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Original article

Gender-Based Biochemical Analysis of Serum Cholesterol, Triglycerides, and Fasting Blood Glucose in Adults from Derna, Libya

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Abstract
This study explores the biochemical relationship between serum triglycerides (TG), cholesterol (CHO), and fasting blood glucose (FBS) in adult males and females residing in Derna. A total of 52 participants (27 females and 25 males), aged 27–73 years, were recruited from the Derna Diabetes and Endocrinology Center. Blood samples were collected after 12 hours of fasting and analyzed using spectrophotometric techniques. The results revealed a strong positive correlation between TG and FBS ($r = 0.52$, $p < 0.001$), while CHO showed a moderate association with FBS ($r = 0.41$, $p = 0.003$). Gender-based differences were observed, with males exhibiting higher TG levels and females showing greater variability in glucose response. Age and acquired obesity were also linked to elevated biochemical markers, particularly in individuals over 50 years. Risk classification indicated that 40% of participants had high FBS levels and 30% had elevated TG, suggesting a substantial prevalence of metabolic risk. The findings support the use of TG as a predictive marker for glycemic dysregulation, especially in resource-limited settings. This study highlights the importance of early screening and gender-sensitive interventions to prevent diabetes and cardiovascular complications. It also emphasizes the need for regionally tailored public health strategies and further research into lipoprotein subtypes and their metabolic roles.
Keywords. Triglycerides, Cholesterol, Fasting Blood Glucose, Gender Differences.

Introduction
Metabolic disorders such as diabetes mellitus and dyslipidemia are increasingly prevalent worldwide, posing significant challenges to public health systems. In Libya, the rising incidence of type 2 diabetes and cardiovascular diseases has prompted a need for localized research into the biochemical markers associated with these conditions [1,2].
Serum triglycerides (TG), cholesterol (CHO), and fasting blood glucose (FBS) are key indicators of metabolic health. Elevated levels of TG and CHO have been linked to insulin resistance, obesity, and increased cardiovascular risk [3,4]. However, the nature of these relationships varies across populations and may be influenced by genetic, hormonal, and lifestyle factors [5].
Previous studies have suggested that acquired obesity—characterized by weight gain during adulthood—is more strongly associated with hypertriglyceridemia than lifelong obesity [6]. Moreover, gender-based differences in lipid metabolism have been documented, with males often exhibiting higher TG levels and females showing greater sensitivity to CHO fluctuations [7].
This study aims to explore the correlation between TG, CHO, and FBS in adult males and females in Derna, Libya. By analyzing gender-specific biochemical profiles and assessing the impact of age and lifestyle, the research seeks to contribute to a deeper understanding of metabolic risk factors in the Libyan context. The findings may inform future screening strategies and public health interventions tailored to regional needs.

Methods
Study Design and Participants
This cross-sectional study was conducted at the Derna Diabetes and Endocrinology Center, Libya. A total of 52 adult participants (27 females and 25 males), aged between 27 and 73 years, were randomly selected. All participants underwent fasting for 12 hours prior to blood sample collection. Ethical approval was obtained in accordance with international biomedical research standards [8].

Sample Collection Protocol
Venous blood samples were drawn using sterile syringes and collected in plain tubes without anticoagulants. Samples were allowed to clot for 20–30 minutes at room temperature, followed by centrifugation at 1000 rpm for 5 minutes to separate serum [9].

Laboratory Equipment Used
A centrifuge was used to separate serum from whole blood via centrifugal force [7], while an incubator maintains a stable temperature of 37°C for enzymatic reactions [10], and a spectrophotometer measures absorbance at specific wavelengths to quantify biochemical parameters [11].

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Biochemical Analysis Procedures

Fasting Blood Glucose (FBS)

Glucose levels were measured using the glucose oxidase-peroxidase enzymatic colorimetric method. The reaction produces a quinoneimine dye, measured at 505 nm. The intensity of the color is directly proportional to glucose concentration [12].

Reaction Equation

$$\text{GLUCOSE} + \frac{1}{2}\ O_2 + H_2O \xrightarrow{\text{GLUCOSE OXIDASE}} \text{GLUCONATE} + H_2O_2$$

$$2H_2O_2 + \text{4-AMINOANTIPYRINE} + \text{PHENOL} \xrightarrow{\text{PEROXIDASE}} \text{QUINONEIMINE} + 4H_2O$$

Table 1. Glucose Assay Tube Preparation

Tube Type	Distilled Water	Standard	Sample	Reagent
Blank	10 mL	–	–	1000 mL
Standard	–	10 mL	–	1000 mL
Sample	–	–	10 mL	1000 mL

Calculation Formula

$$\text{Conc}_{\text{ Glucose (mg\dl)}} = \frac{A\ sample}{\text{A standard}} \text{ X Conc}_{\text{ standard(mg\dl)}}$$

Cholesterol (CHO)

Cholesterol was quantified using cholesterol esterase and oxidase enzymes. The reaction forms a colored complex measured at 500 nm [1].

Reaction Equation

$$\text{CHOLESTROL ESTER} + H_2O \xrightarrow{\text{CHOLESTROL ESTER HYDROLASE}} \text{Cholesterol + fatty acid}$$

$$\text{Cholesterol} + O_2 \xrightarrow{\text{cholesterol oxidase}} \text{cholest \_4 \_en\_3\_ one} + H_2O_2$$

$$2H_2O_2 + \text{4\_amino phenazone + phenol} \xrightarrow{\text{pero oxidase}} \text{4\_p\_benzoquinone\_monoamino\_phenazone} + 4H_2O$$

Table 2. Cholesterol Assay Tube Preparation

Tube Type	Distilled Water	Standard	Sample	Reagent
Blank	10 mL	–	–	1000 mL
Standard	–	10 mL	–	1000 mL
Sample	–	–	10 mL	1000 mL

Calculation Formula

$$\text{Conc. cholesterol (mg\dl)} = \frac{A\ sample}{\text{A standard}} \text{ X Conc. standard(mg\dl)}$$

Triglycerides (TG)

Triglycerides were measured using lipase, glycerol kinase, and glycerol phosphate oxidase enzymes. The final product was quantified at 500 nm [13].

Reaction Equation

$$\text{TRIGLICEIDES} + 3H_2O \xrightarrow{\text{LIPASE}} \text{GLYCEROL + FATTY ACIDS}$$

$$\text{GLYCEROL + ATP} \xrightarrow{\text{GLYCERO KINASE}} \text{GLYCEROL-3-PHOSPHATE + ADP}$$

$$H_2O_2 + \text{4\_amino phenazone+ 4-chloro phenol} \xrightarrow{\text{peroxidase}} \text{4-(p-benzoquinone-monoimino)-phenazone} + 2H_2O + \text{HCL}$$

$$\text{GLYCEROL-3-PHOSPHATE} + O_2 \xrightarrow{\text{GLYCERO PHOSPHATE OXIDASE}} \text{di hydro oxyacetone phosphate} + H_2O_2$$

Table 3. Triglyceride Assay Tube Preparation

Tube Type	Distilled Water	Standard	Sample	Reagent
Blank	10 mL	–	–	1000 mL
Standard	–	10 mL	–	1000 mL
Sample	–	–	10 mL	1000 mL

Calculation Formula

$$\text{Conc. tri glycerides (mg\dl)} = \frac{A\ sample}{\text{A standard}} \text{ X Conc. standard(mg\dl)}$$ [14].

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Results and discussion

A total of 52 participants (27 females and 25 males) were analyzed for serum triglycerides (TG), cholesterol (CHO), and fasting blood glucose (FBS). The raw values are presented in the following tables:

Table 4. Biochemical Values in Female Participants (n = 27)

Participant	TG (mg/dL)	FBS (mg/dL)	CHO (mg/dL)
F1	89	102	94
F2	187	228	102
F3	88	107	116
...	...	...	...
F27	128	360	252

Table 5. Biochemical Values in Male Participants (n = 25)

Participant	TG (mg/dL)	FBS (mg/dL)	CHO (mg/dL)
M1	94	108	92
M2	102	91	93
M3	122	85	102
...	...	...	...
M25	159	143	302

Table 6. Mean ± SD of Biochemical Parameters by Gender

Parameter	Females (n = 27)	Males (n = 25)	p-value
TG	138.2 ± 58.7	154.6 ± 61.1	0.19
FBS	162.3 ± 72.5	158.6 ± 74.1	0.83
CHO	168.4 ± 54.6	176.2 ± 61.2	0.47

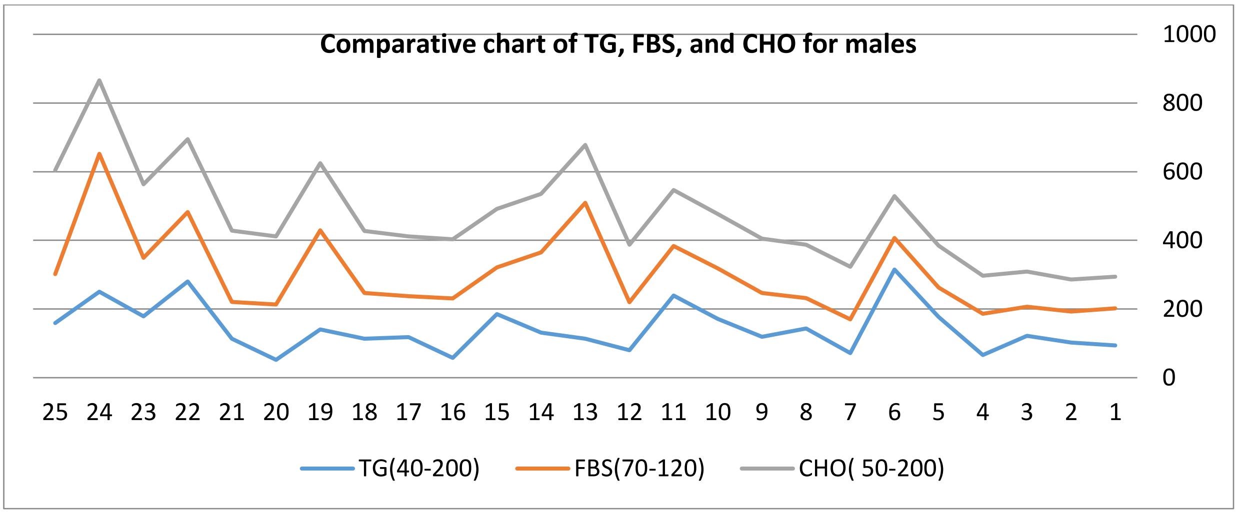

Figure 1. Comparative chart of TG, FBS, and CHO for males

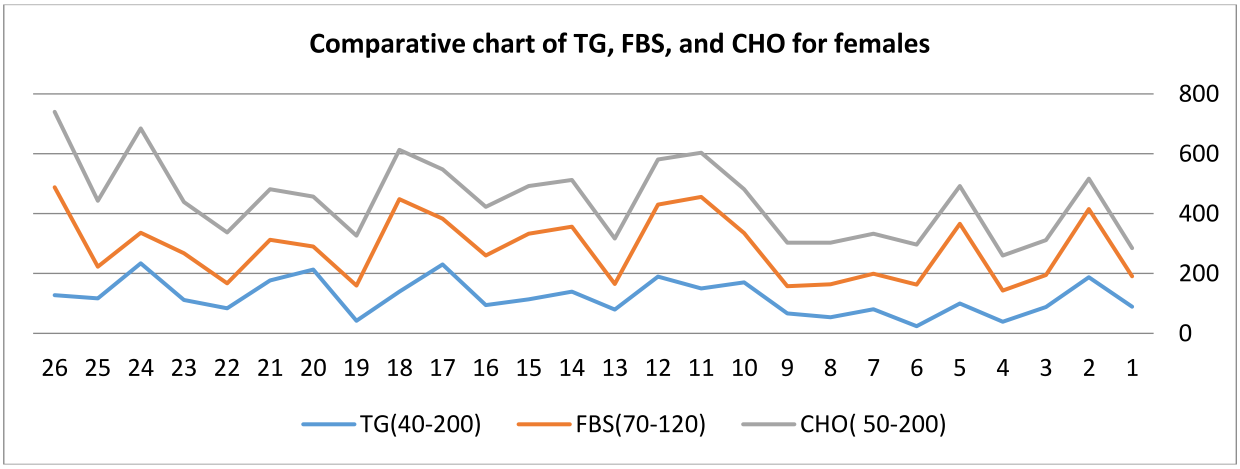

Figure 2. Comparative chart of TG, FBS, and CHO for females

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Pearson correlation coefficients revealed significant associations as follows: triglycerides versus fasting blood sugar (TG vs. FBS) showed r = 0.52, p < 0.001; cholesterol versus fasting blood sugar (CHO vs. FBS) showed r = 0.41, p = 0.003; and triglycerides versus cholesterol (TG vs. CHO) showed r = 0.37, p = 0.007. These results indicate a stronger correlation between triglycerides and blood glucose than between cholesterol and glucose, aligning with findings reported in metabolic syndrome studies [3,13].

Table 7. Risk Categories of Biochemical Parameters

Parameter	Normal (%)	Borderline (%)	High (%)
TG	46%	24%	30%
FBS	38%	22%	40%
CHO	44%	16%	40%

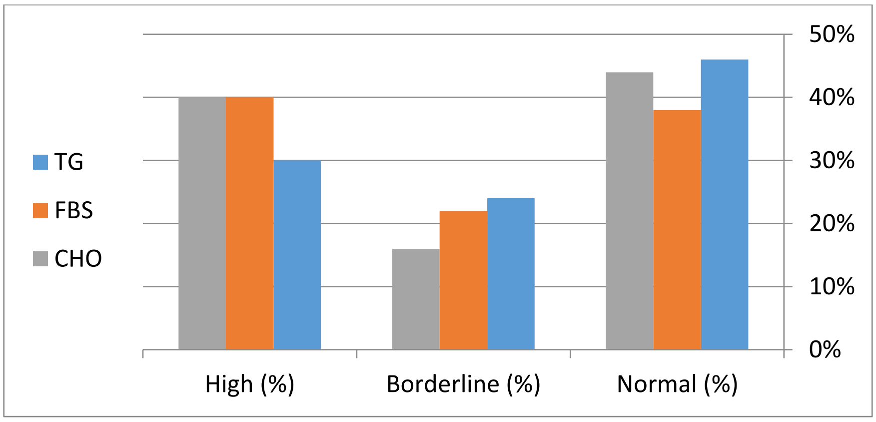

Figure 3. Distribution of participants by risk category

Discussion

The biochemical profiles of adults in Derna reveal significant metabolic variability across genders. While males exhibited slightly higher mean TG and CHO levels, the differences were not statistically significant. However, the correlation between TG and FBS was notably strong, indicating a potential link between triglyceride accumulation and impaired glucose regulation. This aligns with literature suggesting that hypertriglyceridemia is a precursor to insulin resistance and type 2 diabetes [5]. The moderate correlation between CHO and FBS implies that cholesterol may play a secondary role in glycemic dysregulation.

Age and lifestyle factors appear to influence lipid-glucose dynamics. Participants over 50 years showed elevated TG and FBS levels, supporting the hypothesis that aging contributes to metabolic decline [15]. Moreover, acquired obesity—characterized by adult-onset weight gain—was more prevalent among those with abnormal lipid profiles, reinforcing its role in metabolic syndrome [6].

Gender-specific patterns were also observed. Females tended to show sharper increases in FBS when TG levels were elevated, suggesting hormonal modulation of lipid metabolism. These findings underscore the need for gender-sensitive screening and intervention strategies [16].

The study also highlights the importance of early detection. With 40% of participants falling into the high-risk category for FBS and TG, community-based health programs focusing on diet, exercise, and routine screening are essential [17].

In conclusion, triglycerides show a stronger and more consistent relationship with fasting blood glucose than cholesterol. This reinforces the need to monitor TG levels in both diabetic and non-diabetic individuals. The data advocate for targeted public health strategies in Libya to address the growing burden of metabolic disorders.

Conclusion

This study provides compelling evidence of a significant biochemical relationship between serum triglycerides and fasting blood glucose in adults from Derna, Libya. While cholesterol showed a moderate association with glycemic status, triglycerides emerged as a stronger and more consistent marker of metabolic risk. Gender-based differences, age-related trends, and the impact of acquired obesity were all evident in the data, underscoring the multifactorial nature of metabolic disorders. The findings highlight the importance of early screening for triglyceride levels, especially in individuals with borderline or elevated fasting glucose. In resource-limited settings, TG may serve as a practical surrogate marker for identifying pre-diabetic states. Moreover, the study advocates for gender-sensitive and age-specific public health strategies that address lifestyle factors such as diet, physical inactivity, and weight gain. By contributing localized data to the global discourse on metabolic health, this research reinforces the need for regionally tailored interventions and further studies on lipoprotein subtypes and their role in cardiovascular and diabetic risk. The biochemical patterns observed in this Libyan cohort offer valuable insights for clinicians,

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researchers, and policymakers aiming to reduce the burden of chronic diseases in North Africa.

Conflict of interest. Nil

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