Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 3 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Association Between Obesity And Type II Diabetes Mellitus In The D.I.Khan Region: A Case-Control Study

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ABSTRACT

Background: *Type II diabetes mellitus (T2DM) and obesity are an increasing global epidemic of public health, and the rate of its occurrence is disproportionately high in Asia. The number of cases of T2DM due to obesity is still underreported in Pakistani underserved areas, one of which is D.I. Khan.*
Research Question*: The aim of the research was to determine the prevalence of T2DM among obese people in the D.I. Khan area and to establish the linkage between T2DM and body mass index (BMI).*
Methods: *A case-control study was carried out in a period of two weeks and involved 60 participants between the ages of 40 and 70 years who were recruited within DHQ Hospital, MISBAH International Hospital, and Dera Lab. The case group included 60 participants who had T2DM due to fasting blood glucose level ≥ 126mg/dl or random blood glucose level ≥ 200mg/dl and BMI ≥28 kg/ m 2, which aligns with WHO-recommended obesity levels among Asian populations. The relationship between T2DM and BMI was assessed using the Pearson correlation coefficient.*
Findings: *It was found that there is an apparent dose-response relationship between T2DM proportion and BMI: 61% in the BMI 28-30 kg/m 2 category, 75% in the BMI 31-35 kg/m 2 category, and 100% in the BMI 36-40 kg/m 2 category in the study group. Pearson correlation analysis showed that there was a significant positive relationship between obesity and T2DM (r = 0.687, p = 0.0001), and it was found to be significant at 5% level.*
Conclusion: *The research confirms that there exists a strong positive correlation between obesity and T2DM in the D.I. Khan area, with the proportion of T2DM rising steadily with the increased BMI groups. The results indicate the need for an urgent necessity for specific public health interventions among this underserved population, including community-based lifestyle modification, primary screening among high-risk individuals, and healthcare infrastructure to address diabetes prevention and treatment.*
Key Words: *Obesity, Type II Diabetes Mellitus, Body Mass Index (BMI), Epidemiology.*

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Introduction

Diabetes mellitus is a chronic metabolic disorder that is either caused by chronic hyperglycemia (elevated blood glucose levels) caused by a lack of insulin production by the pancreatic beta cells, or insulin production by the body is unable to be used normally (Nathan et al., 2005). This disease has two general types; Type I diabetes mellitus, which is a disease caused by the autoimmune destruction of the beta cells and is generally found in children or adolescents, and Type II diabetes mellitus (T2DM), which is more prevalent and is caused by combination of lifestyle and environmental factors that lead to development of the disease, including obesity, improper eating habits, and physical lack of activities (UK Prospective Diabetes Study Group, 1998).

The incidence of T2DM in the world is already at the epidemic scale since the International Diabetes Federation (IDF) predicts that by 2019, the adult population with diabetes will be approximately 463 million, most of whom are T2DM patients (International Diabetes Federation, 2019). Obesity is the primary contributor to the onset of this epidemic, and it is believed that it is the cause of about 80-85 percent of the T2DM cases. The pathophysiological relationship between overweight and T2DM is quite sound: overweight, particularly visceral fat, leads to insulin resistance, hinders insulin secretion, and predisposes a permanent inflammatory reaction, accelerating the development of type 2 diabetes (Astrup and Finer, 2000; Galicia-Garcia et al., 2020). They have come up with the term diabesity in place of diabetes to show the unattainable relationship between the two conditions (Glory & Ybarra, 2005).

It is particularly worrying that obesity and T2DM rate is the most acute in Asia, where the rising urbanization process, changes in nutrition, and an inactive lifestyle have played their role in the formation of the national health crisis. Asian individuals are more likely to develop T2DM at an earlier age and with a lower body mass index (BMI), which increases lifestyles with the risk of complications and a high complication rate among Asian individuals as compared to the Western population (Yoon et al., 2006). Limited health literacy, poor medical facilities, financial limitations, and changes in diet patterns by consuming energy-rich yet nutrient-poor foods are some of the factors that enhance the obesity epidemic in the Asian low- and middle-income countries (Hu et al., 2001; Sicree et al., 2003). Today, low- and middle-income countries are in the majority regarding morbidity due to diabetes, and more than 60 percent of the entire diabetes population is in Asia (Roglic & King, 2000).

T2DM is now emerging as a major problem in Pakistan, a developing nation in South Asia. The rates of diabetes prevalence in the country are among the highest in the region that is preconditioned by the increasing rates of obesity, physical activity deficiency, and socioeconomic disparities. D.I.Khan Region is a rural semi-urban region that has its unique peculiarities of demographics, diet, and lifestyle, which are not yet fully implemented in the epidemiological statistics on the national level. To develop certain prevention and intervention programs, it is important to be aware of the local prevalence of T2DM and its relationship with obesity.

The current paper has discussed the incidence of Type II diabetes mellitus because of obesity in the D.I.Khan area. This study will provide evidence-based information that

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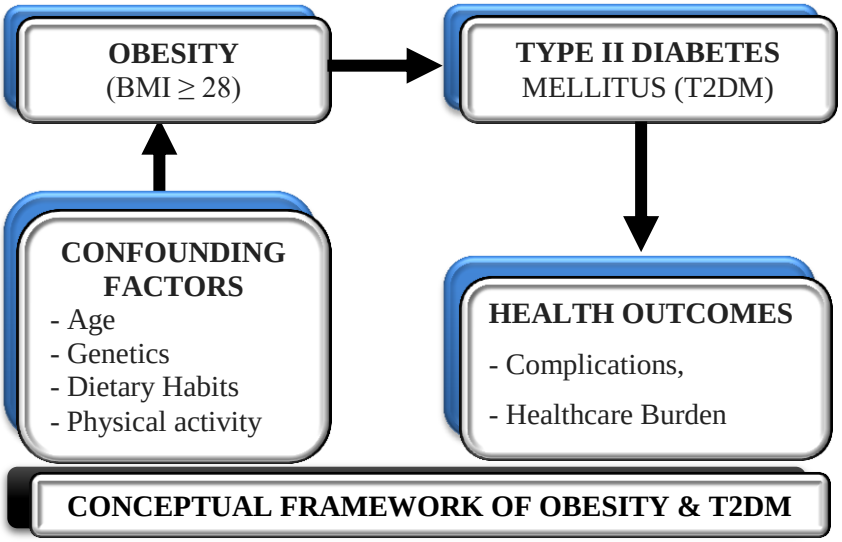
can inform the policy of the general population, resource allocation, and interventions at the community level by researching the demographic and clinical correlates of T2DM in this population. This knowledge gap needs to be bridged to reduce the growing incidence of diabetes and associated complications in geographically underprivileged regions in Pakistan.



Research Gap

Despite the abundance of evidence that presents type II diabetes mellitus (T2DM) and obesity as closely related, the deficit in context-specific mechanisms and factors that mediate the given association remains, particularly in those population groups where the issue of obesity is understudied. Even though the differences in the effects of obesity phenotypes on the risk and progression of T2DM have been identified globally, few studies have been conducted to determine these differences in resource-limited nations. There exists a deficit of epidemiological research in the realm of Pakistan and specifically the region of D.I.Khan, which would quantify the prevalence of T2DM as a result of obesity, and the study that examines the various patterns of obesity and its impact on the disease burden. This is the knowledge gap that is important in the development of regionally fit preventive and management actions that are sensitive to the local demographic, diet, and socioeconomic characteristics of locals.

Statement of the Problem

Obesity has been mentioned as one of the principal modifiable risk factors, as the epidemiology of type II diabetes mellitus (T2DM) is increasing globally. Although the linkage between obesity and T2DM has been established satisfactorily, the mechanisms by which the association between genetic predisposition, lifestyle habits, and determinants of health in society results in the relationship have not been adequately studied in most local contexts. There is a clear deficiency of empirical evidence to assess the burden of T2DM as a result of obesity in the D.I.Khan region. The peculiarities of this population cannot be considered without the assistance of

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effective prevention and intervention strategies unless there is evidence to this end. The study will be focused on investigating the rate of T2DM in relation to obesity in the D.I.Khan region.

Objectives of the Study

The aims of my research were the following:

To identify the prevalence of Type II diabetes mellitus (T2DM) and the correlation with obesity in the D.I. Khan Area through a systematic gathering and evaluation of clinical records, and, consequently, create a baseline to evaluate the extent of the issue.

To investigate the correlation between the body mass index (BMI) groups and the occurrence of T2DM, and to explain the demographic data (age and gender distribution) of affected people in the local population.

Research Significances

The following reasons for the significance of the study

High Prevalence: The prevalence rate of obesity is growing throughout the world, and D.I.Khan region cannot be left out. T2DM rates have a tendency to increase with the increase in obesity rates.

Health Impact: T2DM can cause severe health consequences, such as cardiovascular disease, kidney disease, eye problems, and stroke. They are compounded risks that augment their risks in case they are coupled with obesity. These health complications are a very heavy burdens to the health care resources in the D.I. Khan region in management.

Lifestyle Factors: Obesity and T2DM have comparable risk factors such as unhealthy lifestyles (sedentary lifestyle), inappropriate dieting habits, and genetics. Factors that lead to the problem in the D.I. Khan region include modernization, eating habits and consumption of processed foodstuffs, and lack of physical exercise.

RESEARCH METHODOLOGY

Study Design

The research adopted the case-control study design to establish the interdependence between Type II diabetes mellitus (T2DM) and obesity in the course of two weeks. In case Group 60 individuals who have fasting blood glucose of ≥126mg/dl, random blood glucose of 200mg/dl, and have a body mass index of BMI≥28kg/m².

The attendants who had been with patients in the same healthcare facilities were chosen as controls, whereby the selection was done to ensure that they shared the same environmental and demographic backgrounds. This correspondence minimized confounding and gave more insight into the connection between obesity and T2DM.

Population of the Study

Adult population, aged from 40 to 70 years, both male and female, who are visiting the outpatient departments in DHQ Hospital, MISBAH International Hospital, and Dera Lab in District D.I.Khan, forms the population of the study.

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Sample of the Study

It consists of 60 samples, which were selected from the outpatient department of DHQ Hospital, MISBAH International Hospital, Dera Lab, District D.I.Khan, using the convenience sampling technique. The sample size has been determined based on the expected prevalence of T2DM in the population under study, considering the confidence level that should be attained. Table#1: Showing the cases in relation to the facilities, gender, and glycemic control status.

Table#1: Sample Distribution by Facility & Glycemic Control

Respondent	Numbers of Labs					
	DHQ Hospital		**DERA Lab**		**MISBAH Hospital**	
	M	F	M	F	M	F
	11	07	14	08	10	10
Total	18		22		20	

Total sample collected = 60 (35 males, 25 females)

Research Instrument

The structured tool that was used in the study included the quantitative laboratory results and the important clinical parameters. The standardized procedures were used to determine the blood glucose level at the DHQ Hospital, MISBAH International Hospital, and DERA Lab. Participants who were determined by fasting glucose < 110mg/dl and random glucose < 140mg/dl. Participants who were diagnosed with T2DM in the case study were diagnosed with a fasting glucose level of 126mg/dl and a random glucose level of 200mg/dl according to the WHO and ADA criteria. Moreover, the important variables such as age, body mass index (BMI), fasting glucose level, and random glucose level were measured in a systematic manner using a researcher-conceived instrument to determine the relationship between obesity and T2DM.

Statistical Data Analysis

The correlational design based on statistical analysis was used to investigate the correlation between T2DM and obesity. The data utilized in calculating the correlation coefficient were 60 participants (BMI as XX and fasting blood glucose as YY) who were used to determine the strength and direction of the relationship. A null hypothesis (H0: no correlation, ρ=0) and an alternative hypothesis (H1: a positive correlation, ρ>0) were created, and the 5% level of significance (a=0.05) was used. It was calculated as a test statistic; the formula is: $t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0.687\sqrt{58}}{\sqrt{1-0.687^2}} = 7.20$, with n=60, *df*=58, and *r*=0.687.

The t-value of the critical value of 0.05 at 58 degrees of freedom = t0.05 (58) =1.672 is approximately equal to the critical value in a one-tailed test. Taking into consideration that the t (7.20) was greater than the critical value, the null hypothesis was discarded. The correlation analysis confirms that there is a high positive relationship between obesity and T2DM (p=0.0001).

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Table#2: Data Collection – BMI (X) and Fasting Blood Glucose (Y)

X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
36	166	36	161	29	108	39	220	35	190	29	114
39	210	31	103	28	135	29	103	31	106	28	199
35	175	32	104	35	196	28	101	30	118	37	196
40	250	33	130	32	150	33	130	36	169	35	154
29	106	28	98	29	110	36	143	36	208	33	179
30	120	37	202	36	196	29	104	33	198	33	129
28	100	34	110	34	190	31	118	35	147	34	119
29	120	35	160	36	118	33	101	34	160	38	202
30	128	33	101	36	109	37	175	31	100	35	176
29	122	38	166	35	185	36	221	28	168	36	153

r = 0.687

Results and Discussion

Introduction

This study reported the findings and explained how our study findings relate to our research questions on the occurrence of obesity related Type II diabetes mellitus (T2DM) in D.I.Khan area. The participants used in the study were 60 in number. We will start by giving a summary of the demographic features of the participants and then move on to the critical analysis of the major findings and their implication to the health of the people.

Age Distribution

The sample population was of a heterogeneous age distribution and ranged between 40 and 70 years with a mean age of 55 years. Table 3 illustrates the distribution of the participants in terms of age.

Table#3: Age Distribution of Participants

Age Group (years)	Frequency	Percentage
40-49	18	30.0%
50-59	24	40.0%
60-70	18	30%
Total	60	100%

The trend of the 40-60 age group indicates the general adult population at risk of contracting T2DM in the D.I. Khan area, and it is in line with the general epidemiological trends that indicate the highest T2DM onset in middle adulthood.

Gender Distribution

There were 35 males and 25 females in the sample (58.3% and 41.7%). This equitable representation helps to extend the findings to the two genders in the region.

Table#4: Gender Information

Gender	**Participants**	**Percentage**
Male	35	58.3%

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Female	25	41.7%
Total	60	100%

Proportion of T2DM by BMI Category

Table#5 demonstrates the percentage of people having T2DM in the various BMI groups, and the starting point is at BMI ≥28 kg/m 2, aligning with the WHO obesity cutoff points among Asian people. Since the case group was chosen according to T2DM and obesity, the percentages indicate how diabetes occurs in the mixed sample. A straight dose-response correlation can be observed: the BMI is correlated to the percentage of T2DM. 61 and 75 percent of those in the BMI 28-30 kg/m 2 and 31-35 kg/m 2 categories, respectively, had T2DM, and 100 percent had T2DM in the 36-40 kg/m 2 category. This gradual trend has a high level of support with other studies indicating a very strong correlation between the rising adiposity and the risk of diabetes, especially in Asian people, where metabolic risk is exhibited at lower levels of BMI.

Table#5: Proportion of T2DM by BMI Category

BMI Category (kg/m²)	Number of Participants	Proportion with T2DM
28–30	18	61%
31–35	24	75%
36–40	18	100%

It is necessary to add that the 100% prevalence within the BMI 36–40 kg/m 2 category should be read with a grain of salt because the case-control sampling method used to choose participants was biased in that the individuals were already diagnosed with T2DM. This number thus indicates the spread among the study sample, not the actual prevalence in the general population of D.I.Khan.

Discussion

The results of our study are useful in the region as they offer evidence of the burden of Type II diabetes mellitus (T2DM) attributable to obesity in the D.I.Khan region. These findings have grave implications for the health of populations as well as clinical practice, particularly in resource-limited settings where prevalence and incidence of obesity and diabetes are rising at a terrifying pace (Yoon et al., 2006; Roglic & King, 2000).

The high level of correlation between obesity and the prevalence of T2DM in our study is in line with the high level of literature that indicates the same throughout the world. In their large-scale prospective study, Hu et al. (2001) have proven that high BMI scores were highly correlated with the danger of developing T2DM, particularly in those people who scored higher than 30 kg/m². Similarly, Colditz et al. (1995) found that weight gain and BMI have a positive association with the prevalence of diabetes in women, which can be taken as an argument that obesity is one of the most significant risk factors that can be controlled in relation to T2DM.

The pathophysiological mechanism of this association is the insulin resistance due to the excess adiposity and, consequently, the visceral fat, and the ensuing chronic inflammatory condition that breaks the glucose homeostasis (Galicia-Garcia et al.,

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2020; Scheen et al., 2003). The resultant findings all indicate the necessity of a multifaceted obesity management program that includes lifestyle change programs, dietary measures, and more physical activities, since early management of obesity would go a long way in alleviating the risk of developing T2DM among this population (Astrup and Finer, 2000; Davies et al., 2004). It is important to note that the population with a BMI of 36 or higher, which constituted 100 percent of the study population, was characterized by a high prevalence of T2DM (a high proportion of 100 percent).

This is also in line with general epidemiological trends in the region of Asia, with other countries like Jordan, Saudi Arabia, and Egypt also reporting a rapid rise in prevalence of diabetes due to the increasing prevalence of obesity, urbanisation, and lifestyle changes (Ajlouni et al., 2008; Alqurashi et al., 2011; Hegazi et al., 2015). Diabetes prevalence in Jordan was reported to be age-adjusted at 17.1, with obesity being one of the major determinants (Ajlouni et al., 2008). On the same note, Alqurashi et al. (2011) observed that 85.7 per cent of diabetic patients in Saudi Arabia were overweight or obese, and this was also in line with a steady regional trend that reflects the present study outcomes. The correlation of obesity with T2DM that was found in our study also emphasizes the clinical significance of obesity phenotype, especially the central or abdominal obesity, which has a higher metabolic risk than generalized obesity (Winer and Sowers, 2004; Glory and Ybarra, 2005).

Yoon et al. (2006) have specifically reported that Asian people are prone to developing T2DM at lower levels of BMI and with high levels of visceral adiposity than Western populations, which supports the necessity of population-specific diagnostic measures and treatment approaches. This is especially true with the population of D.I.Khan, where the lack of health literacy, the lack of access to health services, and the shift in the diets of most individuals to energy-rich food items only increase the metabolic risks of obesity. We thus have shown that with specific interventions on obesity-related lifestyle habits, as well as the increased coverage of early screening and diagnosis of T2DM in the underserved area, there is a strong indication of the necessity.

Limitations

This research has a number of weaknesses. The sample size (n=60) is not that big, and convenience sampling is the aspect that restricts the ability to generalize findings to the entire population of D.I. Khan. The case-control design and a two-week duration in data collection do not give the opportunity to make causal inferences related to obesity and T2DM. Besides, the study did not gather dietary habits, the level of physical activity, and genetic predisposition, which are known confounders. Also, the 100 percent T2DM percentage in the largest BMI group cannot be construed as reflecting the population prevalence but as a case-control sample study. Other researchers should use bigger and more diverse samples with longitudinal designs to further elucidate the causal relationships between obesity and T2DM and to establish the effectiveness of interventions of choice.

Online ISSN 3007-3197
Print ISSN 3007-3189

Research Conclusion

The research is an important finding, as results prove that there is a significant positive correlation between obesity and T2DM, and the higher the BMI, the higher the chances of having T2DM. It is important to note that the prevalence of T2DM in the study sample was hundred percent in the individuals with a BMI of 36-40 kg/m 2, indicating the dire metabolic implications of extreme obesity.

The results can be compared to the global and regional epidemiological trends that prove that obesity is one of the most significant modifiable risk factors of T2DM. The sample was of both genders, male (58.3%) and female (41.7%) individuals, which were used to justify the generalizability of the results to the general adult population of the area.

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