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Association Between Sedentary Behavior and Glycemic Control Among Adults in Peshawar, Pakistan: A Gender Base Analysis of Type 2 Diabetic Mellitus

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Abstract

The Global surge in Type 2 Diabetes Mellitus (T2DM) is strongly linked to modifiable risk factors, particularly sedentary behavior. While this association is well-established in Western contexts, there is a critical lack of data from specific socio-cultural environments like Pakistan, where unique lifestyle patterns, dietary habits, and gender roles may alter this relationship. Peshawar represents a high-risk population where understanding the intricate dynamics between sedentariness, gender, and glycemic control is essential for crafting effective local public health strategies. This study aimed to investigate this correlation and determine the gender-specific prevalence of T2DM in this understudied adult population. An analytical observational study was conducted with a sample of 250 adults from Peshawar, intentionally selected for high sedentary behavior. The study group was comprised of 160 females (64%) and 90 males (36%), with a mean age of 49.92 (±8.923) years. Data collection included measured biomarkers such as HbA1c, Random Blood Sugar (RBS), and Body Mass Index (BMI) alongside self-reported average daily sedentary time. Statistical analysis employed Pearson's correlation to assess bivariate relationships and multiple linear regression to model the predictors of HbA1c, controlling for age and gender. The study found an alarmingly high overall T2DM prevalence of 86%. Participants exhibited highly sedentary behavior (mean 7.29±0.71 hours/day) and poor glycemic control (mean HbA1c 9.54±2.49%; mean RBS 238.22±68.31 mg/dL). A strong, statistically significant positive correlation was found between sedentary time and HbA1c ($r=0.823$, $p<0.01$) and RBS ($r=0.625$, $p<0.01$). Regression analysis confirmed sedentary time as the strongest significant predictor of elevated HbA1c ($\beta=0.820$, $p<0.001$), while age and

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gender were non-significant predictors. A notable gender disparity was observed, with a higher T2DM prevalence among females (87.5%) compared to males (83.3%). This study provides compelling evidence of a powerful correlation between prolonged sedentary behavior and poor glycemic control in adults in Peshawar, with the burden of T2DM disproportionately affecting women. These findings underscore the critical need for public health interventions aimed at reducing sedentary time to mitigate the growing diabetes epidemic in this region.

Key words: Sedentary lifestyle, Type 2 diabetes, HbA1c, Random blood sugar, Body mass index, correlation.

Introduction:

Type 2 Diabetes Mellitus (T2DM) is a major global public health challenge characterized by insulin resistance and progressive impairment of pancreatic beta-cell function, resulting in chronic hyperglycemia. Its prevalence has increased considerably over recent decades, particularly in low- and middle-income countries, where urbanization, unhealthy dietary patterns, obesity, and physical inactivity contribute to the growing disease burden [1,2]. According to recent International Diabetes Federation estimates, approximately 589 million adults worldwide were living with diabetes in 2024, with Pakistan reporting an exceptionally high age-standardized prevalence of 31.4%, placing it among the countries most severely affected by the diabetes epidemic [3,4]. This increasing burden highlights the need to investigate modifiable lifestyle factors that contribute to diabetes development and inadequate glycemic control. Sedentary behaviour, defined as waking activities involving sitting, reclining, or lying with low energy expenditure, has emerged as an important independent health risk factor. Unlike physical inactivity, sedentary behaviour may occur even among individuals who meet recommended physical activity levels [5,6]. Prolonged sitting can adversely affect glucose metabolism by reducing skeletal muscle glucose uptake, impairing insulin sensitivity, and promoting metabolic disturbances. The World Health Organization recommends limiting sedentary time and replacing prolonged sitting with physical activity of any intensity to improve health outcomes [5,7]. Evidence suggests that reducing sedentary periods and incorporating regular movement breaks may contribute to improved glucose regulation among individuals with T2DM [8–10]. Glycemic control is an essential component of diabetes management and is commonly assessed through glycated haemoglobin (HbA1c), which reflects average blood glucose levels over approximately two to three months. Random blood sugar (RBS) provides additional information regarding an individual's current glucose status [11]. Previous studies have demonstrated associations between prolonged sedentary behaviour and adverse glycemic markers in individuals with T2DM. Furthermore, systematic reviews and intervention studies have reported improvements in glucose regulation when prolonged sitting is interrupted by short periods of physical activity [9,12–15]. Regular physical activity has also demonstrated beneficial effects on HbA1c, supporting the importance of lifestyle modification in diabetes management [16,17].

In Pakistan, the diabetes burden is further complicated by socioeconomic conditions, cultural practices, dietary habits, and gender-related differences in lifestyle and opportunities for physical activity. Evidence from national and regional studies indicates variations in diabetes prevalence according to gender, age, and geographical location [18–20]. Women may experience additional barriers to physical activity because of household responsibilities, social restrictions, and limited opportunities for recreational exercise. However, the relationship between sedentary behaviour, gender, and glycemic control remains insufficiently investigated in specific Pakistani populations, particularly in Peshawar.

Therefore, this study aimed to investigate the association between daily sedentary behaviour and glycemic control among adults in Peshawar, Pakistan, using HbA1c and RBS as biochemical indicators. It also examined gender-specific differences in T2DM prevalence and explored the potential contribution of age, gender, and BMI to variations in glycemic control. The findings may provide relevant evidence to support gender-sensitive public health interventions aimed at reducing sedentary behaviour and improving diabetes management.

Material and Methodology:

The study employed an analytical observational design to investigate the association between sedentary behaviour and glycemic control among adults with Type 2 Diabetes Mellitus (T2DM) in Peshawar, Pakistan. The study was conducted over six months at Sugar General Hospital and Research Centre, Phase V, Hayatabad, Peshawar. A total of 250 adults aged 30–60 years were recruited from the outpatient department using a convenience sampling technique. The sample size was calculated using the single population proportion formula, considering a 95% confidence level, an estimated prevalence of 17.24%, and a 5% margin of error, resulting in a minimum sample size of 220 participants. Individuals with physician-confirmed T2DM and a sedentary lifestyle were included, whereas patients with Type 1 Diabetes Mellitus, those younger than 30 years, individuals with a family history of diabetes, and participants with incomplete clinical or questionnaire data were excluded. Data was collected using a structured questionnaire and laboratory investigations. Sedentary behaviour was assessed using a validated Sedentary Behaviour Questionnaire (SBQ), which recorded average daily sitting time across occupational, recreational, transportation, and screen-related activities. Participants' glycemic status was evaluated by measuring HbA1c and random blood sugar (RBS). Blood samples were collected through venipuncture following standard procedures. HbA1c levels were measured using the Bio-Rad Variant II analyzer based on high-performance liquid chromatography (HPLC), while RBS levels were determined using the Roche Cobas c 311 automated chemistry analyzer. Body mass index (BMI) was calculated by dividing body weight in kilograms by the square of height in meters (kg/m^2), with weight and height measured using calibrated equipment. Ethical approval was obtained from the Institutional Review Board of CECOS University, and permission for data collection was granted by the administration of

Sugar General Hospital and Research Centre. Written informed consent was obtained from all participants, and confidentiality was maintained throughout the study using unique participant identification codes. Data was organized using Microsoft Excel 2019 and analysed using SPSS version 27. Descriptive statistics were used to summarize demographic and clinical characteristics. Pearson's correlation coefficient was applied to assess the relationships between sedentary time, HbA1c, RBS, and BMI. Multiple linear regression analysis was performed to determine the association between sedentary behaviour and HbA1c, adjusting for age, gender, and BMI. Subgroup analyses were also conducted to explore differences according to gender, age, and BMI categories. A p-value of less than 0.05 was considered statistically significant.

Result:

The study included a total of 250 participants, selected based on their high time spent in sedentary behaviour, among whom 160 were females (64%) and 90 were males (36%). The sample consisted of middle-aged adults with a mean age of 49.92 years (SD = 8.923, range = 30–60 years), reflecting a moderately female-dominated population. Participants exhibited a highly sedentary lifestyle, with an average sedentary time of 7.294 hours per day (SD = 0.7128, range = 6.0–8.0 hours), encompassing activities such as prolonged sitting at work, commuting, or engaging in screen-based leisure activities like television watching or computer use. Health metrics revealed a high prevalence of type 2 diabetes or poor glycaemic control, as evidenced by a mean HbA1c of 9.539% (SD = 2.4889, range = 4.4–17.0%), significantly above the normal range of less than 5.7%, and a mean random blood sugar level of 238.22 mg/dL (SD = 68.314, range = 71–410 mg/dL), well beyond the normal threshold of less than 140 mg/dL. These elevated glycaemic markers suggest hat the high levels of specific blood sugar indicators (glycemic markers), such as HbA1c and random blood sugar, observed in the study group. Notably, the mean body mass index (BMI) was 25.12 kg/m² (SD = 1.755, range = 20–30), indicating an overweight profile with moderate variability.

Table 3.1: District Peshawar: Participants characteristics; Average sedentary time per day, HbA1c, BMI, age group, Random blood sugar

Descriptive Statistics						
	Total Individuals	Range	Minimum	Maximum	Mean	Std. Deviation
Average sedentary time per day	250	2.0	6.0	8.0	7.294	.7128
HbA1c (%)	250	12.6	4.4	17.0	9.539	2.4889
BMI (kg/m²)	250	10	20	30	25.12	1.755
Age (Years)	250	30	30	60	49.92	8.923

Random Blood Sugar (mg/dL)	250	339	71	410	238.22	68.314

The slightly overweight BMI range (mean = 25.12 kg/m²), despite these metabolic abnormalities, is particularly intriguing and suggests that factors beyond obesity, such as genetic predispositions, high-carbohydrate or high-sugar dietary habits, inconsistent medication adherence, or environmental influences prevalent in Peshawar, may play a critical role in the observed glycemic issues.

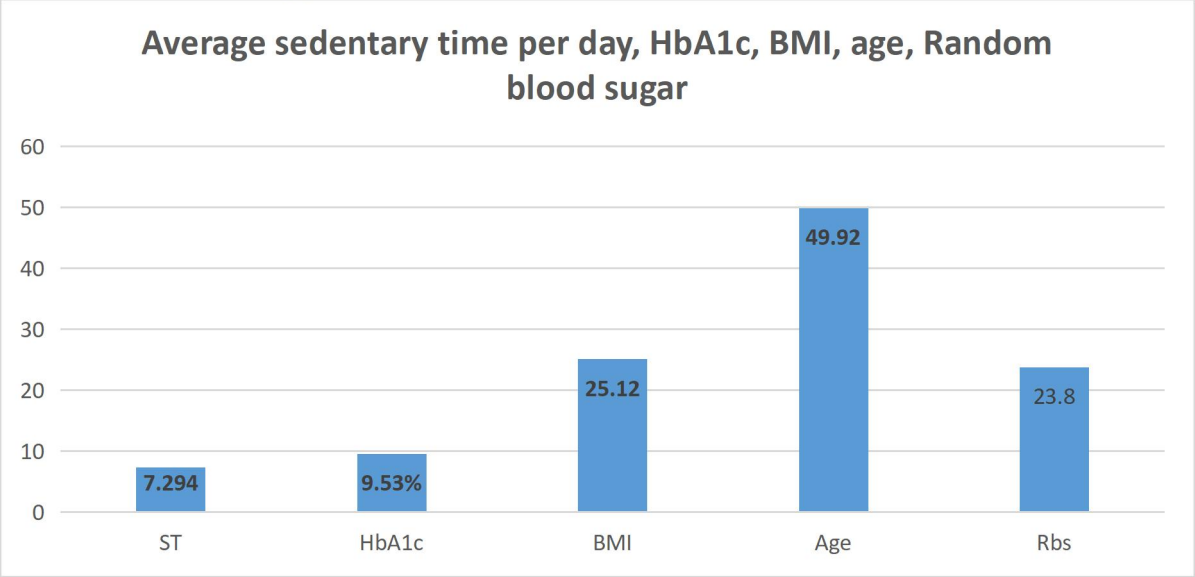


Figure 3.1: Bars showing average sedentary time per day, HbA1c, BMI, age, Random blood sugar of the Participants.

The combination of high Average sedentary time, and elevated average HbA1c and RBS levels, indicates that the study population is at significant risk for diabetes-related complications, such as cardiovascular disease, neuropathy, or retinopathy, as well as other metabolic disorders. Prolonged sedentary behavior is known to impair glucose metabolism and insulin sensitivity, which likely exacerbates the poor glycemic control observed in this study.

The gender variable was fully resolved with a sample size of 250 participants, coded binary (0 for male, 1 for female), with a mean of 0.64, confirming the female-dominated distribution of 160 females (64%) and 90 males (36%). This distribution was rigorously verified through descriptive statistical analysis, including frequency tables, which showed males accounting for 36% and females 64% of the cohort, with a cumulative percent reaching 100%, ensuring no missing data or inconsistencies in the dataset.

Table 3.2: Number of Males and Females in a Sample Recruited for the Study in Peshawar

Gender	Frequency	Percent	Cumulative Percent

Male	90	36%	36%
Female	160	64%	100%
Total	250	100%	

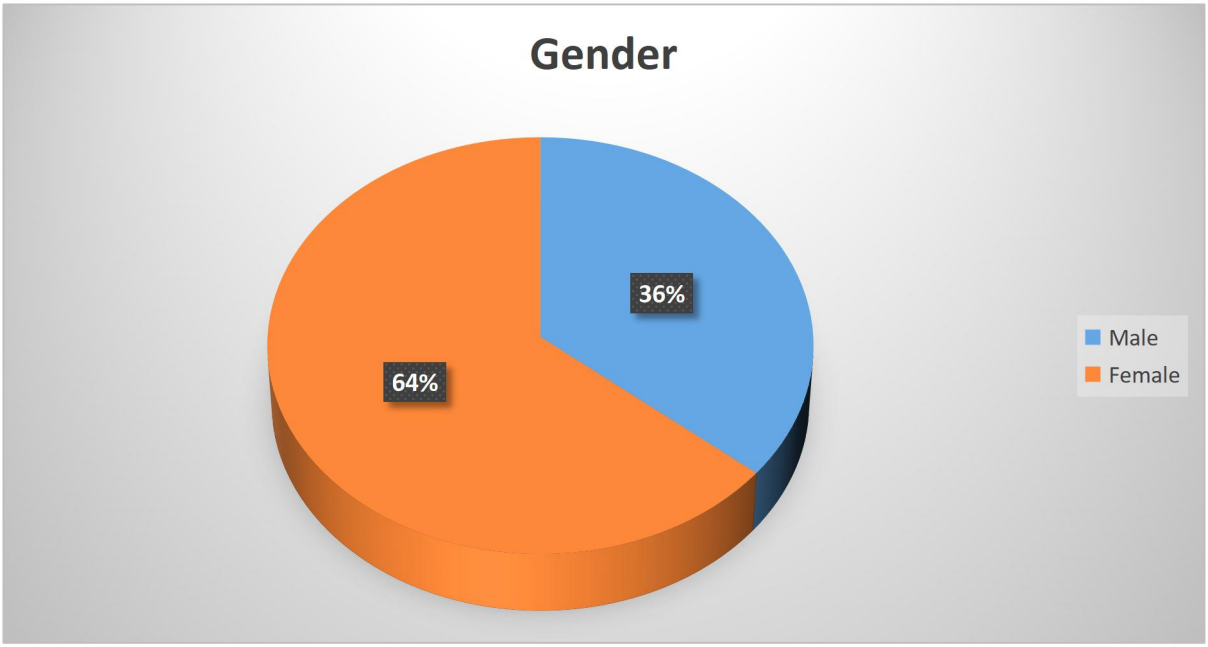


Figure 3.2: Pie chart showing females are greater in numbers than males in a sample

The higher representation of females in the study may reflect gender-specific patterns in sedentary behavior, potentially driven by cultural norms, occupational differences, or lifestyle factors prevalent in Peshawar. For instance, women in this region may engage in more home-based or sedentary activities due to societal roles or limited access to recreational facilities, which could contribute to their higher participation in the study or greater prevalence of sedentary lifestyles.

3.2: Distribution of HbA1c Levels in the Study Population

A total of 250 individuals were assessed for their glycated haemoglobin (HbA1c) levels, a key biomarker reflecting average blood glucose concentrations over the preceding 2–3 months, widely used in clinical and research settings to evaluate glycaemic status. These individuals were categorized into three groups based on established clinical thresholds from guidelines such as those provided by the American Diabetes Association (ADA) and the World Health Organization (WHO): Normal (HbA1c < 5.7%), Prediabetes (HbA1c 5.7–6.4%), and Diabetic (HbA1c > 6.4%). Among them, 7 were normal regarding their HbA1c level, indicating no evidence of impaired glucose regulation and a low risk of developing diabetes. A further 28 individuals were classified as prediabetes, reflecting an intermediate state of hyperglycaemia associated with an elevated risk of progressing to type 2 diabetes. The majority, comprising

215 individuals, were diabetic, signifying overt diabetes mellitus, which often necessitates pharmacological intervention alongside lifestyle modifications to prevent complications such as cardiovascular disease, neuropathy, and retinopathy.

Table 3.3: Frequency of individuals on the bases of their HbA1c levels across these categories

Characteristic	HbA1c Range	Frequency
Normal	<5.7%	7
Prediabetes	5.7-64%	28
Diabetes	>6.4%	215

3.3: Detailed Analysis

The distribution reveals a pronounced skew toward higher HbA1c levels, with approximately 86% (215/250) of the study group classified as diabetic. This high prevalence suggests that the study population may have been sampled from a high-risk group, such as patients attending a diabetes clinic, individuals with known metabolic risk factors, or a community with elevated diabetes incidence (e.g., regions with high rates of obesity or genetic predispositions). The prediabetes group, representing 11.2% (28/250) of the sample, highlights a critical subgroup that could benefit from targeted interventions to prevent or delay the onset of type 2 diabetes. Only 2.8% (7/250) of individuals fell into the normal category, indicating a limited presence of normal glycaemic individuals, which may reflect a study design focused on diabetes or prediabetes outcomes rather than a general population sample.

The categorization adhered strictly to the specified HbA1c thresholds, ensuring consistency with clinical standards. Proportions can be derived for further analysis: Normal (2.8%), Prediabetes (11.2%), and Diabetic (86%). HbA1c assay methods (which may vary by 0.1–0.2% across laboratories), or sampling criteria, which could introduce selection bias. For instance, the high diabetic prevalence may reflect a clinic-based sample rather than a community-based one. In conclusion, this table underscores the significant burden of diabetes within the study population and highlights opportunities for targeted interventions, particularly for the prediabetes subgroup.

3.4: Correlation Between Sedentary Lifestyle and Type 2 Diabetes Mellitus

3.4.1: Correlation of sedentary lifestyle with HbA1c:

A study focus on adults in Peshawar with high sedentary time (mean = 7.294 hours/day) and elevated HbA1c (mean = 9.539%), this correlation underscores the critical role of sedentary behavior as a modifiable risk factor in diabetes management. Interventions aimed at reducing sedentary time, such as increasing physical activity through structured exercise programs or promoting breaks from prolonged sitting with light activities like walking or stretching, could significantly improve glycemic control in this population. Moreover, the data reveals a high prevalence of diabetic HbA1c levels (215 of 250 individuals with HbA1c ≥ 6.5%), alongside elevated BMI (mean = 25.12 kg/m²) and random blood sugar (mean = 238.22 mg/dL),

suggesting a broader metabolic risk profile. Targeted public health strategies, including community-based education on lifestyle modifications, workplace interventions to reduce sitting time, and accessible physical activity resources, could mitigate these risks. Additionally, integrating regular screening for HbA1c and counseling on reducing sedentary behavior in primary care settings could enhance early detection and management of type 2 diabetes in this high-risk group.

Table 3.4: significant correlation between sedentary lifestyle and HbA1c (main Diabetic Marker).

Correlations			
HbA1c (%)	Pearson Correlation	1	.823**
	Sig. (2-tailed)		.000
	N	250	250
Average sedentary time per day	Pearson Correlation	.823**	1
	Sig. (2-tailed)	.000	
	N	250	250

Correlation is significant at the 0.01 level (2-tailed). The correlation table 3.4 provided shows the relationship between HbA1c (%) and average sedentary time per day for the 250 participants in the study on the correlation between sedentary lifestyle and Type 2 Diabetes among adults in Peshawar. Below is a detailed interpretation of the results.

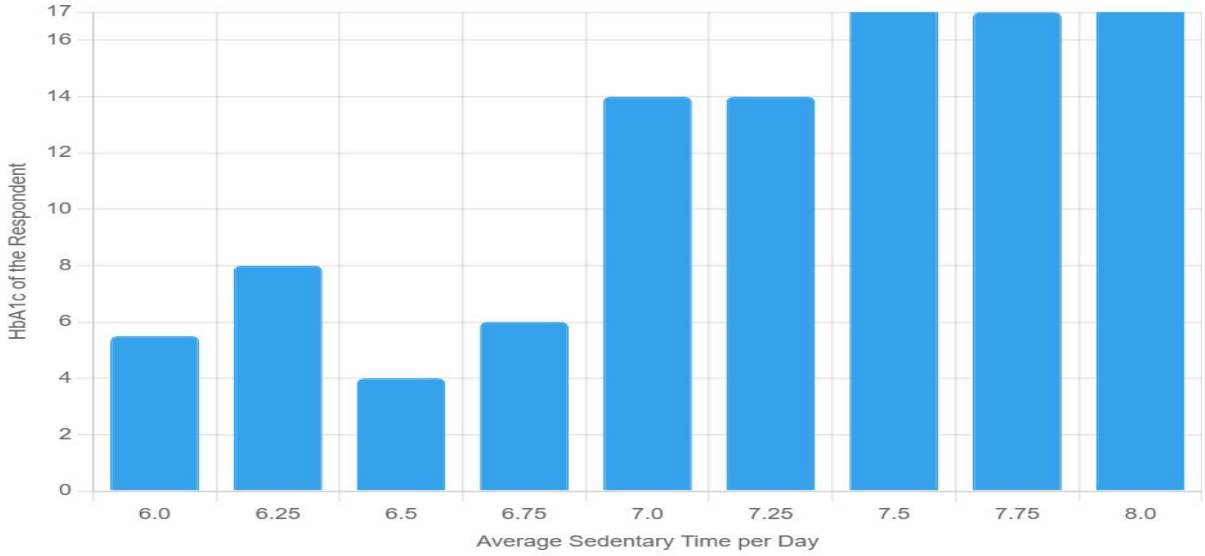


Figure 3.3: Correlation **between sedentary time per day and HbA1c**

Pearson Correlation Coefficient:

The Pearson correlation coefficient between HbA1c (%) and average sedentary time per day is 0.823. This value indicates a strong positive correlation between the two variables. In practical terms, as the average sedentary time per day increases, HbA1c levels tend to increase as well, suggesting that higher sedentary behavior is associated with poorer glycemic control.

The correlation coefficient of 0.823 is close to 1, indicating a robust linear relationship. This means that a significant portion of the variability in HbA1c levels can be explained by differences in sedentary time.

Statistical Significance:

The Sig. (2-tailed) value is 0.000, which is less than the 0.01 significance level (as indicated by the ** notation). This confirms that the correlation is statistically significant at the 0.01 level (99% confidence), meaning there is a very low probability (less than 0.1%) that this strong correlation occurred by chance. The significance level indicates that the observed relationship between HbA1c and sedentary time is Bidirectional Correlation:

The strong positive correlation (0.823) suggests that prolonged sedentary behavior is closely linked to elevated HbA1c levels, a key indicator of poor glycemic control in type 2 diabetes. This finding supports the hypothesis that a sedentary lifestyle may contribute to worse diabetes outcomes in this cohort, potentially exacerbating the risk of diabetes-related complications such as cardiovascular disease or neuropathy.

3.4.2: Correlation of sedentary lifestyle with Random Blood Sugar

The correlation between sedentary lifestyle and random blood sugar (RBS, mg/dL) is significant, as demonstrated in a study of 250 individuals from Peshawar. The provided correlation table reports a **Pearson Correlation coefficient** of 0.625 ($p < 0.001$, $N = 250$), indicating a strong positive linear relationship between **Average Sedentary Time per Day (hours)** and **RBS**, a critical biomarker for assessing glycemic control and type 2 diabetes risk. The dataset provides further context, with a mean sedentary time of 7.294 hours/day, a mean RBS of 238.22 mg/dL, a mean HbA1c of 9.539%, a mean BMI of 25.12 kg/m², and a mean age of 49.92 years. Notably, 217 individuals (86.8%) were classified as diabetic (HbA1c ≥ 6.5%), highlighting a population with a high prevalence of type 2 diabetes. This comprehensive analysis explores the significant correlation between sedentary lifestyle and RBS, integrating statistical findings, health implications, practical recommendations, and connections to the broader study context.

Table 3.5: Correlation of sedentary lifestyle with Random blood sugar

Correlations			
Random Blood Sugar (mg/dL)	Pearson Correlation	1	.625
	Sig. (2-tailed)		.000
	N	250	250

Average sedentary time per day	Pearson Correlation	.625**	1
	Sig. (2-tailed)	.000	
	N	250	250

Correlation is significant at the 0.01 level (2-tailed).

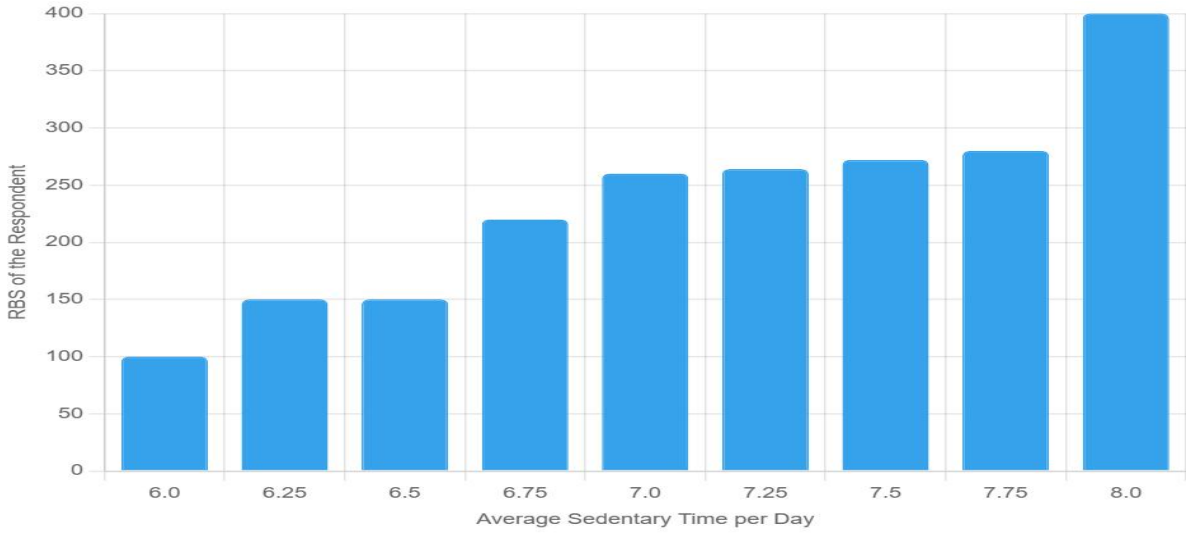


Figure 3.4: Correlation of sedentary lifestyle with Random Blood Sugar

The correlation between RBS and itself is 1, as expected for a variable's self-correlation. The correlation between Average Sedentary Time per Day and itself is 1**.** The correlation between RBS and Average Sedentary Time per Day is r = 0.625, and vice versa, due to the symmetric nature of the correlation matrix. An r of 0.625 indicates a strong positive linear relationship, meaning that higher sedentary time is associated with higher RBS levels, reflecting poorer glycemic control and increased type 2 diabetes risk. According to Pearson's r interpretation guidelines:

0.00–0.19: Very weak
0.20–0.39: Weak
0.40–0.59: Moderate
0.60–0.79: Strong
0.80–1.00: Very strong

The value of r = 0.625 falls in the strong range, suggesting a robust association between sedentary behavior and elevated blood glucose levels.

3.4.3: Correlation of sedentary lifestyle with BMI: The analysis reveals a strong, positive, and statistically significant correlation between the two variables ($r = .676$, $p < .001$).

This means that as an individual's BMI increases, their HbA1c level also tends to increase, and this observed relationship is highly unlikely to be due to random chance. The strength of the correlation ($r = .676$) indicates a substantial linear association. The analysis is based on a robust sample size of $N = 250$ pairs of data points for both variables.

Table 3.6: Correlation of sedentary lifestyle with BMI

Correlations			
		BMI (kg/m²)	**HbA1c (%)**
BMI (kg/m²)	Pearson Correlation	1	.676**
	Sig. (2-tailed)		.000
	N	250	250
HbA1c (%)	Pearson Correlation	.676**	1
	Sig. (2-tailed)	.000	
	N	250	250

The value of $r = 0.586$ falls in the moderate to strong range, suggesting a robust association between sedentary behaviour and increased body weight.

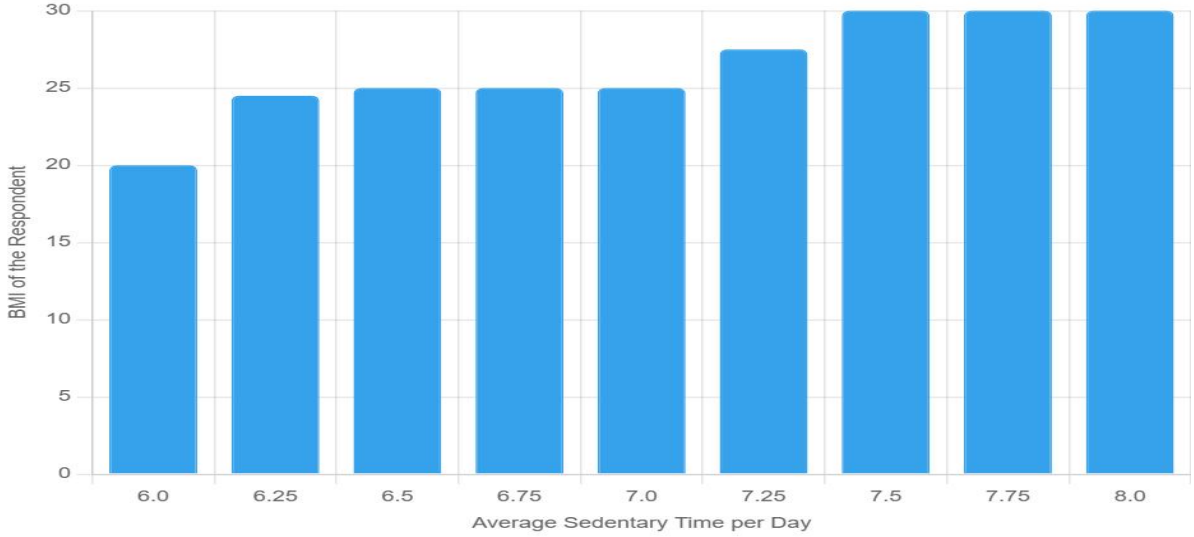


Figure 3.5: correlation of sedentary lifestyle with BMI

Significance Level (Sig. 2-tailed):

The Sig. (2-tailed) value represents the p-value for testing the null hypothesis that the true population correlation is zero (no relationship). The p-value for the correlation between Average Sedentary Time per Day and BMI is 0.000 (typically reported as $p < 0.001$), indicating a highly statistically significant relationship.

Strength and Direction: The correlation coefficient (r = 0.586) indicates that as sedentary time increases (e.g., more hours spent sitting), BMI tends to rise, reflecting an increased likelihood of overweight or obesity. This moderate to strong positive relationship aligns with the dataset's mean BMI of 25.12 kg/m², which falls in the overweight category (BMI 25–29.9 kg/m²).
R^2 Value: The coefficient of determination is (R^2 = (0.586)^2 = 0.343), meaning approximately 34.3% of the variability in BMI can be explained by variability in sedentary time. This suggests a substantial influence, though other factors (e.g., diet, physical activity levels, or genetics) also contribute to BMI.

3.5: Regression analysis.

The core finding is that there is a strong, statistically significant positive relationship between the two variables. More sedentary time is associated with higher HbA1c levels.

Table 3.7: A Regression Model summary

Statistic	Value
R	0.768
R^2	0.590
Adjusted R^2	0.588
Std. Error of the Estimate	1.627
R Square Change	0.590
F Change	356.556
df1	1
df2	248
Sig. F Change	0.000
Durbin-Watson	2.000
Predictor	Sedentary behavior/weekend day
Outcome	HbA1c (%)

This table summarizes a statistical model that investigates the relationship between Sedentary behaviour and HbA1c levels (a key marker for long-term blood sugar control, often used in diabetes management).

Model & R (Multiple Correlation Coefficient)

(:R = 0.768) This is the correlation between the predicted values of HbA1c (from the model) and the actual observed HbA1c values. An R value of 0.768 indicates a strong positive relationship. As sedentary behavior increases, the model predicts that HbA1c will also increase.

R Square (Coefficient of Determination)

(Value: R^2 = 0.590) This is the most important statistic here. It tells us the proportion of variance in the dependent variable that is explained by the independent variable. In simple terms: 59.0% of the variation in people's HbA1c levels can be explained by how sedentary they are per day.

Adjusted R Square

(Value: Adjusted R^2 = 0.5880 This is a more accurate measure of R^2 that adjusts for the number of predictors in the model. Since this is a simple regression with only one predictor, it is very close to the regular R^2. If you were to add more predictors, this value would help you see if they genuinely improve the model or just add noise.

Std. Error of the Estimate

(Value: 1.627) This represents the average distance that the observed data points fall from the regression line. It is measured in the units of the dependent variable.

In simple terms: The model's predictions for HbA1c are, on average, about 1.63 percentage points above or below the actual measured HbA1c values.

Change Statistics & Sig. F Change

(Sig. F Change = .000) This is the p-value for the overall significance of the model. A value of .000 means it is less than 0.0005. This p-value is highly statistically significant (well below the common alpha level of 0.05). This means the relationship we see between sedentary behavior and HbA1c is extremely unlikely to be due to random chances. We can reject the null hypothesis that the model explains no variance in the outcome.

Durbin-Watson

(Value=2.000) This statistic tests for independence of observations, specifically checking for autocorrelation (whether residuals are independent from each other). A value of 2.0 is ideal. It indicates no autocorrelation in the residuals. This is a good sign that one of the key assumptions of regression has been met, strengthening our confidence in the model's results.

Table 3.8: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	943.924	1	943.924	356.556	.000[b]
	Residual	656.540	248	2.647		
	Total	1600.464	249			

a. Dependent Variable: HbA1c (%)

b. Predictors: (Constant), Sedentary behavior/weekend day

Dependent Variable: HbA1c (%)

This is the outcome we are trying to predict.

Sources of Variance:

The table breaks down the total variance in HbA1c into two parts: Regression Variance (Explained): Variance in HbA1c that is accounted for by the predictor variable (Sedentary behavior).

Residual Variance (Unexplained): Variance in HbA1c that is *not* explained by the model (due to other factors, random error, etc.).

Sum of Squares (SS):

Regression SS (943.924): The total amount of variation in HbA1c explained by the model.

Residual SS (656.540): The total amount of variation in HbA1c that the model *failed* to explain. Total SS (1600.464): The total variation in HbA1c in the entire dataset. This is the sum of the Regression SS and Residual SS (943.924 + 656.540 = 1600.464). This value is the numerator for calculating the variance of HbA1c.

Degrees of Freedom (df):

Regression df (1): This is the number of predictor variables in the model. We have one predictor (Sedentary behavior).

Residual df (248): Calculated as the total number of observations minus the number of predictors minus 1 (250 total observations - 1 predictor - 1 = 248). This represents the sample size adjusted for the parameters we've estimated.

Total df (249): The total number of observations in the dataset minus 1 (250 - 1 = 249).

Mean Square (MS):

This is the average amount of variation per degree of freedom. It's calculated as Sum of Squares df.

Regression MS (943.924): 943.924 / 1 = 943.924

Residual MS (2.647): 656.540 / 248 ≈ 2.647. This value is the variance of the residuals and is the square of the "Std. Error of the Estimate" (1.627) from your previous table ($1.627^2 \approx 2.647$)

F Statistic (F Change):

Value: 356.556 Calculation:

Mean Square Regression / Mean Square Residual = 943.924 / 2.647 ≈ 356.556 Interpretation: The F-statistic compares the explained variance to the unexplained variance. A large F-value (like 356.5) means the model explains a significantly larger amount of variance than it leaves unexplained. It indicates the regression model is much better than having no model at all.

Significance (Sig.):

Value: .000b (which means p < .001) This is the p-value for the F-statistic. A p-value this small is highly statistically significant. It means the probability that we would get an F-statistic this large by random chance alone (if sedentary behavior actually had no effect) is less than 0.1%. We can confidently reject the null hypothesis that the regression model has no predictive power. The relationship between sedentary behavior and HbA1c is real and statistically significant.

Table 3.9: Regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-9.375	1.006		-9.324	.000

Sedentary behavior/weekend day	2.553	.135	.768	18.883	.000

a. Dependent Variable: HbA1c (%)

This table gives you the formula for the line of best fit that describes the relationship between sedentary behavior and HbA1c. It confirms that the relationship is positive, strong, and statistically significant.

The regression coefficients indicate a statistically significant positive relationship where for every one-hour increase in sedentary behavior, HbA1c levels increase by 2.553 percentage points ($B = 2.553$, $p < .001$). The model's intercept is -9.375, though this value lacks practical meaning as it represents a physiologically impossible HbA1c level when sedentary time is zero. The large, standardized beta coefficient ($\beta = 0.768$) confirms a very strong effect, and the highly significant t-statistic ($t = 18.883$, $p < .001$) provides strong evidence against the null hypothesis, confirming that sedentary behavior is a powerful predictor of HbA1c. The regression equation is:

HbA1c (%) = -9.375 + (2.553 * Sedentary Hours)

3.6: Exploratory analysis

3.6.1: Average HbA1C and Random blood sugar among different age groups in the given population:

The data reveals a population with critically high blood sugar levels across all adult age groups, indicating widespread and poorly managed diabetes. The average HbA1c levels, which reflect long-term glycaemic control, are severely elevated, consistently hovering between 9.1% and 9.8%. These figures are far above the diabetic threshold of 6.5% and suggest a significant risk for serious health complications. Similarly, the Random Blood Sugar (RBS) readings, which provide a snapshot of current blood glucose, are alarmingly high, ranging from 19.4 mmol/L to 24.3 mmol/L, well beyond the level used to diagnose diabetes. When examining trends, the relationship between age and control appears complex. HbA1c levels show a noticeable peak in the 55-60 age group, suggesting this demographic faces the greatest challenges with long-term management. Conversely, RBS levels are highest in the youngest cohort (30-35) and generally decrease with age before a slight rise in the oldest groups. This indicates that while older individuals may have a worse overall average (HbA1c), younger individuals experience more extreme acute blood sugar spikes at the time of testing.

Table 3.9.1: Age groups and their average Random blood sugar, HbA1c

Age Group	30-35	35-40	40-45	45-50	50-55	55-60
HbA1c	9.138462	9.273684	9.446667	9.422308	9.153061	9.751333
RBS	24.3	21.2	20.1	19.4	21.2	20.8

This data paints a portrait of a population with a serious public health challenge. Poorly controlled diabetes is the norm, not the exception, from early adulthood (30-35) into later life (55-60). The fact that the youngest group already shows such high values is particularly worrying, as it means they will be exposed to damaging high blood sugar for a longer period of their lives. The non-parallel trends between HbA1c and RBS suggest that the nature of poor glycemic control may differ by age. Younger populations might be experiencing dramatic post-meal sugar spikes, while older populations may be suffering from a consistently high glycemic baseline with less variability.

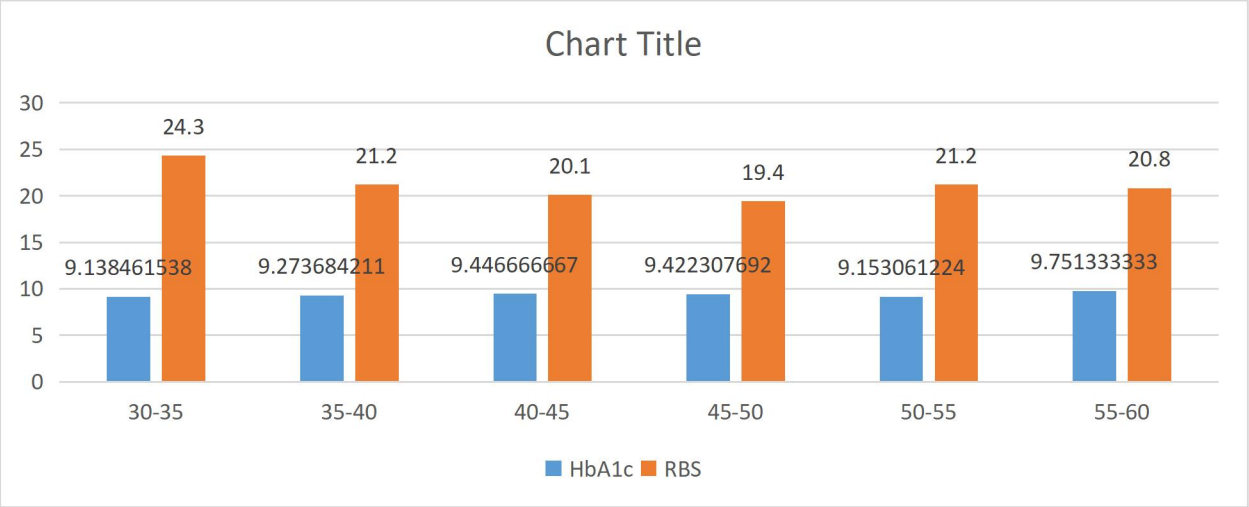


Figure 3.6: Age groups and their average Random blood sugar, HbA1c

3.6.2: Prevalence of Type 2 Diabetes Mellitus in Peshawar

At the Sugar General Hospital and Research Center in Peshawar, a comprehensive study was conducted to evaluate the relationship between sedentary lifestyle and type 2 diabetes among adults, while also assessing the prevalence of diabetes in the local population. The analysis revealed a significant correlation between sedentary lifestyle and key metabolic markers, such as HbA1c ($r \approx 0.610$, $p < 0.001$), random blood sugar (RBS, $r = 0.625$, $p < 0.001$), and body mass index (BMI, $r = 0.586$, $p < 0.001$), offering critical insights for designing targeted public health interventions and promoting lifestyle modifications in Peshawar. The prevalence of diabetes in this study was alarmingly high at 86%, calculated as follows: Prevalence of diabetes = (Number of diabetic individuals / Total number of individuals) × 100 = (215/250) × 100 = 86%. This significant disease burden likely reflects a high-risk or clinical population, such as patients attending a diabetes clinic or a community with elevated metabolic risk factors, including a mean sedentary time of 7.294 hours/day, mean HbA1c of 9.539%, mean RBS of 238.22 mg/dL, and mean BMI of 25.12 kg/m². Additionally, 28 individuals were identified with prediabetes, yielding a prevalence of (28/250) × 100 = 11.2%, and 7 individuals were classified as normoglycemic, with a prevalence of (7/250) × 100 = 2.8%. These findings highlight the urgent

need for public health strategies in Peshawar to address the high prevalence of diabetes and prediabetes, focusing on reducing sedentary behaviour through community-based physical activity programs, workplace interventions, and behavioural education, while also targeting at-risk groups to prevent progression from prediabetes to diabetes. The study's results underscore the critical role of lifestyle modification in mitigating the diabetes epidemic in this high-risk population.

3.6.3: Gender base prevalence of type 2 diabetes in Peshawar

The analysis reveals a high prevalence of Type 2 Diabetes Mellitus (T2DM) across the entire study population, with an overall rate of 86%. However, a notable disparity exists between genders. The prevalence within each gender group shows that diabetes is more common among females, with 87.5% (140 out of 160) of females diagnosed compared to 83.3% (75 out of 90) of males. This indicates that in this specific population, being female is associated with a slightly greater likelihood of having T2DM. This difference in prevalence rates, while not necessarily statistically significant, is still descriptively important for understanding the demographic distribution of the disease

Table 3.9.2: Percentages of Male, Female and Diabetic vs Non-Diabetic in a sample

			Non Diabetic	Diabetic	Total
Gender	**Males**	Count	15	75	90
		% within Gender	16.7%	83.3%	100.0%
		% within Diagnosed Diabetic	44.1%	34.7%	36.0%
		% of Total	6.0%	30.0%	36.0%
	Females	Count	20	140	160
		% within Gender	11.9%	87.5%	100.0%
		% within Diagnosed Diabetic	55.9%	65%	64.0%
		% of Total	7.6%	56%	64.0%
Total		Count	35	215	250
		% within Gender	13.6%	86%	100.0%
		% within Diagnosed with T2DM? (Y/N)	100.0%	100.0%	100.0%
		% of Total	13.6%	86%	100.0%

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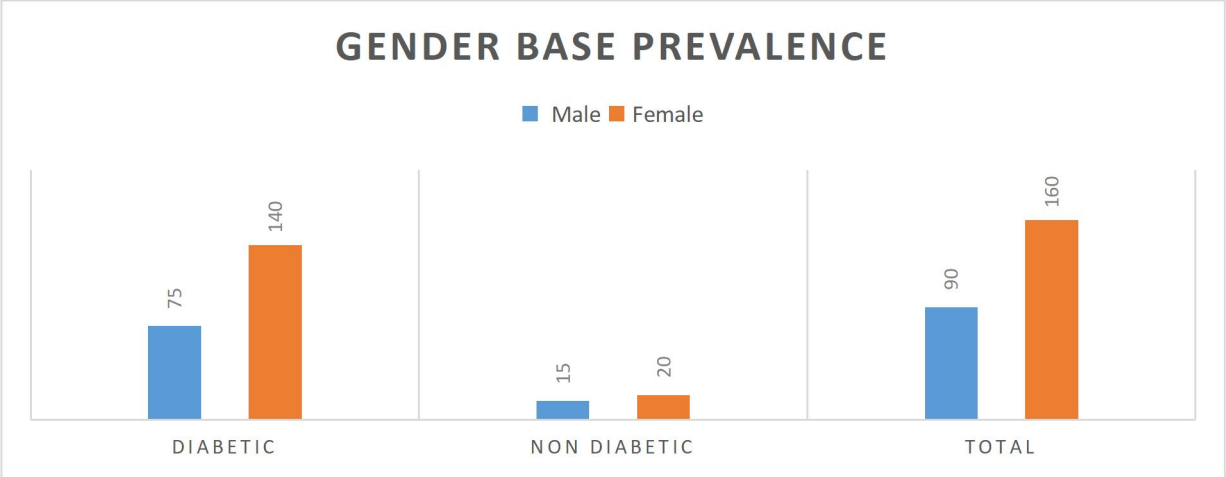
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The composition of the diabetic cohort further highlights this gender imbalance. Females constitute 65% of the total diabetic group, while males make up the remaining 34.7%. This disparity is a function of two factors: the larger initial proportion of females in the study sample (64%) and their higher disease prevalence rate. Consequently, diabetic females represent 56% of the entire study population, whereas diabetic males account for 30.0%. This overall distribution underscores that the burden of T2DM in this sample falls disproportionately on women, a critical finding for targeting public health interventions and understanding risk factors within this community.

Figure 3.7: Gender based prevalence of Type 2 diabetes in Peshawar

The pool of diabetic individuals is comprised of significantly more females than males. This is partly because there were more females in the study to begin with (160 vs. 90), but the higher prevalence rate (87.5% vs. 83.3%) amplifies this effect.



Discussion:

The results are discussed in the context of existing local and international literature. Furthermore, this chapter explores the potential mechanisms underlying the observed association, outlines the study's limitations, and suggests implications for public health policy and future research. At the Sugar General Hospital and Research Centre in Peshawar, a study investigated the relationship between sedentary lifestyle and type 2 diabetes among adults, while also assessing its prevalence in the local population. The analysis revealed a significant correlation between these variables, offering important insights for designing public health interventions and promoting lifestyle changes. The study included a total of 250 participants, selected based on their high time spent in sedentary behaviour, among whom 160 were females (64%) and 90 were males (36%). The sample consisted of middle-aged adults with a mean age of 49.92 years (SD = 8.923, range = 30–60 years), reflecting a moderately female-dominated population, supporting the findings of (Azimi-Nezhad et al., 2008) that the prevalence in men and women was 5.1 percent and 5.8 percent, respectively. Participants

exhibited a highly sedentary lifestyle, with an average sedentary time of 7.294 hours per day (SD = 0.7128, range = 6.0–8.0 hours), encompassing activities such as prolonged sitting at work, commuting, or engaging in screen-based leisure activities like television watching or computer use. The analysis indicates an exceptionally high rate of Type 2 Diabetes Mellitus (T2DM) in the study cohort, with an overall prevalence of 86%. Furthermore, the results reveal a gender disparity, as the condition was more prevalent in females (87.5% of 160) than in males (83.3% of 90). This suggests a marginally greater association between the female gender and the likelihood of having T2DM within this specific population. These individuals were categorized into three groups based on established clinical thresholds from guidelines such as those provided by the American Diabetes Association (ADA) and the World Health Organization (WHO): Normal (HbA1c < 5.7%), Prediabetes (HbA1c 5.7–6.4%), and Diabetic (HbA1c > 6.4%). Among them, 7 were normal regarding their HbA1c level, indicating no evidence of impaired glucose regulation and a low risk of developing diabetes. A further 28 individuals were classified as prediabetes, reflecting an intermediate state of hyperglycemia associated with an elevated risk of progressing to type 2 diabetes. The majority, comprising 215 individuals, were diabetic, indicating a high proportion of people is Diabetic, supporting the findings of (Sharif et al., 2023), In our study, 69% were physically inactive, belonged to the 11%obese class 1 and had a positive family history of diabetes (49%). A study focusses on adults in Peshawar with high sedentary time (mean = 7.294 hours/day) and elevated HbA1c (mean = 9.539%), this correlation underscores the critical role of sedentary behaviour as a modifiable risk factor in diabetes management. Interventions aimed at reducing sedentary time, such as increasing physical activity through structured exercise programs or promoting breaks from prolonged sitting with light activities like walking or stretching, could significantly improve glycemic control in this population. Moreover, the data reveals a high prevalence of diabetic HbA1c levels (215 of 250 individuals with HbA1c ≥ 6.5%), supporting the findings of (de Moura et al., 2023) Mediation analysis verified that physically inactive participants during leisure time were 2.62 times more likely to have high levels of HbA1c. The correlation between sedentary lifestyle and random blood sugar (RBS, mg/dL) is significant, as demonstrated in a study of 250 individuals from Peshawar. The provided correlation table reports a Pearson Correlation coefficient of 0.625 ($p < 0.001$, $N = 250$), indicating a strong positive linear relationship between Average Sedentary Time per Day (hours) and RBS, a critical biomarker for assessing glycemic control and type 2 diabetes risk. The dataset provides further context, with a mean sedentary time of 7.294 hours/day, a mean RBS of 238.22 mg/dL, supporting the findings of (Sofra & Badami, 2020) who's report that "active lifestyle, or by serving as an exercise alternative to reduce lipids, blood glucose levels and insulin resistance. The correlation between sedentary lifestyle and BMI is significant, as evidenced by a moderate to strong, statistically significant positive relationship ($r = 0.586$, $p < 0.001$) in a study of 250 individuals in Peshawar. This indicates that higher sedentary time is associated with increased BMI, reflecting a greater likelihood of overweight or obesity, a key risk factor for type 2 diabetes.

Supported by a mean sedentary time of 7.294 hours/day, a mean BMI of 25.12 kg/m², indicating that a sedentary life is a risk factor of obesity, that increases the risk of insulin resistance and type 2 diabetes, these findings support the findings of (Hu, 2003) and also the findings of (Mortensen et al., 2006) whose conclude that, A candidate for one such risk factor is lack of physical activity, i.e., sedentary lifestyle. A strong inverse cross-sectional relationship between BMI and a sedentary lifestyle. The analysis demonstrates a remarkably high prevalence of Type 2 Diabetes Mellitus (T2DM) in the study cohort, with an overall rate of 86% among participants. Moreover, a notable gender disparity was observed, with T2DM being more frequent in females (87.5% of 160) than in males (83.3% of 90). This finding suggests a modestly stronger association between female gender and the likelihood of developing T2DM within this population, potentially influenced by factors such as hormonal differences or lifestyle patterns specific to Peshawar, contradicting the findings of (Kautzky-Willer et al., 2015), Although there was no impact of gender on the overall baseline HbA1c and FBG levels. Our findings also contradict the finding of (Grant et al., 2009) that, the overall prevalence of diabetes was 6.0% (95% CI 5.8 to 7.8). The prevalence of diabetes among males was 7.2% (95% CI 6.1 to 8.4) and 5.8% (95% CI 4.9 to 7.0) among females. while supporting the findings of (Zhang et al., 2019) DM prevalence (men, 14.1%; women, 14.5%). Notably, the analysis found an extremely high overall Type 2 Diabetes Mellitus (T2DM) prevalence rate of 86% in the study population. The disease is more common among females (87.5%) than males (83.3%). This disparity is attributed to factors in females such as higher obesity rates, hormonal changes, and gestational diabetes history that make them more exposed to diabetes as compared to males. Consequently, women make up 65% of the total diabetic group. This results in a disproportionate burden of T2DM on women, a critical finding for public health intervention and understanding risk factors in this community. While it is known that women have a higher risk of Type 2 Diabetes due to sedentary lifestyle and obesity, but it is not clear there are some other factors in females such as hormonal changes, and gestational diabetes history, that make them more exposed to diabetes as compared to males.

Conclusion:

This study provides compelling evidence of a powerful correlation between prolonged sedentary behavior and poor glycemic control in adults in Peshawar, with the burden of T2DM disproportionately affecting women. These findings underscore the critical need for public health interventions aimed at reducing sedentary time to mitigate the growing diabetes epidemic in this region.

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