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Assessment of Type 1 Diabetes Patients' Sialic Acid Binding Immunoglobulin-Like Lectin-1 Level

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Abstract

Type 1 diabetes is an autoimmune genetic disease. This study aimed to determine the analytical estimation of SBI-like lectin-1 levels in the serum of type 1 diabetes patients and their relationship to hyperglycemia. **Methods:** This study was conducted on type 1 diabetes patients who visited the Diabetes and Endocrinology Center in Najaf Governorate, Iraq, between November 1, 2023, and February 1, 2024. The study also included sixty (60) patients (40 males and 20 females) and thirty (30) controls (apparently healthy), and glycated hemoglobin (HbA1c) values among individuals with diabetes as opposed to the control groups, and a significant decline ($P < 0.05$) in Siglec-1 levels in diabetic patients compared to the control groups. The present results indicated a decrease in sialic acid-like lectin-binding immunoglobulin-1 (Siglec-1) in the serum of type 1 diabetic patients compared to the control group. The study showed a significant decrease ($P < 0.05$) in Ceglic-1 levels in patients who received treatment. Male type 1 diabetes patients showed lower levels ($P < 0.05$) of Siglec-1 compared to female patients. The current study concludes that Ceglic-1 is a prognostic marker used to predict type 1 diabetes, especially in patients newly diagnosed at a younger age and with a shorter disease duration.

Keywords: type 1 diabetes, sex, Siglec-1

Introduction

The insulin is necessary for life to avoid coma, death, and the development of ketoacidosis for Diabetes mellitus type 1 or insulin-dependent diabetes, which is defined by the loss of beta cells in the pancreas, may result in diabetes mellitus (1-3). Hyperglycemia, characterized by abnormally high blood glucose levels, is a hallmark of the complex metabolic disorder diabetes mellitus (DM) or diabetes (4,5).

Hyperglycemia is a chronic and diverse illness that results from abnormalities in either insulin action, production, or both. It manifests as protein, lipid, and carbohydrate metabolic dysfunctions (6-8). Diabetes presents in many different ways, has a complex etiology, and progresses over time (9,10). About 5–10% of all occurrences of diabetes are in earlier nomenclature, type 1 diabetes mellitus (T1DM) was sometimes referred to as insulin-dependent diabetes mellitus (IDDM), juvenile-onset diabetes, or type 1A DM (11,12). The hallmark of this autoimmune disease is the killing of pancreatic β-cells by T-cells, which leads to insulin deficiency and, eventually, hyperglycemia (13,14). Sialic acid recognizes the extracellular lectin domain of a type 1 membrane molecule family called sialic acid binding immunoglobulin-like lectin (Siglecs) (15,16). Tyrosine phosphatase 1,2-containing proteins are

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activated. However, Siglecs have a particular inhibitory receptor by tyrosine-based inhibition motifs immune receptor (ITIMs), which prevents cell activation by dephosphorylating signaling molecules like tyrosine kinase SYK and Src family kinases (SPKs) (17,18). contain glycans and, correspondingly, 1–16 C-set Ig domains of an antibody, and Siglec's structural characteristics play a part as receptors in immunological response and cell signaling (19,20).

Materials and Methods

Subjects

The present study was designed to investigate an important biomarker, Siglec-1, as a prediction or prognostic biomarker in patients with type 1 diabetes and its relationship with hyperglycemia (Glucose concentration and HbA1c)

The following criteria were dependent on the current study

1. Glucose concentration and HbA1c%
2. Biomarker (Siglec-1) level in serum
3. Sex (male or female)

Biomarkers assay

Measurements of fasting blood glucose and HbA1c

A blood glucose monitor (On Call Plus, Acon-Germany) was used to test blood glucose, and an ichroma was used to measure HbA1C. HbA1c is a fluorescence immunoassay (FIA) used to measure HbA1c quantitatively (Botech, Korea).

Biomarker measurement

Human Sialic acid binding immunoglobulin-like lectin-1 kits (My-Biosource, USA) are used to measure serum Sialic acid binding immunoglobulin-like lectin-1 using the sandwich immunoassay technique (enzyme-linked immunosorbent assay-automated microtiter plate ELISA reader, Biotek, USA).

Statistical analysis

SPSS version 20 was utilized for data analysis, and the study employed correlation and the t-test, which is independent across patients and controls.

Results

Diabetes type 1 patients and control group HbA1c(%)

The percentage of glycated hemoglobin (%) in the venous blood of patients with type 1 diabetes was clearly and significantly higher ($p<0.05$) than that of the control group (4.6367 ± 0.653), as seen in Figure 1. As seen in Figure 2, the data revealed no discernible differences between men and women.

Fasting blood Glucose concentrations in patients compared with the control group:

Type 1 diabetes patients had a significantly higher ($p<0.05$) fasting blood concentration (215.576 ± 7.30595) mg/dL than the control group (80.3333 ± 1.72962) mg/dL, according to the data displayed in Figure 3.

Sialic acid binding immunoglobulin-like lectin-1 for type 1 diabetes patients and the control group.

According to Figure 4, the serum Siglec-1 concentration level in type 1 diabetes patients was significantly lower ($p<0.05$) at 2.5555 ± 0.15658 ng/ml than in the control group (12.3050 ± 0.2516 ng/ml).

Sialic acid-binding immunoglobulin-like lectin-1 level between diabetes type1 patients according to sex

According to the findings in Figure 5, the level of Siglec-1 concentration in blood serum at different sexes of patients with type 1 diabetes has significantly decreased ($p<0.05$). The male group's concentration (1.9347 ± 0.234) ng/ml is significantly lower ($p<0.05$) than the female group's (3.7070 ± 0.26851) ng/ml.

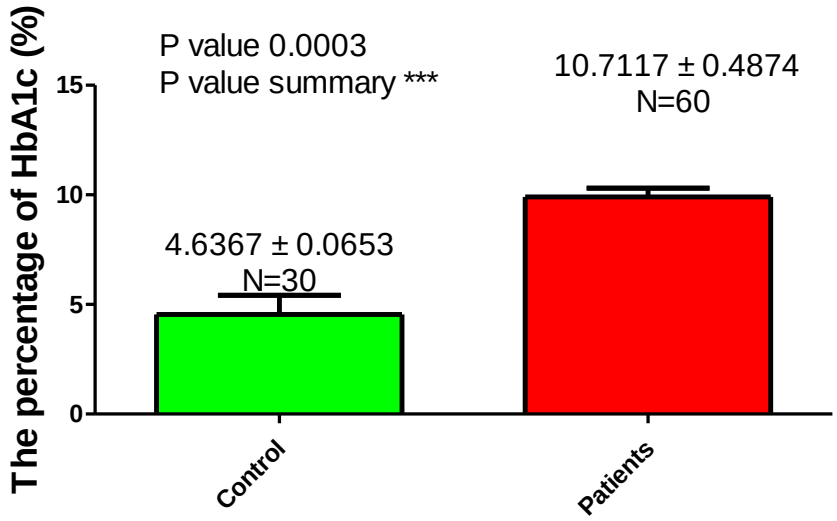


Figure 1: The percentage of HbA1c (%) in diabetes type 1 in patients compared with the control group

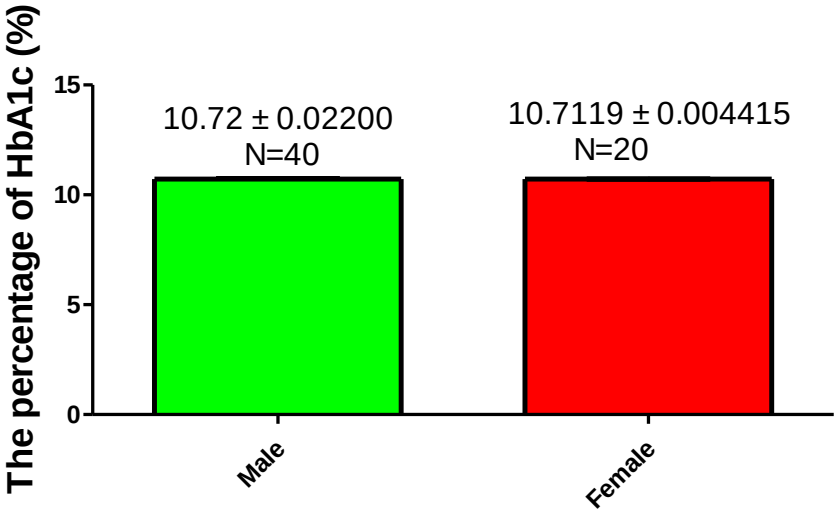


Figure 2: Hemoglobin A1c (HbA1c) (%) in men and women with type 1 diabetes

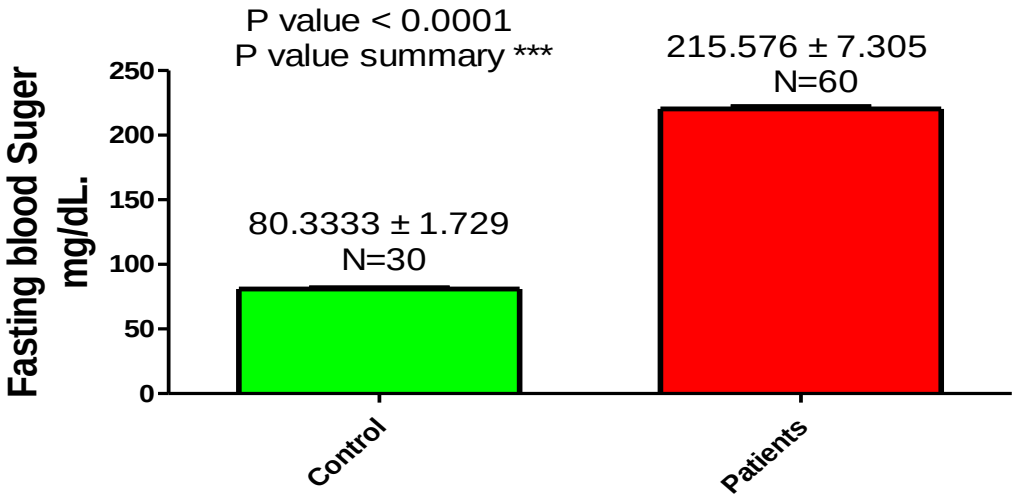
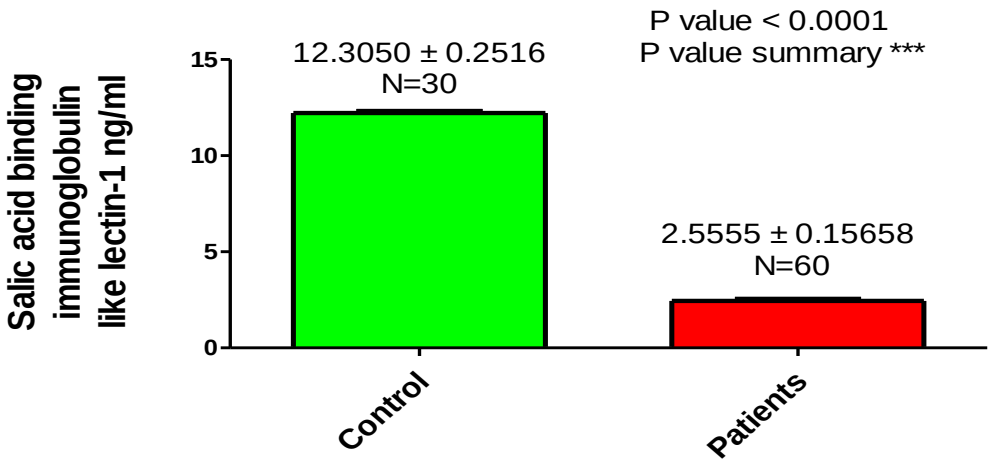


Figure 3: Fasting blood in type 1 diabetes patients compared with the control group



Figurer. (4) Sialic acid-binding immunoglobulin-like lectin-1 level between type 1 diabetes patients and the control group

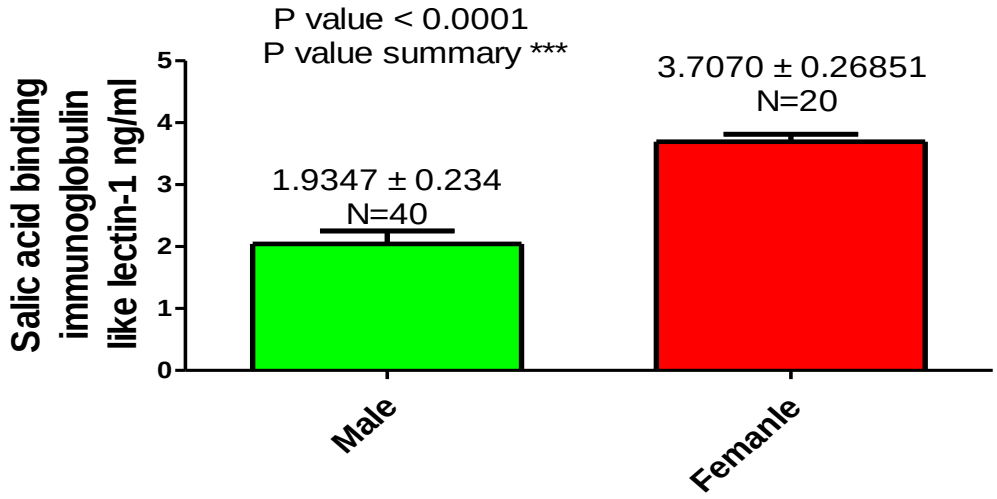


Figure 5: Salic acid-binding immunoglobulin-like lectin-1 level between type 1 diabetes patients according to sex

Discussion

The results showed a significant decrease in Siglec-1 expression in type 1 diabetes patients compared to the control group. Previous studies on the role of Siglec-1 in type 1 diabetes are very few, and the current findings are consistent with previous research that has shown decreased expression of Siglec-1 in several autoimmune diseases, such as rheumatoid arthritis, type 1 insulin-dependent diabetes, and endocrine syndrome. These studies concluded that the altered expression of Siglec-1 may play an important role in autoimmune disease (21,22). A recent study found that Siglecs are transmembrane receptors expressed on many blood cells that bind sialic acid to glycoproteins or glycolipids. This binding plays an important role as an immune checkpoint in regulating the immune response and inflammatory diseases (23,24). The mechanism of inhibition or subsequent activation of Siglec is that both immune receptors, such as

intracellular tyrosine-based inhibitory elements (ITIMs), are phosphorylated by Src family kinases, as well as phosphorylation that produces high-affinity sites for the Src 2 region containing phosphatase 1 (SHP)-1 and SHP-2 may act as dephosphorylated receptor tyrosine phosphorylation and lead to immunosuppression (25,26). Several studies on the Siglik family, such as Siglec-1, have indicated that Sigliks are immunomodulatory receptors that act as immunosuppressants, but when negatively regulated or decreased Siglik levels lead to immune activation and autoimmune diseases due to their ability to be expressed on white blood cells in the immune system, such as Siglec-1, also called sialodisin or CD 169 (27,28). In previous studies, it has been documented that some TLRs may act as inducers of Siglec-1 expression in monocytes, macrophages, and neutrophils, influencing the immune response or triggering autoimmune diseases, such as type I interferon (IFN) activation in patients with systemic lupus erythematosus (SLE) and type 1 diabetes (29,30). An important explanation for the role of Siglec-1 in chronic autoimmune inflammation is provided based on a positive correlation between Siglec-1 and neutrophil recruitment to macrophages (31,32).

The Siglec-1 with glucose concentration and HbA1c. These results agree with (33), who indicated a relation between inhibition of Siglec-1 as an immune checkpoint and incidence of diabetes with high levels of glucose and HbA1c in diabetes type 1and indicated that a low expression of Siglec-1 on β-cell induced type 1diabetes. In a previous study, it has been shown that association between low expression of Siglec-1 and susceptibility to immune diseases, Such as diabetes, with more destruction in β-cells (34,35). The importation of low explanation of low expression of Siglec-1 in autoimmune diabetes 1 in relation to high blood glucose and HbA1c occurs by autoactivation of T-cells may cause high destruction of β-cells (36,37).

Conclusion

According to the current study, lectin-1, an immunoglobulin-binding sialic acid, serves as a predictive marker for the identification of type 1 diabetes. especially in newly diagnosed patients of a younger age with a short duration of disease.

Conflict of interest: NIL

Funding: NIL

References

1- Guati C, Gomez-Coma L, Fallanza M, Ortiz I. Glucose sensors in medicine: overview. Physical Sciences Reviews. 2025 Mar 28;10(3):339-56.

2- Al-Najeem HT, Al-Dujaili AN. Assessment of bone morphogenetic protein receptor 2 level in pulmonary arterial hypertension disease. Research Journal of Pharmacy and Technology. 2017;10(8):2614-8.

3- Yameny, A. Diabetes Mellitus Overview 2024. *Journal of Bioscience and Applied Research*, 2024; 10(3): 641-645. doi: 10.21608/jbaar.2024.382794

4- Dyer RB, Laurenti MC, Christie HE, Mohan S, Egan AM, Dalla Man C, Vella A. Enhanced quantification of α-cell suppression by hyperglycemia using a high-sensitivity glucagon assay. American Journal of Physiology-Endocrinology and Metabolism. 2025 Jan 1;328(1):E62-8.

5- Al-Fatlawi NA, Al-Dujaili AN, Kammona TH. Assessment B-cell-activating factor (BAFF) in thrombocytopenia patients. In AIP Conference Proceedings 2020 Dec 4 (Vol. 2290, No. 1). AIP Publishing.

6- Saleem H, Al-Dujaily AN, Al-murshidi MH. Effect of Methanolic Leaf Extract of Moringa oleifera on some Biochemical Markers in obesity induced rats. RESEARCH JOURNAL OF PHARMACEUTICAL BIOLOGICAL AND CHEMICAL SCIENCES. 2016 May 1;7(3):2222-32.

7- Al-Dujaili AN, Al-Kraity WR. Assessment of CD-147 Level in women with coronary heart disease after menopause. Research Journal of Pharmacy and Technology. 2018;11(1):317-20.

8- Yameny, A. Diabetes Mellitus: A Comprehensive Review of Types, Pathophysiology, Complications, and Standards of Care in Diabetes 2025. *Journal of Medical and Life Science*, 2025; 7(1): 134-141. doi: 10.21608/jmals.2025.424001

9- Al-Najeem HT, Al-Dujaili AN. Assessment of Gremlin-1 Level in Pulmonary Arterial Hypertension Disease. Research Journal of Pharmacy and Technology. 2017;10(11):3803-6.

10- Al-Fatlawi NA, Al-Dujaili AN, Kammona TH. Assessment FC gamma receptors (FCGR) IIb in thrombocytopenia patients in Holy-Najaf. In AIP Conference Proceedings 2020 Dec 4 (Vol. 2290, No. 1). AIP Publishing.

11- Almsaid H, Khalfa HM. The effect of Ketogenic diet on vitamin D3 and testosterone hormone in patients with diabetes mellitus type 2. Current Issues in Pharmacy and Medical Sciences. 2020;33(4):202-5.

12- Al-Msaid HL, Al-Sallami AS. Study the level of cytokines in unexplained and idiopathic infertile men. Journal of Pharmaceutical Sciences and Research. 2018 Apr 1;10(4):808-11.

13- Shakir Alkhafaji R, Muhsin Khalfa H, Lf Almsaid H. Rat hepatocellular primary cells: A cellular and genetic assessment of the chitosan nanoparticles-induced damage and cytotoxicity. Archives of Razi Institute. 2022 Apr 30;77(2):579-84.

14- khalfa HM, al-msaid HL, abood AH, naji MA, Hussein SK. Cellular genetic expression of purinergic receptors in different organs of male rats injected with cyclophosphoamide. In AIP Conference Proceedings 2020 Dec 4 (Vol. 2290, No. 1, p. 020033). AIP Publishing LLC.

15- AL-Msaid HL, Waleed AH, AL-Sallami AS. Relationship Between Hyperviscosity and Sex Hormone in Azoospermia and Oligozoospermia Patients Compares with The Control Group. Int J Pharm Qual Assur. 2019;10(4):637-9.

16- AL-Msaid HL, Khalfa HM, Rashid AA, Hussain NN. Relationship between Sperm DNA Fragmentation and Interleukin 17 in Patients with Leukocytospermia. Journal of Bioscience and Applied Research. 2024 Nov 21;10(4):809-15.

17- Ali LO, Khalfa HM, Al Sahlanee R, Almsaid HL. Histological changes in liver and cardiac rat tissues after exposure to chitosan nanoparticles orally. Medical Journal of Babylon. 2023 Jan 1;20(1):215-8.

18- Tikki KA, Al-Ethari AS, Al-Msaid HL. The effect of fingolimod drug on blood profile in multiple sclerosis patients. InAIP Conference Proceedings 2023 Dec 22 (Vol. 2977, No. 1). AIP Publishing.

19- AL-Msaid HL, Aledhari M, Alrehbawy R. Investigation of Some Clinical Parameters in Renal Failure Patients. Journal of Bioscience and Applied Research. 2024 Dec 19;10(6):174-9.

20- Benucci B, Spinello Z, Calvaresi V, Viviani V, Perrotta A, Faleri A, Utrio Lanfaloni S, Pansegrau W, d'Alterio L, Bartolini E, Pinzuti I. Neisserial adhesin A (NadA) binds human Siglec-5 and Siglec-14 with high affinity and promotes bacterial adhesion/invasion. Mbio. 2024 Aug 14;15(8):e01107-24.

21- Al-Tameemi HK, Al-Husseini RM, Al-Mudhafer RH, Abid HA, Al-Gazali HR, Abdullah DA, Albaldawy MT. Molecular and immunohistochemical study of APC exon 16 and its possible role in colorectal carcinoma development. Heliyon. 2024 Feb 15;10(3).

22- Mohamed AH, AlKhafaji RS, Al-Saadi AH. Association between Vitamin D Deficiency and Vitamin D Receptor Gene Polymorphism

(FokI-rs2228570) among Men with Anemia in Babylon Province, Iraq. Archives of Razi Institute. 2022 Oct 31;77(5):1693.

23- Feng H, Feng J, Han X, Ying Y, Lou W, Liu L, Zhang L. The potential of siglecs and sialic acids as biomarkers and therapeutic targets in tumor immunotherapy. Cancers. 2024 Jan 10;16(2):289.

24- Mejbel FA, ALhadrawi KK, Aljanaby IA, Aljanaby AA. A statistical–retrospective study of pulmonary tuberculosis in Iraqi Kurdistan Governorates. InE3S Web of Conferences 2023 (Vol. 381, p. 01100). EDP Sciences.

25- Mezher MN, Mejbel FA, Hussein HK. Detection of herpes simplex-2 virus in women with spontaneous abortion in Al-Najaf city/Iraq. Journal of Pharmaceutical Sciences and Research. 2018;10(5):0975-1459.

26- Abadi AK, Abdul-Hussein Mejbel F. Study of the effect of antifungal on Candida albicans isolated from different cases. Plant Archives (09725210). 2020 Apr 1;20(1).

27- Hussein, A.R., Mejbel, F.A.H. and Aldujaili, N.H., 2022, October. Detection of insertion/deletion in MIF introns in Rheumatoid arthritis patients and healthy persons in Iraq. In AIP Conference Proceedings (Vol. 2398, No. 1). AIP Publishing.

28- Khalaf S, Mejbel FA. Phenotypic and genotypic diagnosis of Candida albicans isolated from different sources. Plant Archives. 2019;19(2):594-7.

29- Mejbel FA, Raouf EA, Zainab AS, Ali A. EFFECT OF SOME PLANT EXTRACTS AGAINST VIRULENCE FACTORS OF CANDIDA ALBICANS ISOLATED FROM UTI PATIENTS. Biochemical & Cellular Archives. 2018 Apr 1;18(1).

30- Boz V, Tesser A, Burlo F, Donadel N, Pastore S, Amaddeo A, Vittoria F, Padovan M, Di Rosa M, Tommasini A, Valencic E. Siglec-1, an easy and contributory inflammation marker in rheumatology. Clinical & Translational Immunology. 2024;13(7):e1520.

31- Chen Z, Ma Z, Gao J, Gao Y, Mei F. Relationship Between Serum MMP-2, Siglec-1, Th1/Th2 Cell Ratio, and Disease Activity in Rheumatoid Arthritis. Alternative therapies in health and medicine.:AT10385.

32- Faihan WA, Darweesh MF. Investigate role of miRNA146a and IL-17 level in progressive rheumatoid arthritis disease. The Egyptian journal of immunology. 2024 Jul;31(3):71-80.

33- Guo M, Guo H, Zhu J, Wang F, Chen J, Wan C, Deng Y, Wang F, Xu L, Chen Y, Li R. A novel subpopulation of monocytes with a strong interferon signature indicated by SIGLEC-1 is present in patients with in recent-onset type 1 diabetes. Diabetologia. 2024 Apr;67(4):623-40.

34- Honardoost MA, Adinatha A, Schmidt F, Ranjan B, Ghaeidamini M, Arul Rayan N, Gek Liang Lim M, Joanito I, Xiao Xuan Lin Q, Rajagopalan D, Qi Mok S. Systematic immune cell dysregulation and molecular subtypes revealed by single-cell RNA-seq of subjects with type 1 diabetes. Genome Medicine. 2024 Mar 27;16(1):45.

35- Gao W, Zhu Y, Zhang S, Wu Z. Immune mechanisms of type 1 diabetes revealed by single-cell transcriptomics, bulk transcriptomics, and experimental validation. bioRxiv. 2024 Dec 17:2024-12.

36- Yadav K, Pradhan M, Singh D, Singh MR. Macrophage-associated disorders: pathophysiology, treatment challenges, and possible solutions. In Macrophage Targeted Delivery Systems: Basic Concepts and Therapeutic Applications 2022 Feb 22 (pp. 65-99). Cham: Springer International Publishing.

37- Brzezicka KA, Paulson JC. Impact of Siglecs on autoimmune diseases. Molecular aspects of medicine. 2023 Apr 1;90:101140.