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THE EFFECT OF DIABETES MELLITUS TYPE I AND TYPE II ON WHITE BLOOD CELLS

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ABSTRACT

Diabetes mellitus (DM) is a growing global public health problem. The purpose of this study was to evaluate the elevated white blood cell (WBC) count associated with diabetes. Therefore, we investigated the relationship between WBC count and type I and II diabetes. We also examined the relevant variables of WBC count. A total of 300 subjects were recruited. This study found increasing association between age, sex and years of treatment. A total of 300 recruited T1D and T2D patients constituted the subjects for this case-control study. Subjects included 150 patients type I and 150 patients type II. The age range was 3-70 years. The WBC count, lymphocytes and neutrophils were determined using standard methods and the results were compared statistically with values obtained from non-diabetic controls. The white total WBC counts were significantly higher in the study groups in comparison with the control group (P=0.05). This study showed elevated levels of cells in association with diabetes, age, sex as well as years of treatment.

KEYWORDS: Diabetes mellitus, Type I diabetes, Type II diabetes, WBC, Lymphocyte, Neutrophils.

INTRODUCTION

Hematological abnormalities affecting most cell types are common among people with diabetes. White blood cell changes may highlight inflammation or immunological problems before or during the onset of diabetes. Patients with poor glycaemic control (higher blood sugar) had lower PCV compared to those with lower blood sugar level. The mean numbers of platelets (PLT) and WBCs were significantly higher in contrast to non-diabetic controls. We observed that both PLT and WBC counts increased with increasing hyperglycemia. The mean PCV, PLT and WBC count of diabetic subjects based of their blood sugar levels increased, too. We observed a significant positive correlation between high PLT and white blood cell count and raised blood sugar level among the diabetic subjects studied.[1,2] Elevated circulating WBC count was associated with the worsening of glucose metabolism even when the WBC level was within the normal range. Elevated plasma WBC count could indicate higher risk of IGR and T2DM. WBC count was also associated with WHR, BMI, triglycerides, HDL level, HbA1c and 2-h PG, suggesting that weight loss, lipid-modifying therapies, and control of postprandial plasma glucose and HbA1c may ameliorate the chronic subclinical inflammation.[3,4,5] Another study demonstrated that a single measurement of white blood cell in healthy, normoglycaemic young men may predict diabetes incidence independently from the other traditional risk factors for diabetes such as fasting glucose and triglyceride levels, and family history. A previous study reported that for every increase in 1,000 cells/mm^3 within the normal range of the WBC count, the risk for diabetes increases by 7.6%.Additionally, overweight and obese subjects with a relatively low WBC count seem to have a significantly lower risk of diabetes than those with higher levels of leukocytes, which may help in better characterizing obese individuals who are relatively protected from the metabolic derangements frequently associated with obesity. The mean WBC count was 6,620±1,480 cells/mm (range 3,000-12,000) with an average increment of 900 cells/mm3 between consequent quintiles. The WBC level was directly correlated with systolic and diastolic blood pressure, triglyceride level, LDL cholesterol, and rates of current smokers. Physical activity and HDL cholesterol were inversely correlated with white blood cell level.[6,7,8] High levels of WBC predicted the development of diabetes. Moreover, our study demonstrated that a high amount of WBC was associated with a decline in insulin sensitivity. Collectively, these data suggest a role in the cross-sectional relationship between WBC and adiposity of the

degree of obesity. High WBC is associated with a worsening in insulin action and predicts the development of T2D. These findings are consistent with the hypothesis that chronic activation of the immune system may play a role in the pathogenesis of type II diabetes.[10, 11,12] The packed cell volume is lower among diabetic patients compared to those who are non-diabetic. Platelet and total WBC count are significantly higher among diabetic subjects compared to non-diabetic controls. Anemia, thrombocytosis and leukocytosis were associated with raised blood sugar levels among patients with type 1 diabetes.[13,14.15] In general, several studies regarding the effect of diabetes on different systems have been published around the world including the immune system. However, very few studies have been accomplished in Arabic countries particularly in Libya.Therefore, the aim of this study is to assess the influence of diabetes types III on the immune system, exacting on white blood cells count as the elevation of white blood cell count is a suitable and useful marker to confine inflammatory responses. Moreover, acomplete blood count test is inexpensive compared to other inflammatory markers such as interleukin-6 (IL-6). Furthermore, it is a highly sensitivity C-reactive protein (CRP), and is commonly investigated during a regular health check-up in numerous countries.The main aim of this study is to evaluate effects of incidence of type I and type II diabetes on WBC count in the western region of Libya. In addition, to assess whether any association of WBC count with age, sex and years of treatment of diabetic disease.

MATERIALS AND METHODS

Subject and Study Design

The subjects for this study were recruited to the study from November 2017 to September 2018.This case study was designed to investigate some hematological parameters among diabetic patients in western Libya. Our study monitored the total WBC count and platelet count. The inclusion criteria were people of 3-70 years, who agreed to participate in the study. Patients with acute infection and consumption of drugs affecting white blood cell count, such as for hyperthyroidism, immune and haematological diseases, were excluded. All participants were permanent residents. The participants were screened by: (a) a questionnaire for detailed medical history medication use, age and years of treatment, (b) laboratory tests (complete blood count), including white blood cell count, hemoglobin and platelet count.

Study Area

This present research work is carried out at the Central Hospital of Zawia and Zawia Diabetic Center. The Zawia Diabetic Center provides health care to diabetic patients and is located in the south region of Zawia city. Our daily presence in these centers to study some of cases was required.

Procedure

A white blood cell count or complete blood cell test requires a simple blood test. A doctor typically takes blood from a vein in the arm after disinfecting the area. An elastic band goes around the bicep to make the veins swell, which makes it easier to insert the needle and draw blood. Three milliliters of blood were collected from each participant into a tube contained EDTA. EDTA is an anticoagulant which was used for the determination of hematological parameters. WBC count was measured using an automated hematology analyzer Sysmex KX-21N (Sysmex Corporation, china). All tests were made in the same laboratory.

This study was conducted on 300 participants of both types of diabetes. The patients were aged between 3-70 years (150 of the patients were type I diabetics aged 3-25 years, the other 150were type II patients aged 18-70 years).

RESULTS

The main aim of this study was to assess effects of type I diabetes on WBC count (white blood cell, lymphocyte, neutrophils). This case-control study included 300 recruited subjects with T1D aged 3-25 years and with T2D diabetes aged 18-70 years. The immune cells were significantly lower among subjects with T1D and T2D compared to the non-diabetic controls (p=0.05) especially in the first year of disease.

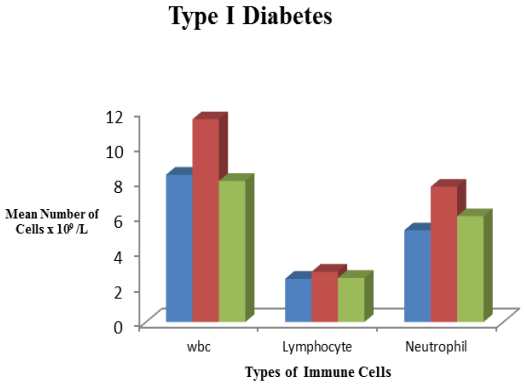

Figure 1: Comparisons of immune cells between male and female with T1D disease.

The mean ± SD of WBC, Blue indicates female, red indicates male and green indicates control. The figure shows that WBCs are significantly higher in males than in females compared with controls (p=0.05). The lymphocytes are slightly higher in males than in females compared to controls. As well as, neutrophils are considerably higher in males compare to females.

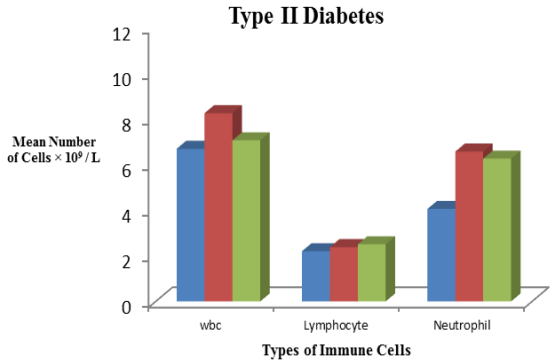

Figure 2: Comparisons of immune cells between male and female with T2D disease.

The mean ± SD of immune cell counts, Blue indicates female, red indicates male and green indicates control. The graph shows that the WBCs are higher in males than in females compared with control. The lymphocytes are slightly lower in males than females. Also, neutrophils are higher in males and lower in females compared with control.

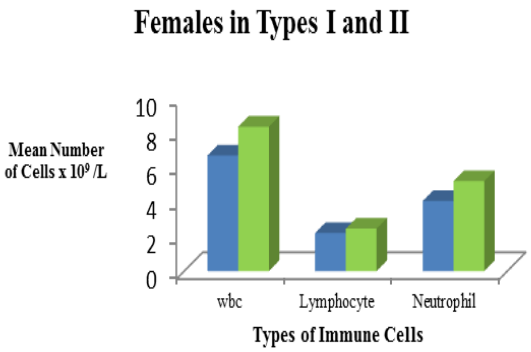

Figure 3: Comparisons of immune cells between females T1D and females T2D.

The portrays significant differences in immune cells between females of T1D and T2D. The figure shows the mean ± SD of immune cell counts. Blue indicates T2D and green indicates T1D. From the graph, it can be interpreted that there is an increase in immune cells (WBCs, lymphocytes, neutrophils) in females of T1D in contrast to females of T2D.

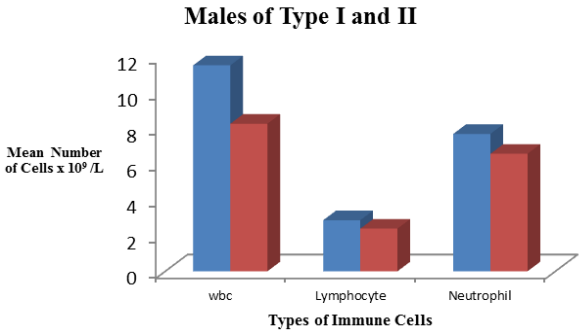

Figure 4: Comparisons of immune cells between T1D males and T2D males.

The mean ± SD of males (T1D and T2D). The figure illustrates an increase in immune cells (WBCs, lymphocytes, neutrophils) among T1D males thanT2D males. Significant differences in immune cells between males of T1D and males of T2D are shown. Blue indicates T1D male and red indicates T2D male.

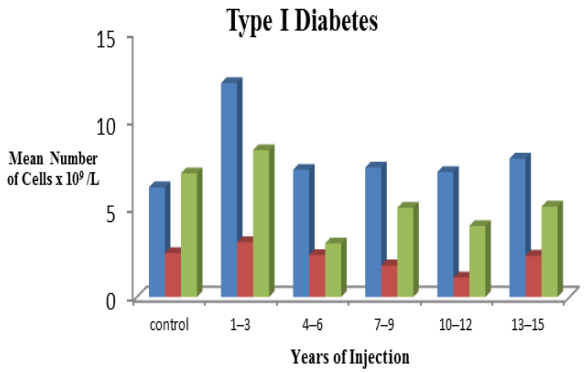

Figure 5: Comparisons of immune cells based on years of insulin injection.

The highest rise of immune cells (WBCs, lymphocytes, neutrophils) is in the first years of injection (1-3 years) compared with control, and then remain almost stable. There are significant differences in immune cells by years of injection. Figure illustrates the immune cells count by mean ± SD. Blue indicates WBC; red indicates lymphocyte and green indicates neutrophils.

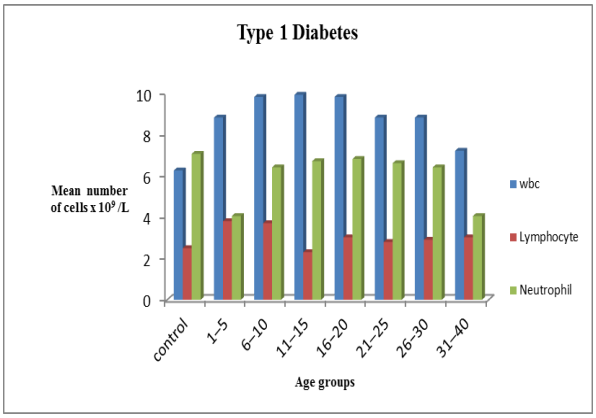

Figure 6: Comparisons of immune cells withT1D based in age.

The immune cell counts (mean ± SD). Blue indicates WBC, red indicates lymphocyte and green indicates neutrophils. From the graph, an increase in the rise of immune cell in patients with T1D among the age groups (1-5, 6-10, 11-15, 16-20) compared with control may be seen. The graph also dictates a fall in the immune cells amid the subjects of the various age groups. It presents significant differences in immune cells by age in T1D.

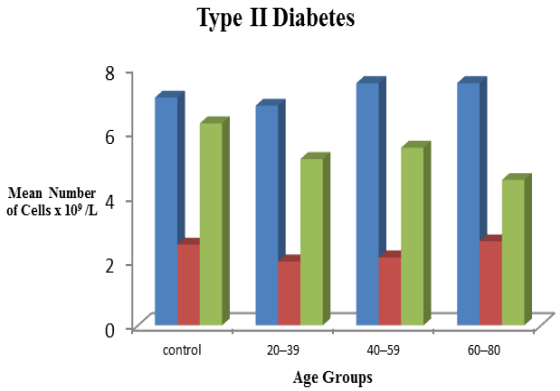

Figure 7: Comparisons of immune cells ofT2D based in age.

The immune cell counts (mean ± SD) according to the age groups (20-39, 40-59 and 60-80). Blue indicates WBCs, red indicates lymphocytes and green indicates neutrophils. It is evidently observed that in T2D there was no significant difference among the age groups. However, in the older age groups, the number of cells tended to be slightly higher.

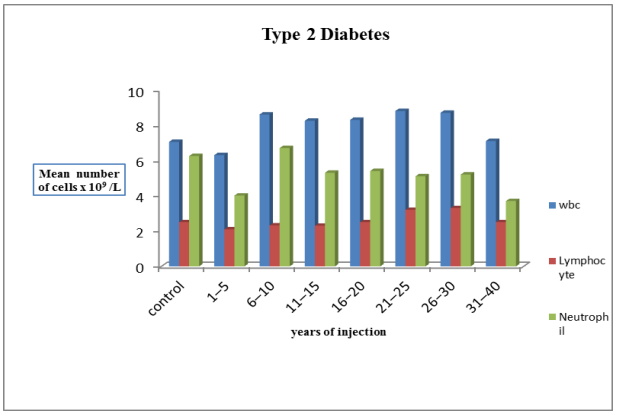

Figure 8: Comparisons of immune cells by years of insulin injection in T2D.

It is visible that there are significant differences in the immune cells according to years of injection in T2D. Blue indicates WBCs, red indicates lymphocytes and green indicates neutrophils. It is interpreted that in the first years of injection (1-5 years), the immune cells are lower compared with the control. However, when the years of injection increase, the immune cells also increase. Nevertheless, after 30 years of injection, the numbers of immune cells fall.

DISCUSSION

The present study was designed to determine the effect of types I and II diabetes mellitus on white blood cells in Zawia city (in the west of Libya). Although this disease is awfully widespread across Libya, very few studies in the region focused on its effects on immune cells. White blood cells can act as an inflammatory marker and evidence suggests elevated counts have a direct relationship with diabetes. In addition, elevated WBC counts, even when within the normal range, may be an independent risk factor in the development of diabetes mellitus-associated with micro- and macrovascular complications. Neutrophils and lymphocyte pattern disturbances in diabetic populations are not widely available in the literature. This study aimed to evaluate whether there are effects of incidence of types I and II diabetes on white blood cell count. The project found increase in white blood cells, lymphocytes and neutrophils in diabetics of both types I and II. This investigation and its findings were supported by previous similar studies in which the conclusions were alike. The findings from a study by Rowan Hillson*et al*. 2008-2013 showed that white blood cell changes may highlight inflammation or immunological problems before or during the onset of diabetes. Moreover, white blood cell counts have shown to be positively correlated with hyperglycaemia.[1,4,7] A study by Int. J. Environ *et al.* 2014 concluded that elevated circulating WBC count was tied with the worsening of glucose metabolism. However, the research carried out by Twig *et al*,2013 reported that the risk of diabetes increased by 7.6%, and levels of white blood cells already as low as 6,900 cells/mm^3.[2,3] The observations from a study by BarboraVozarova*et al*., 2002 revealed that high WBC

levels predicted the development of diabetes. Moreover, our study demonstrated that high intensities of WBC were associated with a decline in insulin sensitivity. Collectively, these data suggest a role of white blood cells in the cross-sectional relationship between WBC and adiposity of the degree of obesity.[11, 12] High measures of WBCs are associated with worsening in insulin action and predict the development of type II diabetes. However, it has been reported that the packed cell volume is lower among diabetic subjects compared to non-diabetics.[1] Platelet and total white cell counts were significantly higher amid diabetic subjects compared to non-diabetic controls. Anaemia, thrombocytosis and leukocytosis were related to raised blood sugar levels amongst patients with type I DM. The present results are consistent with findings of all previous studies mentioned above.[1,7]

This current study also aims to assess the presence of any connection of white blood cell counts with age, sex and years of treatment of diabetes mellitus. The investigation determined that the association between sex and WBC count was significant. Differences were higher in males than females in both types of diabetes. This inquiry also found higher WBC quantities in type I females and males than type II female and male. This study divided the patients of type I and II into groups according to their years of treatment to observe differences between them. Type I patients showed that WBCs were higher in the first years of treatment in contrast to the rest of the years. This is due to the reason that immune cells first resist insulin and then become stable as insulin intake progresses. With type II subjects, this current research perceived that WBC count was low in the first years and gradually increased as the years of treatment continued. From this observation, it was interpreted that WBCs were higher in young subjects than older subjects. In type I, the WBCs were highest during the ages of 1-20 and then almost stable. Type II subjects did not portray significant differences in terms of age groups, but WBC count seemed to be higher in older age groups. To conclude, this investigation found that elevated circulating WBC count was associated with diabetes. It was also established that escalated plasma WBC count could be associated with age, sex and years of treatment in diabetic patients. Understanding the role of white blood cells in the development of diabetes is important for developing future treatment strategies for DM.WBC count, a commonly used and widely available test, is an independent risk factor for diabetes.

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