Texila International Journal of Academic Research
Volume 6, Issue 2, Oct 2019

Comparative Study of Haematological Parameters in Male-Female Diabetics and Non-Diabetics in Abuja, Nigeria

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Abstract

Diabetes mellitus (DM) is a disease caused by a deficiency or diminished effectiveness of endogenous insulin. The complicationsof diabetes mellitus are known to be very severe, unbearable, incapacitating, fatal, and has high health and economic burdens. This study was conducted to compare hematological parameters in diabetic males and females compared with non-diabetic individuals. This study was done at the Defense Reference Laboratory, Asokoro, Abuja, Nigeria. Venipuncture was performed on all participants; Complete Blood Count was carried out with 2ML-EDTA blood tubes using the Sysmex platform while Fasting blood sugar was done using 2ML-Fluoride Oxalate blood tube. This assay was done using an automated Chemistry analyzer (Selectra Pro-S). The data were analyzed using SPSS for Windows version 25.0. A total of 200 participants including 40 diabetic males, 60 diabetic females, 48 non-diabetic males, and 52 non-diabetic females were recruited for the study. The values of FBS and MCHC were significantly higher in the diabetic male and female group. The mean values of PCV and MCV were significantly higher in both male and female non-diabetic group. The values of HB, RBC, and PLT-CT were also significantly lower in diabetic male but not significantly in females. There were 48% cases of anaemia among diabetic females 27% among non-diabetic females whereas only 13% anaemia was seen for diabetic males. Hematological parameters should be evaluated and treated periodically in both male and female diabetic patients to reduce the burden of DM and ocular morbidity due to retinopathy.

Introduction

Diabetes mellitus (DM) represents one of the most challenging public health problems of the 21st century and is reaching epidemic levels globally(Whiting *et al.*, 2011).DM still remains seriously under-reported, partly because many people with diabetes do not realize they have it and do not seek help until they have developed serious complications that may even result in death. About 3.1 million people in Nigeria live with Diabetes mellitus(Chinenye, 2012).

A complication of Diabetes mellitus (acute and chronic) can be severe, debilitating and fatal. Diabetes is the leading cause of non-traumatic lower limb amputation and end-stage kidney disease, and it is also associated with eye disease, particularly diabetic retinopathy. DM has cardiovascular disease as one of its serious and common complications and is the most common cause of death among diabetic patients. Similar to the other parts of the world, Sub-Saharan Africa is experiencing an increasing prevalence of diabetes as it is to other non-communicable diseases(Kimando *et al.*, 2017). With this increasing awareness of the disease, studies conducted on the issue are limited, especially in Nigeria.

Several studies have reported the prevalence of DM among males and females in Nigeria since 1989. Erasmus*et al.*(1988) reported no significant difference between male and female in Ilorin while the ratio of male to the female diabetic patient was reported to be 1.4:1 in Port Harcourt(Rasaki *et al.*, 2017)reported a higher prevalence of DM in females than in males in Oke-Ogun, Nigeria. Although

DOI: 10.21522/TIJAR.2014.06.02.Art007
ISSN: 2520-3088

some data are available on the comparison of the prevalence of DM among males and females in Nigeria, the comparative study of hematological parameters of male and female DM patients is rather scanty; hence this study is timely and important in providing information that will help to better the management of diabetes in Nigeria.

Methods

This case-control study was carried out in Abuja, Federal Capital of Nigeria at the Defense Reference Laboratory, Asokoro. The participants were divided into two groups; 100 diabetic patients and 100non-diabetic participants. The data obtained included socio-demographic data. Both the diabetics and non-diabetics who agreed and gave their informed consent were recruited for this study. Patients with a cute illness including hematologic diseases, atherosclerotic diseases, hepatic failure, renal failure, heart failure, chronic infections, alcohol abuse, and those were on medication that would alter the platelet function were not included in the study. Ethical clearance was obtained from the Federal Capital Territory Health Research Ethics Committee, (FCT HREC), Abuja and participants were made to sign an informed consent before being recruited into the study.

All participants were venipuncture and a total of 4ml of blood was collected from each participant; 2ml in EDTA for complete blood count and another 2ml in fluoride oxalate blood tube for fasting blood sugar using the vacutainer system. A unique number was given to each participant and was used throughout the study in order to concede their identities. Fasting blood glucose (FBS) using plasma was assayed with Selectra pro S automated chemistry analyser with glucose oxidase technique and was performed using the 2ML Fluoride Oxalate blood tube. Complete Blood Count was performed with 2ML EDTA blood tubes using the Sysmex platform.

The data obtained were inputted and analysed using IBM-SPSS (Statistical Package for the Social Sciences) for Windows version 25. Comparison of mean between two groups was done using one-way ANOVA Analysis of variance setting the significant level at $p<0.05$.

Result

This study comprised 200 (100 diabetics and 100 nondiabetic) participants, including40 diabetic males, 60 diabetic females, 48 non-diabetic males, and 52 non-diabetic females. There was no statistical difference between diabetic and non-diabetic gender ($p= 0.319$).

Comparison of gender heamatological parameters between diabetic and non-diabetic groups

This section examines the influence of gender in the significant differences observed in hematological parameters between diabetic and non-diabetic groups. Figures 1 to 9 shows the variation of hematological parameters among gender.

The values of FBS and MCHC were significantly higher in the diabetic male and female group than the non-diabetic male and female group (Figures1 and 2).

On the other hand, the mean values of PCV and MCV were significantly reduced in both male and female diabetic group than the non-diabetic group as shown in both Figures 3 and 4 ($p<0.05$).

The values of HB, RBC, and PLT CT were also significantly lower in male diabetics than in non-diabetic males ($p<0.05$) whereas they were not significantly different in both diabetic and non-diabetic females (Figures 5, 6, and 7).

WBC value was significantly higher in diabetic males than non-diabetic males ($p<0.05$) but not significantly different in diabetic and non-diabetic females (Figure 8). Only MCH was not significantly different between the groups ($p>0.05$; Figure 9).

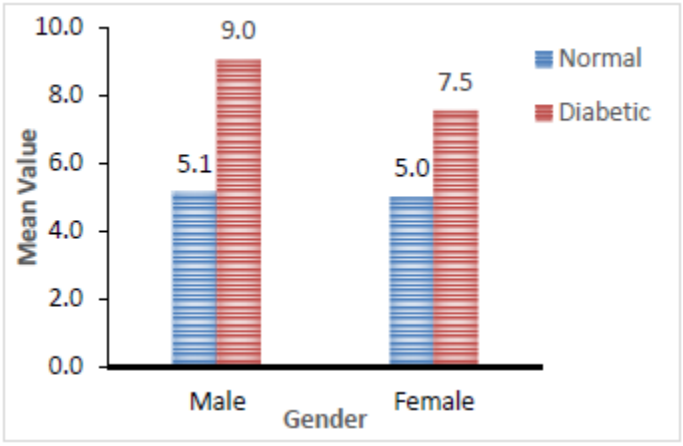

Figure 1. Comparison of gender FBS between diabetic and non-diabetic groups
FBS (P<0.001* for male and female)

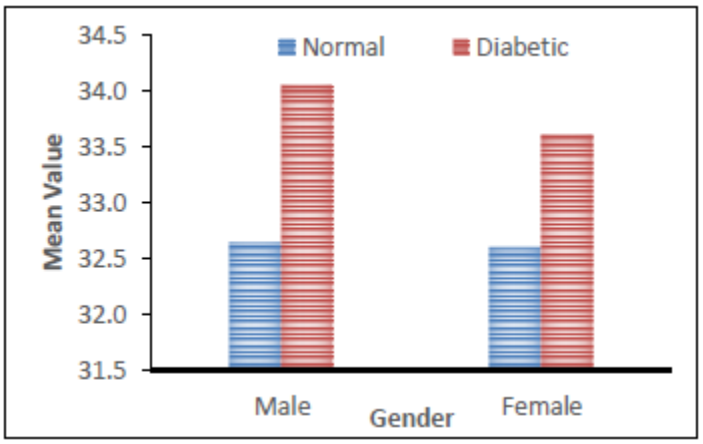

Figure 2. Comparison of gender MCHC between diabetic and non-diabetic groups
MCHC (g/dl) (p<0.001* for both male and female).

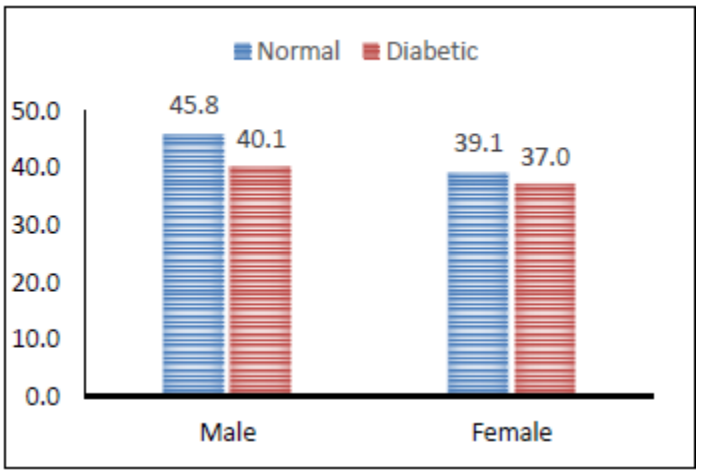

Figure 3. Comparison of gender PCV between diabetic and non-diabetic groups
PCV (%) (Male: p<0.001*; Female: p = 0.021*)

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ISSN: 2520-3088

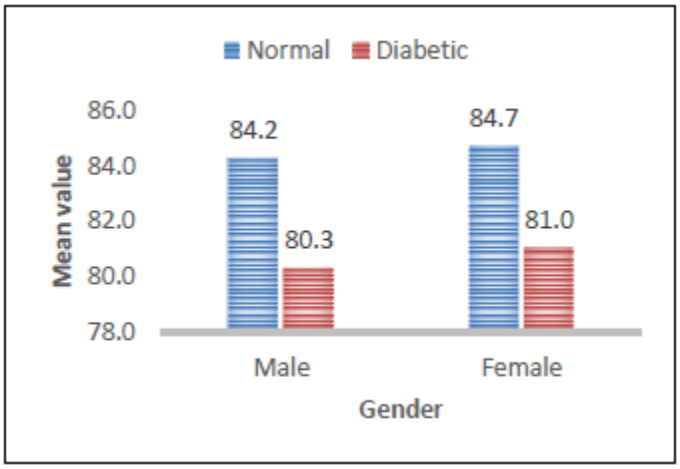

Figure 4. Comparison of gender MCV between diabetic and non-diabetic groups
MCV (fL) p (Male =0.004*; Female = 0.007*)

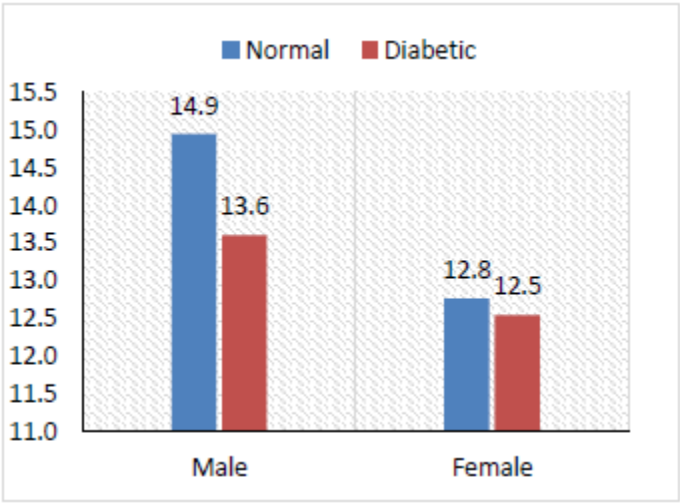

Figure 5. Comparison of gender HB between diabetic and non-diabetic groups
HB (g/dL) (Male; P<0.001*; Female, P =0.434)

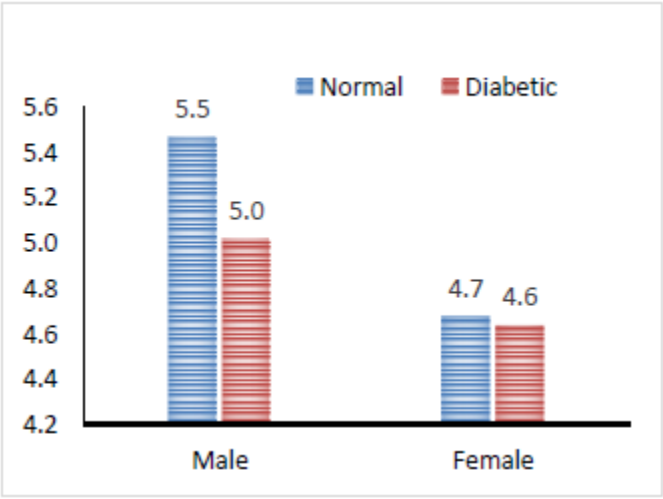

Figure 6. Comparison of gender RBC between diabetic and non-diabetic groups
RBC p (male =0.002*; Female = 0.751)

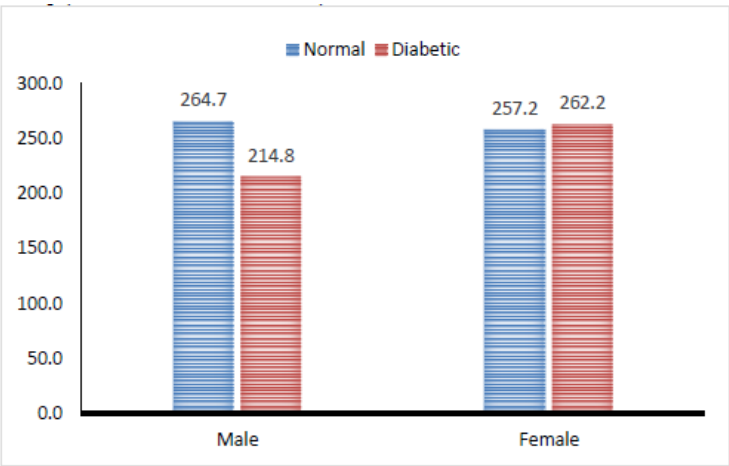

Figure 7. Comparison of gender PLT CT between diabetic and non-diabetic groups
PLT CT. (X109/L) p (male <0.001*; female = 0.769)

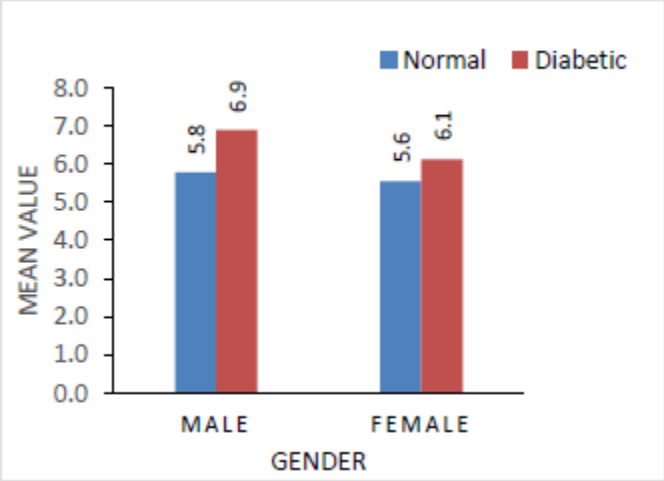

Figure 8. Comparison of gender WBC between diabetic and non-diabetic groups
WBC (X109/L) (p; male = 0.033*; female = 0.073)

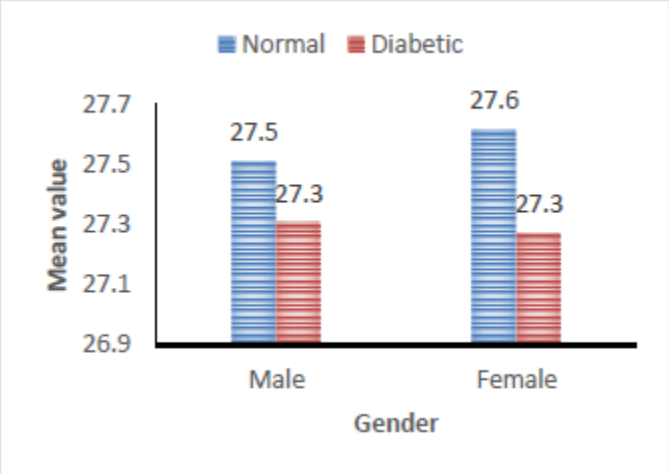

Figure 9. Comparison of gender MCH between diabetic and non-diabetic groups
MCH (pg) (p; male =0.695, female = 0.499

Table 1 shows the comparison of gender differential cell count between the groups. All lymphocytes were significantly different between the groups while Neutrophils were significantly

DOI: 10.21522/TIJAR.2014.06.02.Art007
ISSN: 2520-3088

different in males but not in females. There were significant differences in the values of EOS and BAS between female diabetic and non-diabetic groups but not significantly different in males.

Table 1. Comparison of gender differential cell counts between diabetic and control groups

	Diabetic Male	**Normal Male**	**p value**	**Diabetic Female**	**Normal Female**	**p value**
Neu ($x10^9$/L)	3.97 ± 0.45	2.43 ±0.13	0.001*	3.05 ± 0.16	2.60 ± 0.17	0.053
Neu (%)	53.69 ± 2.23	41.52 ±1.39	<0.001*	48.89 ± 1.17	46.14 ± 1.58	0.158
LYM ($x10^9$/L)	2.36 ± 0.12	2.61 ± 0.11	0.136	2.55 ± 0.96	2.24 ± 0.96	0.025*
LYM (%)	36.91 ± 1.77	45.52 ± 1.30	<0.001*	42.45 ±1.18	40.90 ± 1.18	0.355
MONO ($x10^9$/L)	0.49 ± 0.07	0.49 ±0.02	0.980	0.44 ± 0.05	0.43 ± 0.02	0.843
MONO (%)	7.17 ±0.85	8.67 ± 0.28	0.074	7.01 ± 0.73	7.05 ± 0.31	0.264
EOS ($x10^9$/L)	0.09 ±0.02	0.21 ± 0.02	<0.001*	0.08 ±0.01	0.32 ± 0.10	0.010*
EOS (%)	1.38 ± 0.20	3.60 ±0.41	<0.001*	1.35 ± 0.16	4.41 ± 1.22	0.009*
BAS ($X10^9$/L)	0.01 ±0.00	0.04 ±0.00	<0.001*	0.01 ± 0.00	0.03 ± 0.00	<0.001*
BAS (%)	0.18 ± 0.06	0.71 ±0.05	<0.001*	0.13 ±0.04	0.60 ± 0.05	<0.001*

World health organisation (WHO) anaemia classification of diabetic cases

Table 2 shows the WHO grade of anaemia seen in the present study. Both diabetic and non-diabetic groups recorded one severe anaemia case each. More females had anaemia in both groups than males. There were 48% cases of anaemia among the female diabetic group and 27% among non-diabetic females whereas only 13% of the male diabetic group had anaemia while none of the male non-diabetic group had anaemia.

Table 7. WHO Anemia grading in subjects and control

WHO grade	Range	Diabetic			Control		
		Male	Female	Total	Male	Female	Total
Normal	≥13.0	27	27	54	48	25	73
Mild	(11.0-12.9 d/dl)	8	24	32	0	24	24
Moderate	(8.0-10.9g/dl)	5	8	15	0	2	2
Severe	(<8.0g/dl)	0	1	1	0	1	1
	Total	40	60	100	48	52	100

Discussion

Comparison of gender heamatological parameters between diabetic and non-diabetic groups

Gender was found significantly different in mean FBS of the diabetic group, the mean FBS was significantly higher in males than females, this may be probably due to the fact the males are more involved in activities that predispose them to high FBS accumulation like poor diet and alcohol consumption, etc. more than the females.

There was a significant increase in the mean corpuscular heamoglobin concentration (MCHC) mean value in diabetic patients in this study when compared with the control groups in both males and

females subject, this may be due to the onset of renal insufficiency and also probably due to changes in shape of red blood cells (spherocytosis) ((Demirtas*et al.*, 2015; Harish Kumar, Srinivasa, & Prabhakar, 2017; Kothari & Bokariya, 2012).

It is of interest to note that gender difference and packed cell volume (PCV) of participants correlated significantly with FBS in control subjects. These findings suggest that PCV and heamoglobin levels as an index of aneamia were significantly lower among female diabetics group compared the males as well as the non-diabetic controls. This complements the finding that aneamia is prevalent among female diabetic patients than in their male counterparts. This could be the main reason for heart failure and hypoxia-induced organ damage in diabetic patients, mostly in those with overt nephropathy or renal impairment. So many factors may have increased the prevalence of aneamia in female diabetic patients, the inability or the failure of the kidney to increase the production of erythropoietin in response to the depleting haemoglobin appears to be the dominant factor for aneamia in the diabetics. This study is in line with the previous report of Bharathi in which anaemia was reportedly higher in female diabetic patients than in males (Bharathi, 2016). There has not been any proof that anemia directly contributes to accelerated complications of diabetes or to the progression of diabetic nephropathy; however patients with diabetes are more vulnerable to the effects of anemia due to significant relationship with cardiovascular disease and hypoxia-induced organ damage; the use of ACE inhibitors may also result in anemia in diabetics due to direct blockade of pro-erythropoietic effects (Bharathi, 2016).

There was a significant rise in the WBC of both the male and female diabetic patients as compared with the control groups. The reason for this significant variation might be due to the fact that the high WBC count in the diabetic group is in keeping with the increased oxidative stress triggered by the high levels of hyperglycaemia (Waggiallah & Alzohairy, 2011; Donath *et al.,* 2011).WBC count is a known marker of systemic inflammation and may be involved in the pathophysiology of prediabetes states and subsequently in the manifestation of diabetes.

This study also found that the PLT count was significantly higher among the male diabetics compared to male non-diabetics, but slightly and non-significantly increased in the female diabetic patients when compared with the female non-diabetics. Increase in platelet count with increasing blood glucose level in patients with diabetes could be as a result of the stress response, most especially in males. This finding is in agreement with some similar previous studies ((Demirtas*et al.*, 2015; Kumar *et al.*, 2017).

The significant reduction in HB concentration values in male diabetic patients and very low HB in females when compared with the control group in the study might be as a result of chronic hyperglycaemia, which causes nonenzymatic glycosylation of red blood cell membrane proteins leading to accelerated aging of the RBCs (also reduced in both male and female), which also contribute to the occurrence of aneamia in diabetic patients. This is in agreement with the findings of previous reports have suggested that recombinant human erythropoietin treatment is effective in correcting erythropoietin-deficiency anaemia in patients with diabetes (Waggiallah & Alzohairy, 2011; Bharathi, 2016; Kumar *et al*., 2017).

This research also revealed that the mean value of the Mean corpuscular volume (MCV) in both male and female diabetic patients was highly significantly lower as compared with the mean value of the apparently healthy individuals who participated in this study, this is probably due to the presence of microcytic (small average RBC size) anaemia in diabetic patients (Bharathi, 2016; Kumar *et al*., 2017; Waggiallah & Alzohairy, 2011).

Elevated levels of neutrophil count in type 2 diabetes in both male and female genders, noted in our findings in this study may be as a result of inflammation in the vessel wall. This is consistent with previous studies who also reported neutrophil elevation in type 2 Diabetic Patients (Bharathi, 2016; Biadgo, Melku, Abebe, & Abebe, 2016; Demirtas *et al*., 2015) but contradicts the report of Kumar *et al*. who reported insignificantly higher neutrophils in non-diabetic group (Kumar *et al*., 2017).

Elevated neutrophil level in diabetic patients with glucose intolerance is an indication of systemic inflammation (Gurav & Jadhav, 2011), and has been linked to a diabetic foot ulcer(Kahraman*et al.*, 2016).

DOI: 10.21522/TIJAR.2014.06.02.Art007
ISSN: 2520-3088

The increased Basophil and Eosinophil levels found in normoglycemic controls as against Hyperglycemic subjects could be due to immune disturbance associated with hyperglycemia.

This study suggests that the hematological parameters should be evaluated and treated periodically in both male and female diabetic patients to reduce the burden of DM and ocular morbidity due to retinopathy.

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