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The Prediction of Macrovascular Complications in Individuals with Type 2 diabetes mellitus with Different Risk Factors in ThiQar

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Abstract **—Background:Diabetes mellitus (T2DM) is a major health issue globally, posing a significant financial and social burden on individuals, families, and communities.The objectives of the present study were to evaluate the risk factors of T2DM and its relationship with macrovascular complications.**

Methods:A cross-sectional observational study was conducted on 1189 individuals with T2DM attending Thi-Qar Specialized Diabetes Endocrine and Metabolism Center (TDEMC) in Nasiriya City, Thi-Qar, Southern Iraq. All patients' data were gathered from the direct interviewees and the digital records of TDEMC, which used an internal network system and Microsoft Access Program.

Results: The mean age was 55.9 ±11.7 years, female 58%, body mass index 31.2 ±5.5 kg/m^2, waist circumference 108±11.6 cm, One-fifth (20.9%) of this cohort were having an established atherosclerotic cardiovascular. Dyslipidaemia in T2DM was a common biochemical derangement of 77.6% and it increases the risk of all elements of macrovascular complication at a rate of 87.8% P/<0.001 heart disease, (85.4% P/0.015) stroke and (79.6% P/ 0.063) clinical PAD. Hypertension (63.5%), family history of T2DM (64.9%), history of CVD, sign insulin resistance (61.7%), centralobesity (84.3%), history of gestational diabetes mellitus and estimated glomerular filtration rate <60 ml/min/1.73m^2 were having a significant effect on overall macrovascular complications among T2DM.

Conclusion: History of dyslipidemia is the most significant (p=<0.001) independent risk factor for the prediction of macrovascular complications among T2DM, while other risk factors were considered as dependent to further cofounders.

Keywords**: Iraq, Macrovascular, Risk factors, T_2DM.**

I. INTRODUCTION

Diabetes mellitus is a chronic disease of huge morbidity and mortality; regular medical treatments and self-entraining are needed to ensure optimum glycemic control which is critical in decreasing the long-term risk of diabetes-related complications and mortality(Shubrook*et al*., 2017).

Type 2 diabetes mellitus (T2DM) is responsible for 90–95 % of all cases of diabetes. Individuals with T2DM were overweight or obese in the majority of cases due to the high prevalence of IR among them and or relative (rather than absolute) insulin insufficiency.Those individuals who may not meet typical weight criteria for obesity or overweight may have a higher rate of body fat distributed primarily in the abdominal viscera and liver(Umpierrez*etal*., 2016).

In the early stages of hyperglycemia, T2DM may be developed gradually with mask symptoms of hyperglycemia and it usually stays untreated for years. Those undiagnosed individuals are at a higher risk for developing macro more than microvascular problems(ADA, 2021). Even though patients with T2DM have normal or raised insulin levels, the inability to correct blood glucose reflects a relative deficiency in glucose-stimulated insulin production. As a result, insulin secretion in those people is impaired, and it is insufficient to compensate for IR. Although IRmay improve with different dietary, exercise, and bariatric interventions, have resulted in remission of diabetes in some cases(Cresci*et al*., 2020).

Furthermore, T2DM risk rises with the age, obesity, lack of physical activity, a family history of the disease among first-degree relatives (more than type 1 diabetes), women with a history of gestational diabetes (GDM), hypertension or dyslipidemia, and polycystic ovary syndrome (PCOS)(ADA, 2021). Specific racial/ethnic subgroups (African American, American Indian, Hispanic/Latino, and Asian American) are more likely to develop T2DM. It's frequently linked to a high hereditary predisposition (Chung *et al*., 2020).

Variable information exists regarding the association between these risk factors and glycemic control. Also, some risk variables can predict the likelihood of specific diabetic complications.

The objectives of the study areto evaluate the risk factors of adults with T2DM in Thi-Qar province and to determine which risk factor can predict macrovascular complications.

II. METHODS

A cross-sectional observational study was conducted on 1189 individuals with T2DM attending Thi-Qar Specialized Diabetes Endocrine and Metabolism Center (TDEMC) in Nasiriya City,Thi-QarprovincefromOctober 2021 throughout June 2022. All included patients were diagnosed with T2DM according to American Diabetes Association (ADA) criteria aged 18-year-old and above. Any patients with Type-1 diabetes mellitus and any patients with diabetes who are aged < 18 years were excluded.

All patients' data were gathered from direct interviewees and the digital records of TDEMC, which used an internal network system and Microsoft Access Program to keep track of all patients' information and examinations. The sample size was calculated according to the following equation: Sample size (N) = P (1-P) Z^2 /d^2 where N = the minimum required size of the sample, p = proportion of (T2DM) in the population which was (196 per 1000) according to prior study (Mansour *et al*., 2014), Z = is standard normal variate (at 5% type I error (p <0.05) it is 1.96, d = is the desired margin of absolute error. (=0.05). So that the minimum sample size required to conduct this study was 246, and the actual count of cases in this research was (1189).

A. Demographic and Behavioral Characteristic Data:

Direct in-person interviews utilizing an interviewer-administered questionnaire to collect demographic and risk factors like age, gender, marital status, address, occupation type, duration of T2DM, history of high blood pressure, CVD, and smoking habits.

B. Physical Measurements:

All individuals were examined for weight in kilograms, and height in meters, and body mass index (BMI) was calculated by dividing weight by square height in meters' kg/m^2(Aranetaet al., 2015).The degree of obesity was assessed according to International Diabetes Federation (IDF) (Achila*et al*., 2015) as: underweight < 18.5 kg/m^2, normal (18.5-24.9) kg/m^2, overweight (25-29.9) kg/m^2, class 1 obesity (30-34.9) kg/m^2, class II obesity (35-39.9) kg/m^2, and class III obesity >40 kg/m^2. A flexible plastic tape was used to measure the waist circumference (WC) at approximately halfway between the lower border of the last palpable rib and the top of the iliac crest. WC valuesof 99 cm or more in women and 97 cm or more in men were defined for central obesity Mansour*et al*., 2007).

A digital sphygmomanometer was used to take blood pressure in a sitting position from the right arm. The mean of two blood pressure readings obtained five minutes apart was used as the final BP result. Prehypertension is defined as a systolic blood pressure of 120-139 mm Hg and diastolic blood pressure of 80-89 mm Hg. A systolic blood pressure of 140 mm Hg or more and diastolic blood pressure of 90 mm Hg or more were considered hypertension(Dunietz*et al*., 2017).

C-Biochemical Measurements:

Every individual was sent for plasma glucose measurement according to the ADA diabetes mellitus classification criteria were used to make the diagnosis, with a fasting blood glucose of 126 mg/dl or more, postprandial blood glucose of 200 mg/dl or more, and an HbA1c of 6.5 % or more is considered diagnostic for T2DM. chronic kidney diseases among T2DM which manifests as albuminuria 30mg/mol or more, decreased estimated glomerular filtration rate (eGFR) < 60 ml/min/1.73 ^{m2}, or both (ADA, 2012) .The e GFR < 60 ml/min/1.73 m^2 was the solid method that had been used to define CKD among those individuals.

C. Statistical Analysis:

Parametric variables were normally distributed by using the one-sample Kolmogorov–Smirnoff test and presented as mean and standard deviation (SD). The data were analyzed using statistical SPSS (Statistics Package of Socio Science version 23). Chi-Square cross tab descriptive statistics were used for independent variables. Binary logistic regression analysis was done later to study the significant variables' independence. P value less than or equal to 0.05 was considered significant to be reviewed.

III. RESULTS

Table 1 shows the baseline characteristics of patients with T2DM which were as follows: age 56.0 ±11.6 years, BMI 31.2 ±5.5$^{kg/m2}$, HbA1c 9.6 ±2.1 %, WC 108 ±11.6cm, with 687 (57.8%) women. T2DM rated among self-employer, employee, housewife, student and retired as 17.0%, 13.1%, 51.3%, 0.5% and 17.6 %, respectively.One thousand 83.9% of the individuals were married, 152(12.8%) widows, 20 (1.7%) single, and 20 (1.7%) divorced.T2DM prevalence was higher in the urban group (83.1%) compared to rural humanity (16.9%). The mean duration of diabetes was 10.1 ± 7 and 76.5% of the patients were having T2DM for 5 years or more (P <0.001).Three hundred and twenty-five (27.35%) individuals were smoking.

Underweight, normal weight, overweight, class I obesity, class II obesity, and class III obesity were distributed as (0.3%, 9.8%, 29.0%, 36.8%, 16.5%, and 7.7% respectively). Housewives constituting 51.0% of individuals with T2DM and other occupations retired 17.6%, self-employers 16.9%, employees 13.3%, and students 1.1%.

TABLE 1: BASELINE INFORMATION OF PATIENTS WITH TYPE 2 DIABETES MELLITUS.

Variable		Frequency (%)\ Range
Gender	Men	502(42.0)
	Women	687(58.0)
Age (years)	(M±SD) = 55.9±11.7	
	18 – 30 years	21 (1.85)
	31-40 years	107 (9)
	41-50 years	227 (19.1)
	51-60 years	419 (35.2)
	➢ 60 years	415 (34.9)
Body mass index (Kg/m2)	(M ±SD) = 31.2±5.5	Range (17-55)
	Underweight	4(0.3)
	Normal weight	116(9.8)
	Overweight	345(29.0)
	class I Obesity	437(36.8)
	class II Obesity	196(16.5)
	class III obesity	91(7.7)
HbA1c %	(M ±SD)= 9.6±2.1	Range (3.5-17)
Waist circumference (centimeter)	(M ±SD)= 108±11.6	Range (71-152)
Duration of diabetes mellitus (years)	(M ±SD) = 10.1 ± 7	Range (0-40)
<5 years		280 (23.5)
≥5 years		909 (76.5)
Marital status	Single	20(1.7)
	Married	997(83.9)
	Divorced	20(1.7)
	Widow	152(12.8)
Occupation	Self-employer	202(17.0)
	Employee	156(13.1)
	Housewife	610(51.3)
	Student	6(0.5)
	Retired	214(18.0)
Address	Urban	988(83.1)
	Rural	201(16.9)
Smoking		325(27.3)

According to Figure-1, the prevalence of risk factors for T2DM was distributed in a descending manner as central obesity 84.3%, history of dyslipidemia 74.6%, family history of DM 64.9%, hypertension 63.5%, signs of IR 61.7%, history of cardiovascular disease 20.9%, GDM 10.3%, history of PCOS among women with T2DM 7.6% and pregnant women was representing 2.4% of the enrolled sample.

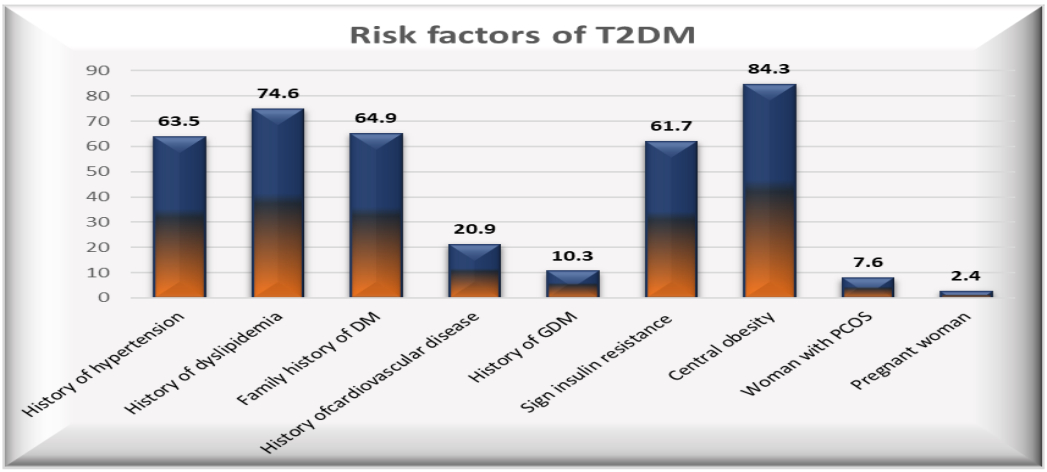

Figure 3.1: Frequencies of risk factors in patients with T2DM. DM, Diabetes Mellitus; GDM, gestational diabetes mellitus; PCOS, Polycystic ovary syndrome.

Table 2 shows the prevalence of different outcomes of macrovascular complications concerning risk factors among T2DM.

Gender, smoking, duration of T2DM of more than five years, any sign of IR, history of cardiovascular disease, hypertension, dyslipidemia, and central obesity significantly increased the chance of developing macrovascular complications (Heart disease,Cerebrovascular accident, andClinical PAD) among individuals with T2DM.

TABLE 2: THE EFFECT OF RISK FACTORS ON MACROVASCULAR COMPLICATIONS AMONG PATIENTS WITH T2DM.

Risk factor	Macrovascular		P value	Heart disease		P value	Cerebrovascular accident		P value	Clinical PAD		P value	Total
	Yes	No		Yes	No		Yes	No		Yes	No		
Gender/Women men	629(57.7) 462(42.3)	58(59.2) 40(40.8)	0.769	127(55.2) 103(44.8)	560(58.4) 399(41.6)	0.381	45(50.6) 44(49.4)	642(58.4) 458(41.6)	0.152	107(15.6) 104(20.7)	578(59.2) 398(40.8)	0.023	687(57.8) 502(42.2)
Smoking	301(27.6)	24(24.5)	0.510	80(34.8)	245(25.5)	0.005	33(37.1)	292(26.5)	0.032	60(28.4)	264(27.0)	0.682	325(27.3)
History of hypertension	718(65.8)	37(37.8)	<0.001	194(84.3)	561(58.5)	<0.001	71(79.8)	684(62.2)	0.001	148(70.1)	605(62.0)	0.026	755(63.5)
History of dyslipidemia	847(77.6)	40(40.8)	<0.001	202(87.8)	685(71.4)	<0.001	76(85.4)	811(73.7)	0.015	168(79.6)	717(73.5)	0.063	887(74.6)
Family history of diabetes mellitus	707(64.8)	65(66.3)	0.762	145(63.0)	627(65.4)	0.505	54(60.7)	718(65.3)	0.382	132(62.6)	639(65.5)	0.421	772(64.9)
History of cardiovascular disease	245(22.5)	3(3.1)	<0.001	226(98.3)	22(2.3)	<0.001	43(48.3)	205(18.6)	<0.001	49(23.2)	197(20.2)	0.323	248(20.9)
History of gestational diabetes mellitus	99(15.9)	23(40.4)	<0.001	14(11.3)	108(19.5)	0.032	4(9.3)	118(18.6)	0.125	18(16.8)	104(18.3)	0.720	122(18.0)
Sign insulin resistance: Any sign of insulin resistance Acanthosis nigricans Obesity Two insulin resistance	688(63.1) 14(1.3) 614(56.6) 54(5.0)	46(46.9) 1(1.0) 43(43.9) 2(2.0)	0.017	171(74.3) 5(2.2) 150(65.8) 14(6.1)	563(58.7) 10(1.0) 507(53.1) 42(4.4)	<0.001	63(70.8) 3(3.4) 53(60.9) 5(5.7)	671(61.0) 12(1.1) 604(55.1) 51(4.7)	0.111	123(58.3) 3(1.4) 104(50.0) 13(6.3)	610(62.5) 12(1.2) 552(56.7) 43(4.4)	0.302	734(61.7) 15(1.3) 657(55.5) 56(4.7)
Central obesity	933(85.5)	69(70.4)	<0.001	214(93.0)	788(82.2)	<0.001	78(87.6)	924(84.0)	0.364	177(83.9)	823(84.3)	0.874	1002(84.3)
Duration of DM of 5 years or more	892(81.8)	17(17.3)	<0.001	199(86.5)	710(74.0)	<0.001	76(85.4)	833(75.7)	0.039	175(82.9)	732(75.0)	0.014	909(76.5)
Estimated glomerular filtration rate <60 ml#min	163(14.9)	5(5.1)	0.007	50(21.7)	118(12.3)	<0.001	17(19.1)	151(13.7)	0.162	36(17.1)	132(13.5)	0.181	168(14.1)
Total	1089(91.8)	98(8.2)		230(19.3)	957(80.7)		87(7.5)	1100(92.5)		976(82.2)	211(17.8)		1187(100.0)

After doing a logistic regression analysis, women's gender, history of dyslipidemia, and history of GDM were considered as independent risk factors for the prediction of macrovascular complications (p=0.039, <0.0001, <0.001 respectively)

Table 3: Regression of risk factors to macro-vascular complication:

Variables	B	S.E.	Wald	df	Sig	Exp(B)
Gender(women)	-1.573-	1.238	1.615	1	.204	.207
Smoking	-.934-	.764	1.494	1	.222	.393
History of hypertension	-.248-	.326	.578	1	.447	.780
History of dyslipidemia	-1.463-	.332	19.412	1	<0.001	.232
Family history of diabetes mellitus	-.410-	.314	1.711	1	.191	.664
history of cardiovascular disease	-1.950-	1.032	3.571	1	.059	.142
History of gestational diabetes mellitus	1.010	.321	9.922	1	.002	2.746
Any sign of insulin resistance	-.219-	-.219-	.392	1	.531	.804
Central obesity	.044	.413	.011	1	.916	1.045
Constant	-1.049-	1.652	.403	1	.525	.350

IV. DISCUSSIONS

In this study, T2DM was more prevalent among married and divorced than in other marital states and these findings are consistent with another study (Murad*et al*., 2014)Previous evidence showed that marital status was not correlated with T2DM; however, differences in the prevalence of diabetes were slightly more noticeable in widowed or divorced personsCornelis*et al*., 2012). Another study (Schwandt*et al*., 2010) showed that singlehood was associated with an increased risk of developing diabetes for women and an increased likelihood of death for men so further studies are warranted to explore this factor.

Regarding gender, T2DM was slightly having a higher prevalence rate among women than men (58.0% and 42.0% respectively). This finding was consistent with a local study done in Basra2020(Mansour*et al*., 2020) and studies conducted in Saudi Arabia(Al-Nozha*et al*., 2004)and Iran (Azimi-Nezhad*et al*., 2008) and is inconsistent with other studies done in Saudi Arabia and France, where T2DM was more prevalent in men (Abou-Gamel*et al*., 2014) This discrepancy may be due to racial differences, community distribution of gender, and the high women prevalence rate of T2DM in our study may be explained by the effect of hormones and lower physical activities.

High BMI was significantly associated with the increase in of incidence of diabetes which might be because obesity enhances IR. Similar to our findings, previous studies (Bakhotmah&Balkees Abed,2013) including a study conducted on Saudi patients, also showed a direct relationship between high BMI and DM. The increasing incidence of DM in the population has been linked to obesity, which is a consequence of major socio-cultural and lifestyle changes. The promotion of fast foods, changes in the traditional diet, both in quantity and quality, and physical inactivity.

Our finding shows May there is a significant relationship bet
Through the current study, there was a strong relationship between central obesity with the risk of T2DM where the range between the highest and lowest value was (71-155) cm for both genders. WC is a more reliable physical measure of visceral fat, as most patients with T2DM have excess visceral fat as compared to less subcutaneous fat which may greatly lead to excess IR and consequently increase the risk of T2DM (Phillips*et al*., 2008).The mean HbA1c was 9.6±2.1% and the range was 3.5-17% which was consistent with a large cohort study done in Basra, Iraq (Mansour*et al*., 2020).

Duration of T2DM has an important effect on the outcome of individuals with T2DM. In this cohort, the mean duration of T2DM was 10.1 ± 7 years which was comparable to the large cohort study done in Basrah (Mansour et al., 2020) which was 9.7. The majority of our participants 76.5% were having T2DM for more than five years. Some studies in middle-aged individuals with T2DM had conflicting results on the relationship between glycaemic control, diabetes length, and risk of death when both glycaemic control and high risk of death were directly dependent on diabetes duration(ADA, 2020) A systematic review done in the Middle East and North Africa found inadequate glycemic control was documented among T2DM with a long history of the disease (Jonas Ghouse*et al*., 2019)More than half of studied T2DM individuals were housewives which was consistent withMurad*et al*., 2014) and the rate of T2DM was slightly higher among retired due to those patients having an advanced age and most of them are physically inactive which both of them increase the incidence of T2DM.

The magnitude of T2DM is significantly more in urban areas than in rural areas where the relative frequencies were (83.1%, and 16.9%) respectively which was similar to the WHO report in 2004 (Al-ma'aitah*et al*., 2022) and it may be due to its description that urbanization leads to an obese environment as many urban areas do not support healthy lifestyle choices.

Smoking was presented in more than a quarter (27.3%) of all cases, current smoking status is a strong modifiable risk factor for T2DM since it is associated with glucose intolerance, impaired fasting glucose, and, consequently, T2DM(Sadikot*et al*., 2004) Our results were matched with those of other authors(Chang et al., 2012), who showed an association between T2DM and current smoking status.

Hypertension was presented in around $^{2}/_{3}$(63.5%)of T2DM in this cohort. The prevalence of T2DM tends to be higher among hypertensive patients and its relationship to T2DM is significant which was similar to that of (Maddatu et al., 2017). In this cohort, those patients were either known hypertensive on medical treatment or newly diagnosed during surveillance. Both T2DM and hypertension were interrelated conditions with overlapping clinical consequences and complications. Some studies found a transient elevation of blood pressure during office evaluation and this could be considered white coat hypertension so taking one reading in one setting is usually not conclusive of blood pressure status(El-Hazmi*et al*., 2001).

Dyslipidemia was the predominantly associated condition in most T2DM as documented in our three-quarters of respondents (74.6%). The overall prevalence of dyslipidemia obtained in this study was comparable with a study done in, Nigeria (69.3%) (Haile*et al*., 2020). Insulin resistance is the most common cause of lipid abnormalities in people with diabetes. Peripheral IR increases the release of free fatty acids from adipose tissue, which the liver absorbs; increased hepatic uptake of free fatty acids leads to more triglyceride synthesis(Bello-Ovosi*et al*., 2019).

Family history of diabetes is a culprit risk factor for the development of T2DM and it was found in less than $^{2}/_{3}$(64.9%) of the patients. Similar data were observed in studies done by (Warraich*et al*., 2017)which showed a positive family history of 66.2% and 67% respectively. As a result, a family history of T2DM is a common risk factor that increasesthe incidence of it, and searching for a genetic predisposition may be of value later.

One-fifth (20.9%) of this cohort were having an established atherosclerotic cardiovascular which was in agreement with a study done at (Patel*et al*., 2011) and slightly lower than studies done in China and South Korea (30.1%, 26% respectively) (Bennet *et al* ., 2013)The burden of cardiovascular disease (CVD), the leading cause of morbidity and mortality worldwide, is disproportionately high in patients with T2DM, with the proportion of CVD caused by diabetes rising in the general population (Moon*et al*., 2010).

In this study, the prevalence of GDM was 10.3%, and a major risk factor for developing T2DM. It was consistent with that of(Moon*et al*.,2010), who reported a prevalence of 8.3% among Nigerians.GDM was thought to impact 14% of all pregnancies worldwide. Ischemic heart disease and T2DM are also linked to it(Anzaku*et al*., 2013).

In the present study, the proportion of patients with signs of IR was 61.7%. IR, also known as impaired insulin sensitivity, has built up a tolerance to insulin, making the hormone less effective. As a result, more insulin is needed to persuade fat and muscle cells to take up glucose and the liver to continue to store it.Overweight or obese people increase the risk of IR(Li*et al*., 2020).

Central obesity was constituting 84.3% of the patients and it had a significant association with T2DM. This was consistent with a study done by(Harris*et al*., 1997). WC is used to assess the patient's abdominal fat. Increased WC was an indicator of excess abdominal fat (central obesity), and consequently increased the risk of having T2DM (Okosun*et al*., 1998).

Women with a history of PCOS 7.6% of T2DM individuals which is acceptable with previous studies(Harris *et al*., 1997). PCOS is considered a hallmark trigger for the development of dysglycemia due to, have insulin secretory defects, and being at high risk for glucose intolerance (Jacobs*et al*., 2010).

In this study, 2.4% of a pregnant lady was having T2DM and they were representing 8.62% of reproductive-age women. These findings were consistent with other studies (Altemimi*et al*., 2021) and pregnancy itself especiallythesecond half of it had a higher chance of developing GDM due to the high occurrence of IR.

Other variables that may contribute to the rising incidence of pre-existing diabetes in pregnancy include pregnancy at later ages, multiple pregnancies, and the rise in the prevalence of T2DM among the young. In Africa, there is some evidence that the burden of T2DM in women of reproductive age is significant, with a recent review estimating a prevalence of 7% (Chivese*et al*., 2021).

Macrovascular complications of T2DM include IHD, Stroke, and PVD. Cardiovascular disease is the primary cause of death in patients with T2DM. Many clinical studies have shown a connection between T2DM and vascular disease, but almost always other risk factors are present in patients with T2DM, such as hypertension, obesity, and dyslipidemia(Chivese*et al*., 2021)Individuals with a history of (hypertension, dyslipidemia, GDM), signs of IR, central obesity, duration DM of 5 years or more, and smoking were significantly at a greater risk for developingT2DM complications.

The overall macrovascular diseases were found in 91.8 % of patients and there was no gender difference in the overall macrovascular complication rate. This high rate of macrovascular complications could be due to the evidence of multiple risk factors leading to more than one element of macrovascular disease in the same patient. More than $^{1}/_{5}$(22.5%) of the participants were

having a solid element of established CVD including either IHD or heart failure with no gender-specific differences which is consistent with another study (ViigimaaMargus*et al*., 2020) While a significant gender difference for developing clinical PAD when men (20.7%) were having a higher rate of clinical PAD than women (15.6%) and it was comparable to the findings of(Enikuomehin*et al*., 2020). This might be due to men having a higher prevalence of poor glycaemic and blood pressure control, and dyslipidemia in this study.

In other studies, the differences and similarities between women and men in T2DM with symptomatic PAD were variable. PAD is a common symptom of atherosclerosis, and it has historically been thought to be more common in men than in women. Recent research, however, has found that men and women have the same frequency of PAD (Kautzky-Willer*et al*., 2010).

Stroke was non-significantly presented in both genders among individuals with T2DM. Although a non-significant relation between stroke and gender was similar to (Al-Zoubi*et al*., 2019), it was different from a local study done in Basrah 2019 whenever a higher case fatality rate of stroke in men than in women with T2DM(Altemimi*et al*., 2019)Women with T2DM have a more significant stroke than men with T2DM, but this could be explained by the fact that women tend to live longer than men and these women were exposed to combined cardiovascular risk factors such as hypertension, dyslipidemia, and obesity as documented in this study.

A prolonged duration of T2DM of more than five years was predominant in most individuals (81.8 /P<0.001) which was in agreement with a cross-sectional study in Pakistan that showed the highest prevalence of macrovascular complications among persons having DM for more than five years(Khuwaja*et al*., 2004).Also, an excess rate of clinical PAD was significantly more among those with a longer duration of T2DM than those with less duration of T2DM (82.9% P/ 0.014) which is in agreement with (Al-Salihi*et al*., 2016)

This study documented that over (65.8% P/<0.001) of persons with T2DM have Hypertension. HTN is a well-recognized factor associated with the development of cardiovascular and cerebrovascular diseases, and this risk increases further when it is associated with T2DM. Results from intervention studies demonstrate that the complications of T2DM can be prevented or delayed by controlling HTN which is in agreementwith(Al-Zoubi*et al*., 2019). More than one-quarter of 27.6% of smokers were having established macrovascular complications(n=301) and Smoking was a significant risk factor for developing stroke (37.1/P 0.032), heart disease (34.8 /P 0.005) and non-significant for clinical PAD (28.4/P 0.682) in T2DM which was in agreement with(Al-Salihi*et al*., 2016). Dyslipidaemia in T2DM was a common biochemical derangement of 77.6% and it increased the risk of all elements of macrovascular complication at a rate (87.8% P/<0.001) heart disease, (85.4% P/0.015) stroke and (79.6% P/ 0.063) clinical PAD. These findings were in agreement with (56)and it may be due toincreased levels of leptin, dysregulated adipocytes, insulin resistance, and C-reactive protein which all contribute to the mechanism causing the increased cardiovascular morbidity and mortality(Chang*et al*., 2012).

Signs of IR that included (obesity, and acanthosisnigricans) were found in 63.1%where obesity was an independent risk factor for heart disease, clinical PAD, and not significant for stroke which was matched with(Narindrarangkura*et al*., 2019).

The prevalence of central obesity has increased in recent years and is currently higher than the prevalence of overall obesity, especially in women (Arambewela*et al*., 2018) This was also observed in our study, which found a prevalence of 85.5% of central obesity to 56.6% of overall obesity.

Central obesity was an important risk factor for CVD and other associated morbidities and it has significant effects on developing heart disease, clinical PAD, and stroke (86.5%/P<0.001, 85.4% /P 0.039,82.9%/P 0.014, respectively).

Both T2DM and CKD increase the risk of CVD and CKD is considered an independent risk factor for developing macrovascular complications even in patients without T2DM. Around 40% of people with T2DM developed CKD, which manifests as albuminuria, decreased estimated glomerular filtration rate (eGFR) < 60 ml/min/1.73 m^2, or both (ADA, 2012)Our results showed a statistically significant relationship between heart disease and eGFR < 60 ml/min/1.73 m^2 (p=<0.001).Although various studies have looked into the link between eGFR and CVD, the majority of them have focused on people who appear to be healthy or who have pre-existing CVD or are at high risk for CVD. Individuals with pre-existing CVD or at high risk for CVD who had an eGFR of 60 ml/min/1.73 m2 or below were at an elevated risk of CVD outcomes, according to the overall epidemiological data (Barroso *et al*., 2017).However, not all research had discovered a substantial inverse relationship between eGFR and the risk of CVD(Van Der Velde*et al*., 2011).

In reverse, there was no significant effect of low eGFR on both stroke and clinical PAD (p=0.162, 0.181 respectively) which was similar to other studies(Kurth*et al*., 2009) where they discovered that incident coronary artery disease and stroke risk increased at eGFR <60 mL/min/1.73 ^{m2} when compared with eGFR ≥90 mL/min/1.73 ^{m2} at baseline, which is consistent with the results(Sarfo*et al*., 2019).

Furthermore, even in participants with mildly lowered baseline eGFR (60–74 ml/min/1.73 ^{m2}) and mean eGFR (60–89 ml/min/1.73 ^{m2}) throughout follow-up, there was an elevated risk of CHD and stroke. Because kidney function might alter over time, this may better reflect the extent of the link between renal function and the risk of incident CVD(Ninomiya et al., 2009).

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