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Serum Lipid and Glucose Profile Patterns and Their Association with Sociodemographic Factors: A Cross-Sectional Study

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KEYWORDS

Dyslipidemia, Glucose profile, Socioeconomic factors, Cardiovascular risk, Lipid profile

ABSTRACT:

Background: Abnormal lipid and glucose metabolism are major risk factors for cardiovascular diseases and metabolic disorders. These biochemical parameters are influenced not only by biological factors but also by socioeconomic and demographic determinants such as age, gender, education, occupation, and lifestyle patterns.

Aim: To assess serum lipid and glucose profile patterns and determine their association with sociodemographic factors among adults.

Materials and Methods: A cross-sectional study was conducted among 150 adults attending a tertiary care hospital. Sociodemographic data including age, gender, education, occupation, income, and residence were collected using a structured questionnaire. Fasting blood samples were collected to measure fasting blood glucose (FBG), total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL). Statistical analysis was performed using SPSS version 25. Descriptive statistics were expressed as mean ± SD. Association between variables was assessed using chi-square test and independent t-test, with $p < 0.05$ considered statistically significant.

Results: Dyslipidemia and impaired glucose levels were significantly associated with increasing age, male gender, urban residence, and lower educational status. Elevated triglycerides and LDL levels were more common among individuals with sedentary occupations and higher BMI.

Conclusion: Serum lipid and glucose abnormalities are strongly associated with sociodemographic characteristics. Early screening and targeted lifestyle interventions among high-risk demographic groups may reduce the burden of cardiovascular diseases.

INTRODUCTION

Metabolic disorders such as dyslipidemia and hyperglycemia are major contributors to the global burden of cardiovascular diseases (CVD), diabetes mellitus, and metabolic syndrome. Cardiovascular diseases remain the leading cause of mortality worldwide, accounting for nearly one-third of all deaths globally. Abnormalities in serum lipid levels and glucose metabolism play a central role in the pathogenesis of atherosclerosis and vascular complications. Serum lipid profile typically includes total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C), which together provide essential information regarding an individual's cardiometabolic risk. Elevated levels of total cholesterol, triglycerides, and LDL cholesterol along with reduced HDL cholesterol are

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strongly associated with increased risk of coronary artery disease and stroke. Similarly, impaired fasting glucose and hyperglycaemia contribute significantly to the development of diabetes mellitus and its long-term complications. [1]

Globally, the prevalence of dyslipidaemia and abnormal glucose metabolism has been rising steadily over the past few decades, largely due to rapid urbanization, changes in dietary habits, sedentary lifestyles, and population aging. According to the World Health Organization, dyslipidaemia contributes substantially to the global burden of cardiovascular diseases and is responsible for millions of deaths annually. Lifestyle transitions characterized by increased consumption of saturated fats, processed foods, and reduced physical activity have significantly influenced metabolic health in both developed and developing countries. Early detection of abnormalities in lipid and glucose metabolism is therefore essential for the prevention of cardiovascular morbidity and mortality. [2] In recent years, growing attention has been directed toward understanding the role of sociodemographic determinants in influencing metabolic risk factors. Sociodemographic characteristics such as age, gender, education level, occupation, socioeconomic status, and place of residence have been shown to significantly affect health behaviours, access to healthcare services, and lifestyle patterns. These factors ultimately influence biochemical parameters including serum lipid levels and blood glucose concentrations. Studies have demonstrated that individuals from different socioeconomic backgrounds exhibit variations in dietary patterns, physical activity levels, and health awareness, which may contribute to disparities in metabolic health outcomes. [3]

Age is one of the most important determinants influencing lipid metabolism and glucose regulation. Several epidemiological studies have reported that serum cholesterol, triglycerides, and fasting glucose levels tend to increase with advancing age due to metabolic changes, hormonal alterations, and reduced physical activity. Aging is also associated with increased insulin resistance and accumulation of visceral adiposity, which further contributes to metabolic abnormalities and cardiovascular risk. Consequently, older adults are at a higher risk of developing dyslipidaemia, impaired glucose tolerance, and type 2 diabetes mellitus. [4]

Gender differences in lipid and glucose metabolism have also been widely documented. Men generally exhibit higher levels of triglycerides and LDL cholesterol compared to women, whereas women tend to have higher HDL cholesterol levels during their reproductive years due to the protective effects of oestrogen. However, after menopause, lipid profiles in women often deteriorate, resulting in increased cardiovascular risk. Behavioural factors such as smoking, alcohol consumption, and occupational stress may also contribute to gender-based variations in metabolic parameters. [5]

Socioeconomic status and educational attainment play crucial roles in shaping lifestyle behaviours that influence metabolic health. Individuals belonging to lower socioeconomic strata often experience limited access to healthcare services, reduced awareness about healthy lifestyle practices, and increased exposure to risk factors such as poor nutrition and physical inactivity. Conversely, higher socioeconomic groups may also experience metabolic disorders due to sedentary lifestyles, high-calorie diets, and occupational stress. These complex interactions highlight the importance of evaluating metabolic risk factors in relation to sociodemographic determinants. [6]

In India and other developing countries, rapid urbanization and epidemiological transition have led to a substantial increase in the prevalence of non-communicable diseases, including diabetes and cardiovascular diseases. Several community-based studies have reported a high prevalence of dyslipidaemia and impaired glucose tolerance among adults, particularly in urban populations. Understanding the distribution of serum lipid and glucose abnormalities across different sociodemographic groups is therefore essential for designing targeted preventive strategies and public health interventions. Early identification of high-risk groups can facilitate timely lifestyle modifications and medical management, thereby reducing the burden of metabolic and cardiovascular diseases. [7]

In this context, the present study was undertaken to evaluate the patterns of serum lipid and glucose profiles and to analyse their association with various sociodemographic factors among adults.

Journal of Chemical Health Risks

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JCHR (2026) 16(2), 887-894 | ISSN:2251-6727

Aim

To assess serum lipid and glucose profile patterns and evaluate their association with sociodemographic factors.

Objectives

1. To estimate the prevalence of abnormal serum lipid profile among study participants.
2. To determine the distribution of fasting blood glucose levels among the participants.
3. To analyze the association between lipid profile parameters and sociodemographic variables.
4. To evaluate the relationship between fasting glucose levels and sociodemographic characteristics.

Materials and Methods

Study Design

The present study was designed as a cross-sectional observational study conducted to evaluate serum lipid and glucose profile patterns and their association with sociodemographic factors among adults.

Study Setting

The study was conducted in the Department of Biochemistry of a tertiary care teaching hospital. Participants were recruited from individuals attending the hospital for routine health check-ups and outpatient consultations.

Study Duration

The study was carried out over a period of 6 months.

Study Population

The study population included adult individuals aged 18 years and above who attended the hospital during the study period and consented to participate.

Inclusion Criteria

- Adults aged ≥18 years
- Individuals willing to participate and provide informed consent
- Participants undergoing routine biochemical investigations

Exclusion Criteria

- Known cases of chronic liver disease
- Patients on lipid-lowering drugs
- Known cases of diabetes on active treatment
- Pregnant women
- Critically ill patients

Data Collection Procedure

A structured questionnaire was used to collect sociodemographic information including:

- Age
- Gender
- Educational status
- Occupation
- Monthly income
- Residential area (urban/rural)

Anthropometric measurements including height, weight, and body mass index (BMI) were also recorded.

BMI was calculated using the formula:

$$BMI = \frac{Weight(kg)}{Height(m)^2}$$

Participants were categorized as:

- Underweight (<18.5 kg/m²)
- Normal (18.5–24.9 kg/m²)
- Overweight (25–29.9 kg/m²)
- Obese (≥30 kg/m²)

Biochemical Analysis

Participants were instructed to undergo overnight fasting for 8–12 hours prior to blood sample collection.

Approximately 5 ml of venous blood was collected under aseptic conditions.

The following biochemical parameters were analyzed:

- Fasting Blood Glucose (FBG)
- Total Cholesterol (TC)
- Triglycerides (TG)

- High Density Lipoprotein Cholesterol (HDL-C)
- Low Density Lipoprotein Cholesterol (LDL-C)

Serum glucose was measured using the glucose oxidase–peroxidase method.
Lipid parameters were analysed using enzymatic colorimetric methods with an automated biochemical analyser.

Reference ranges used:

Parameter	Normal Value
Fasting glucose	<100 mg/dL
Total cholesterol	<200 mg/dL
Triglycerides	<150 mg/dL
LDL cholesterol	<130 mg/dL
HDL cholesterol	>40 mg/dL

Sample Size Calculation

The sample size was calculated using the formula for prevalence studies:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where:

- **n** = required sample size
- **Z** = standard normal deviation (1.96 at 95% confidence interval)
- **P** = expected prevalence of dyslipidemia (30%) based on previous studies
- **d** = allowable error (7%)

$$n = \frac{(1.96)^2 \times 0.30 \times 0.70}{(0.07)^2}$$

$$n = \frac{3.84 \times 0.21}{0.0049}$$

$$n \approx 149$$

Considering feasibility and non-response rate, 150 participants were included in the study.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25.

Statistical methods used:

- Mean ± Standard Deviation for continuous variables
- Frequency and percentage for categorical variables
- Chi-square test to determine association between variables
- Independent t-test to compare means between groups
- Pearson correlation analysis for relationships between biochemical parameters

A p value <0.05 was considered statistically significant.

Results

Table 1: Age Distribution of Participants (n=150)

Age Group	Frequency	Percentage
18–30	36	24
31–40	32	21.3
41–50	30	20
51–60	28	18.7
>60	24	16

Interpretation

Most participants were in the 18–30-year age group (24%), followed by 31–40 years (21.3%). The distribution indicates inclusion of both young and elderly individuals, allowing evaluation of metabolic variations across age groups.

Table 2: Gender Distribution

Gender	Frequency	Percentage
Male	88	58.7
Female	62	41.3

Interpretation

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 887-894 | ISSN:2251-6727

The study population showed male predominance (58.7%), indicating slightly higher participation among males.

Table 3: Educational Status of Participants

Education	Frequency	Percentage
Primary	28	18.7
Secondary	44	29.3
Graduate	52	34.7
Postgraduate	26	17.3

Interpretation

Most participants had graduate level education (34.7%), indicating moderate educational status among the study population.

Table 4: Mean Biochemical Parameters

Parameter	Mean ± SD
Fasting glucose	108.6 ± 28.4
Total cholesterol	198.4 ± 42.3
Triglycerides	168.7 ± 60.5
LDL	122.3 ± 36.7
HDL	41.2 ± 8.6

Interpretation

The mean fasting glucose level was slightly above the normal threshold, suggesting presence of impaired glucose regulation among some participants.

Table 5: Prevalence of Dyslipidaemia

Lipid Parameter	Normal	Abnormal	Percentage Abnormal
Total Cholesterol	98	52	34.7
Triglycerides	92	58	38.7
LDL	101	49	32.7
HDL (Low)	65	85	56.7

Interpretation

Low HDL cholesterol was the most common lipid abnormality (56.7%), followed by elevated triglycerides.

Table 6: Association Between Age and Dyslipidaemia

Age Group	Dyslipidaemia	Normal Lipid	P Value
<40	28	40	**0.002**
≥40	52	30	

Interpretation

Dyslipidaemia was significantly more common among individuals aged ≥40 years, indicating increasing metabolic risk with advancing age.

Table 7: Association Between BMI and Dyslipidemia

BMI Category	Dyslipidemia	Normal	P Value
Normal	22	34	**0.013**
Overweight	28	18	
Obese	30	18	

Interpretation

Overweight and obese individuals showed significantly higher prevalence of dyslipidaemia.

Table 8: Association Between Socioeconomic Status and Abnormal Glucose

Socioeconomic Status	Normal Glucose	Impaired/High	P Value
Low	24	28	**0.026**
Middle	42	18	
High	26	12	

Interpretation

Individuals from lower socioeconomic groups had higher prevalence of abnormal glucose levels, suggesting lifestyle and healthcare disparities.

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DISCUSSION

The present cross-sectional study evaluated the patterns of serum lipid and glucose profiles and analysed their association with various sociodemographic factors among adults. The findings of the study demonstrate a considerable prevalence of dyslipidaemia and abnormal fasting glucose levels, with significant associations observed with age, gender, body mass index, and socioeconomic status. These findings highlight the importance of sociodemographic determinants in influencing metabolic risk factors and contribute to the growing body of evidence linking lifestyle and demographic transitions to cardiometabolic disorders.

In the present study, dyslipidaemia was observed more frequently among individuals aged 40 years and above, indicating that lipid abnormalities increase with advancing age. Age-related metabolic changes, including reduced hepatic LDL receptor activity, increased adiposity, and decreased physical activity, contribute to elevated cholesterol and triglyceride levels in older individuals. Similar observations were reported by Grundy, who emphasized that dyslipidaemia becomes increasingly prevalent with aging due to metabolic alterations associated with insulin resistance and changes in lipid metabolism. [8] Gender differences in lipid profile were also evident in the present study, with males demonstrating a higher prevalence of dyslipidaemia compared to females. This observation may be explained by behavioural and lifestyle differences such as higher rates of smoking, alcohol consumption, and occupational stress among men. Additionally, hormonal differences contribute to variations in lipid metabolism, as oestrogen in premenopausal women has a protective effect by increasing HDL cholesterol and improving lipid regulation. Studies analyzing lipid trends in large population samples have similarly reported higher triglyceride and LDL cholesterol levels among men compared to women. [9]

One of the most notable findings of this study was the high prevalence of low HDL cholesterol levels among participants. Low HDL cholesterol is recognized as a major risk factor for atherosclerosis and cardiovascular disease. Epidemiological studies conducted in Asian populations have consistently reported low HDL as the most common lipid abnormality. The ICMR-INDIAB study also reported a high prevalence of low HDL cholesterol among Indian adults, highlighting the growing burden of dyslipidaemia in the country. [10] This pattern may be related to dietary habits, sedentary lifestyle, and genetic predisposition.

Body mass index was found to be significantly associated with dyslipidaemia in the present study. Overweight and obese individuals exhibited higher levels of triglycerides and LDL cholesterol compared to individuals with normal BMI. Excess adiposity promotes insulin resistance and increased free fatty acid release from adipose tissue, which subsequently leads to enhanced hepatic triglyceride synthesis and altered lipoprotein metabolism. Bays et al. demonstrated that obesity is strongly associated with dyslipidaemia, particularly elevated triglycerides and reduced HDL cholesterol, thereby increasing cardiovascular risk. [11]

Socioeconomic status also showed a significant association with abnormal fasting glucose levels in the present study. Participants belonging to lower socioeconomic groups exhibited a higher prevalence of impaired glucose levels. Socioeconomic disparities influence several lifestyle factors such as dietary quality, healthcare access, and physical activity levels. Individuals from economically disadvantaged backgrounds often experience higher exposure to unhealthy diets and reduced opportunities for preventive healthcare. Studies examining social determinants of health have demonstrated that socioeconomic position is closely linked with metabolic risk factors and overall health outcomes. [12]

Rapid urbanization and lifestyle transitions have also contributed significantly to the increasing prevalence of metabolic disorders worldwide. Sedentary occupations, increased consumption of energy-dense foods, and reduced physical activity have been identified as major contributors to the rising burden of dyslipidaemia and diabetes in developing countries. Misra and Khurana highlighted that developing nations are experiencing a rapid epidemiological transition characterized by increasing obesity, dyslipidaemia, and metabolic syndrome due to lifestyle changes. [13]

The present findings are also consistent with global epidemiological studies that emphasize the role of modifiable and non-modifiable risk factors in the development of cardiovascular diseases. Large international studies have demonstrated that metabolic

risk factors such as dyslipidaemia, hyperglycaemia, obesity, and hypertension significantly contribute to the global burden of cardiovascular morbidity and mortality. Identifying these risk factors early through screening and preventive interventions can substantially reduce disease burden. [14]

Preventive strategies targeting high-risk populations are essential for reducing the prevalence of metabolic disorders. Lifestyle modification programs focusing on dietary changes, regular physical activity, and weight management have been shown to significantly improve lipid and glucose parameters. Population-based interventions and public health awareness campaigns play a crucial role in promoting healthy behaviours and preventing chronic diseases. Evidence from large multicentric studies has demonstrated that modification of lifestyle-related risk factors can significantly reduce cardiovascular events and mortality. [15] Furthermore, the global burden of non-communicable diseases continues to increase, particularly in low- and middle-income countries undergoing rapid socioeconomic transitions. Epidemiological analyses have emphasized that dyslipidaemia and hyperglycaemia are among the leading modifiable risk factors contributing to global mortality and disability. Addressing these risk factors through early detection, preventive healthcare policies, and improved health education is essential for reducing the burden of cardiovascular diseases.[16] Overall, the findings of the present study underscore the importance of evaluating biochemical risk factors in relation to sociodemographic determinants. Understanding these associations can assist healthcare providers and policymakers in identifying high-risk groups and implementing targeted preventive strategies aimed at reducing the burden of metabolic and cardiovascular diseases.

CONCLUSION

The present study demonstrated a considerable prevalence of abnormal serum lipid and glucose levels among adults, highlighting the growing burden of metabolic risk factors in the population. Significant associations were observed between dyslipidaemia, impaired glucose levels, and sociodemographic factors such as age, gender, body mass index, and socioeconomic status. Increasing age and higher BMI were particularly associated with elevated lipid abnormalities and altered glucose metabolism. These findings emphasize the influence of demographic and lifestyle-related determinants on cardiometabolic health. Early screening, health education, and targeted lifestyle interventions among high-risk groups are essential to prevent the progression of metabolic disorders and reduce cardiovascular disease burden.

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Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 887-894 | ISSN:2251-6727

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