

Immunological Role of Serum Matrix Metalloproteinase-13 in Patients with Diabetes Mellitus

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ABSTRACT

Background: Diabetes mellitus (DM) is a longstanding metabolic illness that may be genetic or advanced due to lifestyle and environmental factors. It occurs when the pancreas does not produce sufficient insulin, or when the body is incapable to use the insulin it produces successfully, leading to disorders in the regulation of blood glucose. The goal of this study is to evaluate matrix metalloproteinase-13 as a probable biomarker in complications of diabetes.

Material and Methods: The current study comprised a total of 90 specimens obtained from members. The study was divided into two groups: the first consisted of 60 patients diagnosed with type 2 diabetes mellitus, while the second comprised 30 healthy individuals serving as a control group. All members were employed from a private laboratory in Balad city, Iraq, between September 2025 and January 2026.

Results: Concerning sex distribution, males accounted for a higher proportion of the patients, accounting for 54 (60%), while female established 36(40%). Examination by age group specified that persons aged 51–60 years had the highest occurrence of diabetes. In addition, the findings exposed that the Matrix metalloproteinase-13 (MMP-13) serum level was significantly increased in T2DM patients compared to healthy control ($P < 0.05$).

INTRODUCTION

Diabetes mellitus is a continuing metabolic illness that may arise from progress or hereditary factors later in lifetime. It occurs when the unsuccessful pancreas to produce satisfactory insulin, or when the body cannot correctly exploit the insulin it products. As a result, blood glucose levels continue persistently raised. Over time, uncontrolled hyperglycemia can damage various organs and tissues, particularly the blood vessels and peripheral nerves, leading to serious health complications [1]. T2DM often referred to as late-onset diabetes, was previously known as non-insulin-dependent diabetes mellitus. Insulin resistance joint with a relative deficiency in insulin secretion primarily characterizes this form of diabetes. Therefore, glucose is not successfully taken up by the body's cells, important to a progressive rise glucose levels in blood [2].

Cytokines are small motioning proteins secreted by several cells and play an vital role in communication of cell-to-cell. Further than coordinating immune responses contrary to

infections, they also underwrite to processes such as repair of wound, angiogenesis, and both pathological and normal tissue remodeling [3].

Inflammation plays a major role in the progression of diabetic microvascular complications, particularly diabetic retinopathy and diabetic nephropathy [4]. In conditions of persistent hyperglycemia, elevated levels of cytokines infiltrate vascular tissues, where they disrupt normal cellular function and interfere with repair mechanisms, thereby contributing to ongoing tissue damage [5]. The aim of study to investigate Matrix Metalloproteinase-13 as a Potential Biomarker in Diabetic Complications.

METHODOLOGY

Study area and groups

The study was conducted between September 2025 to January 2026 at the private laboratory in Balad city, Iraq. A total of 90 samples were taken, 54 men and 36 women spanning 15-70 years of age (60 patients and 30 healthy controls). Samples were gathered. Individuals with blood using disposable syringes, 3-5 ml of venous blood were extracted from each human being's radial vein. After that, the blood was put into gel tubes, left to coagulate at room temperature, then spun for fifteen minutes at 1,500 RPM. The sera were then stored at -20 oC until additional analyses were carried out [6].

Estimation of Matrix Metalloproteinase-13 by Enzyme-linked Immunosorbent Assay (ELISA) Protocols: this was obtained by [7].

Statistical analysis

The common statistical set Graph Pad Prism version 7 was used, and the information was summarized by the (Mean Stander division) format [8].

RESULTS AND DISCUSSION

Demographic study

The current study included a total of ninety samples, which were classified into two groups before being processed and analyzed at a private laboratory in Balad city, Iraq. Type II diabetes mellitus = sixty (66.66%) and Healthy control = thirty (33.34%), as shown in figure (1).

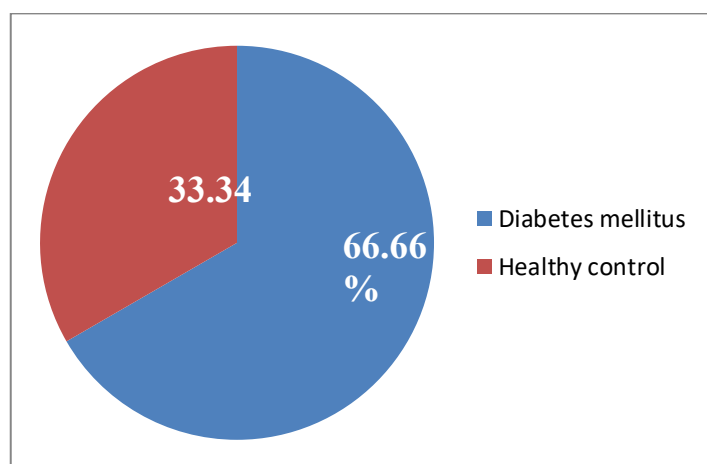


Figure (1): Prevalence of Type II diabetes mellitus among total samples

Distribution of patients according to sex

The findings showed that a total of 90 clinical samples were analyzed and categorized according to sex. Among patients with type II diabetes mellitus, males accounted for 32 cases (53.3%), while females represented 28 cases (46.7%). In the healthy control group, 18 participants (60%) were male and 12 (40%) were female, as presented in Figure (2).

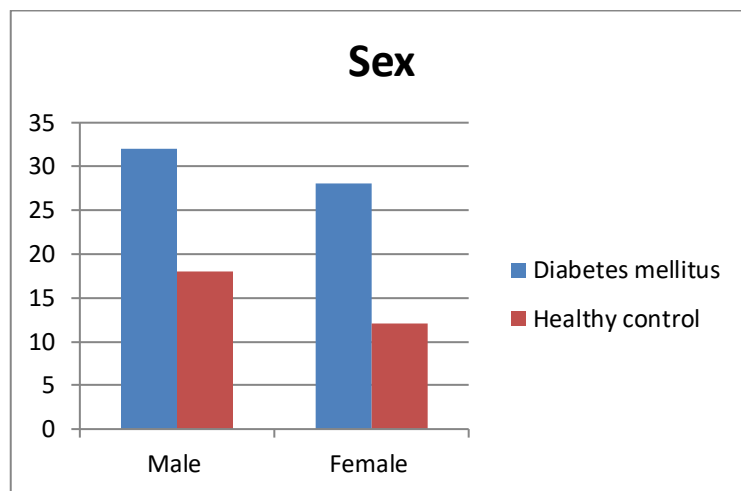


Fig. (2):- T2DM distribution according to Sex.

Diabetes mellitus is presently foreseeable as one of the greatest extensive chronic diseases, representative a thoughtful burden of global health. A significant proportion of patients progress severe complications over time since of persistent hyperglycemia. Among these, T2DM has appeared as an important public health issue, affecting nearly 15% of individuals living with diabetes worldwide [9]. Given the growing prevalence and the ruggedness of its complications, there is a persistent need to improved appreciate the pathological and molecular mechanisms underlying diabetic progression. Improved insight into these procedures may contribute to previous examination and the development of more targeted and active therapeutic strategies [10].

Distribution of T2DM patients according to age groups

The result that showed in Figure (3), the maximum frequency of T2DM was experimental among patients aged 36–45 years, the 26–35 and 46–55 age groups followed this. Lower occurrences were recorded in those older than 55 years, while the 15–25 age group showed the lowest number of cases. The distribution across these groups was 29, 12, 11, 5, and 3 cases, respectively.

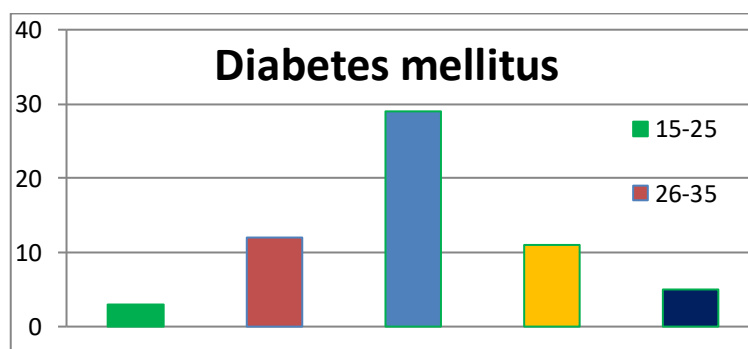


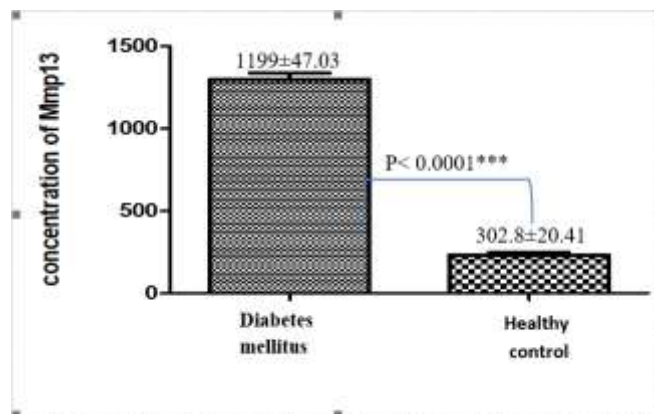
Figure (3):- Type II diabetes mellitus patient’s distribution according to Age.

The results of the present study are linked with those reported by [24], who pragmatic that the prevalence of T2DM was highest (50%) among individuals aged 48–57 years. Similar tendencies have also been recognized in other investigations. For example, [11] noted a

significantly increased incidence of diabetes among older age groups. Likewise, [12] reported a prevalence rate of 31% in individuals between 51 and 60 years of age. These findings cooperatively provision the strong connotation between increasing age and the risk of developing T2DM.

Evaluation of Mmp-13 in Diabetes mellitus

The our study demonstrated that mean the MMP-13 concentration (pg/ml) in patients with diabetes mellitus was 1199 ± 47.03 pg/ml, which was significantly higher compared with the healthy control group, where the mean level was 302.8 ± 20.41 pg/ml, as illustrated in Figure (4).



Figure(4): Serum level of Mmp-13 in Diabetes mellitus patients and healthy control.

The findings of the current study revealed that higher levels of serum MMP-13 in T2DM patients compared with those with control. These results are consistent with the study by [13], which reported a significant elevation in serum MMP-13 levels among patients with type 2 diabetes mellitus compared with healthy controls.

Diabetes Mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia that leads to multiple biochemical and inflammatory alterations in body tissues. Chronic elevation of blood glucose can stimulate inflammatory pathways and oxidative stress, which in turn influence the activity of several extracellular matrix-degrading enzymes. Among these enzymes, Matrix Metalloproteinase-13 plays an important role in the degradation of collagen and remodeling of the extracellular matrix. Increased expression of MMP-13 has been reported in diabetic conditions, where prolonged hyperglycemia may enhance its production through inflammatory mediators. This elevation may contribute to tissue damage and impaired wound healing commonly observed in diabetic patients. Therefore, alterations in MMP-13 levels may reflect pathological changes associated with diabetes and could provide useful insight into the molecular mechanisms involved in diabetic complications [25].

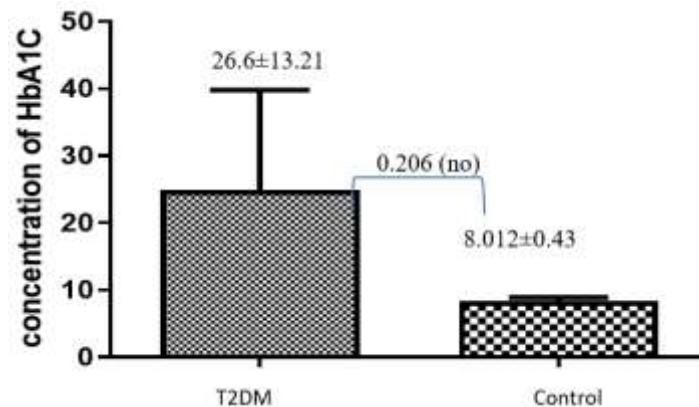
Collagenase-3 is the other name for Matrix metalloproteinase-13, is an interstitial collagenase that has been found to be overexpressed in various types of malignancies as well as in cancer-associated stromal cells [14]. MMP-13 is capable of degrading several extracellular matrix components, including collagens type I, II, and III, in addition to other matrix proteins. Its secretion and expression are strongly controlled at both the cellular levels and transcriptional [15]. Accumulating evidence recommends that MMP-13 plays a significant role in metastasis and tumor initiation, mostly due to its capacity to modify and extracellular matrix (ECM) degradation, thereby facilitating invasion of cancer cell and progression [16].

Various MMPs play essential roles in the normal wound-healing process. At the early stage of repair, MMPs contribute to the removal of necrotic and damaged tissue, thereby preparing the

wound bed for regeneration. During the proliferative phase, they are involved in key processes such as angiogenesis, matrix contraction, and the migration of fibroblasts and keratinocytes, as well as re-epithelialization [17]. In the final remodeling phase, MMPs participate in restructuring connective tissue to restore tissue integrity. Overall, effective wound healing and tissue repair depend on the balanced and precisely regulated expression of different MMPs across specific times and locations [18].

Evaluation HbA1C in T2DM

The current study also found that the mean level of HbA1c (mg/L) in patients with T2DM infection was 26.6 ± 13.21 mg/L, which was no significantly than that observed in control, whose mean level was 8.012 ± 0.43 mg/L, as illustrated in Figure (5).



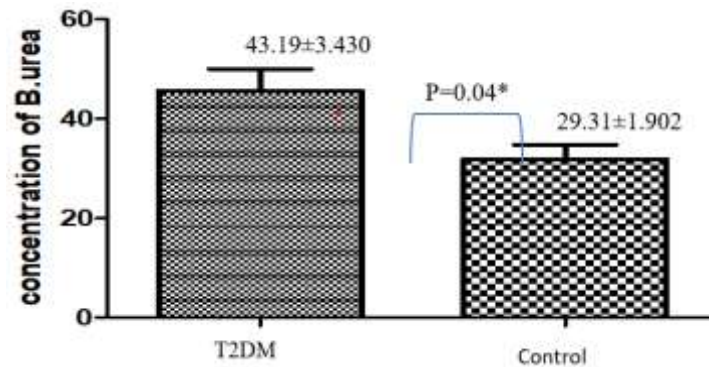
Figure(5): blood level of HbA1C in diabetes patient.

The findings of the present study showed that serum HbA1c levels did not differ significantly between patients with T2DM and the healthy control group ($p = 0.206$). This observation is consistent with the results reported by [19], who likewise found no significant differences between T2DM patients and healthy individuals according to HbA1c levels ($p = 0.9001$).

Earlier studies conducted in Sudan, Australia, and the United States [20] reported that elevated HbA1c levels were associated with an increased risk of T2DM development. In dissimilarity, the results of the current study did not prove such an association. Furthermore, a review of the available literature indicates that no previous investigations have examined the predictive value of HbA1c for T2DM occurrence in the Pacific Islands. The discrepancy between our findings and preceding intelligences may be accredited to methodological limitations, with the use of suitability sampling and a relatively small sample size, which could have limited the statistical power to detect significant differences. Therefore, future studies with larger sample sizes and randomized sampling methods are recommended to provide more robust and generalizable results.

Urea Evaluation in Diabetes patients

The our research also demonstrated that mean the urea concentration (mg/L) in T2DM patients was 43.19 ± 3.430 mg/L, which was low significantly increase than that observed in control, whose mean level was 29.31 ± 1.902 mg/L, as illustrated in Figure (6).



Figure(6): Urea serum level in T2DM patients and control.

The findings of the present study showed that serum urea levels were significantly higher in patients with T2DM compared to those with control alone ($p = 0.04^*$). However, this result differs from the findings of [21], who reported no significant differences in urea levels between patients with T2DM and those with control.

Renal dysfunction differed significantly between T2DM and control, as indicated by abnormal serum urea levels. These findings are supported by [22], who identified renal impairment as an important risk factor for lower limb amputation among individuals with diabetes. Similarly, [23] reported that diabetic patients with kidney dysfunction were at a higher risk of undergoing lower extremity amputation. Impaired kidney function may lead to the accumulation of metabolic waste products in the body, which can contribute to nerve damage and increase the likelihood of developing foot ulcers [24].

CONCLUSION

This study presented increase significantly (MMP-13) levels in T2DM compared to controls, demonstrating its possible role in the pathogenesis of T2DM and connected with tissue injury. A higher proportion of cases was experiential among males, with the 36–45 years age group being the most affected. These findings suggest that MMP-13 may serve as a beneficial biomarker for monitoring disease progression and extracellular matrix remodeling in patients with T2DM.

CONFLICT OF INTEREST:

The authors declare no conflict of interest.

FUNDING:

The study self-funded.

ETHICAL CLEARANCE:

Permission was taken from the concerned authorities. Patients were also informed about the purpose of the study and they all gave their consent to participate in the study.

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