presenting with features suggestive of T_2DM		
Blurring ofVision	19(23.4%)	10(14.9%)
Sensorysymptoms	37(45.67%)	26 (38.8%)
Ulcers	14(17.28%)	9(13.43%)

Increased frequency ofurination	17(20.98%)	20(29.85%)
ncreased hunger and thirst	18(22.2%)	21(31.34%)
Weight loss/weightgain	15(18.51%)	18(26.86%)

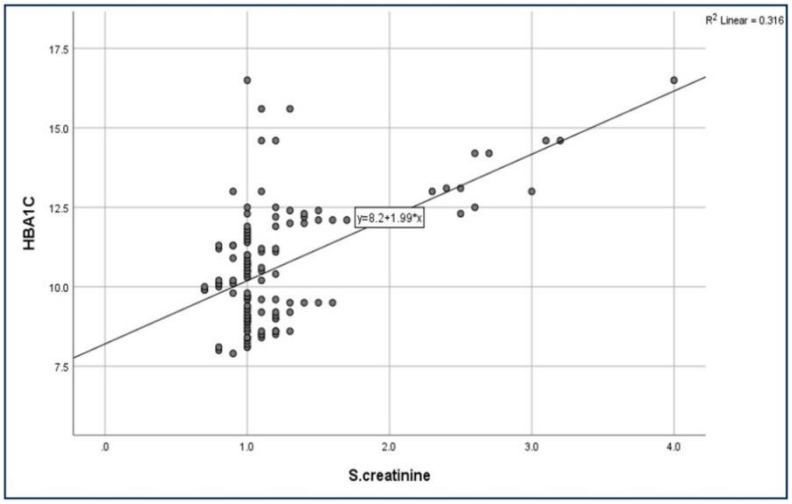

Fig. 3: Correlation between HbA_1C with serum creatinine

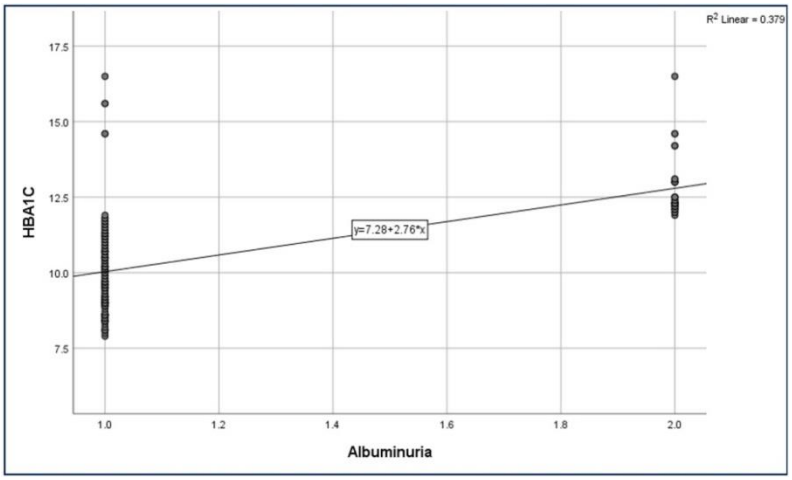

Fig. 4: Correlation of HbA_1C with microalbuminuria

Table 3: Correlation between HbA_1C and other indicators of diabetes complications

Parameter	**Pearson Correlation**	**P-value**
Serum creatinine	0.562	0.01
Serum urea	0.318	0.03
Albuminuria	0.616	0.02
Fundoscopy findings	0.127	0.125
Monofilament test	0.241	0.003
ECG abnormality	0.329	0.081
2D Echo abnormality	0.118	0.076
BMI	0.416	0.119

DISCUSSION

This is a study done over two years in the Department of General Medicine at IMS and SUM Hospital, Odisha, between November 2020 and June 2022, on the cases of newly detected T2DM.

The mean age of the participants in our study was 52.49±9.40years, within a range starting from a minimum of 30 years to a maximum of 70 years. A survey conducted by Drivsholm *et al.*, found the mean age was 66.3 years in female patients and 63.2 years in male patients (14). Similarly, a study by Sirshat *et al.*, found the mean age as 56 years, and a survey by Weersuriya *et al.*, (15) found 43.3± 6.2 years as the mean age of diabetes patients. Out of 148 patients, the male patients contributed around 54.7%, whereas there were 45.3% of female diabetics seen in the present study. A similar study by Zoungas *et al.*, (16) showed 42.4% female diabetics and male preponderance with 57.6% in their research. In the survey conducted by Deepa *et al.*, (17) 62 were men, and 38 were women, with a male: female ratio of

1.63:1. In a western study by Drivsholm *et al.,* (14) the balance is 1.07:1. In a survey done by Weersuriya *et al.,* (15) it was 1.63:1. This variation noted is possibly due to low literacy and low turnover of women to health clinics for general health check-ups.

The prevalence of micro-albuminuria was 21.6% in our study, which was quite similar to the survey conducted by Chowta *et al.,* (18) where they found a 37% prevalence of albuminuria among diabetes patients. A study by Chiu *et al.,* (19) suggested that patients with microalbuminuria and high HbA1c were prone to diabetic complications. The prevalence of diabetic retinopathy was found as 19.6% in our study. A similar study by Mersha (20) reported a 34.1% prevalence of diabetic retinopathy among T_2DM patients. Akaraiwe *et al.,* (21) and Billah *et al.,* (22) reported the prevalence of diabetic retinopathy as 36% and 37%, respectively.

The prevalence of diabetic neuropathy was 26.3% in all diabetes patients in the present study. Andrei Cristian B *et al.,* (23) found that most diabetic neuropathies were 28.70% in patients with T_1DM and 50.70% in those with T_2DM. Beigi *et al.,* (24) reported peripheral neuropathy in 42% of adults with type 2 diabetes at baseline. This is similar to the 39% prevalence reported in the Veteran Affairs Diabetes Trial by Duckworth *et al.,* (25).

Regarding cardiovascular complications, left ventricular hypertrophy was found among 2% of patients of type-2 diabetics. Eguchi *et al.,* (26) found the prevalence of LVH at 23.5% among diabetes patients. In type 2 diabetes mellitus, at the time of diagnosis, complications are increased. Our study showed similar results to Weersuriya *et al.,* (15) study. Reflections from the western globe led to a low incidence of retinopathy. Drivsholm (14) study showed an increased prevalence of nephropathy in men. In our study, the correlation coefficient of FBS and PPBS in relation to HbA1c was 0.86 and 0.83, respectively. A survey by Deepa *et al.,* (17) shows the correlation of HBA_1C with FBS and PPBS as 0.56 and 0.57, respectively.

Limitations of the study

This investigation was carried out at a tertiary care facility in Odisha as a single-centre study. Given the size of India and its many cultures and eating customs, it is challenging to generalize the results, needing much bigger investigations. It is essential to recognize that our study was observational.

CONCLUSION

The HbA1c test is a detailed and simple-to-do investigation with in-time results that can be a valuable tool in diagnosing diabetes, particularly in developing nations. This study emphasizes the importance of evaluating the prevalence of target organ diseases at the detection of Type 2 diabetes patients and the role of HbA1c in detecting these complications. Due to a lack of early detection in developing countries, the target organ disease may remain at the bottom of the iceberg phenomenon. It may get fatal within a short period without proper treatment. Furthermore, HbA1c could also be taken as an indicator of the TOD presence amongst newly diagnosed T_2DM patients. Further research may enlighten with a better estimation of all biochemical parameters suggesting target organ diseases and their correlation with HbA_1C markers.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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