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Hematological and Lipid Profile in Gestational Diabetes Patients: A Systematic Review Analysis of Effect of Gestational Diabetes Mellitus on Different Parameters and Its Association to Maternal and Foetal Outcome

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Study was done to analyze various hematological parameters and lipid profiles in gestational diabetes mellitus and also focused on risk factors and outcome at term and effect on childbirth.

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The study was a systematic review analysis .it was able to conclude that there are so many blood parameters to find out the risk and relationship to the complications of the condition gestational diabetes mellitus patients.
Platelet parameters and White Blood Cells parameters are varying in Gestational Diabetes Mellitus:- a higher prevalence of Gestational Diabetes Mellitus was associated with maternal age, pregnancy weight, prior spontaneous or induced abortion, prior stillbirth, prior low birth weight infant, prior high birth weight infant, and chronic hypertension. Gestational Diabetes Mellitus - affected mothers were more likely than Gestational Diabetes Mellitus -unaffected mothers to produce babies with HBW. Women with Gestational Diabetes Mellitus had a more than two fold increase in caesarean deliveries. The risk of Gestational Diabetes Mellitus increases with age.
The lipid profile is another key sign in Gestational Diabetes Mellitus. Higher Triglyceride, TOTAL CHOLESTEROL, Low density Lipoprotein (LDL), and very Low density Lipoprotein (VLDL) values as well as low High density lipoprotein (HDL) levels were revealed to be significant with Gestational Diabetes Mellitus.

Keywords: GDM and hematological parameter; complete blood count; platelet; lipid profile in GDM; complications in GDM.

1. INTRODUCTION

"Gestational diabetes is a distinct kind of type 2 diabetes that affects women of African, American Indian, Asian, and Hispanic heritage more commonly than other groups. Women who are obese and those with a family history of diabetes are also at increased risk usually goes away following pregnancy. 5% to 10% of women will still have diabetes after giving birth. Type 2 diabetes in later life is substantially more likely to strike women who had gestational diabetes. After five to ten years of giving birth, 40% of women with gestational diabetes go on to develop type 2 DM" [1].

Since more than 50 years ago, it has been known that pregnant women can experience hyperglycemia that return to normal after giving birth. However, there is still no universal agreement on the hyperglycemia thresholds that should prompt a diagnosis of "gestational diabetes mellitus" (GDM) and prompt prenatal care. "The most frequent medical pregnancy complication at the moment is gestational diabetes mellitus (GDM), and young women are increasingly at risk for developing overt diabetes as well as undiagnosed hyperglycemia. Major risk factors for GDM include maternal obesity and overweight, later ages at childbearing, prior GDM episodes, family members with type 2 diabetes, and ethnicity. A non-fasting, glucose challenge test (GCT) is used in some regions of the world to screen women for those who need a full oral glucose tolerance test, however an oral glucose tolerance test (OGTT) is typically used to diagnose the condition" [2].

The prevalence of gestational diabetes mellitus (GDM) in pregnant women ranges from 2% to 5%. Results indicate that higher birth weights, higher cord blood serum C-peptide levels, and, to a lesser extent, primary caesarean births and neonatal hypoglycemia are all associated with rising plasma glucose levels. Obesity, a history of macrosomia, and a strong family history of diabetes are risk factors for GDM. The GDM screening protocol is debatable; some advocate a general strategy, while others exempt low-risk patients. Glycemic control serves as management's pillar. Consuming high-quality nutrients is crucial. Insulin will be necessary for GDM patients whose blood glucose levels cannot be controlled by diet alone. Although there is disagreement over the best time to start insulin therapy, more cautious recommendations have been put in place [3]. The diagnostic cut-offs for gestational diabetes continue to be difficult to determine. All pregnant women without a history of diabetes should undergo a 75 g OGTT at 24-28 weeks of gestation, according to a consensus report from the International Association of Diabetes in Pregnancy Study Groups (IADPSG) that was just released [4].

"While several management strategies exist—including insulin and lifestyle interventions—there is not yet a cure or an efficacious prevention strategy. One reason for this is that the molecular mechanisms underlying GDM are poorly defined. This review discusses what is known about the pathophysiology of GDM" [5].

1.1 Objective of the Study

- To evaluate the status of hematologic profile in GDM patients

- To evaluate lipid profile
- Find out the major risk factors and how its related to glucose level
- How GDM affects delivery and birth weight of the baby

2. METHODOLOGY

The study reviews various literature article by method of data collection .information gathered based on the objectives of the analysis .All the data were collected through various journal, magazine, research paper and publications. The site followed was google scholar, pub med etc.

3. RESULTS

3.1 Related Articles on Hemogram and Lipid Profile in Gestational Diabettes Patients: Analysis of Effect of Gdm on Different Parameters and Its Association to the Complication at Term

According to the study by Liu et al "In comparison to the control group, GDM had considerably greater NLR, PLR, and MPV". "Elevated WBC, NLR, PLR, and MPV were identified as independent variables for predicting GDM in pregnancy" [40].

Study by Sak M et al conclude that "the mean platelet volume and HbA1c were significantly increased in the patients with gestational diabetes". "The mean platelet volume was well correlated with the platelet distribution width and the platelet count" [41].

A study by Esar colak concludes that MPV value will be higher in GDM and also value will be high in those with GDM with advanced age [42].

"As per Erdoğan, when compared to healthy controls, the GDM group's mean platelet distribution width (PDW) values and mean alanine transaminase (ALT) and gamma-glutamyl transferase (GGT) activities were all significantly greater" [43].

Another study by Sun [44] showed a strong correlation between the first-trimester neutrophil count and the development of GDM and unfavorable pregnancy outcomes, particularly macrosomia. When it was greater than 5.0109/l, the neutrophil count constituted a separate risk factor for the development of GDM.

4. DISCUSSION

Alev Akyol et al [45] studied "Lower platelet counts and larger mean platelet volumes (MPV) values were statistically significant in women with gestational diabetes mellitus. According to the findings, platelet count and MPV are significant predictors of gestational diabetes mellitus".

Yilmaz et al [6] found "White blood cell, platelet, neutrophil, and lymphocyte counts, mean platelet volume, and red cell distribution width were all significantly greater in the gestational diabetes mellitus."

Table 1. Scholarly literature on gestational diabetes and hematologic profile, lipid profile and maternal outcome

Sl. No.	Area & focus of the research	Outcome of the research	Reference
1	Association of Complete Blood Count Parameters with Gestational Diabetes Mellitus	White blood cell, platelet, neutrophil, and lymphocyte counts, mean platelet volume, and red cell distribution width were all significantly greater in the gestational diabetes mellitus group compared to the control group. However, neither the neutrophil to lymphocyte ratio nor the platelet to lymphocyte ratio significantly differed across the groups. The first trimester mean platelet volume and red cell distribution width values were revealed to be independently linked with the diagnosis of gestational diabetes mellitus in binary logistic regression analysis.	Yılmaz, et al [6]
2	Platelet profile of patients with gestational diabetes	The platelet indices MPV and PDW showed statistically significant relationship with GDM in this study. These indices which are easily	Khan et al [7]

Sl. No.	Area & focus of the research	Outcome of the research	Reference
		available can be used for the early intervention and prevention of complications to improve maternal and fetal outcomes.	
3	Comparison of thyroid function tests and blood count in pregnant women with versus without gestational diabetes mellitus	While mean platelet volume and free tri iodo thyronine (FT3) levels were significantly lower in the GDM group than in the non-GDM group, the rate of caesarean section, age, platelet count (246.7 68.3 vs., and thyroid-stimulating hormone) were all significantly higher in the GDM group than in the non-GDM group. A higher incidence of GDM was independently linked to older age and lower FT3 levels.	Gorar et al [8]
4.	Comparison of the predictive value of plateletcrit with various other blood parameters in gestational diabetes development	Patients with GDM were shown to have statistically significant associations with plateletcrit, mean platelet volume, and platelet distribution width (p 0.001). Compared to other platelet indices, Plateletcrit has superior sensitivity and specificity. Plateletcrit provides more precise information than platelet count and mean platelet volume, while being a statistic in complete blood count that is often unknown or underutilised. The significance of platelet-related indices and their determination, which are affordable and often ordered markers, is frequently disregarded. In addition to the oral glucose tolerance test, they might be helpful in the screening for gestational diabetes.	Sahbaz et al [9]
5	Investigation of Some Haematological Parameters in Pregnant Women with Gestational Diabetes at Federal Medical Center, Owerri, Imo State, Nigeria	Significantly greater levels of haemoglobin, PCV, TWBC, neutrophils, and platelet count were seen in pregnant women with gestational diabetes. While eosinophil and monocyte counts are not significantly different between gestational diabetic women and healthy pregnant women, gestational diabetes is related with reduced lymphocyte levels.	Hope et al [10]
6	Diagnostic accuracy of first and early second trimester multiple biomarkers for prediction of gestational diabetes mellitus: a multivariate longitudinal approach	This study used more sophisticated statistical techniques to propose a framework for the early diagnosis of GDM utilising common characteristics in the standard CBC tests. According to the projected prediction accuracy indices for the presented strategy, 80% of pregnant women could be correctly divided into GDM and non-GDM groups utilising the framework we suggested. Several of these biomarkers are expensive or difficult for all pregnant women in the majority of poor or low-income countries to access, despite the fact that some researchers have already introduced a number of biomarkers with higher predictive potential for the early detection of GDM. Consequently, there is a pressing need for future research to concentrate on more widely used and available indicators for early GDM prediction, especially in nations with lower GDM prevalence.	Shaarbaf Eidgahi et al [11]

Sl. No.	Area & focus of the research	Outcome of the research	Reference
7	Can A Simple Complete Blood Count Predict Gestational Diabetes Mellitus?	These findings suggest that women with GDM may be accompanied with increased RDW and NRBC levels which seem to be independent predictors of this disease and these parameters may be used to monitor and evaluate the development of GDM.	Aytan P et al [12]
8	Comparison of gestational diabetes mellitus rates in women with increased and normal white blood cell counts in early pregnancy	When compared to women with a normal WBC count, Thai or other South-East Asian women had a significantly higher incidence of gestational diabetes mellitus (GDM). Our findings show that WBC count is a distinct risk factor for GDM.	Paranee pattanathaiyanon et al [13]
9	Study on Neutrophil - Lymphocyte ratio among women with Gestational diabetes mellitus	The ratio of neutrophils to lymphocytes in the body is an indication of neutrophil-lymphocyte balance and a sign of systemic inflammation. Gestational diabetes mellitus is predicted by the neutrophil lymphocyte ratio in expectant women. An effective and reliable predictor of gestational diabetes mellitus is a high neutrophil lymphocyte level. The study's findings indicated that the pathogenesis of gestational diabetes mellitus is largely influenced by inflammation. Thus This research clearly shows a correlation between the neutrophil lymphocyte ratio and a woman's likelihood of developing gestational diabetes. It has been demonstrated that a rise in neutrophil lymphocyte ratio is a predictive factor for hearing loss11 and the development of diabetic retinopathy, early diabetic neuropathy, and other complications associated with diabetes mellitus.	Rajagopal et al [14]
10	Neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios: are they useful for predicting gestational diabetes mellitus during pregnancy?	Leukocyte, neutrophil, and lymphocyte counts in the research groups were noticeably higher than those in the control group. Regarding the NLR and PLR, there were no statistically significant variations between the groups.	Sargın et al [15]
11	Morphology and Chromic Status of Red Blood Cells Are Significantly Influenced by Gestational Diabetes	Compared to controls, 40% of RBCs from GDM patients had microcytic and hypochromic features. In addition, 42.5% more patients than controls exhibited anisocytosis. Women with either type 1 or type 2 diabetes were more likely to have poikilocytosis, target cells, and macrocytes.	Rajab et al [16]
12	Maternal lipid profiles in women with and without gestational diabetes mellitus	It was found that TG, TC, LDL-C concentrations, and TG/HDL-C ratio increased progressively throughout pregnancy; meanwhile, HDL-C amounts increased from the 1st to the 2nd trimester with a slight decrease in the 3rd trimester. Lipid profiles were dramatically different between the GDM group and the control group, except of serum TC and LDL-C	Wang J et al [17]

Sl. No.	Area & focus of the research	Outcome of the research	Reference
		concentrations. Maternal age, pre pregnancy BMI and TG/HDL ratio in the 1st trimester could predict the risk of GDM at an early stage.	
13	Effect of gestational diabetes mellitus on lipid profile: A systematic review and meta-analysis	Compared to healthy pregnant women, women with GDM experience elevated TG levels throughout pregnancy substantially more frequently. In the GDM group, there were higher levels of TC, LDL, VLDL, and TG/HDL ratio and a lower level of HDL. As a result, TG levels and the TG/HDL ratio can be used as a trustworthy indicator and potential risk factor in the diagnosis of GDM. Nonetheless, further study is required in this area.	Rahnemaei et al [18]
14	Associations between Maternal Lipid Profiles and Pregnancy Complications: A Prospective Population-Based Study	Maternal lipid profiles during the whole pregnancy are significantly associated with GDM, HDCP, and ICP. Combining lipid profiles in the first trimester with the other common predictors could effectively improve the power of predicting GDM and HDCP.	Zhang et al [19]
15	Lipid Profile In Ghanaian Women With Gestational Diabetes Mellitus	Lipid profiles have been a helpful tool for the effective diagnosis and treatment of diabetes mellitus patients. Investigators looked at the function of plasma lipids in the aetiology of GDM in Ghanaian women. Patients who were pregnant were chosen for the case-control research. In comparison to controls, GDMs had significantly higher mean values of TG, TOTAL CHOLESTEROL, LDL, and VLDL. Mean HDL levels for GDMs were substantially lower than for controls. GDMs' mean cortisol levels were substantially greater than those of controls. Moreover, GDMs had mean progesterone levels that were markedly greater than controls. These studies demonstrated that LDL, total cholesterol, and VLDL levels were generally considerably higher in GDMs compared to controls. Yet, compared to GDM, controls had HDL that was considerably greater.	Asare-Anane et al [20]
16	Gestational Diabetes Mellitus: Mechanisms, Treatment, and Complications	Gestational diabetes mellitus (GDM) is the most common metabolic disturbance during pregnancy. The prevalence is rising and correlates with the increase in maternal obesity over recent decades. The etiology of GDM is complex, with genetic and environmental factors implicated in mechanistic and epidemiological studies. GDM begets important short- and long-term health risks for the mother, developing fetus, and offspring. This includes the high likelihood of subsequent maternal type 2 diabetes (T2DM), and possible adverse cardiometabolic phenotypes in the offspring.	Johns et al [21]
17	Gestational diabetes: risks, management, and treatment options	GDM is expected to rise to the top of the list of pregnancy-related co morbidities if latest diagnostic recommendations are implemented.	Kim C et al [22]

Sl. No.	Area & focus of the research	Outcome of the research	Reference
		The prevalence of GDM will rise even if the diagnostic standards remain the same as obesity rates rise. While there is broad agreement regarding the link between blood glucose levels and unfavourable prenatal and postpartum outcomes in the mother and kids, medical organisations dispute over monitoring and treatment strategies. The risk of negative outcomes seems to be reduced by paying close attention to foetal growth and stress levels, monitoring maternal glucose and weight levels, and delivering the baby if targets are surpassed.	
18	Gestational diabetes mellitus	The study conclude adequacy of current screening test and major complications in GDM patients. use of insulin analoges and more physiological than insulin.	Alfadhli, et al [23]
19	Gestational diabetes mellitus. Risk factors, obstetric complications and infant outcomes.	Maternal age, pregnancy weight, prior spontaneous or induced abortion, prior stillbirth, prior low birth weight infant, prior high birth weight infant, and chronic hypertension were all linked to a higher incidence of GDM after controlling for confounding variables. Babies with HBW were more likely to be delivered by GDM-affected mothers than by GDM-unaffected mothers. Finally, caesarean deliveries were more than twice as prevalent in women with GDM. older age increases the risk of GDM	McMahon et al [24]
20	Gestational diabetes mellitus: prevalence, risk factors, maternal and infant outcomes	2.5 percent of people had GDM. Age over 35, obesity, a history of newborn deaths, and previous caesarean sections were risk factors for GDM. Women who were pregnant as adolescents and drank alcohol had lower GDM rates. Pre-eclampsia, early membrane rupture, caesarean section, and preterm delivery were all increased risks for mothers with GDM. It was more likely that babies born to mothers with GDM would be macrosomic or large for gestational age. Conclusions: Certain health issues predispose to GDM, which is linked to a markedly elevated risk of maternal and foetal morbidity.	Xiong, X et al [25]
21	Gestational Diabetes and Its Impact on the Neonate	A somewhat frequent medical problem that dates back to the nineteenth century is gestational diabetes mellitus. The pathophysiology of the mother and foetus is covered in this article, as well as how the mother's health affects the newborn. Maternal hyperglycemia can result in foetal macrosomia, newborn respiratory distress syndrome, cardiomyopathy, hypoglycemia, hypocalcemia, hypomagnesemia, polycythemia, and hyperviscosity, which are all explored in length. Included are therapeutic strategies and treatment choices for the mother, newborn symptoms and diagnoses, and current research on this issue.	Jones, C et al [26]

Sl. No.	Area & focus of the research	Outcome of the research	Reference
22	Maternal and Neonatal Outcome in Mothers with Gestational Diabetes Mellitus	Obesity, lipid problems, hypothyroidism, and prenatal hypertension are all linked to gestational diabetes. The majority of women needed insulin for their treatment, and better blood glucose management reduced the risk of problems for the unborn child	Prakash, G. T et al [27]
23	The Impact of Glycemic Control on Neonatal Outcome in Singleton Pregnancies Complicated by Gestational Diabetes	Negative newborn outcomes are linked to mothers with GDM who have suboptimal glycemic control. The care of women with GDM requires careful blood glucose monitoring and the beginning of the appropriate medication.	González et al [28]
24	Pregnancy outcome in gestational diabetes	In women with GDM, aggressive therapy for strict glycemic control improves maternal and neonatal outcomes.	Hod, M et al [29]
25	Pregnancy outcome in pregnancies complicated with gestational diabetes mellitus and late preterm birth	The mean birth weight and percentile of neonates of moms with GDM were significantly greater, along with the prevalence of large-for-gestational-age newborns. There were no variations in neonatal morbidity indices or fatality rates.	Aviram, A et al [30]
26	Maternal lipid profile differs by gestational diabetes physiologic subtype	Depending on their physiologic subtype, women with GDM have unique lipid profiles, which may not be visible when GDM is studied as a whole.	Layton et al [31]
27	pregnancy Adverse Lipid Profile and Subsequent Risk of Gestational Diabetes	Years prior to becoming pregnant, women with GDM had lower LDL peak diameter sizes, higher amounts of high-density lipoprotein, and higher levels of the tiny and very small LDL subfraction groups. A prenatal atherogenic lipid profile may assist in identifying women who should be targeted for prevention of GDM.	Han et al [32]
28	The Predictive Effects of Early Pregnancy Lipid Profiles and Fasting Glucose on the Risk of Gestational Diabetes Mellitus Stratified by Body Mass Index	Among women with GDM, age, p-BMI, and family history of DM were all markedly higher. Moreover, early pregnancy TG/HDL-C and LDL-C/HDL-C ratios as well as early pregnancy serum fasting glucose, cholesterol, and triacylglycerol levels were considerably higher in women with GDM compared to healthy pregnant women.	Wang et al [33]
29	Pregnancy Lipid Profile and Different Lipid Patterns of Gestational Diabetes Treated by Diet Itself	Because while healthy non-pregnant women had the lowest values, women with GDM exhibited the most severe patterns indicating the presence of metabolic syndrome (highest BMI, waist circumference, C-peptide level, and TG). Although not to the same degree as those with GDM, pregnant women without GDM exhibited higher BMI, waist circumference, C-peptide levels, and TG. Pregnant women with and without GDM did not differ in terms of TC (along	Cibickova et al [34]

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		with LDL-C and non-HDL-C). Nonetheless, the levels of TC were noticeably greater in both groups. HbA1c values were lower in healthy pregnant women than in patients with GDM or healthy non-pregnant women.	
30	Association of lipid levels during gestation with preeclampsia and gestational diabetes mellitus: a population-based study	The trough of lipid levels during pregnancy was immediately after conception, and the high was at delivery. Total cholesterol levels rose from 164.4 mg/dL to 238.6 mg/dL and triglycerides (TGs) from 92.6 mg/dL to 238.4 mg/dL compared to preconception levels. 1209 women (12.2%) experienced the composite endpoint (gestational diabetes mellitus or preeclampsia). Although it was unrelated to high-density lipoprotein levels, its prevalence rose with TG levels, rising from 7.2% in the group with low TGs to 19.8% in the group with high TGs (>75th percentile). In multivariate analysis, greater TGs levels were linked to the main endpoint but not low HDL levels.	Wiznitzer et al [35]
31	Lipid profile changes in erythrocyte membranes of women with diagnosed GDM	In contrast, the GDM group had significantly greater OGTT, CRP, total cholesterol, and triglyceride levels than the control group. FPG and HDL concentrations were greater in the GDM group, but these differences were hardly significant.	Bukowiecka et al [36]
32	Association of first-trimester maternal lipid profiles and triglyceride-glucose index with the risk of gestational diabetes mellitus and large for gestational age newborn	Among our subjects, the prevalence of GDM and LGA babies was 18.4% and 26.1%, respectively. The risk of GDM and LGA baby increased significantly with increases in FPG, triglycerides, TG/HDL-C ratio, and TRIGLYCERIDE (TyG) index. After potential confounders were taken into account, women in the top tertile of FPG, triglyceride (TG), triglyceride/high-density lipoprotein-cholesterol (TG/HDL-C), and TyG index had relative risks of GDM that were, respectively, 4.2, 4.2, 3.9, and 4.9 times higher than those of women in the bottom tertile. After accounting for GDM, women in the top tertile of FPG, TG, TG/HDL-C ratio, and TyG index had relative risks for LGA newborns that were, respectively, 3.9, 4.3, 4.8, and 5.3 times higher than those in the bottom tertile.	Pazhohan et al [37]
33	Variations of blood cells in prediction of gestational diabetes mellitus	WBC, RBC, and PLT counts in the mother are significant correlates of GDM. Increased RBC and PLT levels may prevent the development of GDM in pregnant women.	Yang et al [38]
34	Impact of inflammatory factors, hemoglobin A1c, and platelet parameters in gestational diabetes mellitus	The study results show that higher levels of hs-CRP, IL-6, HbA1c, and PDW at 24-28 gestational weeks, even when they are within the typical normal range, may be related to the aetiology of GDM and that regular prenatal care should include their examination	Xiang et al [39]

According to a study led by Zhongwei Zhou [46], MPV levels in GDM patients are elevated, indicating that MPV could be utilised as a tool to track and gauge the progression of GDM.

Buchanan et al [47] study agree with this findings that maternity complications are high in GDM mothers compare to normal. Bharathi et al [48] agree "this findings that Serum triglyceride, total cholesterol and VLDL level are significantly higher among woman with GDM compared to non GDM pregnant women, where in the lipid profile can be used as predictor for gestational diabetes mellitus."

Si-Meng Zhu et al [49] conclude "Elevated maternal lipid profiles in early pregnancy are associated with higher birth weight and increased risks of LGA and macrosomia. We propose that serum lipid profiles in early pregnancy and pre-pregnancy BMI could serve as screening indexes for high-risk women".

Mother to Baby article [50] conclude gestational diabetes can cause birth defects and abortion.

5. CONCLUSION

By this review it was concluded that WBC and platelet parameters are significantly varying in GDM patients .Lipid profile is also can be used as important marker in GDM. A higher value of TG, TOTAL CHOLESTEROL, LDL, and VLDL and low value HDL levels for GDMs were found as significant.

After accounting for confounding factors, a higher prevalence of GDM was associated with maternal age, pregnancy weight, prior spontaneous or induced abortion, prior stillbirth, prior low birth weight infant, prior high birth weight infant, and chronic hypertension. GDM-affected mothers were more likely than GDM-unaffected mothers to produce babies with HBW. Last but not least, women with GDM had a more than twofold increase in cesarean deliveries. The risk of GDM increases with age.

6. LIMITATION OF THE SUTDY

The study analyzed only hematological and lipid profile parameters.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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