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Analysis of the Prevalence and Geographic Spread of Diabetes Mellitus in Kohat

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Abstract

Diabetes Mellitus (DM) is a metabolic condition characterized by persistent high blood sugar levels resulting from impaired insulin secretion. Diabetes mellitus disrupts the metabolism of lipids, carbohydrates, and proteins. The global prevalence of diabetes mellitus is steadily rising, estimated to reach 552 million by 2030. This is the cross- sectional survey study conducted at the District Headquarter Hospital KDA Kohat in Khyber Pakhtunkhwa . Detailed data regarding the age and gender of the patients were gathered, and blood glucose levels were determined using the Glucose oxidase test. The study revealed an overall diabetes mellitus (DM) prevalence of 51.4% with the higher prevalence in females (52%) than in males (48%) . Furthermore, individuals in the age group of 30-40 years were the most effected. Elevated fasting sugar (FBS) levels were observed in the age group of 10-20 years. While Random blood sugar (RBS) levels were more common in individuals aged 40 years and above.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The hormone insulin, produced by the β-cells of the pancreas, plays a fundamental role in maintaining glucose homeostasis by facilitating the uptake of glucose into body cells where it is utilized as a primary energy source. When insulin production is insufficient or when body tissues fail to respond effectively to insulin, glucose accumulates in the bloodstream, leading to elevated blood sugar levels and metabolic disturbances (Prabhakar and Dobli, 2011; Eysenbach, 2023).

Under normal physiological conditions, the digestion of carbohydrate-containing foods leads to the formation of glucose, which enters the bloodstream. In response to rising blood glucose levels, the pancreas releases insulin, enabling glucose transport into tissues such as skeletal muscles and adipose cells. Insulin also promotes the storage of excess glucose in the liver and muscles in the form of glycogen, thereby maintaining stable blood glucose levels and preventing metabolic imbalance (Albisser et al., 2002). Disruption in this regulatory mechanism forms the basis of diabetes mellitus and contributes to long-term complications affecting various organs including the heart, kidneys, nerves, and eyes.

Diabetes mellitus is generally classified into three major categories: type 1 diabetes, type 2 diabetes, and gestational diabetes. Type 1 diabetes is primarily an autoimmune condition in which the immune system mistakenly attacks and destroys the insulin-producing β-cells of the pancreas. As a result, the body produces little or no insulin, and patients require lifelong insulin therapy for survival. This form of diabetes commonly develops during childhood or adolescence and is often associated with genetic susceptibility and immune dysfunction (Wilcox, 2005; Al-Muhsen, 2022). In the absence of adequate insulin, glucose cannot enter cells effectively and accumulates in the bloodstream, resulting in hyperglycemia and metabolic complications (Dai et al., 2022).

Type 2 diabetes, the most prevalent form of the disease, is characterized by insulin resistance in which body tissues become less responsive to insulin. In the early stages of this condition, the pancreas compensates by producing higher levels of insulin to maintain glucose balance. However, prolonged metabolic stress eventually impairs pancreatic β-cell function, leading to inadequate insulin secretion and persistent hyperglycemia (Ahamed et al., 2021). Lifestyle factors such as obesity, physical inactivity, and unhealthy dietary patterns strongly contribute to the development of type 2 diabetes. Although it was previously considered a disease primarily affecting adults, its incidence among younger populations has increased significantly in recent years (Bellou et al., 2018).

Gestational diabetes is another form that develops during pregnancy as a result of hormonal changes that interfere with insulin function. Women who experience gestational diabetes generally return to normal glucose regulation after childbirth; however, they remain at a higher risk of developing type 2 diabetes later in life. Proper screening and management during pregnancy are therefore essential to prevent complications for both the mother and the developing fetus (Di Cianni et al., 2003).

The development of diabetes mellitus is influenced by a combination of genetic and environmental risk factors. Non-modifiable factors include age, ethnicity, family history, and genetic predisposition. Individuals with a family history of diabetes have a significantly higher likelihood of developing the disease due to inherited susceptibility affecting insulin secretion and glucose metabolism (Esposito et al., 2019). Studies involving twins further highlight the role of genetic factors, demonstrating that the risk of type 2 diabetes is considerably higher among monozygotic twins compared to dizygotic twins. In addition, type 2 diabetes is considered a polygenic disorder involving multiple genes located on different chromosomes that collectively influence disease susceptibility (Malecki, 2005).

Alongside genetic predisposition, several modifiable lifestyle factors contribute significantly to the development of diabetes. Obesity is one of the most prominent risk factors, particularly when excess fat accumulates in the abdominal region. Adipose tissue releases free fatty acids and inflammatory mediators that interfere with insulin signaling pathways, thereby promoting insulin resistance and impairing glucose utilization by skeletal muscle (Ravussin and Smith, 2002; Arner, 2002). Physical inactivity further exacerbates this metabolic dysfunction by reducing energy expenditure and promoting the accumulation of triglycerides in muscle tissues (Knol et al., 2006). Regular physical activity, on the other hand, improves insulin sensitivity and plays a crucial role in maintaining glycemic control (ADA, 2015).

Dietary habits also influence diabetes risk, particularly diets rich in saturated and trans fats and low in dietary fiber. Such dietary patterns contribute to dyslipidemia and obesity, which in turn promote insulin resistance and metabolic imbalance (Bellou et al., 2018). Chronic hyperglycemia resulting from excessive carbohydrate consumption can further impair the ability of muscle and adipose tissues to absorb glucose, eventually leading to the progression from prediabetes to type 2 diabetes (Larie, 2019). Psychological stress is another contributing factor, as elevated levels of cortisol increase blood glucose concentrations and interfere with insulin activity, thereby increasing the likelihood of insulin resistance (Wasyluk and Zwolak, 2021).

In addition, chronic low-grade inflammation has been identified as a key factor in the pathogenesis of type 2 diabetes. Elevated inflammatory markers such as interleukin-6 and C-reactive protein are frequently observed in individuals with insulin resistance. Persistent inflammatory responses disrupt metabolic pathways and contribute to the progression of hyperglycemia and β-cell dysfunction (Coudriet et al., 2006).

The symptoms of diabetes vary depending on the type and severity of the condition. Common manifestations include excessive thirst (polydipsia), frequent urination (polyuria), increased hunger (polyphagia), fatigue, blurred vision, and slow wound healing. In type 1 diabetes, symptoms often appear rapidly and may include weight loss, muscle wasting, and diabetic ketoacidosis. In contrast, type 2 diabetes usually develops gradually and may remain undiagnosed for years until complications emerge (Hay, 1996; Hashim, 2020).

From an epidemiological perspective, diabetes represents a major global health challenge. Early estimates suggested that approximately 20 million individuals were affected worldwide, with a substantial proportion remaining undiagnosed (Fletcher et al., 2002). The majority of cases, approximately 90–97% are attributed to type 2 diabetes. The prevalence and incidence of diabetes vary widely across different regions due to differences in genetic background, lifestyle patterns, and socioeconomic factors (Alberti et al., 1998). Understanding these epidemiological trends is essential for designing effective public health interventions and preventive strategies aimed at reducing the growing burden of diabetes worldwide.

MATERIALS AND METHOD

Study Area

This research was carried out at Kohat a city in Pakistan Khyber Pakhtunkhwa region. A total of 250 samples were collected from various medical facilities in Kohat, including KDA Hospital. The glucose oxidase test was employed in the pathology lab of the District Headquarter Hospital to diagnose diabetes.

In this research, patient blood samples were first subjected to centrifugation at 3000 rpm for 4 minutes at 25°C, separating the serum from red blood cells. Approximately 10µl of this serum were then transferred to an Eppendorf tube, into which 1µl of glucose reagent,10µl of Glucose standard, and 10µl of distilled water were added. All the components were thoroughly mixed and left at room temperature for 10 minutes.

The blood glucose level of analyzed through UV spectrophotometric technique. The data was analyzed through software (SPSS Version 17), calculation were done for frequencies, percentage and ratio. For testing significances of frequencies between the groups T test was used. P value is < 0.05 was considered as statistically significant.

RESULTS

About 51.4% of Kohat residents have diabetes mellitus. Total 250 samples were collected out of these 127 samples were positive and 123 samples were negative. The number of males were 62 (48%) and the remaining 64 (52%) were females. This mean that prevalence of diabetes is higher in females as compared to males.

The result revealed 7 were positive cases in the age of 1-10 years , 11 were positive cases in the age of 10-20 years , 30 were positive cases in the age of 20-30 years , 45 were positive cases in the age of 30-40 years ,34 were positive cases in the age of 40 years and above. RBS and FBS level of positive 127 cases were monitored and categorized according to age groups. The FBS range in low age group i.e. 1-10 years was 115-120 mg/dl, however RBS range was 140-155 mg/dl.

Similarly at the age of 10-20 years, FBS range was 118-128 mg/dl and RBS range was 160-177 mg/dl. At the age of 20-30 years, FBS range was 121-127 mg/dl and RBS range was 159-181 mg/dl, at the age of 30-40 years FBS range was 114-121 mg/dl and RBS range was 162-182 mg/dl. FBS range was 113-127 mg/dl and RBS range was 163-189 mg/dl in the age of 40 years and above.

Table No:1: Overall prevalence of diabetes in Kohat

Total sample	Positive cases in number	Positive case in %	Negative case in number	Negative cases in %
250	127	50.80	123	49.20

Table No: 2: Gender wise prevalence of diabetes in Kohat

Gender	Total	Positive case (n)	Prevalence of diabetes (%)
Male	127	61	48
Female	127	66	52

Table No: 3: Age wise prevalence of diabetes in Kohat

Age wise(years)	Total	Positive case(n)	Prevalence of diabetes (%)
1-10	127	7	5
10-20	127	12	9
20-30	127	30	24
30-40	127	45	36
40 and above	127	33	26

Table No: 4: Age wise FBS and RBS level in District Kohat

Age wise(year)	Total	Positive case(n)	FBS range (mg/dl)	RBS range (mg/dl)
1-10	127	7	115-120	140-155
10-20	127	12	118-128	166-177
20-30	127	30	121-127	159-181
30-40	127	45	114-121	162-182
40 and above	127	33	113-127	163-189

DISSCUSION

Diabetes is a big issue in every demographic and region of the world, although it is most prevalent in rural areas of low- and middle-income nations According to the National Diabetes Survey of Pakistan (Butt et al., 2022). The International Diabetes Federation estimates that 26.7% of Pakistani adults would have diabetes in 2022, accounting for over 33,000,000 cases worldwide (Sharif et al., 2023) , the prevalence of DM increased from 8.7% in 1994–1998 to 26.3% in 2017.. This number is alarmingly high and is also increasing with each passing years.

This study showed prevalence of DM as 51.4% in Kohat a city in Pakistan being more prevalent in female as compared to male. According to the most recent analysis, compared to younger and older age groups, diabetes mellitus was more common in the 30- 40 year old age group (36%). Similarly the study done in China by Yong and Weng showed diabetes mellitus more prevalent in age group 60 years and above .FBS range was high in 10-20 years 9 (Lorenzo et al., 2007). But a single outlier in the Kohat study indicated that the FBS range was higher in people between the ages of 31 and 40. The RBS range was high in the age of 40 and above .The present study support another study conducted by Zekewos et al., (2018). According to their study RBS range was high in the age of 40 years and above. This study also support by Peck et al., (2014) that showed the prevalence was high in females.

CONCLUSION

Based on this survey, it can be determined that 51.4% of people have diabetes overall. It was found more commonly in female as compared to male. It could be brought on by a female's high stress level or lack of physical activity. The prevalence of diabetes at the age of 30-40 years age group was high as compared to younger and above 40. The FBS (Elevated fasting blood sugar) range is high in the age of 10-20 years and RBS (Elevated random sugar) range is high in the age 40 and above years as compared to other age group.

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