RESEARCH ARTICLE

Diabetes across the lifespan: A comparative analysis of clinical and biochemical profiles in type 2 diabetes mellitus

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ABSTRACT

Introduction: Type 2 diabetes mellitus (T2DM) is a pervasive and complex metabolic disorder that has emerged as a global health concern. T2DM is frequently associated with alterations in various biochemical markers, such as increased levels of glycated hemoglobin (HbA1c), and abnormal lipid profiles. T2DM is traditionally associated with middle-aged and older individuals, there is a growing recognition of its occurrence in younger age groups also. This research study aims to study the clinical and biochemical profiles in diverse age groups. *Materials and Methods*: The study commenced after obtaining ethics approval from the Institute Ethics Committee (AIIMS/BBN/ IEC/ APR/2021/32/10.5.2021). The study participants included 100 patients with type 2 DM of both genders. A complete general physical examination including height, weight, blood pressure, pulse rate, and waist and hip circumference was done. Blood samples were collected to assess the glycemic status and lipid profile. Neuropathy assessment was done using the Michigan neuropathy screening instrument [MNSI] and Temperature threshold testing. *Results*: The waist circumference and hip circumference are significantly higher in the group III (41-50) and IV (51-60). The glycated hemoglobin (HbA1c) is significantly higher in group I (20-30) and II (31-40). The TG levels are also significantly higher in group III and IV in comparison to other groups. The presence of neuropathy is also significantly higher in group III, IV and V (>60). A significant positive correlation of age with years of DM, SBP and the presence of neuropathy can be observed. *Conclusion*: The triglycerides and HbA1c are higher in middle-aged patients, specifying the need to intervene and for tight control. The neuropathy is increased in older patients especially after 40 years, further emphasizing the proper control on lipid and glycemic profiles to delay the early onset of complications.

Keywords: Diabetes mellitus, Age, Biochemical, HbA1c, Neuropathy.

Indian Journal of Physiology and Allied Sciences (2023); DOI: 110.55184/ijpas.v75i04.187 **ISSN:** 0367-8350 (Print)

Introduction

Type 2 diabetes mellitus (T2DM) is a pervasive and complex metabolic disorder that has emerged as a global health concern, affecting millions of individuals worldwide.[1] Its prevalence continues to rise, posing significant challenges to healthcare systems and society at large.[2] Type 2 diabetes mellitus (T2DM) is characterized by a diverse array of clinical symptoms and distinct biochemical abnormalities. Clinically, T2DM often presents with classic signs such as polydipsia, polyuria, unexplained weight loss, and fatigue.[3] Additionally, individuals with T2DM are at an elevated risk of developing various complications, including cardiovascular disease, retinopathy, nephropathy, neuropathy, and foot ulcers.[4]

T2DM is marked by elevated blood glucose levels due to insulin resistance, where the body's cells become less responsive to the hormone insulin, and impaired insulin secretion from pancreatic beta cells.[1] This results in an imbalance of glucose homeostasis, leading to hyperglycemia, which, if left uncontrolled, can contribute to the development of diabetes-related complications. Furthermore, T2DM is frequently associated with alterations in various biochemical markers, such as increased levels of glycated hemoglobin (HbA1c), which is a long-term indicator of blood glucose control, as well as abnormal lipid profiles, including elevated triglycerides and decreased high-density lipoprotein (HDL) cholesterol.[5]

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How to cite this article: Gaur A, Sakthivadivel V, Taranikanti M, John NA, Umesh M, Ganji V, Medala K. Diabetes across the lifespan: A comparative analysis of clinical and biochemical profiles in type 2 diabetes mellitus. *Indian J Physiol Allied Sci* 2023;75(4):30-34.

Conflict of interest: None

Submitted: 08/09/2023 **Accepted:** 11/10/2023 **Published:** 31/12/2023

While T2DM is traditionally associated with middle-aged and older individuals, there is a growing recognition of its occurrence in younger age groups.[6] This evolving demographic landscape has prompted extensive research to explore the clinical and biochemical profiles of T2DM across various age cohorts.

Understanding the distinct characteristics of T2DM in different age groups is essential for tailoring effective prevention and management strategies. Age-related variations in disease presentation, risk factors, and outcomes necessitate a nuanced approach to diagnosis, treatment, and prevention. This research study seeks to shed light on the multifaceted nature of T2DM by examining its clinical and biochemical profiles in diverse age groups, from young to geriatric populations.

Materials And Methods

After receiving ethics approval from the Institute Ethics Committee (AIIMS/BBN/ IEC/APR/2021/32/10.5.2021), the study was launched. A hundred patients with type 2 diabetes of both sexes between the ages of 40 and 65 were chosen for the study randomly. All the diabetic patients were from the AIIMS Bibinagar's medical OPD. Patients having a history of thyroid disease, any neurological condition, stroke patients, leprosy patients, patients with any psychiatric illness, patients with cancer patients, and patients who were unwilling to participate in the study were excluded.

Socio-demographic information, such as name, age, gender, educational attainment, and job status, was collected on the patient's first visit to the hospital. Regarding the duration of diabetes and medications, a thorough medical history was taken. Height, weight, blood pressure, pulse rate, and waist and hip circumference were all measured as part of a comprehensive general physical examination. Basal metabolic index (BMI) was computed. In order to determine the patient's glycemic status, five millimeters of blood was drawn. This blood sample was used to estimate the patient's fasting blood sugar, postprandial blood sugar (PPBS), HbA1C, and lipid profile, which included total cholesterol (TC), triglycerides, high-density lipoproteins (HDL), and low-density lipoproteins (LDL). The Michigan neuropathy screening instrument (MNSI) and Temperature threshold testing were used to assess neuropathy. The MNSI consists of two distinct evaluations: a lower extremity examination that includes inspection and assessment of vibratory sensation and ankle reflexes, and a 15-item self-administered questionnaire that is scored by adding up abnormal responses.

Temperature Threshold Testing

All the participants of the study were tested for cold and warm thresholds using the digital thermal aesthesiometer (v.4.8.0) for the fingers and digits of the foot of both sides. The subjects are instructed to press the button whenever they start to feel warm or cold. At least 6 trials were given, and the average of the trials will be considered as the mean threshold. The minimum change in temperature the patient can perceive for hot and cold is noted as warm threshold and cold threshold temperatures respectively. The threshold value of warm and cold thresholds is obtained and reported as mean ± SD.

Data were expressed as mean ±SD/E and compared across different age groups. One-way ANOVA was used to compare among groups. The statistical package for social sciences version 25.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The parameters were compared between different age groups and correlation statistics was used to correlate the various parameters with age.

Results

The general and biochemical parameters were compared in the different age groups along with the presence of neuropathy. The year of DM increases as the age increases, and though the trend can be seen it is not statistically significant. The SBP also shows a similar trend, however the absolute value of P shows close to significance. The DBP, PR and weight did not differ much among the groups. The height seems to be statistically different among the age groups, especially group 1. BMI seems to increase in groups III and IV and decrease in group V. The waist circumference and hip circumference are significantly higher in the group III and IV (Table 1). There was not much difference in FBS and PPBS values among the groups (Figure 1). The HbA1c is significantly higher in groups I and II (Figure 2). The TG levels are also significantly higher in groups III and IV in comparison to other groups (Figure 3). The presence of neuropathy is also significantly higher in group III, IV and V (Table 1).

The correlation statistics show a significant positive correlation of age with years of DM, SBP and presence of neuropathy which signifies that increasing age is associated with more years of DM, higher systolic BP and higher incidence of neuropathy. The DBP, weight, BMI, waist circumference, hip circumference, LDL and TG were positively correlated whereas PR, height, FBS, PPBS, HbA1C, HDL were negatively correlated although they are not significant statistically (Table 2).

Discussion

This study was conducted to observe the correlation between age and different biochemical parameters. The study included 100 type 2 DM patients between age group of 20 to 65. The general parameters as well as the biochemical parameters were compared between the groups and among the groups.

The age increases and the years of DM also increase linearly, this is for obvious reasons as the person ages his disease condition also ages along with him. Life expectancy has dramatically increased over the past 50 years, and the prevalence of diabetes among older people has increased at the same time.[7] Due to improved lifestyles and a lengthy life expectancy. In affluent and even developing nations, DM is turning into a grave public health issue among the elderly.[8] Increasing age, altered body composition, and

Figure 1: Values are represented as mean in mg/dl, FBS: Fasting Blood sugar, PPBS: Post Prandial Blood sugar

Table 1: Comparison of general and biochemical parameters among different age groups

Parameter	*Group I 21–30 years (n = 5)*	*Group II 31–40 years (n = 10)*	*Group III 41–50 years (n = 34)*	*Group IV 51–60 years (n = 36)*	*Group V >60 years (n = 15)*	*p-value*
Years of DM (Years)	3.00 ± 4.24	4.40 ± 4.37	5.09 ± 5.25	7.53 ± 6.11	8.00 ± 8.21	0.167
Systolic BP (mm of Hg)	117.40 ± 17.34	123.89 ± 12.61	126.12 ± 18.52	134.36 ± 13.94	134.67 ± 23.87	0.077
Diastolic BP (mm of Hg)	74.40 ± 13.44	77.70 ± 7.54	83.21± 13.91	85.78 ± 10.11	81.27 ± 12.84	0.154
Pulse rate (beats/min)	79.80 ± 9.75	85.30 ± 11.42	85.15 ± 13.28	83.25 ± 10.58	78.00 ± 18.96	0.453
Weight (Kg)	55.20 ± 4.32	56.50 ± 10.93	64.68 ± 12.40	63.94 ± 10.67	59.73 ± 13.19	0.129
Height (cm)	164.20 ± 4.76*	159.30 ± 8.21*	152.56 ± 18.26	158.69 ± 7.56	150.60 ± 6.89	0.044
BMI (Kg/m^2)	20.50 ± 2.16	22.160 ± 3.09	31.00 ± 22.23	25.333 ± 3.39	26.367 ± 5.91	0.208
Waist circ. (cm)	78.00 ± 14.19	81.30 ± 9.70	95.24 ± 22.29*	90.31 ± 9.15*	85.53 ± 10.57	0.028
Hip circ. (cm)	90.80 ± 21.37	93.50 ± 12.57	101.91 ± 10.53*	100.94 ± 10.53*	94.93 ± 8.54	0.039
Neuropathy	1 (20%)	3 (30%)	19 (55%)	26 (72%)	10 (66%)	0.045

DM: Diabetes Mellitus, BP: Blood Pressure, BMI: Basal Metabolic Rate, Waist circ: Waist circumference, Hip circ: Hip circumference. * represents P<0.05

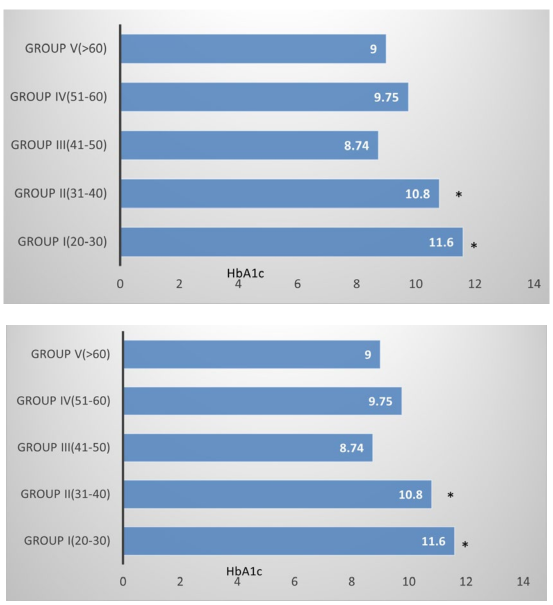

Figure 2: HbA1c: Glycated Haemoglobin. *represents P<0.05

insulin resistance are associated with potential physiological pathway dysregulation.[7]

The SBP also shows a similar trend, however, the absolute value of P shows close to significance Younger individuals who have higher SBP are more likely to experience higher mortality rate regardless of race or diabetes status.[9] In practically every community, age-related increases in blood

Table 2: Correlation of parameters with age

	r value	*p-value*
Years of DM	0.257*	0.010
Systolic BP	0.301*	0.002
Diastolic BP	0.181	0.072
Pulse rate	-0.132	0.189
Weight	0.095	0.349
Height	-0.116	0.252
BMI	0.046	0.648
Waist circ.	0.110	0.276
Hip circ.	.077	0.443
FBS	-0.045	0.655
PPBS	-0.054	0.592
HbA1C	-0.150	0.137
Total cholesterol	0.035	0.728
HDL	-0.067	0.506
LDL	0.089	0.380
Triglycerides	0.132	0.191
NEUROPATHY	0.231*	0.021

DM: Diabetes Mellitus, BP: Blood Pressure, BMI: Basal Metabolic Rate, Waist circ: Waist circumference, Hip circ: Hip circumference, FBS: Fasting Blood sugar, PPBS: Post Prandial Blood sugar, HbA1c: Glycated Haemoglobin, HDL: High Density lipoprotein cholesterol, LDL: Low density Lipoprotein cholesterol, TG: Triglycerides. * represents P<0.05.

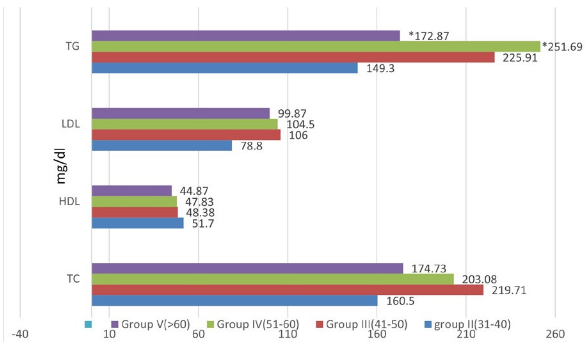

Figure 3: Values are represented as mean in mg/dl,TC: Total cholesterol, HDL: High Density lipoprotein, LDL: Low density Lipoprotein, TG: Triglycerides

pressure is noted.[10] One of the main preventable risk factors for cardiovascular (CV) disease is hypertension in these patients. Increased BP suggests atherosclerosis or arterial stiffness. Increased arterial stiffness may contribute to poor glucose metabolism, metabolic syndrome, and insulin resistance, according to research.[11,12] Generally from age 35 to 79, the chance of having high SBP increased steadily at the same time DBP also increased but decreased after the age of 50.[13]

The height seems to be statistically different among the age groups, especially group 1. Due to the increasing significance of factors affecting height throughout crucial growth phases, such as diet, illness, and socioeconomic situations, height heritability estimates may be lower in low- and middle-income nations.[14] Maybe for this reason as the younger population had better socio-economic conditions, they were taller than the other age group patients.

BMI seems to increase in middle-aged patients and then decrease as the person ages. As people age, their individual organ/tissue mass and tissue-specific organ metabolic rate decrease, further promoting changes in body composition that favor increased fat mass and decreased fat-free mass.[15] For the same reason the waist circumference and hip circumference are also significantly higher in the group III and IV.

Groups I and II have noticeably higher HbA1c values. HbA1c is a crucial indicator of long-term glycemic control because it might represent the cumulative glycemic history over the preceding two to three months.[16] Luo *et al.* reported similar findings, showing that patients with a moderate rise in HbA1c were younger.[17] The HbA1c data for individual diabetic individuals vary depending on their diabetes history, whether they are taking oral hypoglycemic agents or long- or short-term insulin dosages, and other factors (18). In healthy people, there has been evidence of a stronger correlation between HbA1c and insulin sensitivity.[19] Higher HbA1c values were seen in the younger population, which were primarily made up of people with recently diagnosed diabetes who either did not know they had the disease or did not follow their treatment plan.

In agreement with previous studies, dyslipidemia was common in these patients.[20-22] In our study TG levels were significantly higher in age group of 40 to 60 years, similar results were observed by Ahmmed *et al.*[23] Poor glycemic management raises triglyceride levels, lowers HDL-C levels, and increases total cholesterol.[21]

Additionally, neuropathy is substantially more common in people over 40. Age and the length of diabetes both increase the occurrence of neuropathy.[24,25] In our analysis, the correlation data support this as well. Regardless of the existence of other factors, age is regarded as a stand-alone risk factor.[25] One of the microvascular consequences of type 2 diabetes that is more common as people age is neuropathy[26] After 40 years, the prevalence rose in our study.

Patients in their middle and younger years require strict control over their glycemic profile, as well as dietary guidelines and body weight management since these symptoms lead to early onset of complications in them.

Conclusion

The clinical and biochemical presentation of type 2 Diabetes in different age groups is varied. The waist circumference and Hip circumference as well as BMI are higher in middle-age group thereafter, they reduce. The SBP increases as the age increases though not significant. The triglycerides and HbA1c are higher in middle-aged patients, specifying the need to intervene and for tight control. The neuropathy is increased in older patients especially after 40 years, further emphasizing the proper control on lipid and glycemic profile to delay the early onset of complications.

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PEER-REVIEWED CERTIFICATION

During the review of this manuscript, a double-blind peer-review policy has been followed. The author(s) of this manuscript received review comments from a minimum of two peer-reviewers. Author(s) submitted revised manuscript as per the comments of the assigned reviewers. On the basis of revision(s) done by the author(s) and compliance to the Reviewers' comments on the manuscript, Editor(s) has approved the revised manuscript for final publication.