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Evaluation of Haematological Parameters among Pre-Diabetic and Diabetic Subjects in Urban Setting, Nigeria

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ABSTRACT

This study compared the hematological parameters of pre-diabetic and diabetic subjects in an urban setting. The study was conducted between June 2018 and November 2018 in Abuja, Nigeria. Only confirmed diabetic and pre-diabetic subjects were recruited into the study. The plasma glucose level of each of the participants was measured after 12-14 hours of fasting. An oral glucose tolerance test was performed on those that did not have a history of diabetes in line with the American Diabetes Association (ADA) classification. Venipuncture was done on each subject, 2ml of venous blood was collected in EDTA for complete blood count for determination of hematological parameters and the assays were performed using an automated Chemistry analyzer (Selectra Pro S). Data were analyzed with IBM-SPSS for Windows version 24. The study comprised 96 participants (43 diabetics and 53 pre-diabetics). Among the pre-diabetics, 45.3% were males and 54.7% were females while 41.9% of the diabetics were males and 58.1% were females. Only MCHC and platelets were significantly different between the two groups, though no gender difference was observed. There was a positive correlation between WBC and Neutrophils of diabetic subjects with FBS while other parameters did not show a significant association. Lymphocyte was negatively correlated with FBS for diabetic subjects while PCV negatively correlated with FBS among pre-diabetes subjects. No significant between pre-diabetics and diabetics. Hence, periodical screening for the hematological profile is recommended in both pre-diabetic and diabetic subjects to initiate early prevention and management of diabetes.

INTRODUCTION

Both the developed and the developing countries of the world are suffering the impact of the diabetes epidemic and the impact is worse in those countries that are socially and economically disadvantaged [1]. Diabetes threaten the accomplishment of the Millennium Development Goals (MDGs), increases the risk of developing tuberculosis and is closely associated with several other infections [2]. The International Diabetes Federation (IDF) regional estimates for diabetes in the age group 20 to 79 years in 2011 show significant diabetes prevalence in the seven IDF regions; Africa-4.5%; Europe-6.7%; Mediterranean/ North Africa-11.0%; North America/ Carribean-10.7%, South/Central America-9.2%; South-east Asia-9.2%, Western Pacific-8.3%, and the entire world-8.5% [1-2].

According to the IDF (2011) report, Africa has the highest (80%) number of undiagnosed diabetes followed by Western Pacific (60%) and the Middle East/North Africa (55%). Others include South-east Asia (50%), South/Central America (45%), Europe and North America/Carribean (35%) each [2].

Pre-diabetes is described as Impaired Fasting Glucose (IFG), impaired glucose tolerance [3] or a when the range of glycosylated hemoglobin (A1c) is between 6.0% - 6.4%, the situations that put individuals at high risk of developing diabetes and the consequent complications [4]. The World Health Organization (WHO) criteria for diagnosing pre-diabetes are fasting plasma glucose level of between 6.1 mmol/l - 6.9 mmol/l while a fasting plasma glucose level 7.0 mmol/l or more meet the criteria for the diagnosis of diabetes. Fasting value for venous and capillary plasma glucose are identical [5]. A previous study demonstrated that people with impaired fasting glucose (IFG) and impaired glucose tolerance (IGT), i.e. prediabetes, had a greater chance of developing diabetes after 5-10 years [6].

Many researchers have documented the prevalence of diabetes in Nigeria, studies also exist that compared hematological parameters of diabetic patients with apparently healthy controls [7–17] but information on a comparative study of hematological parameters between diabetics and pre-diabetics are rather scanty. Therefore, this study is aimed at evaluating hematological parameters of both pre-diabetic and diabetic subjects in a tertiary institution in Nigeria.

METHODOLOGY

This study conducted at Abuja Metropolis, Nigeria between June 2018 and November 2018. A total of 96 subjects were recruited for this study, which consists of 54 pre-diabetic and 43 diabetic subjects. Only confirmed diabetic and pre-diabetic subjects were recruited into the study after they were made to understand the reasons for the study and signed informed consent. Approval was gotten from the Ministry of health and all samples were analyzed in the laboratory. The plasma glucose level of each of the participants was measured after 12-14 hours of fasting. An oral glucose tolerance test was performed on those that did not have a history of diabetes, using 75 g of glucose; this was done in line with the American Diabetes Association (ADA) classification [18-19]. Fasting Plasma Glucose between 100 – 200 mg/dL was defined as impaired fasting glucose (IFG) while impaired glucose tolerance is taken to be 2-h value in the oral glucose tolerance (OGTT) test ≥ 200 mg/dL. Diabetes cases were determined as one of the FPG ≥ 125 mg/dL, 2-h post-load glucose ≥ 200 mg/dL during an OGTT, previously diagnosed diabetes, or the regular consumption of oral medication or insulin [19]. The subjects with known hematologic diseases were not included in the study. Venipuncture was done on each subject, 2ml of venous blood was collected in EDTA for complete blood count for determination of hematological parameters. These assays were performed using an automated Chemistry analyzer (Selectra Pro S).

The data were imputed and analyzed with IBM-SPSS for Windows version 24. Comparison of mean between two groups was analyzed using paired sample T-test, ($p<0.05$) was considered statistically significant.

RESULT

The study comprised 96 participants (42 (44.8%) diabetics and 53 (55.2%) pre-diabetics). The mean age of all the subjects was 49.55 ± 12.32 years, ranging from 25 – 83 years. The number of male participants was 43 and females were 54. Among the pre-diabetics, 24 (45.3%) were males and 29 (54.7%) were females. Also, among the diabetic participants, 18 (41.9%) were males and 45 (58.1%) were females. No gender significant difference was seen between pre-diabetic and diabetic subjects ($p = 0.837$).

A significant difference in Age was observed between the two groups and between gender. The only significantly different observed between the two groups were the MCHC and platelets, though no gender difference was observed (Table no. 1).

There was a significant positive correlation between WBC and Neutrophils of diabetic subjects with FBS while other parameters did not show significant association. Lymphocyte was found to be negatively correlated with FBS for diabetic subjects while PCV negatively correlates with FBS among pre-diabetes subjects (Table no. 2).

Table no. 1. Demographic and hematological parameter of the Pre-diabetic and Diabetic subjects

	Overall (Mean ± SEM)			**Male (Mean ± SEM)**			**Female (Mean ± SE)**		
Variable	Total Pre-DM	Total DM	p	Male Pre-DM	Male DM	p	Female Pre-DM	Female DM	p
Age (years)	45.8±1.7	54.2±1.6	**0.001***	45.3±2.7	52.1±2.4	0.082	46.1±2.2	55.7±2.0	**0.003***
WBC ($x10^9L$)	6.02±0.3	6.54±0.4	0.257	6.40±0.5	6.45±0.7	0.950	5.71±0.2	6.61±0.4	0.051
Neu (%)	47.1±1.5	49.9±1.8	0.233	46.9±2.8	51.1±3.6	0.358	47.2±1.6	49.0±1.8	0.449
Lym (%)	42.1±1.3	40.2±1.6	0.358	39.9±2.1	38.9±2.8	0.759	43.9±1.5	41.2±2.1	0.281
PCV (%)	40.5±0.9	38.8±1.0	0.184	42.3±1.5	41.6±1.0	0.721	39.0±0.9	36.7±6.7	0.155
RBCs ($10^{12}L$)	4.92±0.10	4.92±0.11	0.970	5.07±0.17	5.27±0.17	0.589	4.80±0.12	4.66±0.11	0.789
Hgb (g/dl)	13.4±0.3	13.3±0.2	0.885	14.0±0.5	14.1±0.3	0.054	12.9±0.3	12.8±0.3	0.741
MCV (fL)	82.5±1.0	80.6±1.1	0.196	83.4±1.4	79.1±1.4	0.933	81.7±1.4	81.7±1.5	0.565
MCH (pg)	27.4±0.4	27.3±0.4	0.972	27.8±0.4	27.0±0.6	0.159	27.1±0.6	27.6±0.6	0.654
MCHC (g/dL)	33.2±0.2	33.9±0.2	**0.013***	33.3±0.3	34.1±0.4	0.231	33.1±0.2	33.7±0.3	0.325
PLT ($x10^9L$)	269.9±10.0	229.5±14.0	**0.018***	262.5±15.9	191.4±11.2	0.123	276.0±12.8	256.9±21.3	0.096

Neu: Neutrophils; Lym: Lymphocytes; WBC: White blood cell; RBC: Red blood cell; Hgb: Hemoglobin; MCV: Mean Cell Volume; MCH: Mean Cell Hemoglobin; MCHC: Mean Cell Hemoglobin Concentration; PLT; Platelet Count. SEM: Standard Error Mean; * Significant at $p<0.05$.

Table no. 2. Correlation of hematological Parameter with FBS among prediabetes and diabetes subjects

	Pre-diabetics		Diabetics	
Variable	r	p	r	p
WBC ($x10^9L$)	0.028	0.842	0.312*	0.042
Neu (%)	0.099	0.482	0.393**	0.009
Lym (%)	-0.002	0.989	-0.393**	0.008
PCV (%)	-0.276	0.046*	0.155	0.323
RBCs ($10^{12}L$)	-0.235	0.090	0.085	0.587
Hgb (g/dl)	-0.245	0.077	0.175	0.261
MCV (fL)	-0.056	0.691	0.173	0.267
MCH (pg)	0.043	0.760	0.070	0.653
MCHC (g/dL)	0.240	0.083	-0.160	0.306
PLT ($x10^9L$)	-0.055	0.697	-0.167	0.284

DISCUSSION

The major focus of this study is to evaluate the hematological parameters of pre-diabetic subjects in comparison with diabetic subjects. This was based on a previous study that demonstrated that prediabetes had a greater chance of developing diabetes after 5-10 years [6]. Many studies had been conducted comparing hematological parameters of apparently normal people with diabetic subjects, but very few studies have compared these parameters with pre-diabetes and diabetes.

This study revealed that diabetic age is significantly higher than the prediabetes age ($p<0.05$). Elevated values of WBC and lymphocytes were observed in diabetics when compared with pre-diabetic whereas there was a reduction in neutrophils, PCV, RBC, Hgb, MCV, and MCH, however, these values were not significantly different. The only observed significant differences between pre-diabetic and diabetic in this study were found in MCHC and platelet counts, however, these significant differences were not observed among genders. FBS of diabetic subjects was positively correlated with WBC and Neutrophils and negatively correlated with lymphocytes, while the only correlation seen in pre-diabetic was the negative relationship observed in FBS and PCV.

The findings of this study are in agreement with Zaiee and his team in Iran in the year 2017, comparing the association of hematological indices with prediabetes in a cross-sectional

study. Similar to the present study, they observed a significant difference in only age and MCHC when compared pre-diabetic with a diabetic and observed a negative correlation between FBS and MCHC [19].

Several other studies comparing diabetic with non-diabetic have found significant differences in hematological parameters of these groups. For example, Kumar *et al.* (2017) observed that the mean MCHC, WBCs, and lymphocytes were significantly higher in diabetics compared to non-diabetics but there was no difference observed for MCH, neutrophil, and platelets between two groups; they concluded that diabetics are prone to anemia, leucocytosis, and lymphocytosis [20]. In a similar study conducted in North-West, Nigeria, Uko, and his team reported significant differences in the mean PCV, PCV, WBC, and Platelet between diabetic and non-diabetic control. They also observed a significant positive correlation between high platelet and raised blood sugar level among the diabetic subjects [21]. Similar reports were given by [22–26].

Whereas many studies have reported a significant difference between the hematological parameters of diabetic and non-diabetic subjects, this study did not find significant differences between hematological parameters of pre-diabetic and diabetic subjects, this affirms the possibility of prediabetes to develop diabetes after 5-10 years as reported by Meigs *et al.*[6].

CONCLUSION

This study did not observe significant differences in the hematological parameter between prediabetic and diabetic subjects except MCHC. Hence, routine and periodical screening for the hematological profile is recommended in both pre-diabetic and diabetic subjects to initiate early prevention and management of diabetes to reduce the related morbidity.

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