Clinical research

Association of causes of type 2 diabetes mellitus and gestational diabetes with the clinical profile in the population of Khyber Pakhtunkhwa Pakistan

Akif Khurshid[1], Zahida Parveen[1], Muddasir Mehmood Jan[2], Mohammad Assad[1]

[1]Department of Biochemistry, Abdul Wali Khan University Mardan, Pakistan
[2]Department of Medicine and Surgery, Khyber Medical College Peshawar, Pakistan

Submitted: 12 August 2022
Accepted: 5 October 2022

Arch Med Sci Civil Dis 2022; 7: e44–e52
DOI: https://doi.org/10.5114/amscd.2022.122272

Corresponding author:
Dr Saira Farman
Department of Biochemistry
Abdul Wali Khan
University Mardan
Pakistan
Phone: +92 314 7571751
E-mail: sairafarman@awkum.edu.pk

Abstract

Introduction: The current study is designed to assess the various risk factors, prevalence, and clinical characteristics of type 2 diabetes (among aged Pakistanis) and gestational diabetes (in pregnant women).
Material and methods: The statistical analysis of a cross-sectional survey included the data of 1479 adults, aged 18–75 years, living in urban and rural areas. Blood glucose was measured by an automatic clinical chemistry analyser. Diabetes was confirmed via an glycated hemoglobin (HbA_{1c}) report from each patient's file admitted in medical and surgical wards. Blood pressures were measured and recorded, and the medical history and prior illness data were collected by interviewing the patients and cross checked with their individual daily progress report.
Results: The prevalence of type 2 diabetes mellitus in different age groups in urban and rural areas was 5.3%, among which 9.8% was found to be previously diagnosed type 2 diabetes mellitus and 7% was newly diagnosed type II diabetes, whereas the percentage of gestational diabetes was 1.36% of the total ratio (5.3%). Type 2 diabetes mellitus affected more women than men, which increased with age. Central obesity and hypertension were highly associated with type 2 diabetes mellitus occurrence. The prevalence of previously diagnosed type 2 diabetes mellitus with overweight or obesity was 68.4%, with central obesity 32.3%, and with hypertension 56.5%. A significant association ($p = 0.005$) was found between obesity, as a risk factor, gestational diabetes, and type 2 diabetes mellitus.
Conclusions: These results show that diabetes has reached high proportions, and comprehensive strategies are needed for the prevention and control of the problem of type II diabetes.

Key words: diabetes, gestational diabetes, clinical profile, prevalence.

Introduction

Type 2 diabetes mellitus affects people of all ages. It is a global health threat that affects both urban and rural life, and both developed and developing countries. According to the International Diabetes Federation, approximately 416 million people worldwide have diabetes, with that number expected to rise to 645 million by 2040 [1]. Diabetes is predicted to affect nearly 20 million people by 2025, up from almost 11 million in 2000. By 2055, this number is expected to exponentially increase by 165% compared to 2001. The projections indicate that the prevalence of

diabetes overall will steadily increase from 3.99% in 2000 to 7.21% in 2050. The number of diabetics in the United States rose from 22.7 million in 2007 to 25.8 million at the beginning of 2011. Type 2 diabetes is becoming more common as a result of an epidemic of overweight and obesity, which has increased rapidly in the last 20 years. According to the most recent National Health and Nutrition Examination Survey, around 33.8% of the adult population in the United States is obese, up from 22.9% between 1988 and 1994 [2].

Pakistan is ranked 10th out of 221 nations in the 2017 Diabetes Atlas of the International Diabetes Federation (IDF), with 7.5 million diabetes cases. Pakistan also appears to lack a national diabetes reaction, including growth and expansion plans, national diabetes recommendations, and a diabetes database, according to the World Health Organization's (WHO) diabetes country profiles 2016. However, Pakistan has performed 3 nationwide diabetes surveys since 1947 [3].

According to the 2nd NDSP (National Diabetes Survey of Pakistan) report, diabetes was more prevalent in 3 out of 4 provinces than pre-diabetes. The age- and gender-adjusted prevalence data also show that pre-diabetes is more prevalent in childhood, but the diabetes prevalence rises sharply after the age of 30 years. The rapid progression from pre-diabetes to diabetes in certain provinces could be a factor. Baluchistan, on the other hand, has a ratio of almost 1 : 2 of people with pre-diabetes to those with diabetes, suggesting that the rate of type 2 diabetes is high in the province. This study unaddressed mysteries were the province of Khyber Pakhtunkhwa's substantially lower prevalence of diabetes and pre-diabetes. Diabetes and pre-diabetes, on the other hand, were substantially more prevalent in the Baluchistan province. Several subsequent studies gave warning of an increase in diabetes-related adverse outcomes in Baluchistan over the last 22 years, but the significant percentage still needs to be evaluated [4].

Diabetes chronic complications are broadly classified as microvascular and macrovascular, with the former having a much higher prevalence than the latter, which are the result of non-enzymatic glycosylation (NEG) of different proteins and osmotic damage. Neuropathy, nephropathy, and retinopathy are examples of microvascular complications, whereas cardiovascular disease, stroke, and peripheral artery disease (PAD) are examples of macrovascular complications.

Diabetic foot syndrome is characterized by the presence of a foot ulcer in conjunction with neuropathy, peripheral artery disease, and septicaemia, and it is a leading causative factor of limb amputation [5].

Peripheral insulin resistance, impaired hepatic glycaemic production control, and rapidly deteriorating cell activity distinguish the pathogenesis of type II diabetes, which ultimately leads to apoptosis. Cell dysfunction in type 2 diabetes is first detected by a decrease in the first component of insulin production in response to glucose stimulation, which should eventuate before the initiation of glucose intolerance [6].

Type 2 diabetes results from a variety of pathogenic mechanisms. Insulin insufficiency can result from autoimmune destruction of pancreatic beta cells, as well as insulin resistance due to abnormalities within the cells. The disruptions in carbohydrate, fat, and protein metabolism in diabetes are caused by ineffective action of insulin on target tissues. Inadequate insulin secretion and/or tissue responses to insulin at one or more stages in the complex hormone action pathways lead to poor insulin production [7, 8].

Severe hyperglycemia causes polyuria, fluid retention, weight loss, and sometimes polyphagia, as well as blurred vision. Chronic hyperglycemia can impair growth and make you more vulnerable to certain illnesses. Hyperglycemia with ketoacidosis or non-ketotic hyperosmolar syndrome comprise 2 acute, life-threatening challenges of uncontrolled diabetes.

Long-term complications of diabetes usually involve retinopathy (vision loss), nephropathy (renal failure), peripheral neuropathy (foot ulcers, amputations, and Charcot joints), and autonomic neuropathy (gastrointestinal, genitourinary, and cardiovascular symptoms, as well as premature ejaculation). People with diabetes are more likely to have hypertension and anomalous lipoprotein metabolic activity [9].

Most diabetes cases are classified as belonging to one of 2 broad aetiopathogenetic groupings. Serological evidence of an autoimmune pathologic process in the pancreatic islets, as well as genetic indicators, can usually identify persons who are more likely to develop this kind of diabetes. Type II diabetes, which is far more common, is caused by a combination of insulin resistance and a lack of compensatory insulin secretory response [10].

Diabetes is most common in people in their 40s and 50s; however, the absolute burden of the disease may be much greater in younger groups due to their larger numbers and longer lifespans. The fact that diabetes is expected to rise even further among young people as overweight and obesity become more common is intriguing. Non-communicable diseases, such as type 2 diabetes mellitus, are growing more common in all countries, regardless of economic growth, epidemiological diversity, or demographic heterogeneity. According to a society comparative study conducted in Gondar, the occurrence of type 2 diabetes mellitus in people aged 35 years and over was 3.6%: 5.1% in urban residents and 2.1% in the rural population [10].

Most diabetic cases (69%) were newly diagnosed, with rural residents accounting for the majority (82.6%).

Diabetics now account for the leading cause of death and morbidity in children throughout the world. Studies suggest that focusing on hyperglycemia, one of the disease's hallmarks, as well as hypertension and hyperlipidaemia, which typically coexist with it, could greatly reduce the burden of type II diabetes. Additionally, early intervention to treat pre-diabetes could further reduce the burden of diabetes, as mounting evidence suggests that this approach holds promise for preventing or at least delaying progression to overt diabetes. Because pre-diabetes is largely underdiagnosed, most people do not benefit from this [11].

Gestational diabetes mellitus (GDM) is a serious complication of pregnancy, in which the pregnant woman develops hyperglycemia resulting from impaired glucose tolerance due to β-cell dysfunction. It currently affects 16.5% of pregnancies all around the world [12]. In Pakistan the prevalence of GDM ranges from 4.2% to 26%, with Peshawar having the highest GDM presence (26%) and Karachi the lowest (4.2% and 8%), of which 50% GDM are diagnosed in the 3rd trimester [4].

Psychological stress, including exposure to stressful life events, has been suggested to play a role in the development of diabetes [13]. To date, most research in this emerging field is on profession-related stress (e.g., long working hours, job strain) [14], but the role of stressful life events on diabetes has been less studied and demonstrated. It has also been reported that family history can cause perception of disease risk, and those who have a family history were more likely to have greater perceived risk for diabetes [15]. With the support system being very weak in KPK, it is most likely that psychological traumas, events, and emotional distress are simultaneously present with rising prevalence of diabetes.

The present study aimed to estimate the prevalence and clinical profile of type 2 diabetes mellitus and gestational diabetes in pregnant women in the population of Khyber Pakhtunkhwa Pakistan based on several causes of diabetes including hypertension, stress, family history, age, obesity, etc.

Material and methods

Ethical statement

The proposed study was approved by the Ethics Committee of the Department of Biochemistry of Abdul Wali Khan University Mardan.

Data collection

This included a total of 1479 type II diabetic patients. The data were collected from male (572) and female (n = 907) patients of different age groups including 156 subjects with age up to 30 years, 1105 participants aging from 31 to 60 years, and 218 subjects of age above 60 years, residing in both urban and rural localities of different regions of KPK, with type II diabetic patients admitted in surgical and medical wards of Qazi Hussain Ahmad Medical Complex Nowshera via interviews with the patients according to a designed questionnaire.

Because of the advancement in technology and due to the centralized and accessible location of the QHMC, patients of various concerns from different region of KPK are treated in this hospital, which is why subjects included in this study were not only from Nowshera but also from various regions of the KPK province. Hence, we can generalize the data on the population of KPK.

Blood samples were collected from all the patients, including males and females, with their consent. Random blood sugar was measured with these blood samples using a digital glucometer, and glycated haemoglobin (HbA_{1c}) data were noted from the patient's file, which had been recorded a day before. Subjects with $HbA_{1c} \geq 6.5\%$ were considered diabetic, while pregnant patients with fasting blood glucose ≥ 92 mg/dl or post prandial 1-hour glucose levels of ≥ 180 mg/dl and after 2 h with ≥ 153 mg/dl OGTT were considered to be gestational diabetic, as suggested by the American Diabetic Association [16]. None of our patients were pregnant, but they had a history of hyperglycemia and use of anti-diabetic drugs during their late gestational period. The blood pressure of patients was monitored regularly by trained staff in the ward. To calculate body mass index (BMI), height and weight scales were recorded from the patients' files. A WHO standard BMI classification for the evaluation obesity was used [17, 18]. Using the perceived stress scale [19], subjects were interviewed in privacy for negative thoughts, behaviour, and anxiety. The effect of diabetes on the daily lives of patients was assessed by interviewing them regarding several areas, which included decrement in self-care, family relationships, sexual relationships, social activities, livelihood, travel, sport, and exercise. After a detailed assessment, diabetes was considered as a hurdle in terms of the daily life activities of the patient if patient declared that any of these major aspects of life were affected due to their current condition.

Data analysis

SPSS 23.0 software (SPSS, Chicago, IL, USA) was used for data analysis. The defining factors were analysed using binary logistic regression in SPSS. The association between type II diabetic patients and variables such as hypertension, age, family

history, and other possible related variables were assessed using univariate and step-wise multivariate regression models.

Definitions

Differences between type I and type 2 diabetes mellitus: this refers to a group of diseases that affect how a human body uses blood sugar (glucose). Type I diabetes symptoms manifest more quickly. According to the International Diabetes Federation, polydipsia, polyuria, enuresis, lack of energy, excessive weariness, polyphagia, abrupt weight loss, slow-healing wounds, recurring infections, and blurred eyesight are some of the symptoms of type 1 diabetes [20].

People with type 2 diabetes are more susceptible to a variety of short- and long-term problems, which can lead to premature death. Because of the prevalence of type 2 diabetes, its insidious start, and late identification, especially in resource-poor developing countries, individuals with type 2 diabetes have a higher risk of morbidity and mortality [21, 22]. Because type II symptoms manifest more slowly, they are more likely to be eliminated. Insulin is used to control blood sugar in people with type I diabetes. Type 2 diabetes can be managed in more ways than type I diabetes. Type 2 diabetes is diagnosed more often in patients above 30 years old.

Gestational diabetes refers to new onset of a hyperglycemic condition in females during the 3rd trimester of gestation. Gestational diabetes is a condition that occurs when a pregnant woman's body is unable to produce sufficient insulin or has a glucokinase deficiency in late pregnancy. Gestational diabetes is connected to being overweight or obese. When women who are overweight or obese become pregnant, they may already have insulin resistance. It is also possible that gaining too much weight during pregnancy is a factor [23].

BMI is a measure of fat in adults based on height and weight.

Results

A total of 1479 type II diabetic patients were studied (907 female and 572 male), who ranged in age from 18 to 75 years, and among whom several were found to be diagnosed with gestational diabetes. All the admitted patients were diabetic and had $HbA_{1c} \geq 6.5\%$ with a mean of 9.064%, SD = 1.8. The study was categorized into certain variables like age, gender, family history, Stress, medical history, obesity, and hypertension.

Age groups

The age variable was further divided into 3 categories: below 30 years old, 30–60s and above 60s, as shown in Table I. Age group of (30s-60s) exhibited percentage of patients with family history of diabetes as 33.5% and those with almost no history were 41.2%. Lastly, percentage of patients with above 60s showed percentage as 6.2% and with no family history as 8.2%. Apart from all other variables, family history of hypertension revealed percentage of patients (below 30s) with family history of hypertension as 3.2% and patients with no family history of hypertension as 7.4%. Patients with age (30s-60s) showed percentage of family history of hypertension as 28.5% while those with no family history as 46.2%. Percentage of patients with above 60s showed family history of hypertension as 6.2% and with no such history as 8.5%.

In the group below 30 years old 9.8% were previously diagnosed and 7% were newly diagnosed with diabetes mellitus. The percentage of patients diagnosed with hypertension and diabetes was 6.2%, and diabetic patients with no history of hypertension comprised 4.4%. According to BMI, a total of 39 (2.6%) were obese. For family history of diabetes in a 2nd degree relative, 81 (5.5%) were positive. However, the last factor revealed that 5.9% of diabetic patients were living their life with almost no stress while 4.7% were leading a very stressful life, associating their lifestyle with their condition of type 2 diabetes mellitus.

For the age group of 30–60s 67.2% were previously diagnosed, which indicates that patients of productive age were at high risk of diabetes. The proportion of patients diagnosed with hypertension and diabetes was 41.9%, while those with no history of hypertension was 32.8%. In perspective of obesity, 270 (18.3%) patients suffering from type 2 diabetes mellitus were class II obese ($\rho = 0.005$). However, this age group also contained 56 (3.8%) underweight and 52 (3.5%) diabetic patients in normal range of BMI, which is probably because of their reproductive age and active lifestyle. One-third, i.e. 495 (33.5%), of the total in this age group had a positive family history of diabetes in 2nd degree relatives while 610 (41.2%) had no such history. The last factor, about having a stressful life, showed that 35.6% diabetic patients were living their life with no stress but 39.1% were having a stressful life.

In the old age group (above 60s) the indicated percentage of previously diagnosed was 13.9% and newly diagnosed was 9% in case of history of diabetes mellitus. The percentage of patients diagnosed with hypertension and diabetes was 8.5%, and diabetic patients with no history of hypertension comprised 6.3%, which showed high risk of these hypertensive patients towards diabetes. However, with increasing age, only 12.5% with above normal levels of BMI were diabetic, which

Table I. Prevalence of previously diagnosed and newly diagnosed type 2 diabetes mellitus and association with possible causes of diabetes and their family history

Variables		Age groups		
		Below 30s	30–60s	Above 60s
History of T2DM	Previously diagnosed	145 (9.8%)	994 (67.2%)	205 (13.9%)
	Newly diagnosed	11 (7%)	111 (7.5%)	13 (9%)
History of hypertension	None	65 (4.4%)	485 (32.8%)	93 (6.3%)
	Present	91 (6.2%)	620 (41.9%)	125 (8.5%)
History of obesity	Not obese	106 (7.2%)	747 (50.5%)	148 (10%)
	Obese	50 (3.4%)	358 (24.2%)	70 (4.7%)
	Underweight	8 (0.5%)	56(3.8%)	16(1.1%)
	Normal	7 (0.5%)	52 (3.5%)	17(1.1%)
	Overweight	30 (2.0%)	230 (15.6%)	56 (3.8%)
	Obese	39 (2.6%)	220 (14.9%)	41 (2.8%)
	Obese class1	38 (2.6%)	236 (16.0%)	37 (2.5%)
	Obese class 2	29 (2.0%)	270 (18.4%)	37 (2.5%)
	Obese class 3	5 (0.3%)	41 (2.8%)	14 (0.9%)
Stressful life	No	86 (5.9%)	579 (39.10%)	118 (8.0%)
	Yes	69 (4.7%)	526 (35.6%)	100 (6.8%)
Family history of diabetes	None	75 (5.1%)	610 (41.2%)	126 (8.2%)
	Present	81 (5.5%)	495 (33.5%)	92 (6.2%)
Family history of hypertension	None	109 (7.4%)	684 (46.2%)	126 (8.5%)
	Present	47 (3.2%)	421 (28.5%)	92 (6.2%)

probably due to muscle wasting and deteriorated. Another variable of stressful life showed 8.0% with no stress and 6.8% of diabetic patients living a stressful life.

Gender

The second most important variable of the current study was gender, with male and female patients further categorized according to history of diabetes mellitus, history of hypertension, history of obesity and history of stressful life, as shown in Table II. The prevalence of male patients previously diagnosed with diabetes was 35.6%. History of hypertension was 21.7% among male patients while those with no history of hypertension comprised 17%. History of obesity showed percentage of male patients as 13.5% and non-obese as 25.2%. However, the last factor revealed that only 21.4% of diabetic patients were living their life with almost no stress while 17.3% were living a stressful life, which associated stressful life with diabetes. In the case of female patients, 55.2% were previously diagnosed with diabetes followed by 6.1% newly diagnosed with type 2 diabetes mellitus, which indicated that females were at higher risk of diabetes as compared to males. One-third were hypertensive and a quarter non-hypertensive. History of obesity reflected the percentage of female obese patients suffering from type 2 diabetes mellitus as 18.8% and non-obese as 42.5%. The last factor about stressful life showed that 31.6% of diabetic patients were living their life with almost no stress but 29.7% had a stressful life.

Gestational diabetes

Female patients who had a history of GDM comprised 83 (9.2%), of whom 15 (1.7%) developed type 2 diabetes mellitus ($\rho = 0.009$). According to Table III, 75 (9.1%) females were found to be newly diagnosed with diabetes without any history of gestational hyperglycemia and antidiabetic drug use, and 749 (82%) were diagnosed with type 2 diabetes mellitus before the gestation.

Diabetes affecting lives

According to data analysis, the prevalence of type 2 diabetes mellitus was 5.30% in the current settings, and it showed that diabetes has impaired the lives of more than one-fourth of the diabetic patients, restricting their performance of daily chores and work, as shown in Figure 1. If steps like screening prophylactic and anticipatory treatment are not taken into consideration, then the percentage in 2025 could reach 20 million, affecting a remarkable proportion of the population.

Table II. Clinical profiles of those diagnosed with type 2 diabetes mellitus, undiagnosed T2DM with history of obesity, and lifestyle of diabetic patients based on demographic and biological variables between male and female participants

Variables		Gender	
		Male	Female
History of T2DM	Previously diagnosed	527 (35.6%)	817 (55.2%)
	Newly diagnosed	45 (3.0%)	90 (6.1%)
History of hypertension	None	251 (17%)	392 (26.5%)
	Present	321 (21.7%)	515 (34.8%)
History of obesity	Underweight	0 (0.0%)	80 (5.6%)
	Normal	0 (0.0%)	76 (5.1%)
	Overweight	125 (8.5%)	191 (12.9%)
	Obese	139 (9.4%)	161 (10.9%)
	Obese class 1	146 (9.9%)	165 (11.2%)
	Obese class 2	162 (11.0%)	174 (11.8%)
	Obese class 3	0 (0.0%)	60 (4.1%)
Stressful life	No	316 (21.4%)	468 (31.6%)
	Yes	256 (17.3%)	439 (29.7%)

Table III. Percentage comparison of patients with a history of GDM preceded to T2DM and patients with no history of GDM preceded T2DM

Variable	Percentage
Percentage of patients with GDM	83 (9.2)
Diabetic patients with no history of GDM	824 (90.8)
GDM Patients preceded to T2DM	15 (1.7%)
GDM Patients with family history of T2DM	36 (4.0%)
GDM patients with no family history of DM	47 (5.2%)

Associations

Multiple chi-square tests were performed between risk factor variables and type 2 diabetes mellitus and gestational diabetes mellitus. Obesity with BMI greater than 29.9, as classified for the Asian population [17, 18], was found to be significantly associated ($p = 0.005$) with both gestational diabetes mellitus and type diabetes mellitus. However, other risk factors including family history of diabetes and hypertension, history of hypertension, hepatitis C, drug history of hypertension and hepatitis C, and exercise were non-significant.

In females there was also a significant association ($p < 0.001$) between gestational diabetes and type 2 diabetes mellitus, i.e. patients who had gestational diabetes were more likely to develop type 2 diabetes mellitus later in life.

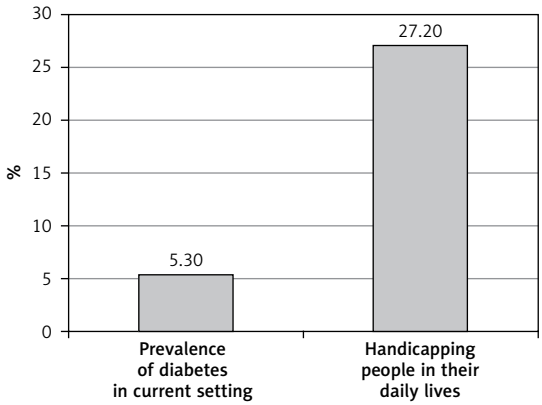

Figure 1. Prevalence of diabetes in the current setting and its effect on patients' daily life

Discussion

The prevalence of previously diagnosed type 2 diabetes mellitus was 4.1%, while the occurrence of newly diagnosed type 2 diabetes mellitus was 1.2%, indicating that previously diagnosed type 2 diabetes mellitus was more prevalent than newly diagnosed type 2 diabetes mellitus, as in other countries such as the United States and Turkey, where originally diagnosed type 2 diabetes mellitus was more prevalent than undiagnosed type 2 diabetes mellitus. To control diseases, Pakistan's healthcare programs for early diagnosis of type 2 diabetes mellitus must be assessed. If a comprehensive survey is conducted, the prevalence of type 2 diabetes mellitus may be higher than the level observed in the current study [24]. The healthcare program for early detection of type 2 diabetes mellitus must be evaluated in Pakistan to control the disease. The prevalence of type 2 diabetes mellitus might be greater than the level found in the present results if we undertake a detailed survey. The prevalence of type 2 diabetes mellitus and hypertension were higher among women than men. These results were different

from those obtained in China and Japan, where males had a higher prevalence than females [25].

Type 2 diabetes mellitus prevalence increased with age, so we separated the participants' ages into 3 categories. Older participants were more likely to develop hyperglycemia, which is linked to a decline in pancreatic function. The pancreas undergoes various pathological changes with ageing, including increased fatty replacement, fibrosis, lymphoplasmacytic infiltration, amyloid deposition, weight loss, and the development of intra-epithelial neoplastic changes. Type 2 diabetes mellitus was more prevalent in the upper socioeconomic group, but according to some studies, low-income groups had a higher prevalence [26]. The global diabetes prevalence in 20–79-year-olds in 2021 was estimated to be 10.5% (536.6 million people), rising to 12.2% (783.2 million) in 2045. The prevalence of diabetes was similar in men and women and was highest in those aged 75–79 years [27].

Hyperglycemia and hypertension were found to be linked. Individuals with hypertension had a higher risk of hyperglycemia than non-hypertensive participants. According to some research, higher hypertension is associated with increased hyperglycemia [28]. The prevalence of hypertension was high in the previously diagnosed type 2 diabetes mellitus and newly diagnosed groups.

Diabetes is a complex disease with numerous subtypes and no obvious aetiology. If a person's family has a history of diabetes, they are more likely to develop the disease themselves. T2DM is characterized by a combination of external factors and a significant genetic component [29].

Obesity, a sedentary lifestyle, a low or high birth weight, and stress are well known risk factors for the development of T2DM. Toxins and other dietary variables may also play a role [30]. Individuals with one T2DM-affected parent have a 40% lifetime risk of acquiring T2DM, and those with both parents have a 70% lifetime risk.

From this study it can be concluded that a child having a genetic history of diabetes should take more care in terms of the particular diseases. Genes play a role in type II diabetes, but lifestyle choices are equally important. A person may have a genetic mutation that makes them vulnerable to type II diabetes, but if they take care of their body, they may avoid developing diabetes.

According to the results mentioned above, those having different kinds of stress in life are more likely to develop type 2 diabetes mellitus than those having low or no stress in life. However, stress can also increase a person's blood sugar and glycated hemoglobin levels. Research has also linked high levels of lifetime stress to an increased risk of developing type 2 diabetes [31].

Overweight and obese participants had a high risk of hyperglycemia compared with normal persons, as shown in Table I. Obese people are more inclined to be diagnosed with diabetes mellitus, and the UK has the highest rate of obesity in Europe, with nearly a quarter of all adults (28.1%) obese and nearly two-thirds of all adults (63.4%) overweight. The number of obese adults in the United States is expected to rise to 26 million in the next 20–25 years. Experts estimate that such an increase would result in an additional million cases of type II diabetes, cardiovascular disease, and cancer [32]. Our study has revealed that obesity is significantly associated (p = 0.005) with gestational as well as type 2 diabetes mellitus.

The most common risk factors for stroke, according to Zhang and He, were hypertension, smoking, and hypertriglyceridemia. Hypertension, diabetes, dyslipidemia, smoking, and alcohol are among the modifiable risk factors for stroke, according to a review by McFarlene, stressing the importance of intervention to reduce stroke in diabetic and hypertensive populations [28, 33]. Apart from this, in the region of Asia a significant increase in new onset and mortality due to diabetes was observed [34].

There is a great variation in the literature regarding the proportion of women with a history of GDM who develop diabetes [35]. GDM is linked to insulin resistance as well as impaired insulin secretion, and it shares the same risk factors as type 2 diabetes mellitus (T2DM). The prevalence of GDM in a population closely resembles that of T2DM [22].

Women with gestational diabetes mellitus had a 10-fold higher risk of developing type 2 diabetes mellitus over a 10-year follow-up period than women without gestational diabetes mellitus, even after controlling for other influencing factors. When compared to women with no history of GDM, women with a history of GDM have a 10-fold elevated risk of type 2 diabetes mellitus later in life [36].

50% to 60% of gestational diabetes mellitus pregnancies result in type 2 diabetes mellitus later in life. The relative risk of developing diabetes after GDM was calculated to be 6.0 (95% CI: 4.1–8.8) based on 6 follow-up studies. In women with a history of gestational diabetes mellitus, each additional pregnancy increases the risk of T2DM three-fold. Furthermore, GDM can cause maternal and infant complications, such as pre-eclampsia, premature rupture of membranes, and premature delivery, and it increases the risk of long-term endocrine disorders. Gravidas with GDM have a 70% probability of developing diabetes within 28 years after delivery [37]. The findings of our studies were similar, i.e. there was a significant

association ($p < 0.001$) between gestational diabetes and type 2 diabetes mellitus, which means that patients who had gestational diabetes mellitus were more likely to develop type 2 diabetes later in life. However, if screening and preventive controls are adopted, this unnecessary disaster can be resisted. Female participants have a higher ratio of previously diagnosed diabetes and newly diagnosed diabetes compared to male participants. According to the findings, type 2 diabetes mellitus patients in various age groups have a variety of critical factors and complications. Obesity, high blood pressure, and complications such as massive heart attack, tuberculosis, and diabetic wounds were among the risk factors they possessed. Diabetic patients require special attention as well as a comprehensive approach to treatment and prevention of complications. Furthermore, effective diabetes preventive and control methods are critically needed in the Pakistani community. Obesity and hypertension must be addressed as part of the national health agenda. Those of productive age, and especially those in younger group, must develop durable and effective lifestyle programs in the community. In the community, health education on diabetes its risk factors, presentation, and complications, as well as healthy food, physical exercise programs, drug management, and counselling must all be implemented.

Acknowledgments

I am thankful to Qazi Hussain Ahmad Medical Complex Nowshera for providing the environment in which to investigate patients admitted to the Medicine and Surgical wards.

Conflict of interest

The authors declare no conflict of interest.

References

1. Ogurtsova K, da Rocha Fernandes JD, Huang Y, et al. IDF Diabetes Atlas: global estimates for the prevalence of diabetes for 2015 and 2040. Diabetes Res Clin Pract 2017; 128: 40-50.
2. Yang MH, Hall SA, Piccolo RS, Maserejian NN, McKinlay JB. Do behavioral risk factors for prediabetes and insulin resistance differ across the socioeconomic gradient? Results from a community-based epidemiologic survey. Int J Endocrinol 2015; 2015: 806257.
3. Adnan M, Aasim M. Prevalence of type 2 diabetes mellitus in adult population of Pakistan: a meta-analysis of prospective cross-sectional surveys. Ann Glob Health 2020; 86: 7.
4. Riaz M, Nawaz A, Masood SN, Fawwad A, Basit A, Shera AS. Frequency of gestational diabetes mellitus using DIPSI criteria, a study from Pakistan. Clin Epidemiol Glob Health 2019; 7: 218-21.
5. Amin N, Doupis J. Diabetic foot disease: from the evaluation of the "foot at risk" to the novel diabetic ulcer treatment modalities. World J Diabetes 2016; 7: 153-64.
6. Halban PA, Polonsky KS, Bowden DW, et al. β-cell failure in type 2 diabetes: postulated mechanisms and prospects for prevention and treatment. J Clin Endocrinol Metab 2014; 99: 1983-92.
7. Galicia-Garcia U, Benito-Vicente A, Jebari S, et al. Pathophysiology of type 2 diabetes mellitus. Int J Mol Sci 2020; 21: 6275.
8. Association AD. Diagnosis and classification of diabetes mellitus. Diabetes Care 2009; 32 (Suppl 1): S62-7.
9. Sayin N, Kara N, Pekel G. Ocular complications of diabetes mellitus. World J Diabetes 2015; 6: 92-108.
10. Association AD. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care 2012; 36 (Suppl): S67-74.
11. Pratley RE. The early treatment of type 2 diabetes. Am J Med 2013; 126 (9 Suppl 1): S2-9.
12. Plows JF, Stanley JL, Baker PN, Reynolds CM, Vickers MH. The pathophysiology of gestational diabetes mellitus. Int J Mol Sci 2018; 19: 3342.
13. Hackett RA, Steptoe A. Psychosocial factors in diabetes and cardiovascular risk. Curr Cardiol Rep 2016; 18: 95.
14. Kivimäki M, Virtanen M, Kawachi I, et al. Long working hours, socioeconomic status, and the risk of incident type 2 diabetes: a meta-analysis of published and unpublished data from 222 120 individuals. Lancet Diabetes Endocrinol 2015; 3: 27-34.
15. Ferrer R, Klein WM. Risk perceptions and health behavior. Curr Opin Psychol 2015; 5: 85-9.
16. Association AD. Standards of medical care in diabetes--2011. Diabetes Care 2011; 34 Suppl 1: S11-61.
17. Nuttall FQ. Body mass index: obesity, BMI, and health: a critical review. Nutr Today 2015; 50: 117-28.
18. Consultation WHOE. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004; 363: 157-63.
19. Lee EH. Review of the psychometric evidence of the perceived stress scale. Asian Nurs Res 2012; 6: 121-7.
20. Cederberg H, Laakso M. Obesity and type 2 diabetes. In: Handbook of Obesity: Epidemiology, Etiology, and Physiopathology. Third Edition 2014; 539-48.
21. Zeru MA, Tesfa E, Mitiku AA, Seyoum A, Bokoro TA. Prevalence and risk factors of type-2 diabetes mellitus in Ethiopia: systematic review and meta-analysis. Sci Rep 2021; 11: 1-15.
22. Herath H, Herath R, Wickremasinghe R. Gestational diabetes mellitus and risk of type 2 diabetes 10 years after the index pregnancy in Sri Lankan women – a community based retrospective cohort study. PLoS One 2017; 12: e0179647.
23. Farrar D. Hyperglycemia in pregnancy: prevalence, impact, and management challenges. Int J Womens Health 2016; 8: 519-27.
24. Aamir AH, Ul-Haq Z, Mahar SA, et al. Diabetes Prevalence Survey of Pakistan (DPS-PAK): prevalence of type 2 diabetes mellitus and prediabetes using HbA1c: a population-based survey from Pakistan. BMJ Open 2019; 9: e025300.
25. Mukai N, Hata J, Hirakawa Y, et al. Trends in the prevalence of type 2 diabetes and prediabetes in a Japanese community, 1988–2012: the Hisayama Study. Int 2019; 10: 198-205.
26. Min H, Chang J, Balkrishnan R. Sociodemographic risk factors of diabetes and hypertension prevalence in republic of Korea. Int J Hypertens 2010; 2010: 410794.
27. Sun H, Saeedi P, Karuranga S, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence

estimates for 2021 and projections for 2045. Diabetes Res Clin Pract 2022; 183: 109119.
28. Zhang YN, He L. Risk factors study of ischemic stroke in young adults in Southwest China. Sichuan Da Xue Xue Bao Yi Xue Ban 2012; 43: 553-7.
29. Ali O. Genetics of type 2 diabetes. World J Diabetes 2013; 4: 114-23.
30. Pulgaron ER, Delamater AM. Obesity and type 2 diabetes in children: epidemiology and treatment. Curr Diab Rep 2014; 14: 508.
31. Hilliard ME, Yi-Frazier JP, Hessler D, Butler AM, Anderson BJ, Jaser S. Stress and A1c among people with diabetes across the lifespan. Curr Diab Rep 2016; 16: 67.
32. Lin X, Xu Y, Pan X, et al. Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. Sci Rep 2020; 10: 14790.
33. McFarlane SI, Sica DA, Sowers JR. Stroke in patients with diabetes and hypertension. J Clin Hypertens 2005; 7: 284-6.
34. Shrestha DB, Budhathoki P, Raut S, et al. New-onset diabetes in COVID-19 and clinical outcomes: asystematic review and meta-analysis. World J Virol 2021; 10: 275-87.
35. Kgosidialwa O, Bogdanet D, Egan AM, et al. A core outcome set for the treatment of pregnant women with pregestational diabetes: an international consensus study. BJOG 2021; 128: 1855-68.
36. Vounzoulaki E, Khunti K, Abner SC, Tan BK, Davies MJ, Gillies CL. Progression to type 2 diabetes in women with a known history of gestational diabetes: systematic review and meta-analysis. BMJ 2020; 369: m1361.
37. Yaping X, Chunhong L, Huifen Z, Fengfeng H, Huibin H, Meijing Z. Risk factors associated with gestational diabetes mellitus: a retrospective case-control study. Int J Diabetes Dev Ctries 2022; 42: 91-100.