TRIGLYCERIDE LEVELS AND RISK FACTORS IN GILGIT, PAKISTAN: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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ABSTRACT

Triglycerides are a substantial risk factor for cardiovascular disorders. Therefore, it continues to be the leading cause of death worldwide. Understanding triglyceride levels can help minimize and mitigate loss of lives. However, there has been a significant lack of comprehensive epidemiological data regarding triglyceride levels, in the Gilgit-Baltistan. The key purpose of the study was to assess triglyceride levels in patients across age and gender. Data was collected from 448 patients in Gilgit visiting Shaheed Saif-ur-Rehman Hospital (n=213), PHQ Hospital (n=115), and a Private Diagnostic Laboratory (n=120). Standardized enzymatic methods were used to measure the levels of triglycerides. Following established clinical protocols, the data were then analyzed for risk stratification, age-related trends, and gender distribution. Results revealed an average triglyceride level was 216.8 ± 127.4 mg/dL for all patients. Among all, 68.8% (n=308) were female and 31.2% (n=140) male. Almost 69.4% of the patients had hypertriglyceridemia (≥150 mg/dL). In contrast, 18.1% had very high levels (≥500 mg/dL), 23.2% had high levels (200–499 mg/dL), and 28.1% had borderline high levels (150–199 mg/dL). From gender-specific perspective, women had higher mean triglyceride levels (223.3 ± 132.8 mg/dL) than men (201.4 ± 112.1 mg/dL). Nearly 70% of patients in the study had higher triglyceride levels. This indicated that the population in Gilgit has a worryingly high prevalence of hypertriglyceridemia. Results highlighted the urgent need to adopt focused cardiovascular risk assessment programs and lifestyle change tactics.

Keywords: cardiovascular risk, lipid profile, hypertriglyceridemia, triglycerides, Gilgit-Baltistan, and cross-sectional study

INTRODUCTION

About 17.9 million deaths a year, or 31% of all deaths, are caused by cardiovascular diseases (CVDs), making them the primary cause of morbidity and mortality worldwide. Atherosclerotic cardiovascular disease (ASCVD) is largely caused by dyslipidemia, which is characterized by aberrant lipid profiles like elevated triglycerides. Dyslipidemia is also a major modifiable risk factor for CVD (Grundy *et al.,* 2019; Mach *et al.,* 2020).

The primary source of dietary fat and the body's energy store are triglycerides, which are esters of glycerol and three fatty acids. Triglycerides move through the bloodstream as components of lipoproteins, primarily chylomicrons and very-low-density lipoproteins (VLDL), under normal physiological conditions (Ginsberg *et al.,* 2021). Despite being essential for metabolic processes, high triglyceride levels are associated with an increased risk of cardiovascular disease through a number of pathophysiological mechanisms, such as endothelial dysfunction and stiffened arteries (Miller *et al.,* 2011; Nordestgaard and Vabro, 2014).

Beyond cardiovascular risk, hypertriglyceridemia is clinically significant because extremely high levels (≥500 mg/dL) significantly increase the risk of acute pancreatitis, a dangerous illness (Scherer *et al*., 2014). Furthermore, insulin resistance, hypertension, and other elements of metabolic syndrome frequently coexist with hypertriglyceridemia, raising the risk of cardiometabolic disease overall (Nisra *et al.,* 2009; Joshi *et al.,* 2014).

Globally triglyceride levels are measured: normal (<150 mg/dL), borderline high (150-199 mg/dL), high (200-499 mg/dL), and very high (≥500 mg/dL). This classification is according to the American Heart Association (AHA) and the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) (NCEP, 2001). Triglyceride and their level in the blood are considered as important indicators of cardiovascular risk. This

assessment is endorsed by the European Society of Cardiology (ESC), and the European Atherosclerosis Society (EAS) (Mach *et al.,* 2020).

Studies conducted worldwide on the prevalence reveal that there are noticeable regional, racial and ethnic differences towards hypertriglyceridemia and triglyceride levels. according to the reports that adults with hypertriglyceridemia are 25% to 35% in developed countries (Carroll *et al.,* 2012; Fryar *et al.*,2012). Due to sedentary lifestyles, high-carb and saturated-fat diets, urbanization, and genetic factors, studies in South Asia show even higher prevalence rates[6,7]. Although dyslipidemia and CVD are markedly prevalent in Pakistan. There is a dearth of comprehensive data from isolated regions (Jafar *et al.,* 2006; Badruddin *et al.,* 2012).

Gilgit Baltistan, in the far north of Pakistan, has varied socioeconomic, geographic, and ethnographic characters. Which could influence cardiovascular risk differentially. The population exhibits distinct dietary patterns influenced by high altitude. Research on lipid profiles and cardiovascular risk is, nevertheless, lacking in this area. Although previous research in other parts of Pakistan has found concerning patterns in dyslipidemia, its relevance to Gilgit-Baltistan is doubtful because of its unique features (Hakeem *et al.,* 2016).

It is important to understand epidemiology of triglyceride levels to take preventive strategies. Furthermore, these results can help local people improve lifestyle for controlling hypertriglyceridemia (Berglund *et al.,* 2012; Jacobson *et al.,* 2015).

The goal of the investigation was to assess the triglyceride levels of patients visiting major medical facilities in Gilgit. Study evaluates the prevalence of hypertriglyceridemia across gender, and age. This study provides baseline data for upcoming interventions and public health initiatives. And it is one of the first comprehensive assessments of triglyceride profiles in Gilgit-Baltistan.

MATERIALS AND METHODS

1. Study Design and Setting

From January to August of 2025, this cross-sectional observational study was carried out. The study was carried out at three important medical facilities in Gilgit, Gilgit-Baltistan, Pakistan: Shaheed Saif-ur-Rehman(SSR) Hospital, PHQ Hospital Gilgit, and the Private Diagnostic Laboratory close to PHQ Hospital. These establishments were chosen due to their ability to offer standardized laboratory services and their representation of the main healthcare infrastructure (see figure showing area location).

2. Study Population and Sampling

Convenience sampling was used to select 448 subjects in total. Participants included people who were going to medical facilities for different medical evaluations that required lipid profile checks. Both sexes were represented in the cohort, which ranged widely in age from 11 to 100.

Criteria for Inclusion/ Exclusion: Participants above 11 years who are being tested for triglycerides at the facilities were considered. Also, people with a willingness (or parental consent for minors) were entertained. Patients taking lipid-lowering drugs were ignored.

3. Data Collection

Data was collected using standard data tools. This included parameter related to name, age, and gender. Blood samples were collected from patients after overnight fasting. Which is in accordance with prevalent phlebotomy procedures to gauge an accurate assessment of triglycerides.

4. Analysis in the Lab

Using standardized protocols and enzymatic colorimetric techniques, the concentrations of serum triglycerides were ascertained. To guarantee accuracy and uniformity in measurements across facilities, quality control procedures were implemented.

5. Classification of Triglyceride Levels

According to NCEP ATP III guidelines[16], triglyceride concentrations were categorized:

S#	Level	Range
1	Normal:	<150 mg/dL
2	Borderline High:	150-199 mg/dL
3	High:	200-499 mg/dL
4	Very High:	≥500 mg/dL

6. Data Analysis

Descriptive and inferential statistical methods were used to aggregate and analyze the data. While categorical variables were displayed as frequencies and percentages, continuous variables (such as age and triglyceride levels) were reported as means ± standard deviations. Age-stratified and gender-specific analyses were carried out. SPSS v.17.

7. Ethical Considerations was used to analyze the data.

The Declaration of Helsinki was followed in the research. The appropriate ethics committee granted ethical clearance. Adult participants gave their informed consent, and minors' parents gave their consent. Data were anonymized, and patient privacy was maintained.

RESULTS

1. Demographic Characteristics

Four hundred forty-eight subjects were enrolled from three health care facilities in Gilgit. According to the facilities, three facility Shaheed Saif-ur-Rehman Hospital (n=213, 47.5%), one Private Diagnostic Laboratory near PHQ Hospital (n=120, 26.8%) and one PHQ Hospital Gilgit (n=115, 25.7%) (Table 1).

Table 1. Demographic Characteristics of Study Participants.

Parameter	Total (N=448)	Percentage
Gender Distribution		
Female	308	68.8%
Male	140	31.2%
Age Statistics		
Mean Age ± SD	43.2 ± 18.9 years	-
Median Age	42 years	-
Age Range	11-100 years	-
Facility Distribution		
PHQ Hospital Gilgit	115	25.7%
Private Lab near PHQ	120	26.8%
Shaheed Saif-ur-Rehman Hospital	213	47.5%

Table 2. Classification of Triglyceride Levels According to NCEP ATP III Guidelines.

Classification	Range (mg/dL)	Number	Percentage	Mean TG ± SD
Normal	<150	137	30.6%	96.3 ± 28.7
Borderline High	150-199	126	28.1%	174.5 ± 14.2
High	200-499	104	23.2%	268.4 ± 78.6
Very High	≥500	81	18.1%	629.7 ± 152.3
Total Hypertriglyceridemia (≥150 mg/dL)		**311**	**69.4%**	

2 Triglyceride Level Distribution

The average triglyceride concentration for all individuals was 216.8 ± 127.4 mg/dL (median 185 mg/dL; range: 29-1211 mg/dL). The distribution was highly skewed, with one-third of subjects displaying normal levels and the remaining individuals analyzing with various degrees of hypertriglyceridemia (Table 2)

3. Gender-Specific Analysis

Study revealed distinct patterns in triglyceride distribution in sexes. Majority of the females demonstrated slightly higher mean triglyceride levels compared to males.Table 3

Table 3. Gender-Specific Triglyceride Levels.

Parameter	Female (n=308)	Male (n=140)
Mean TG ± SD (mg/dL)	223.3 ± 132.8	201.4 ± 112.1
Median TG (mg/dL)	193.5	170.0
Range (mg/dL)	36-1211	29-1162
Normal (<150 mg/dL)	87 (28.2%)	50 (35.7%)
Borderline High (150-199 mg/dL)	88 (28.6%)	38 (27.1%)
High (200-499 mg/dL)	72 (23.4%)	32 (22.9%)
Very High (≥500 mg/dL)	61 (19.8%)	20 (14.3%)

4. Age-Stratified Analysis

Age-stratified analysis was performed by dividing participants (N=448) into five age groups to examine age-related patterns in triglyceride levels (Table 4).

This includes key parameters: sample size per age group, mean triglyceride levels with standard deviations (measured in mg/dL), and prevalence of hypertriglyceridemia (elevated triglyceride levels, typically >150 mg/dL). Data revealed a clear age-related increase in triglyceride level (165.8 ± 89.4 mg/dL in youngest group i.e., 11-20 years to 256.2 ± 189.7 mg/dL in over 80 years). This represents a 54.5% increase. Hence it is evident that hypertriglyceridemia prevalence rises from 50.0% in young to 83.3% in the elderly.

Table 4. Age-Stratified Triglyceride Levels.

Age Group (years)	N	% of Total	Mean TG ± SD (mg/dL)	Hypertriglyceridemia (%)
11-20	52	11.6%	165.8 ± 89.4	50.0%
21-40	156	34.8%	209.7 ± 118.6	66.0%
41-60	178	39.7%	231.4 ± 138.2	74.7%
61-80	56	12.5%	218.9 ± 132.5	73.2%
>80	6	1.3%	256.2 ± 189.7	83.3%

Abbreviations: TG = triglycerides; SD = standard deviation; mg/dL = milligrams per deciliter; N = sample size.

5. Facility-Specific Comparison

Comparison across the three healthcare facilities revealed variations in mean triglyceride levels and prevalence of hypertriglyceridemia (Table 5).

Table (5) include parameters: sample size (N), mean triglyceride levels with standard deviation (SD) measured in milligrams per deciliter (mg/dL), median values, and the percentage of patients with hypertriglyceridemia (elevated triglycerides). Statistics revealed, despite having the largest sample size (N=213) Shaheed Saif-ur-Rehman shows the highest mean triglyceride levels (231.5 ± 139.2 mg/dL) and the highest prevalence of hypertriglyceridemia (73.2%). Contrarily, Private Lab exhibit the lowest mean TG (198.2 ± 104.8 mg/dL) except with similar hypertriglyceridemia prevalence (65.8%) to PHQ Hospital (64.3%). All three facilities show concerning hypertriglyceridemia rates exceeding 64%.

Table 5. Facility-Specific Triglyceride Level Comparison.

Facility	N	Mean TG ± SD (mg/dL)	Median TG	Hypertriglyceridemia (%)
PHQ Hospital	115	203.8 ± 125.4	170.0	64.3%
Private Lab	120	198.2 ± 104.8	178.5	65.8%
Shaheed Saif-ur-Rehman	213	231.5 ± 139.2	192.0	73.2%

6. Clinical Risk Stratification

According to triglyceride level categories, subjects were categorized by clinical risk profile for both cardiovascular disease and acute pancreatitis.

Key Findings:

- Hypertriglyceridemia (TG ≥150 mg/dL) were found in 69.4% of the subjects (n=311)
- 41.3% (n=185) of participants had TG ≥200mg/dL suggesting at least moderate CVD risk
- 18.1% of patients (n=81) had extremely high triglycerides (≥500 mg/dL), which represent a level which significantly increase the risk of acute pancreatitis
- Normal triglycerides were present in 137 subjects (30.6%)

DISCUSSION

This study reveals an alarmingly high prevalence of hypertriglyceridemia (69.4%) in Gilgit, Pakistan. It revealed that a mean triglyceride level was 216.8 mg/dL. Which far exceeds recommended limits. This indicated an elevated cardiovascular risk (NCEP, 2001; Mach *et al.,* 2020).

The rate is substantially higher than in developed nations (25-35%; less than 150 mg/dL (1.7 mmol/L) (Carroll *et al.,* 2012; Fryar *et al.,* 2012). Also exceeds than the other South Asian populations (Misra *et al.,* 2009; Joshi *et al.,* 2014). Contributing factors likely include local diets high in wheat, dairy, and nuts, combined with increasingly sedentary lifestyles (Ginsberg *et al.,* 2021).

Females had higher mean triglyceride levels (223.3 mg/dL) than males (201.4 mg/dL). Age-stratified analysis showed a progressive increase with age, with an alarming 50% of subjects aged 11-20 already exhibiting hypertriglyceridemia (Huxley *et al.,* 2011). A concerning 18.1% of subjects had very high triglyceride levels (≥500 mg/dL). This carries a risk for acute pancreatitis (Huxley *et al.,* 2011). These findings urge urgent public health interventions (Scherer *et al.,* 2014). These actions must focus on health screening, awareness, and improved healthcare systems for dyslipidemia management (Alberti *et al.,* 2009; Kahn *et al.,* 2005).

This study did not consider BMI and dietary habits which might have impact on the overall study design. However, this data offers baseline data indicating an urgency towards local population who can confront a significant cardiovascular risk crisis. This required immediate action.

Conclusion

The current investigation reveals a critically concerned public health issue of hypertriglyceridemia affecting 69.4% of population (mean:216.8 mg/dL). This means value substantially exceeds the recommended values for a normal range. This shows an alarming situation of high prevalence. This prevalence level is higher than the developed nations (25-35%) and south Asian population. This indicates higher cardiovascular risks for the region.

The gender specific mean value analysis demonstrated that females have higher triglyceride level (mean: 223.3 mg/dL) as compared to male (mean: 201.4 mg/dL). Investigation also revealed that triglyceride level increases in progression of age in both genders. Most significantly, 50% of subjects aged between 11-20 exhibit hypertriglyceridemia. This suggests and signals that an early onset of metabolic dysfunction of cardiovascular morbidity11. Similarly, 18.1% of the population have a critically higher level of triglyceride (≥500 mg/dL). Which means that this population is already at the utmost risk of acute pancreatitis and other severe complications.

This etiology of hypertriglyceridemia situation stems in irregulated dietary patterns and increasingly sedentary behavior. This means that populations in the area consume more wheat, dairy and nuts combined with less physical.

This study provides an epidemiological baseline for future studies, planning and interventions. The findings express an urgency towards a comprehensive public health intervention primarily targeting this population.

Findings are evident that the populations in Gilgit-Baltistan are facing a critical crisis of cardiovascular risks. Therefore, it demands immediate coordinated efforts by policy makers, implementors and community stakeholders. Otherwise, populations in the area can face severe consequences. This study serves as an alarming call for public health mobilization.

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Conflict of Interest

The authors declare there are no conflicts of interest related to this study.

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