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Article

Association between Glycemic Status and Lipid Profile in Adults: A Narrative Review

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Abstract: The association between glycemic control and lipid levels is a significant topic for medical research because there is usually some kind of link between the two factors and plays a crucial role in the development of cardiovascular diseases. Diabetes Mellitus (DM) is more specifically linked with the specific pattern of dyslipidemia that includes lower levels of HDL-C and higher triglycerides and increased levels of low-density, small lipoproteins. However, importantly, all these metabolic abnormalities might have started during the pre-diabetic phase if there is any pre-diabetic phase wherein all the problems in lipid metabolism may occur even in the absence of diabetes. This is a narrative review, and this article addresses the interaction between glycemic condition and lipid profile among adults and this is based on scientific literature within the last 15 years from 2010 to 2026. This includes the biological process behind the alterations in the lipid profile and hyperglycemia or insulin resistance, the findings of observational and clinical research and its clinical significance. The focus of definite attention is fasting blood glucose, glycated hemoglobin (HbA1C), triglycerides, total cholesterol, LDL-C and HDL-C. The present review also examines the influence of age, sex, lifestyle, obesity, medication and other metabolic risk factors on this relationship. There is some evidence to suggest that there is a close association between impaired glucose regulation and an unfavorable lipid profile. The strength and nature of this association, however, varies between populations, and is affected by several clinical and demographic factors. This relationship may help identify cardiometabolic risk earlier in the lives of adults and better preventative approaches.

Keywords: Glycemic status; lipid profile; diabetes mellitus; prediabetes; HbA1c; fasting blood glucose; dyslipidemia; insulin resistance; cardiovascular risk.

Introduction

One of the most important metabolic disturbances that affects the adult population is diabetes mellitus. Diabetes mellitus is one of the most important metabolic disturbances that affect the adult population of the world. Both statuses are significantly associated with cardiovascular complications such as stroke, coronary artery disease, and peripheral vascular disease and their increasing prevalence is a major public health problem [1], [2].

The glycemic condition is assessed by the capacity of regulating blood glucose levels and is usually assessed using the fasting blood glucose (FBG), glycated hemoglobin (HbA1c) and, on some occasions, by the oral glucose tolerance test (OGTT). These indices provide additional data on glucose metabolism. FBG shows blood glucose levels at a specific point in time, while HbA1c provides a guess on the average glucose levels over the past 2-3 months. This is how the utilization of the two methods simultaneously will provide a more comprehensive evaluation of the control of glucose [3], [4].

However, there is ample information regarding the role played by the lipid profile in heart and metabolic diseases. Normally, the lipid profile is composed of triglycerides (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C). The functions of these lipid fractions are different [5]. HDL-C has been demonstrated to be inversely related to cardiovascular risk in epidemiological studies, whereas increased LDL-C has been proven to be well-placed to the atherosclerotic cardiovascular disease. Hypertriglyceridaemia can often be observed in patients with insulin resistance, particularly in combination with a low HDL-C level [6].

A recent clinically relevant finding in metabolic research is that lipid abnormalities can occur prior to the diagnosis of diabetes. Persons suffering from prediabetes, which is characterized by elevated blood glucose levels, although not elevated enough to be classified as diabetes, may show an abnormal lipid profile [7], [8]. This demonstrates that metabolic diseases develop in a progressive way and that the link between glucose regulation and lipid metabolism exists even prior to developing the disease [9], [10].

Insulin resistance is considered to be the major link between the two metabolic pathways. Insulin acts to inhibit hepatic glucose production, stimulate glucose transport into skeletal muscles, and inhibit excessive lipolysis in fat tissues [11], [12].

With less insulin sensitivity, the regulatory functions become compromised. Increased release of free fatty acids from adipose tissue is associated with an increased supply of fatty acids to the liver, leading to increased triglyceride production in the liver and increased production of triglyceride-rich very-low-density lipoprotein (VLDL) particles [13], [14].

These changes are part of the typical diabetic lipid profile comprising: elevated serum TG levels, reduced HDL-C levels, increased production of small, dense LDL particles, increased VLDL production and altered VLDL metabolism, and normal or even relatively elevated LDL-C levels with potential increased atherogenicity [15], [16].

Another important factor is that there is not always a linear relationship between glycemic status and lipid pattern. Others may show relatively normal conventional lipid levels but elevated triglycerides and low HDL-C for poorly controlled diabetes, while some may have relatively normal levels of conventional lipids with underlying cardiovascular risk. This may be attributed partly to genetic differences, renal function, physical activity, nutrition, adiposity, disease duration and lipid-lowering treatment,[17],[18],[19].

The wider availability of HbA1c assaying has also inspired researchers to seek to answer the question of whether there are lipid abnormalities as well as increased fasting glucose as a result of long-term glycemic exposition. The HbA1c and triglycerides, total cholesterol, LDL-C and HDL-C relationships have been investigated by many studies [20], [21]. However, all the results obtained are not always consistent, especially where the levels of LDL-C and total cholesterol are concerned. This inconsistency emphasizes the importance of taking into consideration the characteristics of the population under study and the condition in which the treatment is administered [22], [23].

The amount of work that has been done on the relationship between glycemic status and lipid

profiles is immense, considering various aspects of clinical practice. For one thing, it can serve as a way to detect those at risk of developing cardiometabolic disease long before the development of the symptoms of diabetes [24], [25]. For another, it lays the foundation for the importance of assessing lipid parameters in people with prediabetes and diabetes. Third, it could also affect the understanding of the integrated impact of dyslipidaemia and hyperglycaemia on cardiovascular complications [26], [27].

Despite considerable studies have searched diabetes and dyslipidemia solely, an combined understanding of their link across various glycemic categories keeps valuable [28], [29].

A novel literature narrative synthesis can help determine consistency of reported data, understand the biological mechanisms and identify areas for further research .

So current review is aimed to investigate the association between glycemic status and lipid profile in adults particularly with respect to evidence published in the period from 2010 to 2026.

The specific objectives are:

1. To evaluate the association of FBG with each individual lipid index.
2. To examine the correlation between HbA1c and triglycerides, total cholesterol, LDL-C and HDL-C.
3. To compare the lipid profile of different glycemic states: normoglycemic, pre-diabetic and diabetic adults.
4. To understand the physiological mechanisms between insulin resistance, dyslipidemia and hyperglycaemia.
5. For evaluating the clinical significance of lipids with varying degrees of glycaemic control.
6. To acknowledge the methodological weaknesses and gaps in the literature.

Materials and Methods

Study design

The aim of the present study was to undertake a systematic narrative review of the available literature that addressed the associations of glycemic control and lipid profile in adults. The choice of the narrative approach allowed for the inclusion of findings of studies that used different study designs, populations, and clinical contexts to discuss the correlations collectively and to appreciate the biological mechanisms that relate to these observations.

Original research articles, observational studies, cross-sectional investigations, cohort studies, clinical trials, systematic reviews, meta-analyses, and the appropriate clinical guidelines published from January 2010 to November 2026 were reviewed.

The goal of the master objective was not to measure a single estimate of association between the different measures of glycemic regulation and the individual lipid indices, but to synthesize the available evidence.

Literature search strategy

Relevant publications were recognized via searches of master biomedical and scientific databases, involving:

- PubMed/MEDLINE.
- Scopus.
- Web of Science.
- Google Scholar.
- Cochrane Library.

- Springer Nature

Additional information was gained from identified international organizations and professional guidelines, especially the American Diabetes Association (ADA) and the World Health Organization (WHO).

The search approach included using keywords and medical subject headings (MeSH) related to glycemic condition, glucose metabolism, diabetes and lipid abnormalities.

The following search terms and combinations were considered;

Main concept	Search terms
Diabetes	Diabetes mellitus, type 2 diabetes, prediabetes
Glycemic status	Glycemic status, blood glucose, fasting blood glucose, hyperglycemia
Long-term glucose control	HbA1c, glycated hemoglobin, glycemic control
Lipid parameters	Lipid profile, total cholesterol, triglycerides
Lipoproteins	HDL cholesterol, LDL cholesterol, VLDL
Metabolic mechanisms	Insulin resistance, dyslipidemia, metabolic syndrome
Clinical outcomes	Cardiovascular risk, atherosclerosis, cardiometabolic risk

Examples of search combinations involved:

- "Fasting blood glucose AND triglycerides AND HDL cholesterol."
- "Glycemic control AND LDL cholesterol."
- "HbA1c AND lipid profile AND adults."
- "Insulin resistance AND diabetic dyslipidemia."
- "Prediabetes AND dyslipidemia."
- "Type 2 diabetes AND lipid abnormalities."

Inclusion criteria

Publications were deemed relevant when they fulfilled the persuading criteria:

1. Published between January 2010 and November 2026.
2. Performed in human adult populations aged 18 years or older.
3. Surveyed glycemic condition, diabetes, prediabetes, or glucose metabolism.
4. Involved at least one lipid parameter, such as triglycerides, total cholesterol, LDL-C, or HDL-C.
5. Recorded an correlation association, comparison, or clinically relevant link between glycemic and lipid estimations.
6. Published as full-text original study, systematic reviews, meta-analyses, or authoritative clinical guidelines.
7. Available in English or with sufficient English-language information for scientific interpretation.

Exclusion criteria

The following publications were excluded from the prime synthesis:

- Studies done only on children or adolescents.
- Studies on pregnant women.

- Animal experimentation and literature review when human clinical trials do not exist.
- Trials where glucose and lipid profiles were examined independently without exploring their correlation.
- Case reports and editorials lacking any original evidence.
- Duplicate papers and those where methodology is not provided.

Data extraction and synthesis

Relevant information was organized following to the persuading variables:

- Authors and year of publication.
- Study design and population features.
- The number of participants, if any.
- Glycemic parameters, such as FBG and HbA1c.
- Lipid parameters, including TG, TC, LDL-C, and HDL-C.
- Prime statistical data and reported links.
- Potential confounding factors.
- Clinical implications.

The obtained data was not statistically combined but thematically synthesized.

The prime themes involved:

1. FBG concentration and its correlation with lipid parameters.
2. HbA1c concentration and its correlation with lipid profile.
3. Differences between lipid parameters for normoglycemia, prediabetes, and diabetes mellitus.
4. Biological background of glucose metabolism-lipid relationship.
5. Clinical importance and cardiovascular risk associated with it.

Clarification on methodology: This is a narrative review and not a complete systematic review. The total number of articles screened is not necessary, nor is it required to have a PRISMA flow chart and any impact estimation. This is because these elements will only be needed after conducting a database search.

Results

General association between glycemic condition and lipid profile

Most of the literature published during the review period has confirmed the presence of a significant relationship between glucose metabolism and lipid metabolism in adults. Nevertheless, there is a relatively stronger relationship between triglyceride levels and HDL-C levels as compared to total cholesterol and LDL-C [30],[31],[32].

Patients who have disturbed glucose regulation often exhibit elevated triglycerides and reduced HDL-C. These anomalies can be observed more definitively in adults who have type 2 diabetes mellitus, insulin resistance, and central obesity [33],[34],[35].

One important input made towards achieving this scope was through Yang [36] who explored the relationship between blood glucose and lipid parameters among adults from results obtained from the National Health and Nutrition Examination Survey (NHANES). The analysis involved 6,093 adults above the age of 20 years.

The positive association between FBG and triglycerides, as well as the inverse association between FBG and HDL-C, was noted by the investigators. It should be noted that the associations

between fasting glucose and total cholesterol and LDL-C were nonlinear, namely, U-shaped. Moreover, a positive association between fasting glucose and apolipoprotein B was documented.

These results become especially significant considering the fact that the correlation between glucose and lipids does not exist uniformly across all lipid fractions; each of these components responds in a differential manner upon changes in glucose metabolism [37], [38].

Overall, the current available information indicates that worsening glycemia is often associated with an atherogenic lipid pattern, even though the degree of these changes may differ from one individual to another [39], [40].

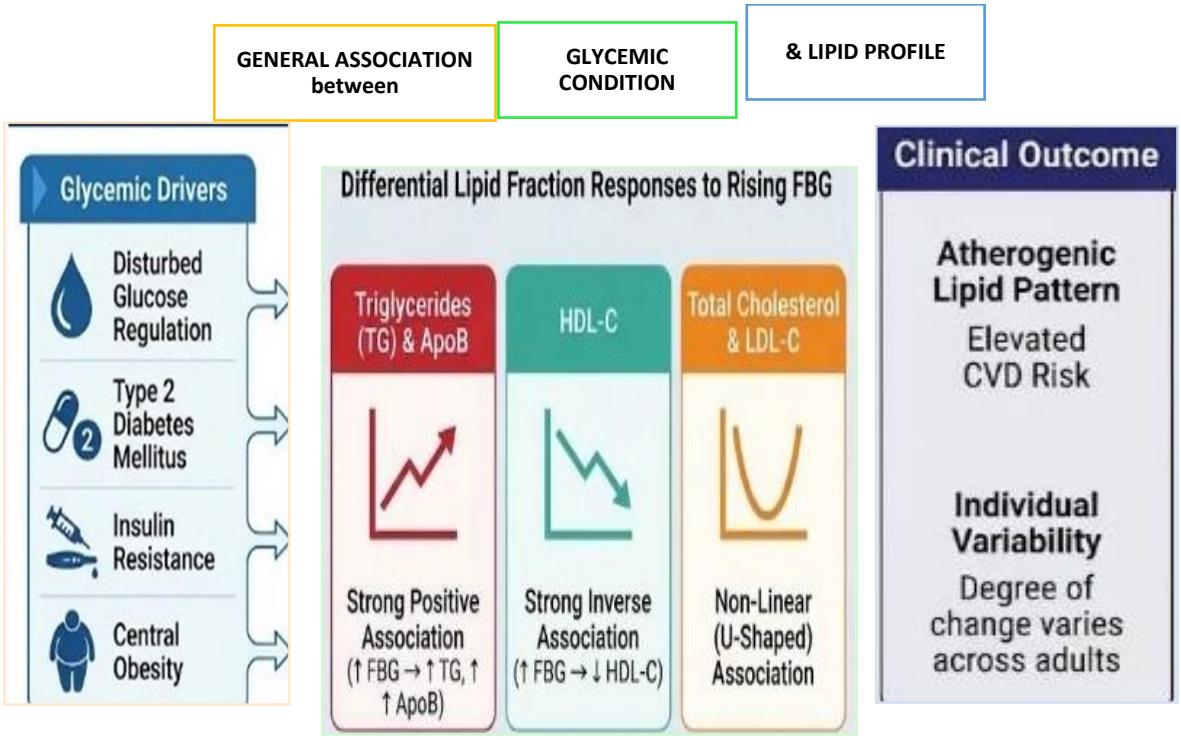

Figure 1: relationship between glycemic status and lipid profile, Yang.

Relationship between fasting blood glucose and lipid parameters

Fasting blood glucose and triglycerides

It appears that triglycerides are one of the lipid measures that is consistently associated with glucose dysregulation.

There are several explanations for this association. When the body physiology is normal, insulin prevents the release of triglycerides from the fat tissues and limits the production of free fatty acids. However, in the presence of insulin resistance, this effect gets weakened, hence increasing free fatty acid production [41],[42],[43].

The liver then proceeds to use these fatty acids to synthesize triglycerides and form very-low-density lipoproteins (VLDL). The result is that the levels of triglycerides in the blood become elevated [44],[45],[46],[47].

This metabolic disease can happen before the manifestation of diabetes itself. Therefore, high levels of triglycerides could serve as a marker for the presence of metabolic dysfunction instead of a complication arising from diabetes itself [48], [49].

Evidence supporting the above mentioned relation is provided by the population-based study of Yang, using 2024 NHANES data. It has been found that there is a positive correlation between FG and TG after controlling for related confounders.

Insulin resistance and metabolic disorder might be suspected if both elevated FG and TG are present [50],[51],[52],[53].

Fasting blood glucose and HDL cholesterol

High-density lipoprotein cholesterol (HDL-C) typically shows an inverse relationship with metabolic risk. Insulin-resistant patients with high blood glucose levels often show low levels of HDL-C [54],[55].

The correlation is partially attributed to increased TG and cholesteryl ester exchange between circulating lipoproteins. An elevated level of TG-rich VLDL particles increases the content of TG in HDL particles. Such altered HDL particles undergo rapid metabolism and catabolism, leading to low HDL-C levels [56],[57],[58]. Inverse correlation between FG and HDL-C levels has been shown in many studies. The result is consistent with the notion that poor glucose regulation is often accompanied by impairment of HDL-related lipid profile component [59],[60],[61].

Nevertheless, it is important to recognize that HDL-C level alone does not completely reflect the functioning of HDL. Additionally, other characteristics of HDL, including its antioxidant and anti-inflammatory activity, as well as cholesterol transport, can be affected in diabetics [62], [63].

Fasting blood glucose and LDL cholesterol

In contrast to triglycerides and HDL-C, the association between FG and LDL-C is a bit complex [64]. LDL-C is an estimation of the quantity of cholesterol in LDL particles but does not show the number or specific characteristics of these particles [65]. People with inadequately controlled diabetes exhibit high LDL-C levels; however, some people with diabetes have normal levels of LDL-C. This paradoxical observation is probably due to differences in body mass index, diet, time spent with diabetes, insulin resistance, and hypolipidemic drugs [66],[67],[68]. Moreover, the presence of insulin resistance leads to the formation of smaller and denser LDL particles. They are considered more atherogenic due to the higher probability of oxidative modification and connections with other metabolic abnormalities [69], [70]. The importance of 2024 NHANES study is that it reveals a nonlinear association between FG and LDL-C. The revelation implies that linear correlation measurement may be inappropriate for studying this association.

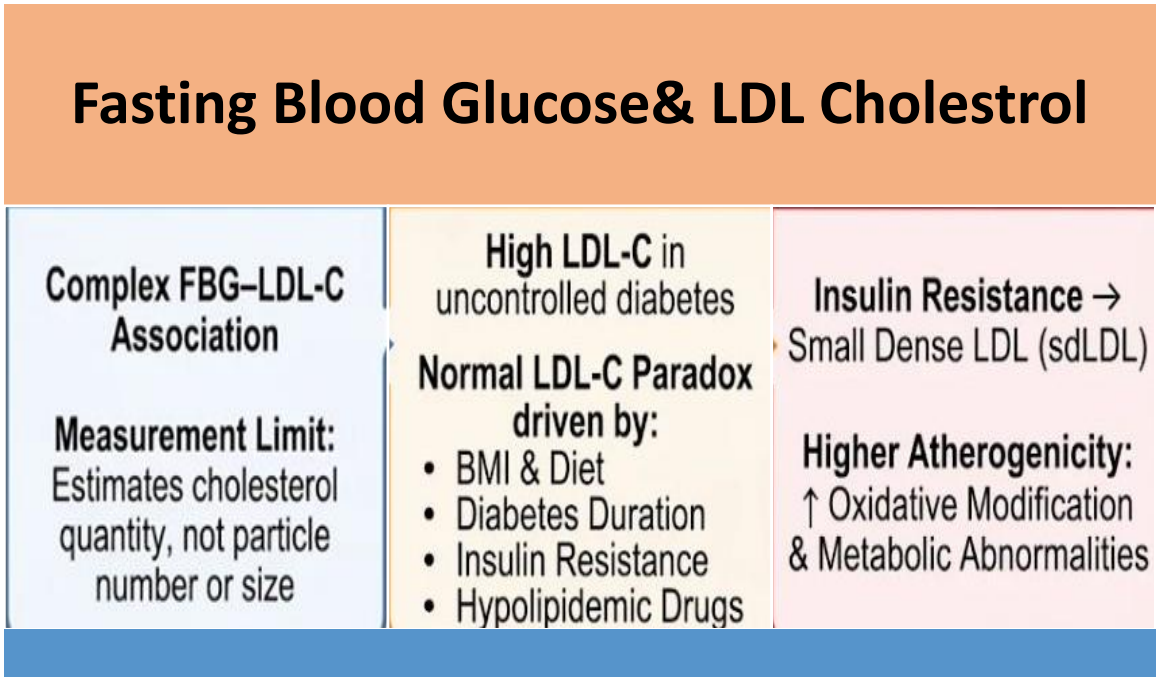

Figure 2: correlation between FBG and LDL cholesterol, Huang.

Fasting blood glucose and total cholesterol

FG total cholesterol relationship is also not constant. Total cholesterol includes the cholesterol content of different fractions of lipoproteins such as HDL, LDL, and VLDL. This means that changes in individual lipid components could lead to different effects on total cholesterol [71], [72]. It is

possible for triglyceride-rich VLDL levels to increase while HDL-C is reduced at the same time. Such changes could have different results for total cholesterol depending on metabolic characteristics of an individual [73],[74].

The nonlinear relationship found by Yang makes clear the importance of studying the lipid fractions of individuals rather than solely relying on total cholesterol to investigate the connection between glycemic state and lipid metabolism.

Association of HbA1c and lipid profile

HbA1c is especially helpful in studying the connection between glycemic coexistence and lipid metabolism over a prolonged period of time. As compared to FG, which measures glucose concentration in blood only during a certain time period, HbA1c reflects the mean level of glycemic exposure over 2-3 months. This factor helps to establish a connection between hyperglycemia and metabolic disorders [75],[76],[77],[78].

HbA1c and triglycerides

A positive relationship between the concentrations of HbA1c and TG is often found among adults who suffer from type 2 diabetes. The lack of control of glucose level can increase the production of triglycerides in the liver and reduce the clearance of lipoproteins rich in triglycerides. Meanwhile, insulin resistance affects the excess release of free fatty acids from fat tissue [79],[80],[81].

This association may be even more pronounced in patients suffering from obesity, central obesity, and metabolic syndrome [82],[83],[84]. However, HbA1c and triglycerides cannot be viewed as equivalent measures. While one person may suffer from high HbA1c but has low hypertriglyceridemia due to various factors such as diet, genetics, or medication[85].

HbA1c and HDL-C

Increased HbA1c is often associated with reduced HDL-C [86]. The association may be due to changes in metabolism related to insulin resistance, which includes increased production of VLDL and enrichment of HDL with TG [87],[88],[89],[90]. The subsequent decrease in HDL-C levels is an additional risk factor for cardiovascular disease [91]. On the other hand, the relationship between HDL-C and blood sugar regulation is influenced by other factors, including body composition, sex, exercise, diet, and medication use [92],[93],[94],[95].

Population level data also support the notion that the relationship may differ across different demographic segments. Triglycerides and HbA1c showed a positive relationship in an NHANES analysis in 2026 presented at the Scientific Sessions of the American Diabetes Association, while the relationship between HDL and HbA1c had varied for different racial and ethnic subgroups. Since the study is a conference abstract, it needs to be seen in the context of preliminary results55.

HbA1c and LDL-C

In comparison to triglyceride levels, there is less correlation found between the two variables. There have been some studies reporting elevated levels of LDL-C levels in individuals with elevated levels of HbA1c, but others have reported non-significant associations [96].

One reason could be that the LDL-C level might get affected significantly by lipid lowering drugs. For instance, poorly controlled diabetes cases might have a comparatively lower level of LDL-C due to the use of statin drugs and other lipid lowering drugs [97],[98],[99],100].

Moreover, glycaemic control does not contribute to significant reduction of LDL-C level. It is hence important to take into account LDL particle advantages, non-HDL cholesterol and apo-B [101],[102].

HbA1c and total cholesterol

The relationship between HbA1c and total cholesterol will vary from one clinical population to another. Increased levels of HbA1c can be associated with high total cholesterol in cases where diabetes is poorly controlled and dyslipidemia is not under treatment. Nonetheless, the relationship

between HbA1c and total cholesterol can be difficult to detect in patients who are getting proper treatment through diet and drugs [103],[104].

Lipid profile across different glycemic categories

One important area that is covered in the literature is the study of lipid profiles of adults who have different types of glucose metabolism.

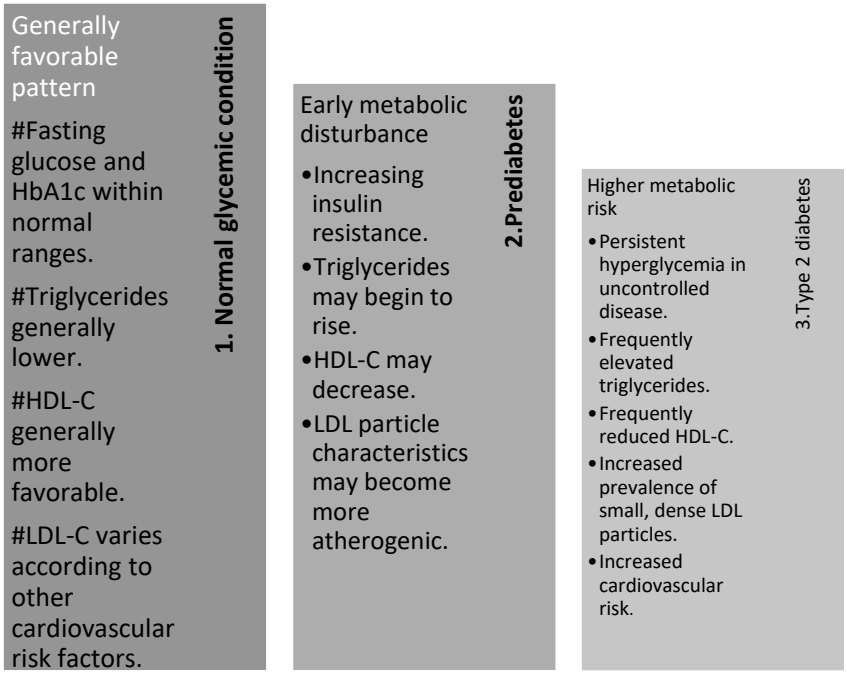

Figure3. Expected metabolic profile across glycemic categories, Bardini.

Conceptual overview of common reported metabolic profiles rather than predicted results of one comparative study. The individual lipids vary greatly with treatment and other risk factors.

Normal glycemic status

Individuals with a normally controlled glucose level usually exhibit good insulin sensitivity and balanced lipid metabolism.

Insulin effectively prevents lipolysis in adipose tissue, whereas the production of triglycerides in the liver and serum levels of very low-density lipoproteins are properly regulated.

Though people with normally controlled glucose level can develop dyslipidemia by genetic or behavioral reasons, the distinctive feature of a combination of hypertriglyceridemia and reduced HDL-C levels is less prevalent than in insulin-resistant individuals [105],[106].

Prediabetes

Prediabetes is a middle ground of metabolism and affords a unique chance for early diagnosis of cardiometabolic disease. The Standards of Care for 2026 states that prediabetes is based on impaired fasting glucose, impaired glucose tolerance, and/or HbA1c levels of 5.7% to 6.4%. The guideline also makes the relationship between prediabetes, obesity, elevated triglyceride levels, and reduced HDL-C [107].

Type 2 diabetes mellitus

A common characteristic associated with type 2 diabetes is an association with hyperglycemia, insulin resistance, and dyslipidemia.

In the case of dyslipidemia, patients often have higher levels of triglycerides, low HDL-C, and high amounts of small, dense LDL particles. Notably, this type of dyslipidemia may be observed even when there is regulation of LDL-C levels [108].

According to Feingold [109], who has written on the topic of Endotext in 2026, people with type 2 diabetes often have increased triglycerides and non-HDL cholesterol, decreased HDL-C, and elevated small, dense LDL particles. Poor glycemic control may result in higher triglyceride and decreased HDL-C levels.

Pathophysiological mechanisms linking glycemic status and lipid metabolism

The association between glycemia status and lipid profile can be elucidated via numerous interrelated approaches.

Insulin resistance

Insulin resistance is among the major factors that contribute to the relationship between hyperglycemia and dyslipidemia. During physiological conditions, insulin regulates the intake of glucose and prevents the release of free fatty acids from adipose tissues. With insulin resistance, insulin sensitivity in adipose tissues is reduced, thereby increasing the release of free fatty acids. This causes more fatty acids to reach the liver where they are converted into triglycerides and increase the secretion of VLDL.

Increased hepatic VLDL production

The liver is a significant player in lipid metabolism.

Increased influx of free fatty acids coupled with altered insulin signaling increases triglyceride synthesis and VLDL secretion from the liver.

As the levels of VLDL rise, triglyceride content in the blood is increased. This causes hypertriglyceridemia, which is one of the characteristic lipid diseases associated with insulin resistance [110].

Altered HDL metabolism

Triglycerides levels that are elevated have an effect on the composition and metabolism of HDL particles. In a process of lipid exchange, HDL particles acquire triglycerides and hence are removed from circulation faster. The outcome of this is lower HDL-C levels [111].

Formation of small, dense LDL particles

Large amounts of triglyceride-rich lipoproteins can contribute to the formation of smaller and denser LDL particles by means of lipid exchange and further remodeling via enzymes. This leads to the conclusion that even though the calculated LDL-C content is not high, patients with diabetes can have an unfavorable LDL particle profile [112], [113].

Chronic hyperglycemia and oxidative stress

Persistence of high blood sugar level contributes to oxidative stress, advanced glycation end-product formation, endothelial dysfunction, and chronic low-grade inflammation.These factors contribute to modification of plasma lipoproteins and cause vascular damage. Coexistence of hyperglycemia, insulin resistance, and dyslipidemia creates a conducive metabolic milieu leading to atherosclerotic heart disease [114],[115],[116],[117].

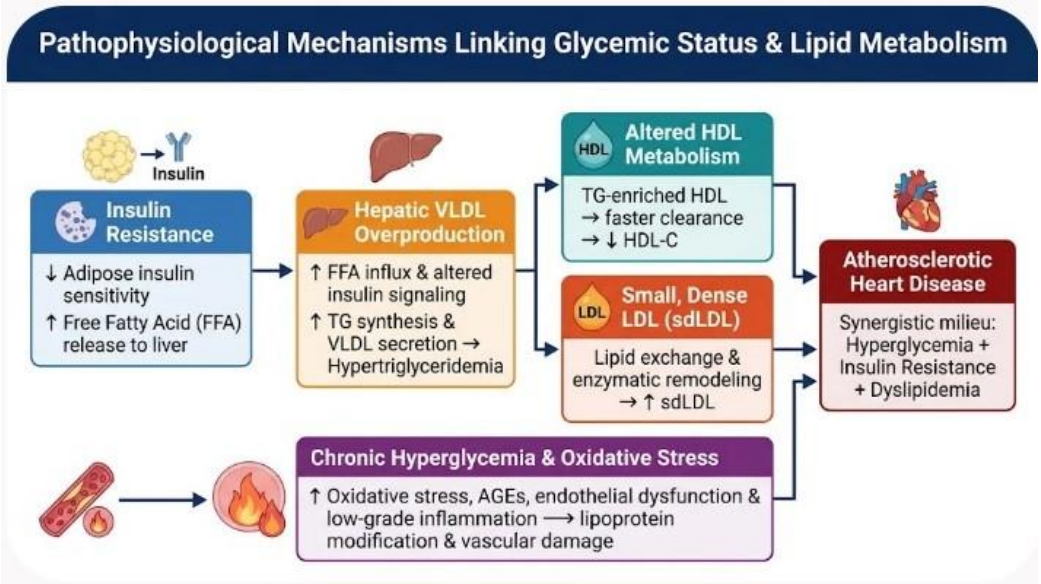

Figure 4: Pathophysiological relationship between Glycemic condition and lipid metabolism, Alamri, – Ginsberg.

Effect of demographic and clinical factors

The relation between glycemia status and lipids profile should not be looked at separately from other metabolic conditions.

Age: With aging there occur changes in insulin sensitivity, body composition and lipids metabolism. Elderly individuals will show more complicated relationships between glycemia control and lipid levels [118], [119].

Sex: Differences in hormonal status, fat deposition, and lipids metabolism can influence the association between glucose and lipid profiles [120].

Body mass index and abdominal obesity: Obesity in general, but especially central obesity, is highly associated with insulin resistance, elevated triglycerides, and low HDL-C levels [121].

Physical activity: Physical activity is known to have an effect on insulin sensitivity and is likely to contribute to reducing triglycerides and improving HDL cholesterol [122].

Diet: Diet high in processed carbs, sugar, and saturated fat is likely to impair glucose metabolism and lipid profile [123].

Smoking and alcohol: These lifestyle factors are likely to affect lipid levels independently [124],[125].

Medication: Statins, fibrates, hypoglycemic drugs, and others can interfere with the observed association between glycemic and lipids indices [126].

Duration of disease and complications: Diabetes duration, diabetic nephropathy, and metabolic complications accompanying diabetes can influence lipid metabolism [127], [128].

According to ADA recommendations for 2026, it is important to consider comprehensive evaluation of the patient's cardiovascular risk and the presence of additional related disorders including obesity, kidney disease, hypertension, and others.

Clinical implications of the association

The data discussed in this review have numerous significant clinical implications.

1. Lipid derangements cannot be considered solely an effect of diabetes mellitus due to the presence of these disorders in the prediabetic state. This might imply the necessity of early metabolic complications investigation and evaluation.

2. Results obtained through measurement of HbA1c and FBG provide complementary data. The examination of both these tests can provide more information about glucose metabolism although none of them alone accounts for the whole lipid profile.
3. All key lipid components should be included into the lipid panel. Normal LDL-C values do not preclude atherogenic dyslipidemia in the case of adult patients with insulin resistance and high triglyceride level.
4. Glycemic control is connected with triglyceride normalization although in the case of elevated blood glucose. However, lipid management should not be restricted only by glucose lowering measures.

According to the ADA Standards of Care 2026, it is advised that individuals with diabetes be involved in lifestyle modification, including weight control, regular exercise, and changes in their dietary practices to help improve their lipid profile and cardiovascular risk reduction .

This underscores the need to manage both hyperglycemia and dyslipidemia, which are interrelated aspects of cardiometabolic health.

Results and Discussion

The results found in published literature from 2010 to 2026 have shown that the association of glycemia status and lipid metabolism is strongly correlated in adult individuals. Even though the strength of this relationship differs with respect to individual lipid parameters, there is evidence to suggest that abnormal glucose metabolism is commonly associated with an abnormal lipid profile.

The other common finding is the correlation between the concentration of FBG and TG. The major reason for such correlation is due to the presence of insulin resistance, lipolysis of fat tissue, and increase in VLDL secretion from the liver. This leads to high concentration of TG in blood, which is usually seen in cases of prediabetes and type 2 diabetes.

The third critical discovery is that there is an inverse correlation between the values of glycemic parameters and HDL-C. Patients who suffer from insulin resistance often have low levels of HDL-C.

However, the association between glycemic status and LDL-C is less stable. There are some people whose HbA1c is high but still have high levels of LDL-C, whereas there are some people whose HbA1c is high but have normal levels of LDL-C. This might be caused by different factors such as intake of drugs, dietary habits, genetics, and metabolic conditions. Another point is that small dense LDL means that the level of LDL-C is unreliable in determining atherosclerosis.

In addition, these findings bring to light the importance of prediabetes as a precursor to metabolic disease. Lipid abnormalities may occur even before glucose abnormalities occur enough for the disease to be considered diabetes. In this regard, the relationship between glucose and lipids metabolism should be viewed as a continuum and not a result of having been diagnosed with diabetes.

Yang conducted an important study based on the population, which found that FBG showed a positive relationship with TG, but negative relation with HDL-C, whereas LDL-C and total cholesterol were seen to have a non-linear relationship with fasting glucose. This indicates that there is a complicated relationship between glucose and lipid metabolism rather than simply increase or decrease in all lipids.

The clinical significance of detecting dyslipidemia in prediabetic and diabetic patients is also highlighted in the 2026 ADA Standards of Medical Care in Diabetes. These standards advocate for the assessment of cardiovascular risk, lipid management, and strategies to reduce cardiovascular risk.

Overall, the literature suggests the need to measure glycemic and lipid indicators together as this will provide broader knowledge about metabolism and may help in detecting people who have

an increased risk of heart diseases at an early stage.

Limitations

Although the existing literature provides abundant details about the relationship between glycemic status and lipid profile, it is important to consider some limitations while discussing the results of this review.

Heterogeneity of study designs

The literature that was reviewed includes cross-sectional studies, cohort studies, clinical trials, and systematic reviews. Due to differences in design, sample selection, and statistics used, it is hard to compare the results of research.

In particular, cross-sectional studies may identify associations between glucose and lipid levels; however, they cannot prove if the changes in the glycemic status caused changes in lipid metabolism.

Variations in glycemic assessment

Studies do not always employ the same parameters for defining glycemic status. While some of them rely on FBG, others depend on HbA1c, OGTT, or a combination of all these methods.

These approaches assess different aspects of glucose regulation and may identify different populations of people suffering from impaired glucose metabolism.

Variability in lipid measurements

Laboratory methods, fasting status, estimation vs direct measurement of LDL-C, and reference ranges may influence the data presented.

Moreover, traditional lipid profile does not provide a comprehensive understanding of lipoprotein particles' numbers, sizes, or functions.

Confounding factors

Variables like age, gender, body mass index, waist size, exercise levels, food intake, smoking, drinking, and genetics have an impact on the metabolism of both glucose and lipids.

Not accounting for these variables properly could cause an over or underestimation of the observed correlations.

Impact of medications

The use of fibrates, statins, metformin, insulin, and other hypoglycemic drugs can change lipid and glucose measurements completely.

As such, study differences could be based on variations in treatments and not on biological relationship.

Variations in study populations

The association of glycemic state and lipid profile could vary depending on ethnic background, geographical location, socio-economic characteristics, and access to health care facilities.

Results from one population might not necessarily be applicable to all other populations of adults.

Limited information on advanced lipid markers

The majority of these researches are centered around traditional lipids parameters which include triglycerides, total cholesterol, LDL-C, and HDL-C.

Less consideration has been given to lipoprotein particle sizes, ApoB, remnant cholesterol, and other more sophisticated markers of lipids.

Limited evidence establishing causality

Though many studies prove relationship between hyperglycemia and dyslipidemia, the exact nature of their causative relation remains to be established.

Longitudinal study and well-designed clinical trial should be conducted in order to ascertain the effect of changes in glycemic status on lipid fractions.

Conclusion

Glycemia-lipid relationship is among the factors that make up the metabolism in adults. From the literature review in the period of 2010 to 2026, abnormality in the regulation of glycemia goes hand in hand with an anomaly in lipid metabolism, especially hypertriglyceridemia and hypo-HDL-C. This connection can mainly be attributed to insulin resistance and its effects on fat breakdown in adipose tissue, triglyceride formation in the liver, VLDL production, and lipoprotein remodeling. The above metabolic changes may develop during prediabetes and continue to advance in individuals suffering from type 2 diabetes. Triglyceride is among the lipid biomarkers that have been found to show the greatest correlation with FBG and HbA1c. The relationship between HDL-C and these glucose markers is usually inverse. Conversely, the relationships involving LDL-C and total cholesterol levels are less constant because their concentrations may be influenced by other factors apart from the ones that affect the glycemic markers. An important point from these results is that even though seemingly normal levels of LDL-C or total cholesterol do not indicate that one has a completely desirable metabolic profile. Those adults who have compromised glucose homeostasis can have increased cardiovascular risk due to high triglycerides, low HDL-C, and more atherogenic LDL particles. The presence of lipid abnormalities among prediabetics is further evidence of the need to test for metabolic function in the early stages of prediabetes. Detecting such abnormalities before the development of diabetes may offer the chance of preventing it. As far as the clinical aspect goes, FBG, HbA1c, and lipid profile tests should be considered complementary tests in metabolic testing. The results obtained from all three tests would offer a more comprehensive cardiometabolic risk assessment than those from either of the individual tests. However, the connection between glycemic status and lipids profile can be impacted by several confounders, and more longitudinal and interventional studies are needed for the elucidation of the causal relationship. In conclusion, glycemic status and lipids have complex interactions in adult patients, and should be evaluated as an integral component of cardiometabolic risk assessment, particularly in prediabetic, insulin resistant, and diabetic patients.

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