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Estimation of serum electrolytes in type-II diabetic patients in Durg District Chhattisgarh, India

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***Abstract*---** The study was to figure out to estimation of electrolytes in type 2 diabetics of diverse ages. For blood sugar analysis, sodium fluoride tubes were used, K3 EDTA tubes were used for Glycosylated Haemoglobin analysis, and plain tubes were used for other parameters analysis. Plasma glucose was calculated using GOD-POD, HbA1c was calculated using nephelometric method, and serum sodium, potassium, and chloride were measured using colorimetric method. Out of 1500 people screened, 299 people with Type 2 diabetes were found, with 46 percent of them being women. The average age was 38.36 years old, and the average BMI was 27.24.8 kg/m2. In this study, we divided type 2 diabetic patients into three age groups: G1 (18-27 years old), G2 (28-37 years old), and G3 (38-47 years old). There was a statistically significant difference observed between Age-wise distributions with respect to blood fasting glucose level ($p<0.05$). There was no statistically significant difference observed between Age-wise distribution with respect to blood HbA1c percentage ($p>0.05$), Serum electrolyte, There was statistical significant difference observed age wise among all three study groups with respect to Sodium, There was no statistical significant difference observed between Age wise Distributions with respect to Potassium and There was statistical significant difference observed Age wise

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among all three study groups with respect to Chloride. This study looked at increase electrolytes in Type 2 diabetes individuals of various ages in the Durg area (CG).

***Keywords*---**type 2 diabetes mellitus, plasma glucose, electrolytes, renal complication.

Introduction

Diabetes mellitus is a metabolic condition that has a large global impact. According to epidemiological data, there were 285 million diabetics in the globe in 2010, and it is predicted that by 2030, there would be around 440 million diabetics (Shaw et al., 2010). Approximately 7% of the population has type 2 diabetes (Pereira et al., 2014). Increased urine causes electrolyte and water loss, causing an electrolyte and water imbalance that disrupts sodium and potassium balances in the body. Due to osmotic diuresis, uncontrolled diabetes mellitus can also cause hypovolumic hyponatremia. Furthermore, urinary electrolyte loss exacerbates renal sodium wasting in diabetes ketoacidosis (Amenabar et al., 1999; American Diabetes Association, 1999). There are contradictory reports regarding the prevalence of electrolyte disturbances among patients with patients with type 2 diabetes mellitus (Weisinger *et al.*, 1998; Barbagallo *et al.*, 2007).

As a result of diabetic ketoacidosis, the loss of urine electrolytes exacerbates renal salt wasting (Dong et al., 2011; Liamis et al., 2008). Dysnatremia is caused by diabetes mellitus through a variety of mechanisms (Virtanen et al., 2003; tuomilehto et al., 1999). Diabetic nephropathy, often known as diabetic kidney disease, is a common microvascular consequence of Type 2 diabetes mellitus (T2DM). Diabetic renal disease is a major public health issue that affects both the patient and the healthcare system. Chronic kidney disease is caused by two major risk factors: diabetes and hypertension (Lea et al., 2002). The myriad of complications resulting from DM, therefore, create a considerable health burden. Of note, diabetic nephropathy is one of the significant complications of DM; it was reported that kidney complications occurred in about 25–40% of individuals with Type 2 DM (T2DM) (Remuzzi *et al.,* 2002). Early detection and treatment of renal complications has been found to reduce, stop, or even reverse disease progression and kidney function decline (Hussain *et al.*, 2019; Sarnak *et al.*, 2003). Despite this, the majority of CKD cases go undetected for years. The biggest impediment to early diagnosis and prevention of disease progression is a lack of awareness about CKD (Van Dipten *et al.*, 2018). A study indicated that the general public has a poor understanding of CKD, and it is suggested that future studies be conducted on a population of high-risk individuals (Chow *et al.,* 2012).Therefore, present study aimed to estimate of electrolytes in Type 2 diabetes mellitus patients in Durg district Chhattisgarh India.

Materials and Methods

Participants

Maitri College of Dentistry and Research Centre Anjora Durg, Chhattisgarh, were used to recruit participants. To ensure maximum participation, college and research centre heads were consulted; following written or verbal informed consent was obtained, informants were given a unique study identification number that was used to de-identify them at the time of blood collection by experienced technicians. A total of 1500 people were enrolled in the study, with 299 of them being assessed for type 2 diabetes. The participants in the study ranged in age from 18 to 47 years old. Maitri College of Dentistry and Research Centre, Anjora, Durg (Ref- MCDRC/2017/834, Dated: 01/08/2017) granted the necessary approval.

Criteria and sites for study

The selected parameters were taken only from the patients who visited the institution, i.e., Maitri College of Dentistry and Research Centre Anjora, Durg Chhattisgarh, for treatment purposes. The patients were selected according to the fasting glucose level > 100 mg/dl. In this study, we have taken different age groups of type 2 diabetic patients, such as; age group G1- 18-27 years, age group G2- 28-37 years, and age group G3- 38-47 years.

Inclusion Criteria

- Age above 18 years
- Both major gender i.e. male and female
- Fasting for 10 hours
- Willing to give informed consent

Exclusion Criteria

- Known cases of type 1 diabetes
- Secondary causes of hyperglycaemia such as pregnancy, corticosteroid therapy and other pharmacotherapy leading to hyperglycaemia
- Patients living in rural areas

Study Procedure

Institutional Ethical Committee approved the present case-control study. All participants signed informed written consent forms. A questionnaire was used to collect demographic information such as age, sex, smoking habits, and alcoholism. A detailed history of diabetes duration, treatment, complications, associated comorbidities, as well as past and family medical history was gathered. Anthropometric data was gathered. The BMI was computed as weight (kg) divided by height (m) (m2). Following a complete clinical evaluation, all individuals were instructed to donate blood samples after a 12-hour fast and to refrain from smoking and consuming alcohol for 24 hours before to the investigation. Blood samples were taken in sodium fluoride tubes for blood sugar analysis, K3 EDTA tubes for Glycosylated Haemoglobin analysis, and plain tubes for other

parameters analysis with serum. Serum was separated by centrifugation at 3000rpm for 10 min. The biochemical parameters were estimated in the samples.

The WHO consultation group report and the International Diabetes Federation IDF set the criteria for diabetes, which included plasma fasting blood glucose 126 mg/dl or 2-hour plasma post glucose value 200 mg/dl or HbA1c >6.5 percent and known cases of type 2 diabetes mellitus (International Diabetes Federation 2015; Winocour et al., 1992). The glucose Oxidase-peroxidase (GOD-POD) method was used to test plasma glucose. To ensure an accurate reflection of glycemic management, we used the Nephelometric method to quantify HbA1c and checked the patient's HbA1c records. HbA1c levels below 7 were considered good glycemic control, while HbA1c levels above 7 were considered poor glycemic control. The colorimetric approach was utilised for Sodium, Potassium, and Chloride. The entire tests were performed in the School of Sciences, MATS University, Raipur, Chhattisgarh, India.

Statistical Analysis

Statistical analysis of data was performed using Statistical Package for Social Sciences version 19.0 (IBM, Chicago, IL, USA) Categorica variables were expressed as absolute number and percentage, and continuous variables were expressed as mean and standard deviation (SD). A one-way ANOVA Statistical test has been used to find a significant difference among the three study Age Groups.

Results and Discussion

299 Type 2 Diabetic eligible patients were enlisted out of 1500 screened subjects, with 46 percent of them being females. The average age of the participants was 38.36 years. We divided the patients into three age groups: G1 (18-27), G2 (28-37), and G3 (38-47) Type 2 Diabetic patients.

Table I
Age-wise distribution of overall study population based on diabetic parameters

Parameter	18-27 Yrs (G1)	28-37 Yrs (G2)	38-47 Yrs (G3)	Overall	P-value
Age in Years	23.2±2.59	30.77±2.69	42.4±2.82	38.36±6.78	0.000 (S)
Glucose Fasting (70-110mg/dl)	115.9±3.82	121.2±5.62	122.4±5.64	121.7±5.73	0.000 (S)
HbA1c (4.6-6.2%)	6.60±0.22	6.65±0.19	6.69±0.20	6.68±0.19	0.124 (NS)

(Data are mean ± SD Values, S= Significant, NS= Non-Significant)

Parameter Age in years: G1 has a mean & SD value of the age of 23.2±2.59. G2 has a mean & SD value of the age of 30.77±2.69 and G3 has a mean & SD value

of the age of 42.4±2.82, and overall age in years has a mean & SD of 38.36±6.78. (Figure: 1)

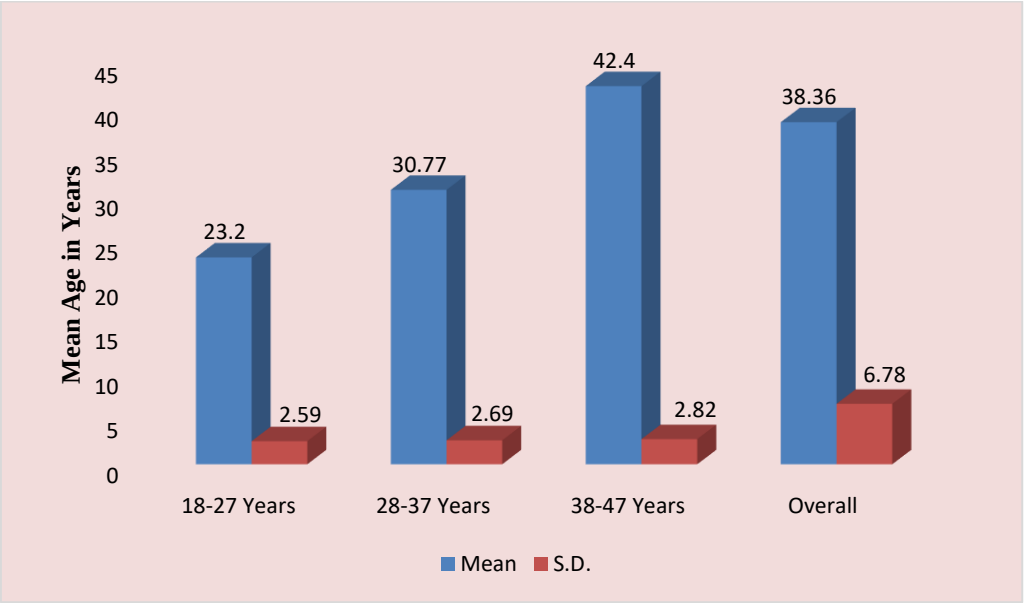

Figure 1. Age wise distribution of study population

Parameter: Glucose Fasting, Reference value (70-110mg/dL)
Group-1 (G1) has a fasting glucose level of 115.93.82 with a mean and SD of 115.93.82. G2 has a mean and SD value of 121.25.62 for fasting glucose, while G3 has a mean and SD value of 122.45.64 for fasting glucose. Fasting glucose values are 121.75.73, with a mean and SD of 121.75.73. In terms of blood fasting glucose level, there was a statistically significant difference in age-wise distributions. ($p<0.05$). This means that as people become older, their fasting glucose levels rise as well (Figure 2)

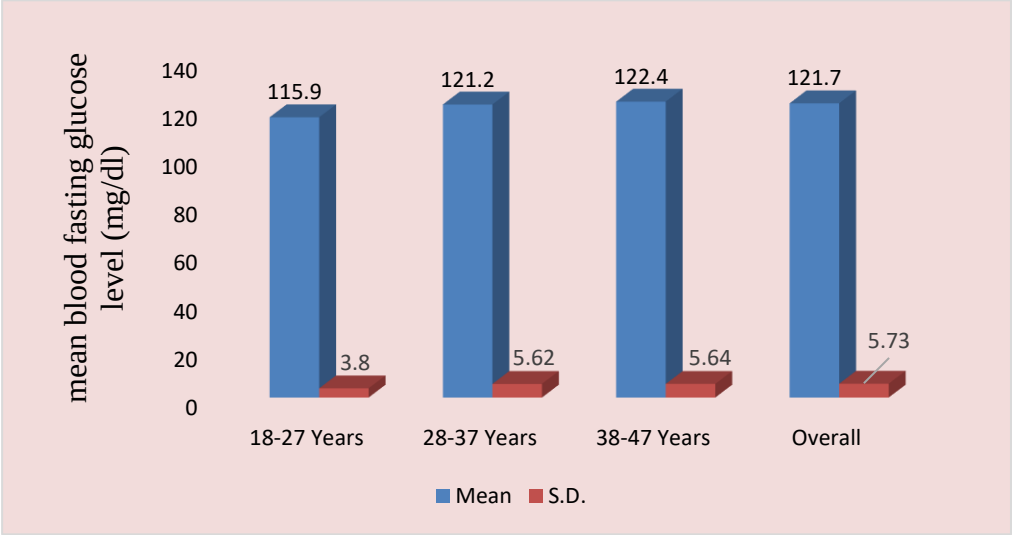

Figure 2. Age wise Comparison of mean blood fasting glucose level (mg/dl) among all the groups

Parameter: HbA1c, Reference value (4.6-6.2%)
G1 has a mean & SD value of fasting glucose level of 6.60±0.22. G2 has a mean & SD value of fasting glucose level of 6.65±0.19, and G3 has a mean and S.D. value of fasting glucose level of 6.69±0.20. Overall, HbA1c in percentage has a mean & SD value of fasting glucose of 6.68±0.19. There was no statistically significant difference observed between Age-wise distribution with respect to blood HbA1c percentage (p>0.05). This means with increasing age HbA1c level was not changed much. (Figure: 3)

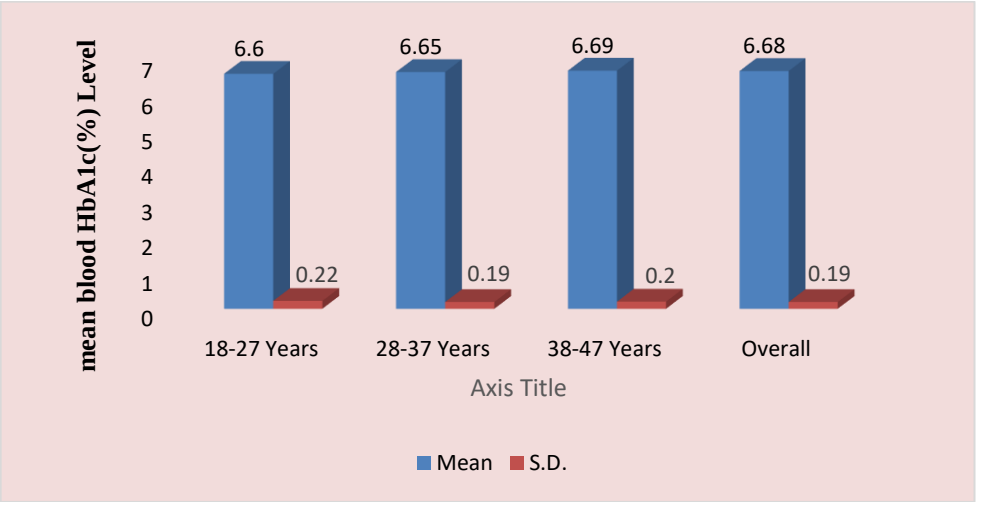

Figure 3. Age wise Comparison of mean blood HbA1c (%) among all the groups

Table II
Age-wise Comparison: Distribution of Diabetic population based on various parameters of Renal Profile

Parameters & Reference Value	18-27 Yrs (G1)	28-37 Yrs (G2)	38-47 Yrs (G3)	Overall	P-value
Sodium (135-155 mmol/L)	140±6.79	136.2±6.72	131.7±6.61	135.9±6.70	0.008 (S)
Potassium (3.5-5.5mmol/L)	4.57±0.67	4.62±0.70	4.76±0.68	4.69±0.69	0.215 (NS)
Chloride (98-106 mmol/L)	100.94±2.98	100.1±3.87	99.2±2.92	100.2±3.46	0.023 (S)

(Data are mean ± SD Values, S= Significant, NS= Non-Significant)

Parameter: Sodium, Reference Value (135-155 mmol/L)

G1 has mean & SD value of Sodium level of 140±6.79. G2 has mean & SD value of Sodium of 136.2±6.72 and G3 has mean and S.D. value of Sodium level of 131.7±6.61. Overall age in years has mean & SD value of Sodium of 135.9±6.70. There was statistical significant difference observed age wise among all three study groups with respect to Sodium. (Fig. 4)

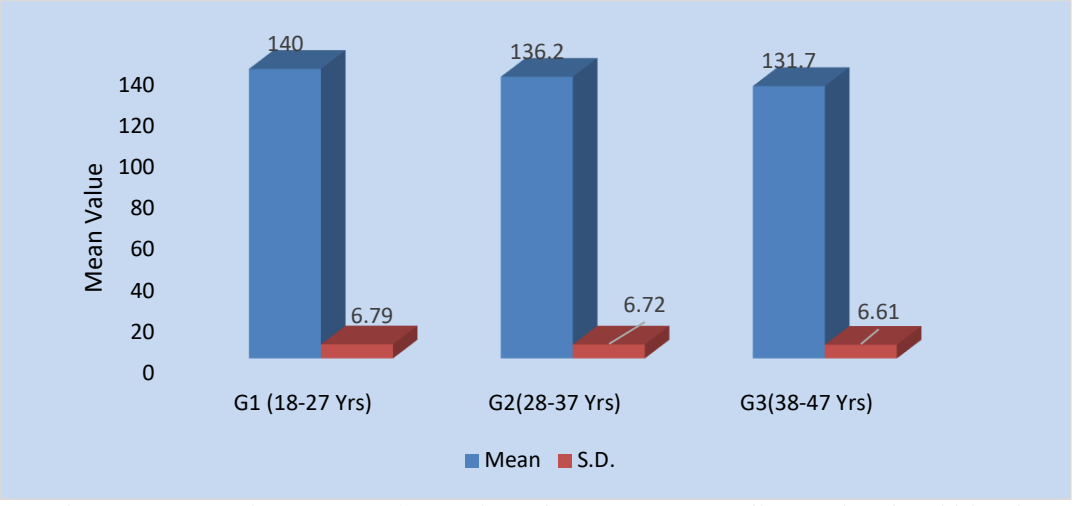

Figure 4. Age wise Comparison of study groups according to levels of blood Sodium (mmol/L)

Parameter: Potassium, Reference Value (3.5-5.5mmol/L)
G1 has mean & SD value of Potassium level of 4.57±0.67. G2 has mean & SD value of Potassium of 4.62±0.70 and G3 has mean and S.D. value of Potassium level of 4.76±0.68. Overall age in years has mean & SD value of Potassium of 4.69±0.69. There was no statistical significant difference observed between Age wise Distributions with respect to Potassium. (Fig. 5)

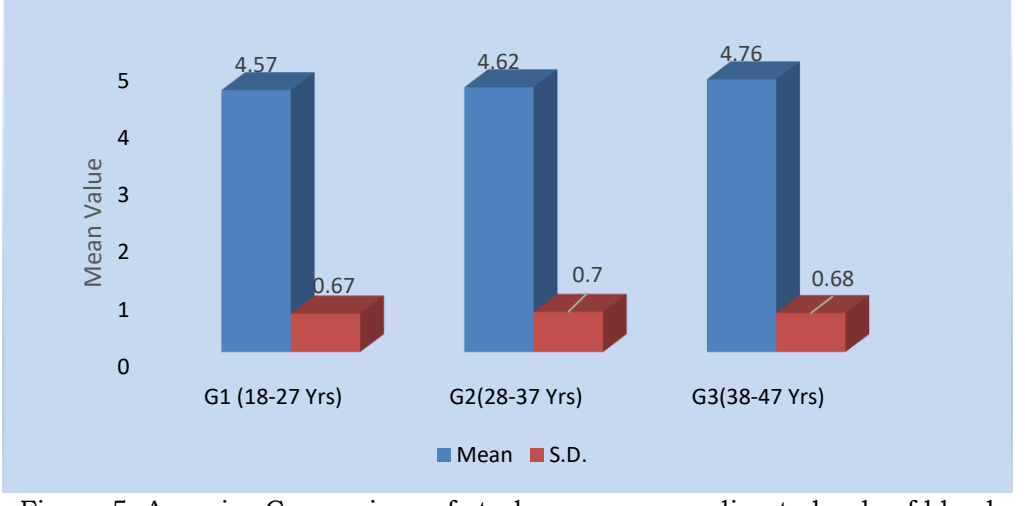

Figure 5. Age wise Comparison of study groups according to levels of blood Potassium (mmol/L)

Parameter: Chloride, Reference Value (98-106 mmol/L)
G1 has mean & SD value of Chloride level of 100.94±2.98. G2 has mean & SD value of Chloride of 100.1±3.87 and G3 has mean and S.D. value of Chloride level 99.2±2.92. Overall age in years has mean & SD value of Chloride of 100.2±3.46. There was statistical significant difference observed age wise among all three study groups with respect to Chloride. Showed in (Figure: 6)

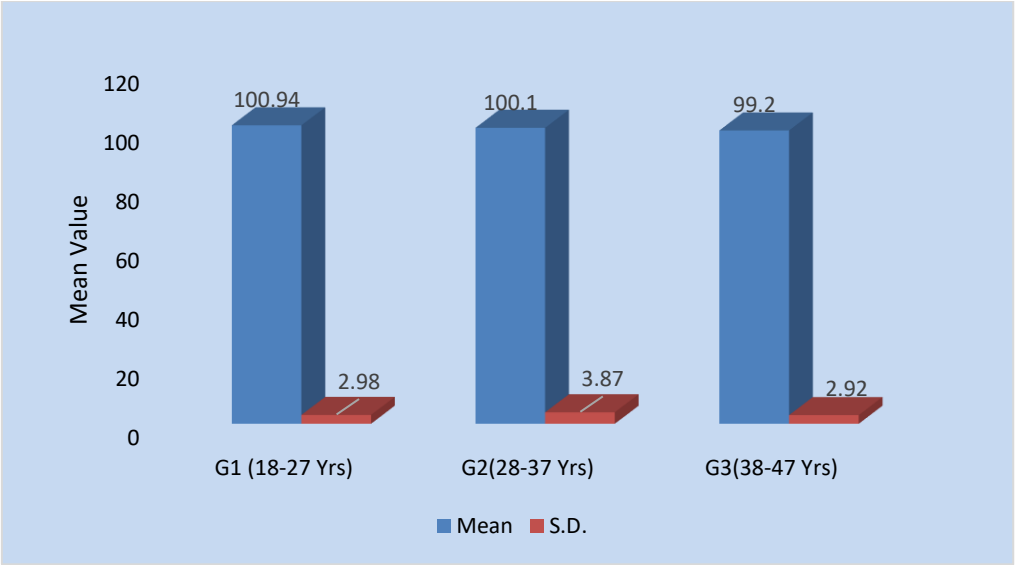

Figure 6. Age wise Comparison of study groups according to levels of blood Chloride (mmol/L)

The typical sodium level in the blood is 135-155 mmol, however sodium levels in type 2 diabetic individuals tend to be lower (Dong et al., 2011; Liamis et al., 2008). We found a normal sodium level in our study, which could be due to the fact that we included young and middle-aged type 2 diabetic patients, ranging in age from 18 to 47 years. In our research, we discovered that as people get older, their sodium levels fall. Renal sodium waste is aggravated by urine electrolyte loss (Amenabar et al., 1999; ADA, 1999). Girndt et al. (2011) and Hoorn et al. (2012) found similar results in prior studies (2017).Exogenous insulin has been demonstrated in certain investigations to cause mild hyperkalemia by promoting potassium influx into skeletal muscles and hepatic cells, which enhances the activity of the Na+ and K+ ATPase pump (Datchinamoorthi et al., 2016). Hyperkalemia is also linked to reduced insulin production and peripheral glucose utilisation, leading to carbohydrate intolerance and hyperglycemia (Lindner et al., 2013). Potassium levels in type 2 diabetic individuals increased with age in our study. Previous research by Chnsky et al. (2008) and Burtis et al. (2009) found similar results (2012).

In our research, we discovered that diabetic patients had lower serum Cl- levels. The acid-base balance is further disrupted by ketoacidosis, which produces a drop in blood pH. In our investigation, the amount of chloride in type 2 diabetic patients decreased as they became older. Das et al. (2016) and Khan et al. (2016) both found similar findings (2019). Datchinamoorthi and Rajgopalan discovered

an increased amount of chloride (2016). This study reported estimation of electrolytes in Type 2 diabetic patients in the different age groups of Durg district, Chhattisgarh.

Conclusion

In this study, it was discovered that dysregulation of glucose homeostasis can lead to electrolyte imbalance due to an increase in Sodium, Potassium, and Chloride levels in type 2 diabetic patients in Durg District, Chhattisgarh, India, which could help with early disease detection, prevention, and control.

Limitations of the study

The large sample sizes give better insight to understand the actual degree of type 2 diabetic associated complications.

Acknowledgements

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Conflict of interest
There is no conflict of interest in present study.

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