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RESEARCH ARTICLE

CORRELATION OFLIPID PROFILE WITH GLYCATED HEMOGLOBIN (HBA_{1C}) IN DIABETIC PATIENTS IN KING ABDULLAH HOSPITAL, BISHA, SAUDI ARABIA

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Abstract

Background: This study aimed to observe the lipid profile in diabeticpatients and to find out correlation between glycated hemoglobin (HbA_{1C}) and lipid profile.

Methods: Lipid profiles, fasting blood sugar and HbA_{1C} values of 100 diabetic patients were studied. Blood samples of 41 male and 59 female diabetic patients were assessed for fasting blood glucose (FBG), total cholesterol, TG, LDL and HDL andHbA_{1C}.

Results: The 100 diabetic patients were havingHbA_{1C} mean valuewas 9.1±1.9%. Means of HbA_{1C}, cholesterol, HDL, LDL, and FBG were higher in females than males. In contrast, means of triglycerides and age were lower in female than males. All parameters have positive correlation with HbA_{1C}. Significant correlation of HbA_{1C} levels wereseen with FBG (p<0.01).TGwas having negative correlation with HDL, LDL and FBG. The HDL values of diabetic patients were negatively significantly correlated with age with p value 0.008. LDL levels were significantly correlated with cholesteroland age (p<0.01 and 0.049).About 60% of diabetic patientstheir HDL was >46mg/dl (1.2mmol/L) and >70% were having HDL>30mg/dl (0.8mmol/L). Findings indicate>50% of patients participated in this study may be at low risk, or in a good diabetic control or on medication, since, poor glycemic control in diabetic patients can lead to decreased HDL.

Conclusion: Results in this study indicated the need for therapeutic attention for diabetic patients, especially those who are of small ages.Depending on antidiabetic medications only is not enough to treat diabetic patients.

Introduction:-

Diabetes mellitus DM is characterized by chronic hyperglycemia with disturbances in carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both(Bennett, et al. 2000).Global figure of people suffering from diabetes mellitus is estimated to rise from current estimate of 415million to 642million by 2040. The number of people with type 2 DM is increasing in every country and 75% of people with DM are living in

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developing countries (Powers, et al. 2015).With an increasing incidence worldwide, DM will be a likely leading cause of morbidity and mortality in the future(Wild, et al. 2004).The international diabetes federation (IDF) has estimated the total number of persons with diabetes across the world will rise from 171millions in 2000 to 366millions by 2030(Wild, et al. 2004).Overall prevalence of DM in adults in Kingdome of Saudi Arabia (KSA) is 23.7%. A national preventing program at community level targeting high risk groups should be implemented sooner to prevent DM (Al-Nozha, et al. 2004).Theworld health organization WHO has reported that Saudi Arabia ranks the second high in the Middle East and the seventh in the world for the rate of DM. It is estimated that a round 7millions of the population are diabetic and almost around 3millions have prediabetes. Even more worrying perhaps is the increasing pattern of DM noted in Saudi Arabia (SA) in the recent past. In facts, DM has approximately registered a tenfold increase in the past three years in SA. DM has been found to be related to lower quality of life in SA. DM is quickly reaching disturbing proportions and becoming significant cause of medical complications and even death (Mohamed, et al. 2016).

Dyslipidemia is commonly seen in DM patients. Type 2 DM is one of the most common secondary causes of hyperlipidemia. The relationship between hyperlipidemia and vascular complication of diabetes has long been of interest because both tend to occur with greater frequency in Type 2 DM. Insulin resistance and obesity combine to cause dyslipidemia and hyperglycemia and hyperlipidemia have additive cardiovascular risk. It is recommended that patients with DM should be treated as if they already have coronary artery disease.Hence identification, critical evaluation, and follow-up of serum lipid profile in Type 2 DM continue to be important (Chaturvedi, et al. 2001), (Mazzone, 2000), (Ginsberg, et al. 2001) and (Harvey, 2002).

Glycated hemoglobin (HbA_{1C}) is routinely used as a marker for long-term glycemic control. Apart from functioning as an indicator for the mean blood glucose level, HbA_{1C} also predicts the risk for the development of diabetic complications in diabetes patients(Selvin, 2004).Glycemic control with decreased level of HbA_{1C} is likely to reduce the risk of complications (Irene, et al. 2000). Estimated risk of Cardio Vascular Diseases (CVD) has shown to be increased by 18% for each 1% increase in absolute HbA1c value in diabetic (Selvin, et al. 2004). Even in non-diabetic cases with HbA_{1C} levels within normal range, positive relationship between HbA_{1C} and CVD has been demonstrated (Khaw, et al. 2004) and (Deeg, et al. 1983). A few studies have previously tried to find the correlation between HbA_{1C} levels and lipid profile. Some of these have shown that all the parameters of lipid profile have significant correlation with glycemic control (Gligor Ramona, et al. 2011). On the other hand, some studies do not report significant correlation between glycemic control and all parameters of lipid profile (Zhe Yan, et al. 2012). This study aimed to measure the lipid profile and to find out correlation between glycated hemoglobin (HbA_{1C}) and lipid profile in diabetic patients attending the Diabetic OPD clinic, King Abdullah Hospital -Bisha**.**

Material and Methods:-

This study was designed as cross-sectional observationalhospital-based study.Samples of patientswho are attending the diabetic clinic in King Abdullah hospital, Bisha, Saudi Arabia, were taken during the period from November 2011 to April 2012. Samples were collected from100 patients (41 men and 59 women) with known history of DM. Permission to curry out this study was obtained from college of medical laboratory sciences, University of Bish aand King Abdulla hospital, Bisha, Saudi Arabia.

After fasting for at least 10 hours, about 5ml of blood sample were obtained from diabetic patients by venipuncture using sterile disposable syringes and needles. Collected blood was divided into two parts. The first part,(2ml) was put in EDTA container ready for use tomeasure HbA_{1C}. From the second part serum was obtained after blood was allowed to clot for at least 15mins at room temperature and then centrifuged at 3000 rpm for 5mins. The obtained serum was pipetted into a clean container ready for use to measure lipid profile and serum glucose.

Analyzed on the day of collection, blood HbA_{1C}, serum sugar and lipid profile were tested. Serum total cholesterol was determined by an enzymatic (CHOD-PAP) colorimetric method. (Allain, 1974).And triglycerides were determined by an enzymatic (GPO-PAP) method (Jacobs, et al. 1960). HDL-Cholesterol was estimated by a precipitant method (Gordon T, et al. 1977) and LDL-Cholesterol by was estimated by using Friedewald's formula (Friedewald,et al. 1972) as it has been shown below:LDL-C = TC - HDL-C – (TG/5).

Serum glucose was determined using the glucose oxidase enzymatic method (Trinder, 1969) and glycated hemoglobin (HbA_{1C}) by Ion Exchange Resin method. All parameters were determined using commercially available reagent kits. The lipid profile of the subjects was classified, based on the ATP III model (NCEP).

In the literature, diabetic patients are classified into two groups depending on their glycated hemoglobin (HbA1c); Good Glycemic Control (GGC) group having HbA_{1C}<7.0% and Poor Glycemic Control (PGC) group having HbA_{1C}>7.0%. For serum lipid reference level, National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) guideline was referred. According to NCEP-ATP III guidelines, hypercholesterolemia is defined as TC >200mg/dl, high LDL when value >100 mg/dl, hypertriglyceridemia as TG >150 mg/dl and low HDL when value < 40 mg/dl. Dyslipidemia was defined by presence of one or more than one abnormal serum lipid concentration (Ram Vinod Mahato, et al. 2011).

Statistical Analysis: all results were analyzed statistically; using statistical packaged of social sciences (SPSS) for windows, version. 20. And t-test was usedto compare means. Results were considered significant when *P* value (<0.05). Figures were plotted using Excel program.

Results:-

In this study, means and standard deviations of HbA_{1C}, cholesterol (CHOL), TGs, LDL, HDL, FBG and age of 100 diabetic patients (41 males and 59 females) are listed in table 1. However, in table 2, these parameters are correlated with each other and *P* value is obtained. Figures 1, 2 … and 5, illustrate HbA_{1C} correlation with TGs, cholesterol, LDL, HDL and FBG. And figure 6, illustrates glucose correlation with HDL. The correlation is considered significant when p value <0.05. Means of HbA_{1C}, cholesterol, HDL, LDL, and FBG were higher in females than males. However, means of triglycerides and age were lower (table; 1). In our study all parameters have positive correlation with HbA_{1C}. Significant correlation of HbA_{1C} levels were observed only with fasting blood glucose level (*P*<0.01).Cholesterolwas having positive correlation with all parameters except age.Triglycerides were having positive correlation with HbA_{1C}, and cholesteroland negative with HDL, LDL and FBG. The HDL values of all diabetic patients were negatively significantly correlated with age with *P* value 0.008. LDL levels were significantly correlated with cholesterol and age (*P* <0.01 and 0.049), respectively (table; 2).

Discussion:-

This study aimed to correlate HbA_{1C} with lipid profile of diabetic patients. All parameters are measured and analyzed statistically. When we compare our findings with results in the literature, the HbA_{1C} mean level in our study is differ than that of study done by Mohieldein, *et al*. in 2006 (Mohieldein, *et al*. 2008). However,it is nearly similar to results of study done by Ahmed, *et al*. in 2015 (Ahmed, et al. 2015). In study done by Fadlalla,*et al*. in 2014, and Ahmed, *et al*. in 2014,they reported that HbA_{1C} mean level was 10.4±4.5% for diabetic patients (Fadlalla, *et al*. 2014, and Ahmed, *et al*. 2014). These findings are differed than our findings. Also, our results are differed than results of Karar, *et al*. in 2015, as their result showed mean level of HbA_{1C} was 8.4% (Karar, *et al*. 2015).

In our results nearly all diabetic patients have HbA_{1C}>6.0% and about 81% ofthe patients have HbA_{1C} level of >7.0%. However, nearly half of the diabetic patients have HbA_{1C}>9.0%. These findings to some extent aresimilar to results done by Ahmed, *et al*. in 2015, whereas nearly half of the diabetic patients have HbA_{1C}>9.0% and 91% of the diabetic patients theirs HbA_{1C} level is >6.0% (Ahmed, *et al*. 2015).Our results are differed than results of study conducted by Khattab, *et al*. in 2010, in Jordanian population (Khattab, *et al*. 2010). As they found that diabetic patients were having HbA_{1C} ≥7.0% (Khattab, *et al*. 2010).Our results are also differed than results of study done in Pakistani, and United Kingdom populations (Khattab, *et al*. 2010).These studies reported that, HbA_{1C} level in types 2 diabetics was >7.5%. However, in a study done in Kuwaiti population HbA_{1C} was ≥8% (Khattab, *et al*. 2010). Our findings are also differed than results of study done by Ahmed, *et al*. in 2014. They found that >40% of diabetic patients were having HbA_{1C} mean value >9% (Ahmed, *et al*. 2014).

It is reported that the level of HbA_{1C} ≥6.0% was associated with increased risk of diabetic complications (Edelam, et al. 2004). Development of diabetic complications was associated with the level of glycemic controlwhich it is assessed by HbA_{1C} level (Obot, et al. 2013).Hence, patients in this study are at high risk of diabetic complication.

Dyslipidemia is one of the major risk factors for cardiovascular disease in diabetes mellitus (Arshag, 2009).Diabetic dyslipidemia is characterized by high levels of plasma triglyceride, low HDL cholesterol concentration and increased concentration of small dense LDL-cholesterol particles (Arshag, 2009).Management of lipids plasma levels is considered as approach effective in reducing risks in diabetic patients, especially the reduced HDL (Makamto, et al. 2005). Low levels of HDL are common among diabetic patients (Drexel, 2004) and it constitutes one of the characteristics of dyslipidemia in type2 diabetic patients (Syvanne, et al. 1995). Patients in this study have

variable HDL levels. And differ than results of El-Hazmi, *et al*. in 1999 in Saudi populations, whichshowed elevation in cholesterol and triglyceride levels in diabetic patients (El-Hazmi, *et al*. 1999).Also, they reported that lipids parameters increased with cholesterol except HDL, which decreased as cholesterol increased (El-Hazmi, *et al*. 1999).Not like our results, Ahmed, *et al* in 2008, concluded that HDL level was normal in type 2 diabetic patients with dyslipidemia (Ahmed, *et al.* 2008).

In this study, 60% of the patients have HDL >46mg/dl (1.2mmol/L). Also, >70% of the patients have HDL level >30mg/dl (0.8mmol/L). Our findings are differed than results of Ahmed *et al*. in 2014, as they found that 42% of diabetic patients have HDL level <40mg/dl (1.06mmol/L) (Ahmed *et al*. 2014).Because poor glycemic control in diabetic patients can lead to decreased HDL (Imani, et al. 2006).Our findings indicate that greater than 50% of patients participated in this study may be at low risk, or in a good diabetic control or on medication. Raising plasma HDL to the level >1.2mmol/L is desirable in high-risk individuals, as it was recommended by the American Diabetes Association (ADA) guidelines (Chan, et al. 2006).

It is reported that total cholesterol concentrations were normal in diabetic patients (Valabhji, et al. 2003).However, in study done by Ahmed, *et al*. in 2015, the diabetic patients were having high cholesterol mean level. And 60% of the diabetic patients have cholesterol level >3.8mmol/L (Ahmed, *et al*. 2015).In our study, total cholesterol level of >150mg/dl (3.88mmol/L) is reported in >70% of our patients. However, only 10% of them were having cholesterol level >250mg/dl (6.47mmol/L). Thus, depending on these findings, cholesterol results may not indicate high risk to our patients.

In the literature, the desirable level of triglycerides is <1.95mmol/L (Arshag, 2009).American Diabetes Association guidelines for diabetic dyslipidemia, and the Australian guidelines recommend lowering of triglycerides to <1.5mmol/L in high risk diabetic individuals (Chan, et al. 2006).In our study nearly 50% of our diabetic patients their TGs levelsare>1.5mmol/L. Our findings were differed than findings of study done by Mohammed, *et al*. in 2014, they reported that triglycerides levels were increased in patients with prolonged hyperglycemia with mean concentration of 1.95mmol/L (Mohammed, et al. 2014).Patients participated in this study should be advised to lower their TGs levels.

In this study there are more than 40% of diabetic patients have LDL >100.4mg/dl (2.6mmol/L). Our results are nearly similar to results of Ahmed, *et al*. in 2015, they found that more than 66% of diabetic patients have LDL >2.6mmol/L (Ahmed, *et al*. 2015).However, it is differed than study done by Mohammed, *et al*. in 2014, they reported that the LDL mean value of the patients with prolonged hyperglycemia was 92.8mg/dl (Mohammed, et al. 2014).

Previous study done by Ramprasad, *et al*. in 2007, reported that current guideline treatment is needed to reduce LDL level in diabetic patients (Ramprasad, et al. 2007).Besides, Shen, in 2007, wrote that the abnormalities in the metabolism of LDL or HDL in diabetic patients often require pharmacological intervention (Shen, 2007).As well as, it is recommended that LDL level of diabetic patients should be kept at <1.81mmol/L to reduce coronary artery disease and cardiovascular risks (Arshag,2009).Thus, patients participated in this study were at risk of cardiovascular risk. Results in this study also indicate the need for therapeutic attention for diabetic patients. Depending on antidiabetic medications only was not enough to treat diabetic patients, lipids lowering agents were also needed (Ahmed, *et al*.2014).

In this study, cholesterol and LDL wereweakly positively correlated with $HbA_{1C,}$ this may indicate high risk. These findings are similar to study of Karar, *et al*. in 2015 in Saudi population.They reported that therewas a weak positive correlation between HbA_{1C} and total cholesterol and LDL in diabetic patients (Karar, *et al*. 2015).Weakly positive correlation between HbA_{1C} and HDL in this study indicates good diabetic control especially for those who are at increased ages.

Table 1:- Descriptive statistics of study parameters of diabetic patients.

	Mean ± Std. Deviation		
	All diabetic patients N =100	Males N= 41	Females N = 59
HBA1C %	9.1 ± 1.9	8.8 ± 1.7	9.3 ± 2.0
CHOL mmol/L	4.5 ± 1.04	4.3 ± 0.9	4.7 ± 1.1

(mg/dl)	(175.1 ± 40.1)	(166.9 ± 35.0)	(181.1 ± 42.7
TGs mmol/L (mg/dl)	4.06 ± 2.2 (156.9 ± 86.5)	4.07 ± 2.22 (157.4 ± 85.9)	4.1 ± 2.3 (156.6 ± 87.8
HDL mmol/L (mg/dl)	1.09 ± 0.35 (42.4 ± 13.4)	1.03 ± 0.3 (39.8 ± 11.6)	1.15 ± 0.4 (44.3 ± 14.3
LDL mmol/L (mg/dl)	2.66 ± 0.83 (102.7 ± 32.2)	2.5 ± 0.4 (96.6 ±14.3)	2.77 ± 0.85 (107.1 ± 32.7
FBG mmol/L (mg/dl)	10.9 ± 5.6 (195.7 ± 99.9)	10.4 ± 5.2 (186.3 ± 94.1)	11.3 ± 5.8 (202.6 ± 104.4)
Age (years)	49.3 ± 15.9	52.8 ± 16.8	46.9 ± 14.8

Table 2:- Correlation of parameters of diabetic patients (N=100).

		HBA_{1C}	CHOL	TGs	HDL	LDL	FBG	Age
HBA_{1C}	Correlation	1	0.155	0.052	0.054	0.158	0.714**	0.138
	Significance		0.137	0.622	0.607	0.133	0.000	0.172
CHOL	Correlation	0.155	1	0.089	0.069	0.707**	0.139	-0.173
	Significance	0.137		0.401	0.511	0.000	0.208	0.083
TGs	Correlation	0.052	0.089	1	-.526**	-0.086	-0.099	0.328**
	Significance	0.622	0.401		0.000	0.417	0.375	0.001
HDL	Correlation	0.054	0.069	-0.526**	1	0.009	0.198	-0.275**
	Significance	0.607	0.511	0.000		0.934	0.072	0.008
LDL	Correlation	0.158	0.707**	-0.086	0.009	1	0.165	-0.206**
	Significance	0.133	0.000	0.417	0.934		0.137	0.049
FBG	Correlation	0.714**	0.139	-0.099	0.198	0.165	1	-0.052
	Significance	0.000	0.208	0.375	0.072	0.137		0.629
Age	Correlation	0.138	-0.173	0.328**	-0.275**	-0.206**	-0.052	1
	Significance	0.172	0.083	0.001	0.008	0.049	0.629	

**significant at 0.01 (Pearson correlation) 2- tails

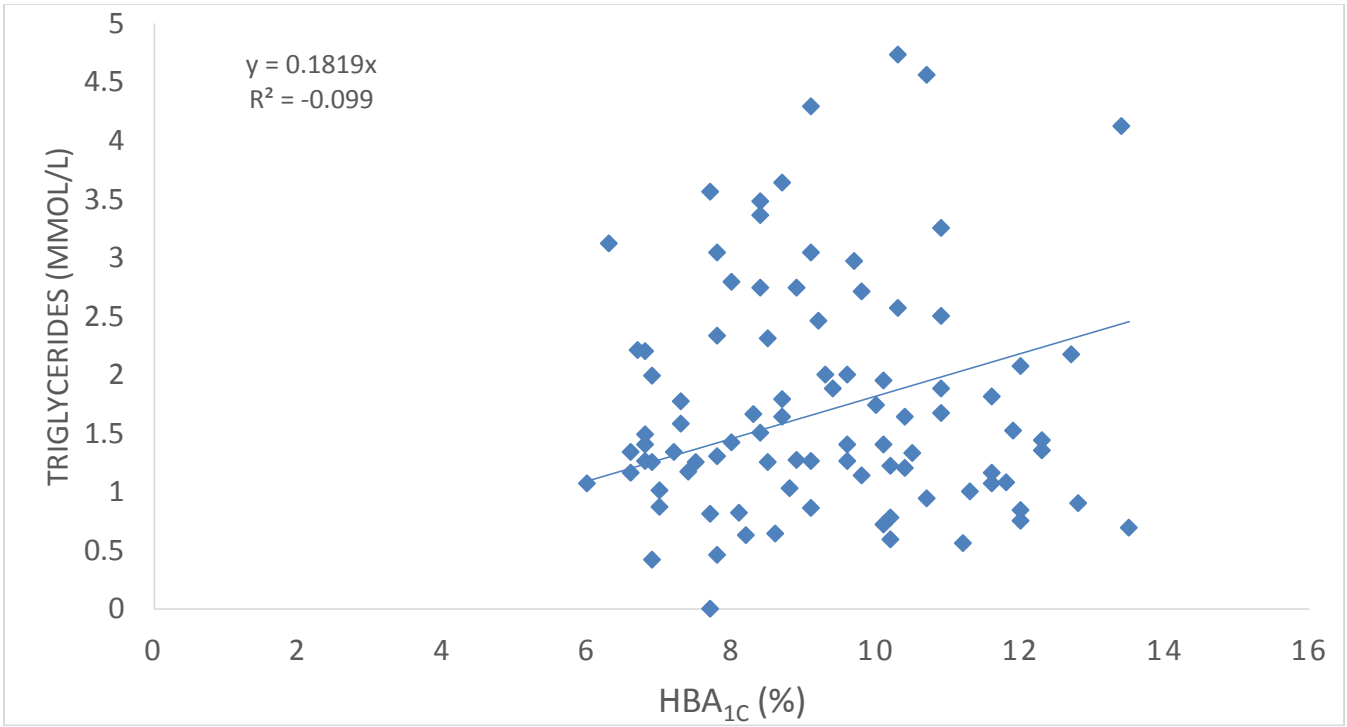

Figure 1:- Illustrates scattered plot of HbA_{1C} correlated with triglycerides.

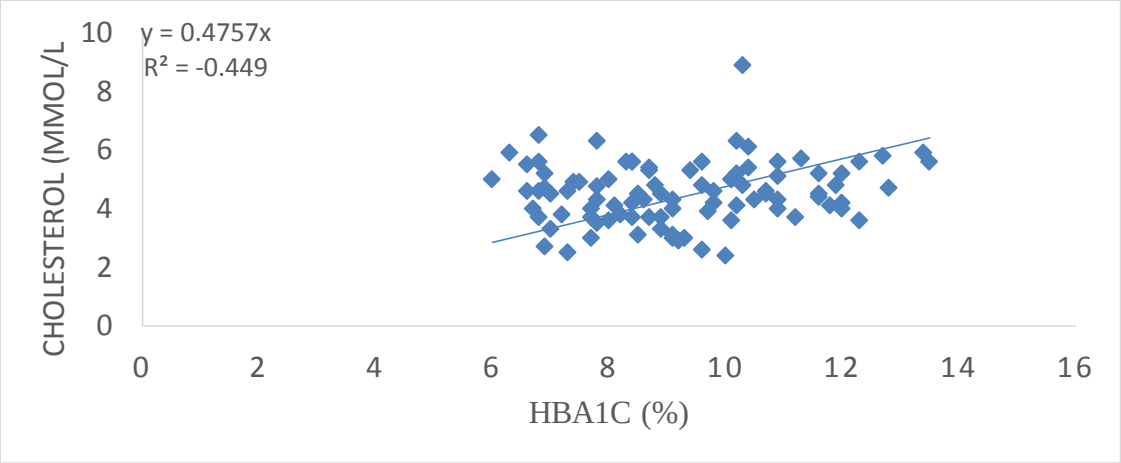

Figure 2:- Illustrates scattered plot of HbA_{1C} correlated with cholesterol.

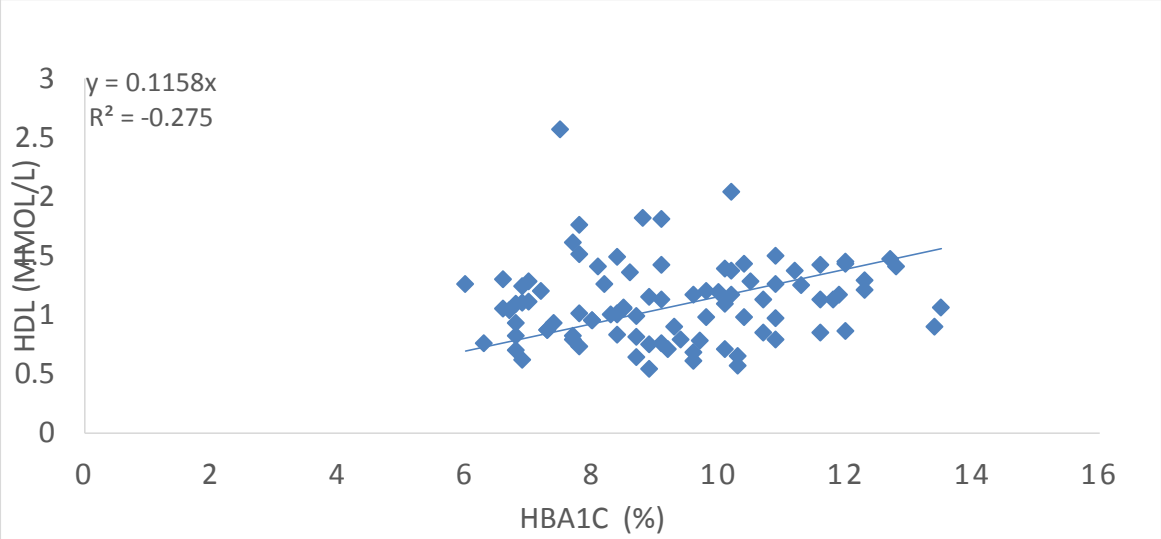

Figure 3:- Illustrates scattered plot of HbA_{1C} correlated with HDL.

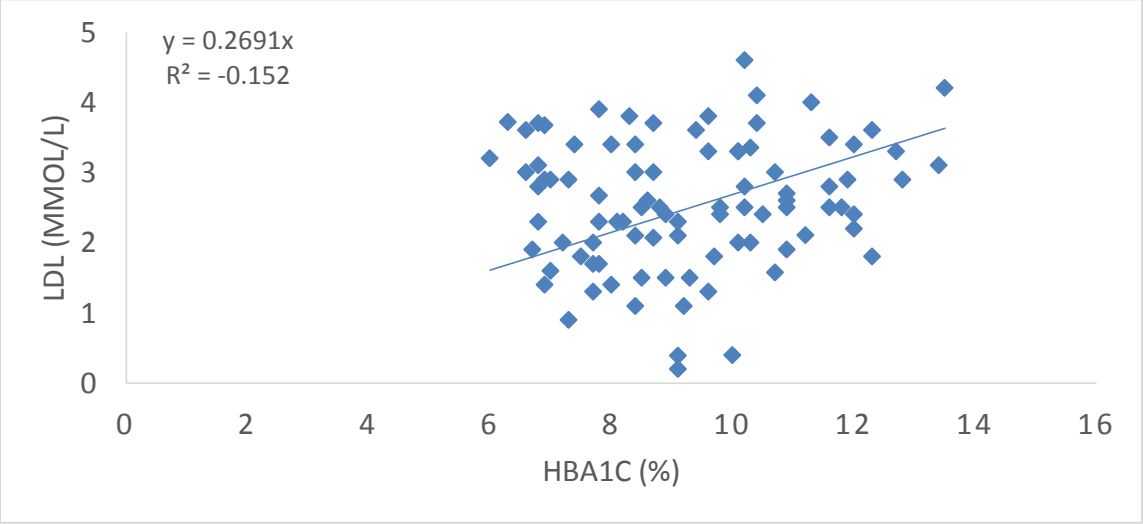

Figure 4:- Illustrates scattered plot of HbA_{1C} correlated with LDL.

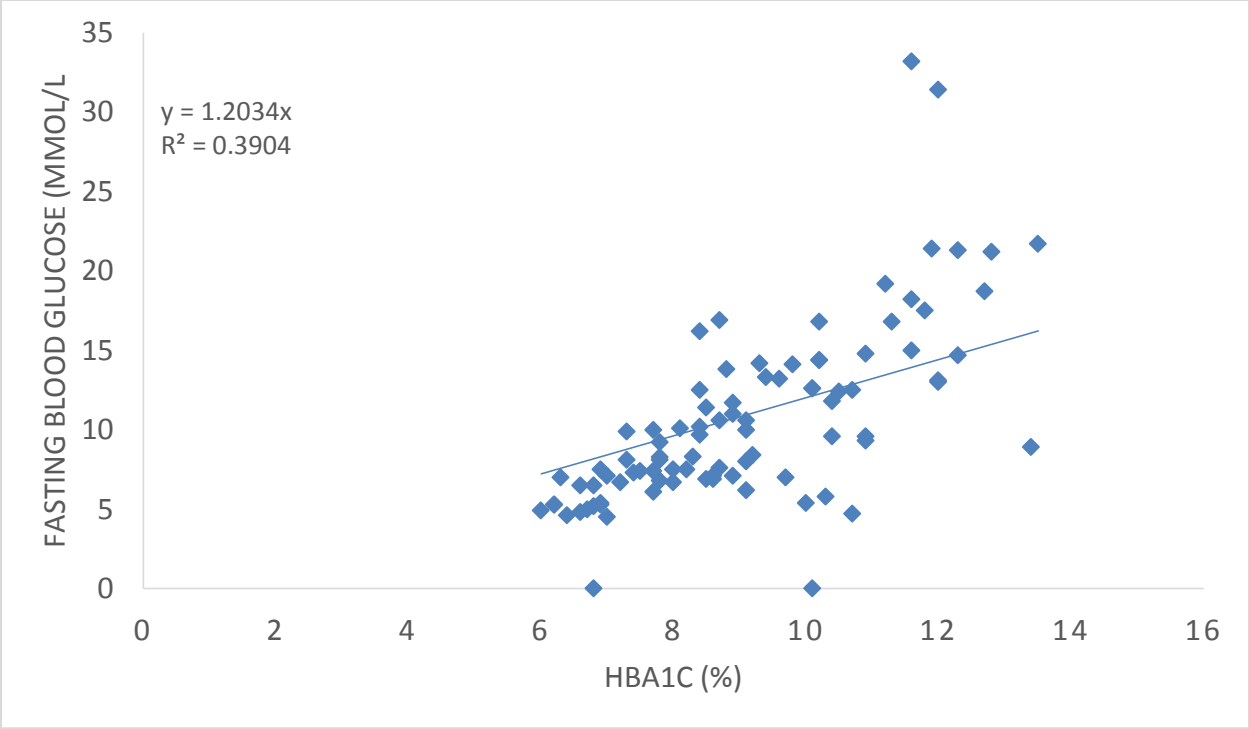

Figure 5:- Illustrates scattered plot of HbA_{1C} correlated with fasting blood glucose.

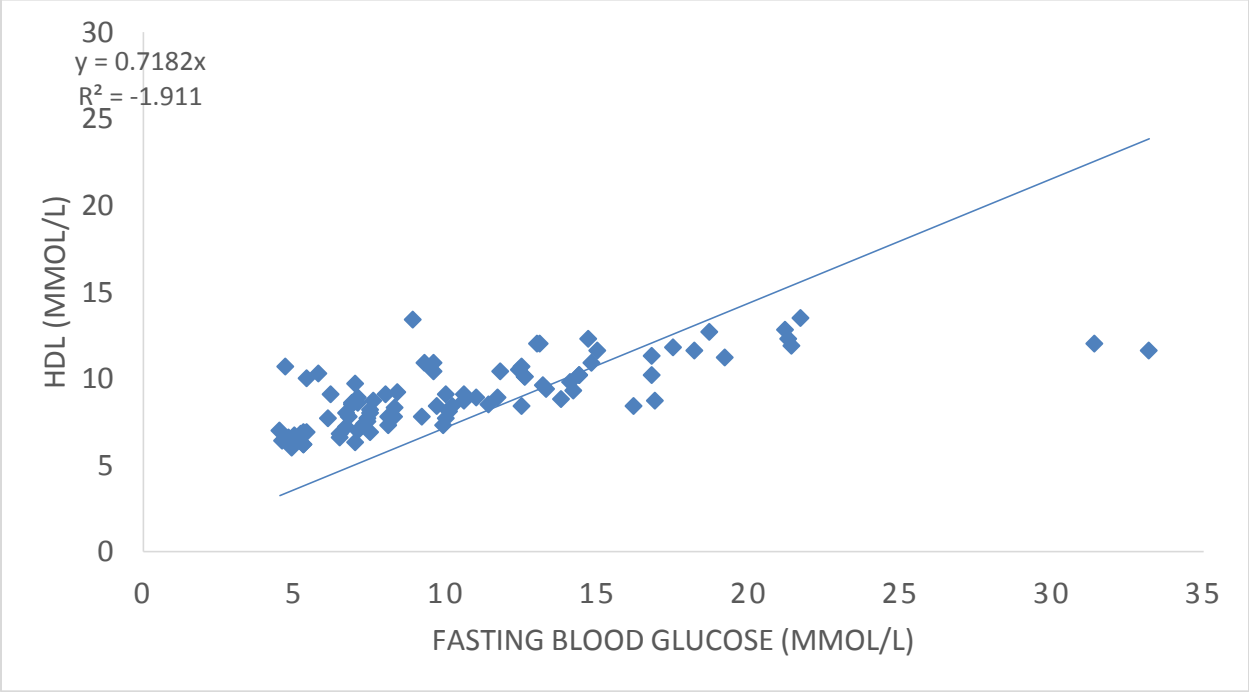

Figure 6:- Illustrates scattered plot of fasting blood glucose correlated with HDL.

Conclusion:-

There was difference in the glycemic status between males and females as measured by Fasting glucose and HbA_{1C}. HbA_{1C} showed positive correlations with cholesterol, TGs, LDL and HDL. These findings suggest that HbA_{1C} level can be used as a good parameter for predicting the lipid profile in both male and female diabetic patients. So that,

HbA_{1C} may be utilized for screening diabetic patient for risk of cardiovascular events and also for timely intervention with lipid lowering drugs.

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