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ORIGINAL ARTICLE

Exploring the relationship between family history of type 2 diabetes mellitus and anthropometric, blood sugar, and lipid parameters in normal individuals: A comparative study.

Jawed Iqbal[1], Khushboo Chandio[2], Altaf Hussain Memon[3], Aamir Hussain[4], Rizwan Ali Talpur[5], Ameer Abbas Ali[6]

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ABSTRACT… Objective: To examine the anthropometric, blood sugar, and lipid profiles of healthy adults, including those with and those without a history of type 2 diabetes mellitus. **Study Design:** Case-control study. **Setting:** Peoples University of Medical & Health Sciences for Women (PUMHS) in Nawabshah. **Period:** October 1st 2022 to 31st March 2023. **Material & Methods:** The research included 110 participants. 55 of them had at least one parent with type 2 diabetes mellitus, and the other 55 did not. Males and females between the ages of 18 and 25 were present in the study. The following measurements were compared: fasting blood sugar, lipid profile, waist height to hip ratio, and body mass index. **Results:** This case-control study compares offspring with and without a family history of type 2 DM to determine if there are any anthropometric or metabolic differences. Participant with a family history of type 2 DM showed higher BMI, WC, and WHtR according to the anthropometric measurements. Statistically significant differences were found in their BMI (P-value <0.0001). Even though BMI showed a significant difference, the mean value did not fit into the criteria to be categorized as obese. **Conclusion:** The present research has shown that people with a family history of type 2 diabetes mellitus are overweight and have abnormal lipid profiles even before they manifest overt type 2 DM.

Key words: Type 2 Diabetes Mellitus, Lipid Parameters, Anthropometric, Blood Sugar, Family History.

INTRODUCTION

Type 2 diabetes mellitus (DM) is a complex metabolic syndrome characterized by hyperglycemia resulting from poor insulin production and insulin resistance. It is a significant global health issue and is becoming increasingly common worldwide.[1] The development of type 2 DM is influenced by a combination of heritable and environmental factors, including lifestyle changes and physical inactivity. Genetic factors play a significant role, with individuals having a higher risk if they have a family history of the disease.[2] Additionally, there has been a decrease in physical activity due to automation, contributing to the rise in type 2 DM prevalence.[3] In Pakistan, insulin resistance and hyperinsulinemia are more prevalent compared to other populations, despite a relatively lower obesity rate.[4]

While there is considerable knowledge about the causes and risk factors associated with type 2 diabetes mellitus, there are still many aspects that remain unknown.[5] The exact interplay between genetic and environmental factors in the development of the disease is not fully understood.[6] Although obesity and physical inactivity are known to contribute to insulin resistance, the precise mechanisms behind these relationships require further investigation.[7] The impact of other potential factors, such as dietary patterns, stress, and the gut microbiome, on the development of type 2 DM also requires more research. Additionally, the optimal strategies for preventing or delaying the onset of the disease in individuals at high risk, particularly those with a family history, are still being explored.

1. MBBS, M.Phil (Physiology), Lecturer Physiology, Bilawal Medical College for Boys, Liaquat University of Medical & Health Sciences Jamshoro, Sindh Pakistan.
2. BSc Nursing (Generic), Lecturer, Peoples Nursing School, Liaquat University of Medical & Health Sciences Jamshoro Sindh Pakistan.
3. MBBS, M.Phil (Physiology), Assistant Professor Physiology, Peoples University of Medical and Health Sciences for Women Shaheed Benazir Abad.
4. MBBS, M.Phil (Physiology), Associate Professor Physiology, Bilawal Medical College for Boys, Liaquat University of Medical & Health Sciences Jamshoro, Sindh Pakistan.
5. MBBS, M.Phil (Physiology), Assistant Professor Physiology, Bilawal Medical College for Boys, Liaquat University of Medical & Health Sciences Jamshoro, Sindh Pakistan.
6. MBBS, DCP M.Phil, Associate Professor Pathology, Peoples University of Medical & Health Sciences for Women, Nawabshah -Shaheed Benazirabad, Sindh - Pakistan Nawabshah.

Correspondence Address:
Dr. Jawed Iqbal
Department of Physiology
Bilawal Medical College for Boys,
Liaquat University of Medical &
Health Sciences Jamshoro, Sindh Pakistan.
driqbalbajeer@gmail.com

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Research efforts have focused on understanding the risk factors associated with type 2 diabetes in high-risk patients, especially those with a family history of the disease. Studies have demonstrated the strong influence of genetic factors, with children of parents with type 2 DM being more likely to develop the disease.[8] The role of obesity, particularly abdominal obesity, in promoting insulin resistance and increasing cardiovascular risk has been investigated.[9] Anthropometric measurements such as body mass index (BMI) and waist circumference (WC) have been studied as indicators of obesity and visceral adipose tissue.[10] Monitoring fasting blood sugar levels has been identified as a diagnostic tool for detecting type 2 DM at an early stage. Efforts are ongoing to identify modifiable risk factors and develop interventions that can help prevent or delay the onset of type 2 diabetes in high-risk individuals.

MATERIAL & METHODS

The Peoples University of Medical & Health Sciences for Women (PUMHS) in Nawabshah enlisted 110 participants during the study period of six months from October 1st 2022 to 31st March 2023 to participate in a study in which 55 participants were diabetes mellitus type 2 patients, and 55 without a family history of type 2 diabetes mellitus. Patients were in the age group of 19-25 years of either gender. Patients were select from the general community and the children of diabetes patients attending the outpatient departments at the (PUMHS) Nawabshah. Patients were screened for their overall health and well-being during the examination. Following the normal proforma, we collected the subject's medical history and related information. In the current research, participants were distributing into two distinct groups. Group-1: controls (without family history of type 2 diabetes mellitus) and Group-2: cases (with family history of type 2 diabetes mellitus). Informed written consent was got from all the patients. The ethical approval was obtained from the PUMHS University with latter NO. PUMHS/REC/-819

Inclusion Criteria

Healthy non-diabetic patients of either gender in the age group between 19-25 years with a family history of type 2 DM with no major illness

Exclusion Criteria

1. Patients with type 2 DM.
2. Patients with a history of other systemic diseases, hypertension, endocrinopathies.
3. Subjects on medicines like antidiabetic, antihypertensive, glucocorticoids, and others can influence the parameters.

Procedure

Participants had to be at the lab at 7 a.m. the next morning, having fasted the night before and having eaten nothing. The technique was explained to the patients and written permission was received. Anthropometric measures were taken following a sufficient amount of rest.

Height in cm, waist circumference in cm, hip circumference in cm.

Standard calibrated balancing scale with a vertical measuring rod was used to measure the patients' weight and height. Without footwear, the patient's height and weight were recorded in meters and kg, respectively. In order to gain the lowest possible measurement of the waist circumference, the patient stood with his feet together and his arms outstretched to the side of his body and exhaled normally. The largest girth around the hips with the least amount of clothing was used to calculate hip circumference.
With the above got data following measurements were calculated.

Blood Sampling

Having fasted for 12 hours, the patient's blood was drawn for testing. In the cubital fossa, the venipuncture was performed. To prevent an unnatural rise in blood lipid levels, a tourniquet was employed, but it was removed right before the sample was taken. It took a round 3 ml of blood to be extracted from the veins using absolutely dry and sterilized hypodermic tubes, and the blood was transferred to dry glass bottles. Centrifuged at 5000 rpm for 10 minutes, the serum was alienated. The clean supernatant serum was then pipetted out using dry piston pipettes and disposable tips, and it was then kept

at 4^0C in dry, thin-walled vials. Haemolysed serum had to be kept out of the sample. Fasting blood sugar, Total cholesterol, Triglycerides, HDL were measured by Technicon RA-XT random access auto analyzer (ERBA Diagnostics Mannheim GmbH, Germany).

Diagnosis of Dyslipidemia

Dyslipidemia is diagnosed when any of the following or combination is found

Total Cholesterol	>200 mg/dl
Triglycerides	150 mg/dl
High-density lipoproteins	<40 mg/dl
Low-density lipoproteins	130 mg/dl

Statistical Analysis

In order to calculate the mean and standard deviation (SD), the results were calculated. One-way ANOVA was used to compare the data, and Pearson's correlation was used to study anthropometric and lipid characteristics. P-value <0.05 is regarded to be a statistically significant threshold. Prism 5 (graph pad) was used to create the visual representations of the data in SPSS version 23.0

RESULTS

This case-control study compares offspring with and without a family history of type 2 DM to determine if there are any anthropometric or metabolic differences. According to Table-I, anthropometric variables are associated with mean and standard deviation, which are compared between both groups. Patients with a family history of type 2 DM showed higher BMI, WC, and WHtR according to the anthropometric measurements. A comparison was also made between both groups of metabolic parameters, such as fasting blood sugar and lipid profiles (TC, HDL, TRI, LDL, and VLDL) as shown in Table-I.

Anthropometric and metabolic parameters were compared between offspring with and without a family history of type 2 diabetes to determine the effect of generalized obesity. A comparison of anthropometric values is shown in Table-II among group 1 and 2.

There was a statistically significant difference between the WC of group.1 was 76.92±9.91 cm and group.2 was 88.99±12.99 cm (P-value <0.001). WHR were significantly different among group1 and 2, with mean values 0.918±0.068 and 0.986±0.070 respectively, P-value 0.004).

Similarly, WHtR was also significantly more between group 2 when compared to group 1, the respective mean values were 0.61±0.07 and 0.51±0.053 (P-value <0.001). Based on the results of our study, overweight patients with a family history of type 2 diabetes had significantly greater WC, WHR, and WHtR than overweight individuals with a normal BMI. In Table-II, we compare lipid parameters between groups 1 and 2.

All the parameters were comparable between both the groups. To evaluate the statistical causality between observed changes in the anthropometric and lipid parameters, Pearson's correlation was carried out.

An analysis of the relationship between BMI and lipid profile is presented in Table-III. The BMI of participants was positively related to total cholesterol (r = 00.342, P-value <0.001), LDL (r = 0.337, P-value 0.001), and HDL/LDL (r = -0.367, P-value 0.010).

WC was positively correlated with total cholesterol (r= 0.361, P-value 0.005), LDL (r= 0.264, P-value 0.007) and negatively interrelated with HDL/LDL ratio (r= -0.112, P-value 0.034) (Table-III).

Interestingly, WHtR showed the similar correlation with that of BMI showing a positive correlation with total cholesterol (r= 0.185, P-value 0.002) and LDL (r= 0.203, P-value 0.001) and negative with HDL/LDL ratio (r= - 0.244, P-value 0.017) (Table-III).

BMI seems to be more significant than the other anthropometric variables that have been found to have positive correlations with TC and LDL and negative correlations with the HDL/LDL ratio.

The results show that offspring who come from

families with type 2 DM have an elevated body mass index, waist circumference, WHtR, total lipids, LDL, and a decreasing HDL/LDL ratio. A positive relationship was started among BMI, WC, and WHtR and total cholesterol levels and a negative relationship between HDL/LDL levels among these subjects. In this study, BMI strongly correlated with altered lipid status than other anthropometric measures. There was no difference in lipid profile between overweight subjects (i.e. Group 2) and normal weight subjects (i.e. Group 1). Changes in anthropometric precede alterations in lipid profiles in young people at high risk.

As a result, total cholesterol and LDL levels were higher in offspring of type 2 diabetes, while the HDL/LDL ratio was lower. Average BMI was 27.38±4.91 mg/kg^2, which is rather close to the overweight value. A minimum BMI of 18 mg/kg^2 and a maximum of 37.20 mg/kg^2 were observed among participants. Therefore, these subjects were further classified into two groups to evaluate the effect of overweight (BMI > 24.9 to < 29.9 mg/kg^2) and obesity (> 29.9 mg/kg^2) on the anthropometric and lipid profile. Group.1 (n=34) average body mass index was 22.66±1.84 mg/kg^2 and Group.2 (n=21) average BMI was 28.08±5.37 mg/kg^2. There was a statistically significant change in their BMI (P-value <0.001). Even though BMI showed a significant difference, the mean value did not fit into the criteria to be categorized as obese. WHO has classified BMI over 24.9 mg/kg2 as overweight, accordingly Group.2 was overweight when compared to Group-1.

Parameters	Control (n=55)	Case (n=55)	P-Value
Age in years	22.631.71	22.86±1.80	0.208
Height (cm)	174.4±71	182.69±8.75	0.321
Weight (kgs)	57.5±8.67	77±14.8	0.001
Waist Circumference (cm)	72.41±7.21	1.3±13.15	0.001
Body Mass Index (BMI) Kg/m^2	23.8±3.17	27.38±4.91	0.001
Waist-Hip Ratio	0.92±0.077	0.91±0.059	0.114
Waist Height Ratio	0.33±0.05	0.49±0.07	0.001
Compared the Fasting Blood Sugar and lipid parameters among controls and case.			
Total cholesterol (mg/dl)	163.96±18.99	171.6±27.81	<0.001
Fasting blood sugar (mg/dl)	85.54±4.44	87.9 ±3.71	0.143
Triglycerides (mg/dl)	126.64±12.26	122.16±18.9	0.314
Low-density lipoproteins (LDL) (mg/dl)	93.88±17.9	109±28.09	<0.001
High-density lipoproteins (HDL) (mg/dl)	39.23±2.04	38.34±1.8	0.008
Very low-density lipoproteins (VLDL) (mg/dl)	24.46±3.72	26.08±5.51	0.318
HDL/LDL ratio	0.35±0.077	0.38±0.067	0.001

Table-I. Controls and cases are compared in terms of anthropometric parameters

Parameters	Group 1 n =(34)	Group 2 n = (21)	P-Value
Height (cm)	168.88±9.0	166.99±9.81	0.272
Weight (kg)	61.91±8.52	76.89±17.08	<0.001
Body mass index (kg/m^2)	22.66±1.84	28.08±5.37	<0.001
Waist circumference(cm)	76.92±9.91	88.99±12.99	<0.0001
Waist-hip ratio	0.918±0.068	0.986±0.070	0.004
Waist height ratio	0.51±0.053	0.61±0.07	<0.001
Comparison of Lipid Parameters within cases between BMI Groups			
Triglycerides (mg/dl)	123.99±18.9	116.5±15.41	0.114
Total cholesterol (mg/dl)	167.1±30.61	178.6±32.8	0.130
HDL (mg/dl)	38.9±1.87	39.8±3.05	0.056
LDL (mg/dl)	104.58±19.78	116.78±30.99	0.071
VLDL (mg/dl)	25.82±4.71	23.98±3.87	0.068
HDL/LDL ratio	0.38±0.068	0.38±0.090	0.242

Table-II. Comparison of anthropometric parameters within cases between BMI groups

Pairs	r Value	P-Value
BMI vs Cholesterol	0.342	0.001
BMI vs HDL	0.283	0.002
BMI vs Triglycerides	-0.073	0.536
BMI vs VLDL	-0.086	0.252
BMI vs LDL	0.337	0.001
BMI vs HDL/LDL	-0.367	0.010
Correlation of Waist circumference (WC) with Lipid Parameters		
WC vs Cholesterol	0.361	0.007*
WC vs HDL	0.104	0.032
WC vs Triglycerides	- 0.142	0.128
WC vs VLDL	-0.173	0.067
WC vs LDL	0.264	0.007*
WC vs HDL/LDL	-0.112	0.034
Correlation of Waist height ratio (WHtR) with Lipid Parameters		
WHtR vs Cholesterol	0.185	0.002*
WHtR vs HDL	0.213	0.023*
WHtR vs Triglycerides	- 0.176	0.064
WHtR vs VLDL	- 0.217	0.041*
WHtR vs LDL	0.203	0.001*
WHtR vs HDL/LDL	- 0.244	0.017*

Table-III. Correlation of Body mass index (BMI) with lipid parameters

DISCUSSION

In the current study, anthropometric measurements (BMI, WC, WHR, WHtR), fasting blood sugar levels, and lipid profiles were compared in healthy male and female in the age group of 19-25 years with family history of type 2 diabetes milletus and without family history in both genders. Compared to the controls, cases had significantly higher BMI, WC, and WHtR in this research. There was a significant change in body mass index among participants with type 2 DM and the control group, showing that they were more likely to be obese. This follows other studies that have showed a higher prevalence of general obesity among offspring. The risk of developing DM and impaired glucose in patients with family history is increased in the presence of obesity.[6,11–13]

There is a higher prevalence of type 2 diabetes among teens who are obese, and obesity is associated with a higher pervasiveness of type 2 diabetes among teenagers.[14]

For insulin resistance and metabolic syndrome, obesity is the most crucial factor. Insulin resistance becomes more severe when a person's body mass grows.[15]

Studies have showed that increasing insulin resistance (IR) raises the likelihood of developing type 2 diabetes. In descendants of individuals with type 2 diabetes, insulin resistance and diabetes may be exacerbated.[13]

Similar to pregnancy and gestational diabetes, obesity may delay the onset of type 2 diabetes in individuals of disadvantaged individuals.[16]

For insulin resistance, being overweight is the most significant risk factor. According to Weyer et al.,[17]

increased subcutaneous abdominal adiposity had an increased risk of developing type 2 diabetes.[17]

This indicates that obesity appears to be more damaging to genetically predisposed individuals than to individuals without a genetic inclination.[18]

Among non-obese patients, increased TG levels and decreased HDL-C levels may serve as good indicators of IR in addition to BMI.[19]

Furthermore, obesity and a positive family history of diabetes were independently linked to type 2 diabetes development.[20]

Administration of adiponectin to obese person increased insulin sensitivity and muscle free fatty oxidation.[18]

We found that the offspring of individuals with type 2 diabetes in the family had higher BMI, WC, and WHtR, which were associated with both general and central obesity. Insulin resistance is more likely to develop in these individuals. However, among these non –obese subjects we also found increased total cholesterol, LDL and decreased HDL which are considered to be markers of insulin resistance.[19]

According to the study, people who have a family

history of diabetes have higher LDL levels than those who don't. This is called an atherogenic lipid profile. It is possible that obesity, insulin resistance, lack of exercise, and a poor diet can be related with higher percentages of lipids in individuals with a family history of type 2 diabetes.[21,22]

The findings of this study confirm previous studies showing that body fat is negatively associated with HDL-C and positively associated with LDL-C and TC.[23-25]

Diabetes and metabolic syndrome patients have abnormal fat metabolism, resulting in altered lipoprotein compositions, increasing their risk of atherosclerosis.[26]

CONCLUSION

Our study indicates that patients with a family history of type 2 diabetes are more likely to be obese and suffer from altered lipid metabolism. In this research, there was a positive relationship between BMI, WHtR, and LDL and an opposite relationship between HDL/LDL in this research.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Jawed Iqbal	Designed the research, assessed the vases, wrote the paper, Interpretation of discussion and data entry in SPSS.	
2	Khushboo Chandio	Collected the data, did the literature search, drafted the manuscript assisted in writing the paper.	
3	Altaf Hussain Memon	Involved in data collection, analyzed the data revised the manuscript, proof reading, help in methodology.	
4	Aamir Hussain	Revised the original manuscript reviewed the cases, analyzed the data and assisted in wirting the paper, Interpretation in results writing.	
5	Rizwan Ali Talpur	References, citation manager & amp; designing of resutls and charts and Graphs in manuscript.	
6	Ameer Abbas Ali	Data entry in SPSS and other technical help, help in corrections.