Article

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The Association between Global DNA Methylation and BMI: A Possible Prospective Contributor for Retinopathy Iraqi Patients

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العلاقة بين مثيلة الحمض النووي الكلية ومؤشر كتلة الجسم: مساهم محتمل في مرضى اعتلال الشبكية العراقيين

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Abstract

Background:

Retinopathy is a major T2DM complication that still to be a worldwide cause of curable and avoidable vision loss.

Materials and Methods:

The current study protocol included study the impact of BMI on some glycemic control markers (fasting blood glucose (FBG), glycated hemoglobin (HbA1C), insulin, insulin sensitivity (IS)and insulin resistance (IR)) and some oxidative stress markers (reactive oxygen species (ROS), total antioxidant, capacity (TAC), and oxidative stress index (OSI). Also, the present study included an important epigenetic parameter: the global DNA methylation.

Results:

Patients were divided into four BMI categories: (normal, overweight, obesity and over obesity), the highest percent for both patients were within obesity group. The highest levels of FBG were in obesity and morbid obesity in both retinopathy and T2DM. Highest levels of HbA1C in Morbid obesity were compared with other BMI groups in T2DM only. Insulin and IR showed a significant raise in obesity and morbid obesity in retinopathy and T2DM. IS significantly decreased in morbid obesity compared with others. Methylation analysis revealed that patients with diabetes (T2DM and retinopathy) had a significantly increase in levels of 5mC% compared healthy subjects. Also, a significant increase was recorded in retinopathy compared with T2DM. In all of the studied groups, the correlation analysis found a significant positive association between BMI and 5mC %.

Conclusion:

The positive correlation between BMI and DNA methylation can lead to adverse effects for diabetes patients, which may lead to the progression of retinopathy.

Key words**:**

DNA methylation, retinopathy, T2DM, ROS, and TAC.

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of the main global causes of disability, reduced quality of life, and early mortality [1]. Worldwide, the number of those with T2DM is increasing over time [2]. Retinopathy is a serious T2DM consequence that continues to cause curable and avoidable vision loss worldwide [3]. Retinopathy is detected by the appearance of different types of lesions on a retina image, these lesions are microaneurysms, haemorrhages, soft and hard exudates [4].

The primary causes of diabetic retinopathy include long-term diabetes, poor glycemic control, high blood pressure, alterations in redox balance, and oxidative stress [5 and 6].

The most significant risk factor for T2DM and associated consequences is obesity (body mass index (BMI) 30 kg/m2) [7]. It is connected with metabolic abnormalities resulting in insulin resistance [8]. There is a converse linear relationship between age and the BMI at diagnosis of T2DM [9]. BMI and diabetic retinopathy have not been linked in any apparent way as of now. While other researchers have shown BMI as a protective factor for diabetic retinopathy, some have shown a direct correlation between obesity and retinopathy [10].

Microvascular blockage causes hypoxia in retinal tissues, which releases vasogenic mediators including vascular endothelial growth factor (VEGF), leading to aberrant vascular diseases [11]. Though effective outcomes are obtained with this treatment, reducing VEGF levels in the body can cure patients of retinopathy, but only about 50% of patients respond to these therapies; and in addition to side effects of anti-VEGF, it requires repeated intraocular injections [12].

Epigenetic study is presently one of the most pertinent hot issues due to the reversible nature of its mechanisms, flexibility, and phenotypic effect, which offers new therapeutic options for retinal disorders [13]. DNA methylation is the most widely studied and best characterized epigenetic mechanism and plays important roles in gene regulation and genome stability [14 and 15]. DNA is methylated by covalently attaching a methyl group to the carbon 5 of cytosine nucleotides to produce 5-methylcytosine [16]. More lately, it was proved that methylation of DNA is involved in T2DM premature stages showing a mechanism of metabolic memory [17]. Additionally, it is found that 5mCmechanism intimately connected to the normal development of the human retina [18]. Suggesting that a rise level of DNA methylation might be a risk factor for diabetic retinopathy [19].

Cell structures, included Lipids, membranes, Proteins, and nucleotides can all be harmed by extravagant ROS, so it can affect and triggered methylation of DNA [20]. However, DNA methylation promotes oxidative stress and which eventually results contributes to the expansion of retinopathy [21].

Aims of study: The goal of present study is to research the association and quantify the relationship of retinopathy with epigenetic and BMI in patients with T2DM, as well as quantify the importance of association between epigenetic and BMI in progression of diabetic retinopathy

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METHODOLOGY

- **Participant Subjects and Study Sitting**

The current investigation involved collection blood samples from120 subjects, 40 were healthy subjects as a control group, as well as 80 diabetic patients: 40 T2DM patients without complications and 40 patients with diabetic retinopathy. The study was approved by the ethics committee of the College of Science for women, university of Babylon. Also, all participants were taken consent and were guided to fast for 10–12 hours before starting to collect blood samples. The study protocol included calculation of BMI for all participant subjects and study the impact of BMI on some glycemic control markers (fasting blood glucose (FBG), glycated hemoglobin (HbA1C), insulin, insulin resistance (IR) and insulin sensitivity (IS)) and some oxidative stress markers (total antioxidant, capacity (TAC), reactive oxygen species (ROS), and oxidative stress index (OSI). Also, the present study included an important epigenetic parameter: the global DNA methylation.

- **Collection of blood sample and preparation**

Fasting venous blood samples were collected from all subjects. Whole blood was pushed into EDTA tubes for determination of HbA1C concentration and the remaining blood was stored at 20°C for use in DNA extraction. For serum preparation, remaining blood pushed into disposable gel tubes was allowed to clot at room temperature for (10-15 minutes) and then centrifuged at (2000 × g) for approximately (10-15 minutes), and stored the obtained sera at -20° C for further analysis of FBG, insulin, urea, creatinine, TAC and ROS.

- **Analysis of Biomarkers**

Determination of Body mass index

The body mass index values of participating individuals have been calculated using the BMI formula **[21]**. BMI = weight (kg) / height^2 (m)^2

Evaluation of Fasting blood glucose

Enzymatic colorimetric method of Barham and Trinder [22] has been utilized to estimate FBG (mg/dl) utilized the Linear kit, Spain.

Evaluation of Glycated Hemoglobin

Glycated hemoglobin was measured using ichroma HbA1C test, DxGen / Korea.This test reveals the amount of glycated hemoglobin as a percentage of total hemoglobin in the blood [23].

Evaluation of Insulin

Insulin hormone has been inspected byutilized (CalbiotechInc/ Germany) ELISA kit specific for human insulin which relay on the standard sandwich enzymerelated immune-sorbent method [24].

Calculation of Insulin Resistance and Insulin Sensitivity

Insulin resistance has been assessed by determining of homeostasis model estimation of insulin resistance (HOMA-IR) and calculate by utilized the following equation [25]:

IR = (I0 × G0) / 405

I0: Fasting insulin level. G0: Fasting glucose level.

The quantitative insulin sensitivity checks index (*QUICKI*) is derived utilizing the inverse of the sum of logarithms of fasting serum insulin and FBG [26].

IS = 1 / (log (fasting insulin μIU/ml) + log(fasting glucose mg/dL)

Evaluation of Total Antioxidant capacity

TAC has been calculated using the cupric ion reduction antioxidant capacity (CUPRAC) method, which is based on an antioxidant's capacity to reduce an oxidant [27].

Evaluation of Reactive oxygen species

The ROS in serum have been evaluated using a method created by Erel [28]. This method relay on changing the ferrous ion-o-dianisidine complex ferric ion by the oxidants in the serum.

Evaluation of Oxidative Stress Index

Oxidative stress index is a marker for the magnitude of oxidative stress by measure the ratio of oxidants and antioxidants. It was calculated by the following formula [29 and 30]:

$$\text{OSI (arbitrary unit)} = \text{ROS} \div \text{TAC} \times 100$$

Genomic DNA have been extracted using ReliaPrep™ Blood gDNA Miniprep extraction kit (Promega, USA). The concentration and purity of the resulting DNA was measured using Nano drop spectrophotometry at 200 to 320nm wave length.

Evaluation of Global DNA Methylation

Methyl flash™ Global DNA methylation (5-mC) ELISA Easy Kits (colorimetric) were used to determine the amount of global DNA methylation. This kit is provided by Epigentek Group Inc, USA. This global method of evaluation works to calculate the DNA methylation levels of the all CpG, regardless where they were map in the genome. Whereas, this type of tests determines the levels of global DNA methylation using the 5-methyl cytosine antibody (5-m) and then determines the percentage of methylation by measuring it by absorbing readings at 450 nm in the micro-plate reader Global methylation levels can be estimated as proportional to the measured OD density.

RESULTS AND DISCUSSION:

Distribution of diabetic patients according to BMI

Distribution of the retinopathy and T2DMM patients according to their BMI values is elucidated in [Fig. 1, 2]. They were divided into four BMI categories: (Normal, Overweight, Obesity and Over obesity), The highest percent for retinopathy and T2DMM patients were within Obesity group.

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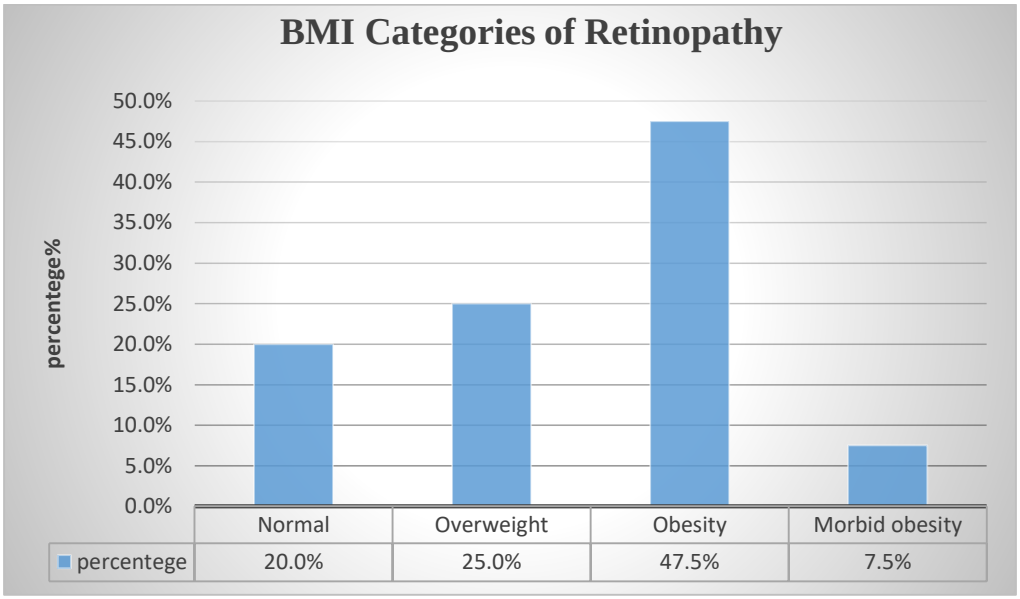

Figure (1): Distribution of retinopathy patients according to the BMI (kg/m2).

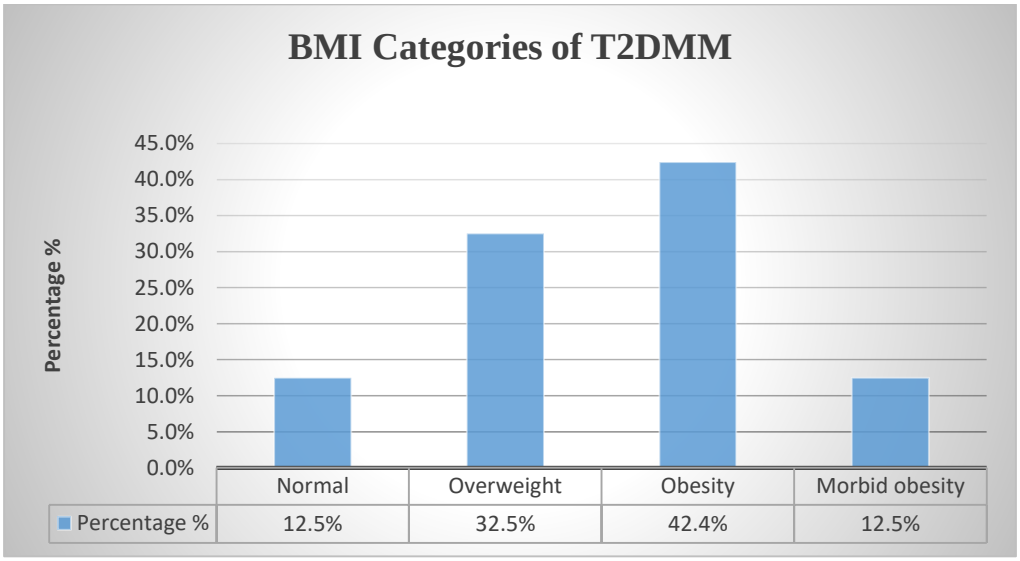

Figure (2): Distribution of T2DMM patients according to the BMI (kg/m2)

Present study indicated that highest percent for T2DM and retinopathy patients were within obesity group, it had an inverse relationship with retinopathy and T2DM without complication. Obesity is well recognized as a risk factor for type 2 diabetes, and body mass index is a common predictor of this condition [31]. BMI in diabetic patient is one of the most substantial clinical parameter for their health and disease progression. The current findings that the majority weight status of T2DM patients is obese is in agreement with previous studies [32, 33 and 34]. The relationship amidst diabetic retinopathy and BMI is yet unknown. The current findings that the majority weight status of retinopathy patients is obese is in agreement with previous studies [10

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and 35]. In addition, Data with a cohort of 50,64 overweight and obese Saudi patient associated with an inverse risk of retinopathy next adjustment for age and gender have been reported [36]. Although the precise mechanism behind the opposing association between BMI and retinopathy has not yet been determined, it may be related to the poor glycemic control found in diabetic individuals. Also, it is considered as a risk factor for increasing IR that leads to T2DM as a result of abdominal obesity such as: low muscle mass, thick subcutaneous adipose tissue [37]. Obesity is a pandemic disease had a notable role in T2DM pathogenesis and a multitude of related complications [38]. On the other hand, the results of the current study did not agree with a previous study, had reported no connected or even discordant results in which higher BMI is associated with lower spread of retinopathy [39]. The current finding in line with a previous study confirming a U-shaped association of BMI with mortality in T2DM patients [32].

Obesity, which is viewed as a risk factor for T2DM, is frequently indicated by BMI [31]. However, the results of previous studies examining the relationship between BMI and retinopathy have been contradictory. Some researchers have suggested that obesity or a higher BMI will rise the risk of retinopathy [40 and 41], however, some research has shown no link or even contradictory results, where a higher BMI is connected with a lower risk of developing retinopathy and prevalence of retinopathy [39 and 42].

Impact of BMI on The physiological markers in both Diabetic retinopathy and T2DM patients

The effect of BMI on physiological markers in retinopathy and T2DM is explained in [Table. 1]. The statistical analysis using one-direction ANOVA was employed to detection the considerable differences in the levels of both diabetic related parameters and oxidative stress and VEGF-A factor. [Table. 1]showed that all patient BMI groups' FBG levels had a significant ($P \leq 0.05$) impact, the highest levels of FBG were in obesity and Morbid obesity in both retinopathy and T2DM. A significant ($P \leq 0.05$) increased also was found in HbA1C level in Morbid obesity compared with other BMI groups in T2DM only. Also, a significant ($P \leq 0.05$) increased was found in the levels of insulin and IR in Obesity and Morbid obesity in both retinopathy and T2DM. In the other hand, the value of IS showed significantly ($P \leq 0.05$) decreased in Morbid obesity group compared with other BMI groups.

In concerned with oxidative stress markers, present study recorded a significant ($P \leq 0.05$) increased in TAC in normal weight and overweight groups in retinopathy; and a significant ($P \leq 0.05$) increased within normal weight group only in T2DM. The highest levels of ROS and OSI were in Obesity and Morbid obesity in both retinopathy and T2DM, with significant ($P \leq 0.05$) differences.

According to VEGF-A factors, a significant ($P \leq 0.05$) increased was found in Obesity and Morbid obesity groups compared with other BMI groups in both retinopathy and T2DM patients as shown in [Fig. 3, 4], respectively.

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Table (1): Impact of BMI on physiological markers in retinopathy and T2DM patients

The Glycemic control Parameters						
Case	BMIcategories	FBG (mg/dl)	HbA1c	Insulin (µIU/ml)	IR	IS
Retinopathy	Normal	180.51±58.87	8.29±1.79 ^{a}	17.16±2.5^{*b}	9.15±4.8^{*b}	0.28±0.02^{*a}
	Overweight	202.91±65.73^{*b}	8.79±1.48 ^{a}	20.83±5.71^{*b}	11.02±5.3^{*b}	0.27±0.02^{*b}
	Obesity	278.52±72.13 ^{*a}	9.31±2.18 ^{a}	28.66±9.37 ^{a*}	21.11±13.5^{*a}	0.25±0.01^{*d}
	Morbid obesity	254.01±65.55^{*a}	8.99±2.12^{a}	26.1±8.96 ^{a*}	18.53±7.89^{*a}	0.26±0.04^{*c}
P value		0.01*	0.13^{NS}	0.03*	0.01*	0.01*
T2DM	Normal	169.22±70.48^{*c}	8.39±1.06^{*c}	18.4±8.47^{*b}	9.56±5.20^{*c}	0.28±0.01^{*a}
	Overweight	206.88±74.94^{*b}	8.61±1.5^{*c}	20.46±8.25^{*b}	10.99±8.83^{*c}	0.28±0.03^{*a}
	Obesity	225.12±83.79^{*a}	9.59±2.02^{*b}	25.53±11.07^{*a}	13.81±7.54^{*b}	0.26±0.02^{*b}
	Morbid obesity	255.15±28.19^{*a}	11.77±1.75^{*a}	30.2±8.29^{*a}	19.65±4.21^{*a}	0.25±0.007^{*c}
P value		0.00**	0.020*	0.004**	0.001**	0.01*
Oxidative Stress markers						
Case	BMI categories	TAC (mmol/l)		ROS (µmol/l)		OSI %
Retinopathy	Normal	1227.4±149.68 ^{a}		18.62±4.12^{*c}		2.01±1.07^{*b}
	Overweight	1036.2±198 ^{a}		26.9±6.62^{*b}		2.51±0.7^{*b}
	Obesity	799.78±105.79^{*b}		34.62±9.89^{*a}		3.77±2.08^{*a}
	Morbid obesity	879.87±160.35^{*b}		37.97±13.32^{*a}		3.92±1.04^{*a}
P value		0.01*		0.006*		0.006**
T2DM	Normal	1284.51±197.12^{*a}		19.89±3.54		1.45±0.25^{*b}
	Overweight	979.91±196.43^{*b}		22.6±10.54^{*b}		3.14±1.15^{*a}
	Obesity	918.51±195.78^{*b}		29.48±14.75^{*a}		3.43±1.10^{*a}
	Morbid obesity	771.06±178.77^{*b}		31.99±14.2^{*a}		3.78±2.12^{*a}
P value		0.04*		0.001**		0.02*

SD: Standard Deviation, NS: Non-Significant. *(P≤0.05), NS (P>0.05).

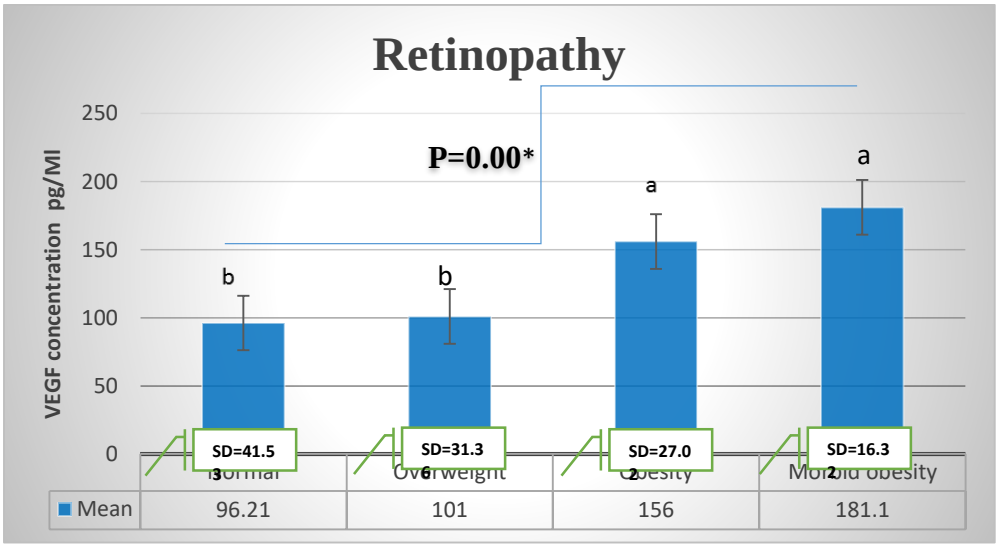

Figure (3): Impact of BMI on VEGF-A concentration as evaluated using BT LAB Kit (cat. No. E0050Hu) in Retinopathy patients (P= 0.00*, t=Test).

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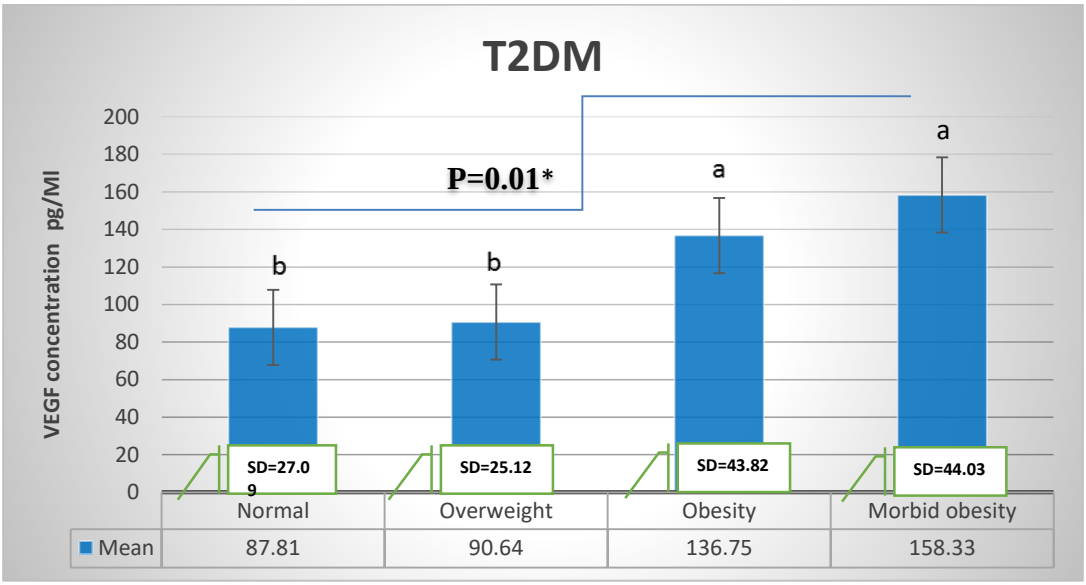

Figure (4): Impact of BMI on VEGF-A concentration as evaluated using BT LAB Kit (cat. No. E0050Hu) in T2DM patients (P= 0.01*, t=Test).

The current study revealed the presence of significant differences for each of diabetic retinopathy and T2DM patients between BMI groups in FBG levels, and also the presence of significant differences in HbA1C levels in diabetic retinopathy patients. These results are proportionate with former research findings that showed a positive association with BMI and higher HbA1C [43 and 44]. But no significant difference was shown in T2DM patients as in previous studies pooling data from 7 single-arm studies and 51 randomized trials demonstrated a consistent linear connection between weight loss and reduced HbA1C between subjects for T2DM who were overweight or obese [45]. There is strong consistent evidence that obesity management is beneficial in the treatment of T2DM, according to the American Diabetes Association (ADA) [46]. Additionally, a research has shown that being overweight later in life increases the risk of T2DM as being overweight in adolescence [47].

Numerous epidemiological studies have looked at the relationship between retinopathy and anthropometric factors like BMI, but the results have been conflicting. BMI and the likelihood of developing retinopathy are inversely correlated, according to recent research in Asian populations, suggesting a protective role for a higher BMI in the development of retinopathy. For example, epidemiological studies of eye diseases in Singapore found evidence of association of BMI with having retinopathy, and the Shanghai Diabetes Registry Database Study of 2,533 patients with T2DM found that patients with weight gain they have less decrease. The risk of developing retinopathy is greater than in people of normal weight [35 and 48].

A Netherlands research had demonstrated a negative effect of greater BMI on retinopathy, while the research of the Diabetes Management Project carried out in Australia also showed a substantial link between higher BMI and risk retinopathy. However, studies from Western nations have reported different results [41 and 49]. Obese diabetics compared to non-obese diabetics, have

higher insulin production but higher levels of IR [50]. Further, those with a higher BMI have been reported to demand less insulin therapies, indicating excellent beta-cell activity, which may support the idea that fat plays a protective role in retinopathy [51].

The mechanism implicit the impact of total body fats on retinopathy is now not clear. A viable explanation for the association between weight problems and a decrease danger of retinopathy is the manufacturing of adipokines, especially adiponectin which is predominantly expressed in white adipose tissue [52]. Age-related macular degeneration, diabetic retinopathy, and retinopathy of prematurity are examples of neovascular ocular illnesses for which adiponectin plays a critical function in metabolic modulations [53]. Indeed, dyslipidemia, as nicely as hyperglycemia, along with caused oxidative stress are acknowledged risk factors for the improvement of retinopathy [54]. In sufferers with T2DM, adiponectin appears to intone lipid metabolism, leading to a discount in cholesterol, and an expand in peripheral insulin sensitivity by way of controlling glycogen synthesis [55].

T2DM is highly connected with obesity, and the spread of obesity-related diabetes is expected to double to 300 million by 2025 [56]. This close connection has also led to the connotation of "diabetes" highlighting the fact that the plurality of people with diabetes are overweight or obese [57].

Recent studies indicate that the development and effects of obesity may be significantly influenced by abnormalities in the oxidant/antioxidant balance. Reactive oxygen species and nitrogen species that are produced in excess change cellular signaling pathways such NF-B, NJK, and p21RAS, resulting in oxidative damage to lipids, proteins, and nucleic acids [58]. Additionally, in obesity, ROS activates AMP-activated protein kinase (AMPK), which impairs insulin signaling in target organs as well as proliferation, apoptosis, and cell death [59].

Several studies indicate that metabolic diseases associated with obesity can occur not only due to the high gathering of bioactive lipids [60 and 61], but also due to disturbances in the balance of pro-oxidants/antioxidants [62]. Indeed, an individual who are obese, there has been an increase and a reduction in the antioxidant barrier [63].

Increased levels of TAC, FRAP, and DPPH may signify an improved capacity to scavenge free radicals and, thus, more efficient defense against oxidative stress in obese individuals. This is understandable considering that the first line of defense against excessive ROS/RNS generation is antioxidants. However, individuals with severe obesity showed more oxidative damage to DNA, lipids, and proteins [64].

In term of VEGF-A, the results of the current study are also reinforced by what was stated in the investigation of Jung *et al*. [65], who indicated that there is a significant positive correlation between BMI and VEGF-A factor in retinopathy patients.

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Analysis of global DNA methylation

The percent of measuring global DNA methylation by estimation the 5mC % in whole genomic DNA using MethylFlash™ Methylated DNA Quantification Kit. The analysis of Global DNA methylation displays in [Fig. 5], which revealed that Diabetic patients (both T2DM and Retinopathy) have a significant (P<0.05) increases in mean levels of 5mC% than healthy control subjects. Also, this figure shows that there is a significant (P<0.05) increase in the levels of methylation in retinopathy compared with T2DM patients.

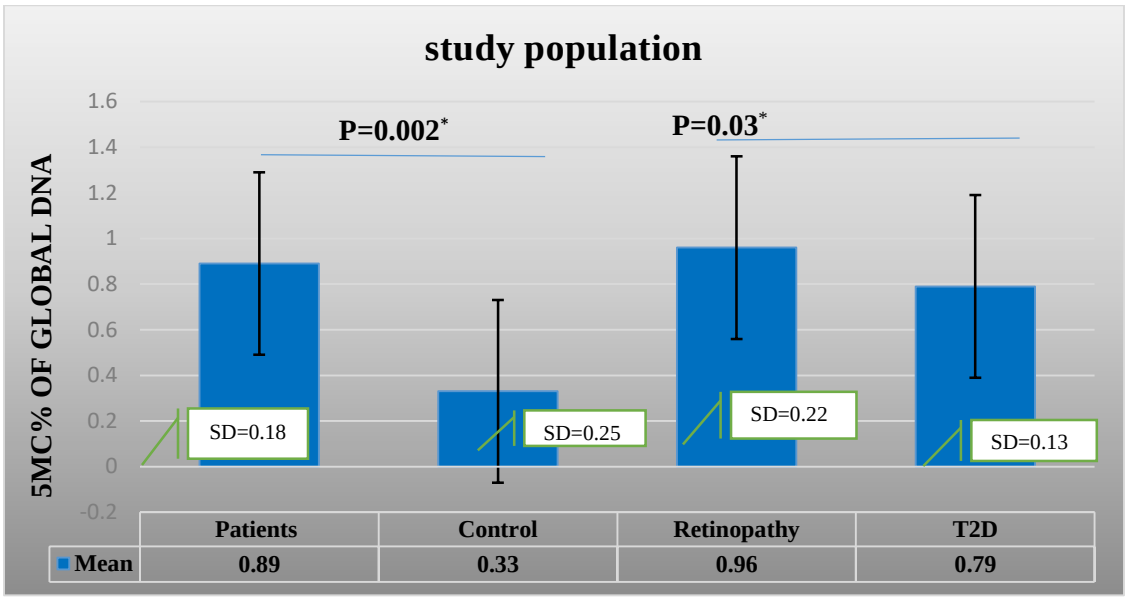

Figure (5): Global DNA methylation levels as evaluated by 5mC% using Methyl Flash™ Methylated DNA Quantification Kit (Cat. No. # P-1034) in Study Population, t=Test.

Traditional biomarkers are insufficient to explain the development of diabetic retinopathy, and genetic risk factors discovered by GWASs only account for 10% of the heritability of T2DM and its complications [66],so, Research on epigenetics is becoming more popular. This tendency has been accelerated by the reversible epigenetic pathways, which provide novel treatment options for retinal illnesses [13]. The expression of several important genes for diabetes mellitus may be modulated by epigenetic mechanisms involved DNA methylation and signaling pathway engaged in oxidative stress, inflammation, apoptosis, obesity, and aging [67]. For this reason, the current study evaluated the percentage of global DNA methylation and its relationship to BMI, to be another evidence of the importance of DNA methylation in the development of diabetes and its related complications.

In the present study, global DNA methylation analysis revealed that Diabetic patients (both T2DM and Retinopathy) have a significant (P<0.05) increases in mean levels of 5mC% than healthy control subjects. Also, a significant (P<0.05) increase in the levels of methylation in Retinopathy compared with T2DM patients had been reported as shown in [Fig. 5].

DNA methylation is a physiological process that regulates gene expression and, when it goes wrong, can result in illness [68]. Aberrant DNA methylation could be an etiological factor implicated in the onset and development of T2DM [69].

The present study showed a favorable correlation between DNA methylation and the development of retinopathy and T2DM. The findings of the current research are consistent with previous studies that found that global DNA methylation was enhanced in diabetic and prediabetes patients compared to a control group [70 and 71]. It is also evident from the result of the current study that there is a significant increase in DNA methylation level in patients with retinopathy compared to patients without retinopathy, which may reinforce the importance of DNA methylation in the development of complications in diabetic patients. We conclude that the current study provides objective findings as a previous study by Maghbooli and colleagues suggested that this complication may be predicted by variations in the overall DNA methylation profile in T2DM individuals with or without diabetic retinopathy [71]. Suggesting that an elevated potential risk factors for diabetic retinopathy may include DNA methylation status [19].

The association Between BMI and Global DNA Methylation Level in Study Groups

The association between BMI of participant's subject and the levels of Global DNA methylation has been assessed using correlation analysis which displays in [Fig. 6]. The correlation and regression analysis revealed a significant ($P<0.05$) positive correlation1between BMI and the percent of 5mC in all studied groups.

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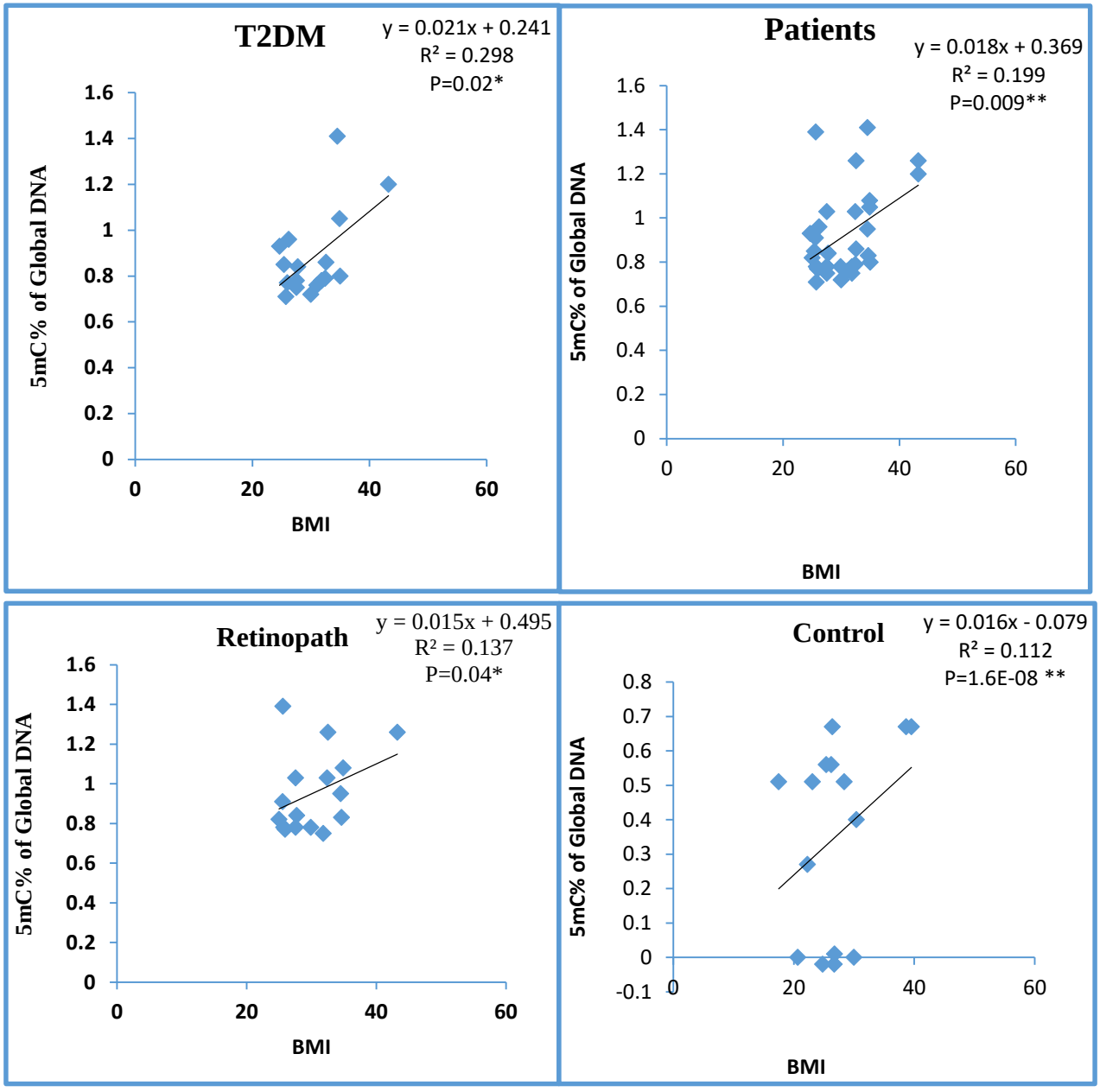

Figure (6): Correlation between BMI and global 5mC% in Study Groups.

Regarding the correlation between methylation of DNA and BMI, the results in **[Fig. 6]** indicated a significant (P<0.05) positive correlation1between BMI values and the percent of 5mC in all studied groups. DNA methylation status changes may occur secondary to obesity and may therefore influence the development of obesity-related diseases such as diabetes, dyslipidemia, hypertension, and cardiovascular disease. There are still significant gaps in knowledge about how obesity and its effects are related to human epigenetic alterations **[72].** It is still unclear how much of the inter-individual variation in body weight can be attributed to observable lifestyle and genetic

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factors. Increased global methylation levels with boost in BMI values may explains the significant increased IR in obese patients compared with other BMI groups that recorded in present study.

On the other hand, increased methylation levels in obese patients may be attributed to poor glycemic control parameters, particularly persist hyperglycemia as well as increased levels of ROS in obese patients. Several studies have focus on the employ of DNA methylation information as diagnostic tool for the development of obesity related co-morbidities like T2DM **[73].** Present study agrees with prior studies that stated an association between obesity and gene specific methylation in T2DM **[74 and 75]**.

It has been suggested that normal variation in DNA methylation levels may be a danger factor for certain diseases and play a part in the phenotypic variability of several traits **[19].** However, the relationship between DNA methylation and BMI-related sites is extra complicated. The study of Mendelson et al **[76]** suggests DNA methylation results may be useful in detecting negative health effects linked to BMI. While the results of other study showed a contradiction to our results, in which the global DNA methylation is negatively associated with BMI **[77]**.

CONCLUSION

BMI is an important clinical indicator for diabetic patients and one of the most important factors that lead to the evolution of diabetic complications such as retinopathy. The results of the current study have demonstrated the existence of a positive correlation between BMI and DNA methylation. Therefore, it is reasonable to attribute these negative effects of BMI to the stimulation of some epigenetic pathways such as DNA methylation. The positive correlation between BMI and DNA methylation can lead to adverse effects for diabetes patients, which may lead to the progression of retinopathy.

Conflict of interests.

There are non-conflicts of interest.

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الخلاصة

المقدمة:

يعد اعتلال الشبكية من المضاعفات المهمة لمرض السكري النوع الثاني T2DM الذي لا يزال سببًا لفقدان البصر الذي يمكن الوقاية منه وعلاجه في جميع أنحاء العالم.

طرق العمل:

تضمن بروتوكول الدراسة الحالي حساب مؤشر كتلة الجسم لجميع المشاركين ودراسة تأثير مؤشر كتلة الجسم على بعض معايير التحكم في نسبة السكر في الدم: سكر الدم الصائم، السكر التراكمي، الأنسولين، مقاومة الأنسولين وحساسية الأنسولين وبعض علامات الإجهاد التأكسدي: مضادات الأكسدة الكلية، وأنواع الأكسجين التفاعلية، ومؤشر الإجهاد التأكسدي كما تضمنت الدراسة الحالية احدى المعلمات الفوق جينية المهمة: مثيلة الحمض النووي الكلية.

النتائج:

تم تقسيم المرضى إلى أربع فئات وفقا لمؤشر كتلة الجسم: (normal ، overweight obesity , morbid obesity)، أعلى نسبة لكلا مجاميع المرضى كانت ضمن مجموعة obesity. أعلى مستويات FBG كانت في مجموعة obesity و morbid obesityفي كل من مجموعة اعتلال الشبكية ومجموعة T2DM .أعلى مستويات HbA1C في morbid obesity مقارنة مع مجموعات BMI الاخرى بالنسبة لمجموعة T2DM فقط ، حيث أظهر الأنسولين وIR زيادة معنوية في مجموعتي obesity وmorbid obesity في مجموعتي اعتلال الشبكية و. T2DMانخفض IS بشكل معنوي في morbid obesity مقارنة بالمجاميع الاخرى. كشف تحليل مثيلة الحمض النووي أن مرضى السكري (T2DM واعتلال الشبكية) لديهم زيادة معنوية في متوسط مستويات 5mC ٪ مقارنة بالأشخاص الأصحاء. كما سجلت زيادة معنوية في مجموعة مرضى اعتلال الشبكية مقارنة مع مرضى T2DM . أظهر تحليل الارتباط علاقة ارتباط موجبة معنوية بين مؤشر كتلة الجسم ونسبة 5mC في جميع المجموعات المدروسة.

الإستنتاجات:

يمكن أن يؤدي الارتباط الإيجابي بين مؤشر كتلة الجسم ومثيله الحمض النووي إلى تأثيرات سلبية على مرضى السكري، مما قد يؤدي إلى تطور اعتلال الشبكية.

الكلمات المفتاحية:

مثيلة الحمض النووي، اعتلال الشبكية، T2DM، ROS، TAC