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Dyslipidaemia among children and adolescents in Pakistan: a five-year retrospective cohort study based on laboratory data

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Abstract

Background Dyslipidaemia is a significant risk factor for cardiovascular diseases, which can manifest early in life. Despite its importance, the prevalence of dyslipidaemia in the paediatric population of Pakistan remains poorly understood. This study uses laboratory data to determine the prevalence of dyslipidaemia and lipid testing practices among Pakistani children and adolescents.

Methods This retrospective cohort study analysed the laboratory data from children and adolescents, aged up to 19 years, who underwent lipid testing. The data was obtained from two centres with collection points all over Pakistan for five years (March 2019–March 2024). Logistic regression models were used to assess relationships between demographic factors (age, sex and regions/provinces) and lipid profile parameters.

Results Over five years, 9,787 children and adolescents with a mean age of 13.8 ± 5.1 years underwent lipid testing. Boys accounted for 59.7% of those tested compared to 40.3% of girls ($p = 0.09$). Most tests were conducted in Punjab (81.2%), with minimal representation from Balochistan (0.5%) and Gilgit Baltistan (0.3%). Among tested children and adolescents, 33.3% had elevated total cholesterol, 25.4% high low-density lipoprotein cholesterol, 46.6% low high-density lipoprotein cholesterol, 48.0% abnormal non- high-density lipoprotein cholesterol and 41.7% hypertriglyceridemia. Compared to boys, girls had significantly lower odds of abnormal high-density lipoprotein cholesterol (Odds Ratio 0.556, 95% CI 0.511–0.607, $p < 0.001$) and triglyceride levels (Odds Ratio 0.702, 95% CI 0.642–0.767, $p < 0.001$).

Conclusion This study highlights a high prevalence of dyslipidaemia among Pakistani children, with boys more affected than girls. The study also highlights a gender-based inequality in lipid testing where girls appear to be less frequently tested compared to boys.

Keywords Lipid Screening, Paediatric, Dyslipidaemia burden, Cardiovascular Diseases, Lipid Testing, Universal screening

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Background

Dyslipidaemia is the major contributing factor for the development of atherosclerosis which significantly increases the risk of developing cardiovascular diseases (CVDs) such as coronary artery disease (CAD) or stroke [1]. Despite advancements in the diagnostic and treatment facilities, prevention with early detection as well as proper management of CVDs still remain a great challenge. Early screening of serum lipid levels serves as a foundation in the assessment of CVDs [2].

Several guidelines recommend universal screening of children in their prepubescent age for dyslipidaemia [3–6]. The American Academy of Paediatrics and the National Heart, Lung, and Blood Institute recommend universal lipid screening for children aged 9–11 years and 17–21 years, as these periods are less affected by hormonal changes during puberty [7, 8]. The U.S. Preventive Services Task Force does not recommend universal screening due to insufficient long-term evidence on clinical outcomes [9]. Organizations like the American Heart Association and European Atherosclerosis Society support targeted screening for children with risk factors such as obesity, diabetes, or a family history of early cardiovascular disease [10, 11]. Cascade screening is recognized as a cost-effective method for identifying familial hypercholesterolemia (FH) in relatives of affected individuals and is endorsed by the European Society of Cardiology [12].

These screening programs have been effective in the early detection of dyslipidaemia leading to prompt therapy and prevention [13, 14]. Despite being effective, incorporation of such a program remains a challenge, particularly for developing countries like Pakistan primarily due to limited resources, lack of government support, and low healthcare prioritization [15, 16]. This problem is made worse by underdeveloped healthcare system, which includes limited access to healthcare in rural areas and the absence of national policies focused on preventive healthcare for children.

Genetic factors, lipid imbalance, and obesity collectively or alone make children and young individuals susceptible to premature atherosclerosis. Elevated levels of low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), and low high-density lipoprotein cholesterol (HDL-C) levels during childhood have been associated with a higher likelihood of developing atherosclerosis and other cardiovascular diseases later in life [2, 17]. There is a rising trend of dyslipidaemia among the United States paediatric population affecting about 20% of children aged between 6 to 19 years [18, 19]. In Asia, smaller cohort studies from India report a prevalence of 19% to 23% [20, 21], while a study in China the prevalence of high total cholesterol (TC) (6.5%), high TG (7.5%), high LDL-C (5.2%), low HDL-C (9.1%) was observed [22]. In Korea, a study conducted on school children aged 10–18 years revealed that the prevalence of high TC, elevated LDL-C, elevated TG, and low HDL-C was 6.5%, 4.7%, 10.1%, and 7.1%, respectively [23]. Despite the growing burden of paediatric dyslipidaemia globally, large-scale prevalence studies remain limited, particularly in low- and middle-income countries like Pakistan, where urbanization and changing dietary habits may worsen the problem.

In Pakistan, lipid measurement is performed in a very small proportion of the paediatric population, leading to missed opportunities for early screening [16]. Limited knowledge exists regarding the frequency of lipid testing and the prevalence of dyslipidaemia among Pakistani children and adolescents. The present study aims to address this gap by investigating both the prevalence of dyslipidaemia and the current practices in lipid testing by employing laboratory data from two major private laboratories with centres all over Pakistan.

Methods

Study design and data information

This retrospective cohort study utilised data from two major private healthcare networks in Pakistan. The first source was Shifa International Hospital in Islamabad, along with its extensive diagnostic network spread across the country. The second was Chughtai Laboratories, based in Lahore, which operates a widespread network of diagnostic centres and collection points throughout Pakistan. The lipid testing data was collected from March 2019 to March 2024 for individual children and adolescents aged up to 19 years ($n=9787$). The dataset included TC, HDL-C, LDL-C, and TG levels and their respective age, sex, and area of their residence at the time of lipid measurements. Unfortunately, no data was available on anthropometric parameters, family and personal history of dyslipidaemia, CVD, associated comorbidities and lipid-lowering therapy.

Initially, lipid data for 10,578 children was obtained. To ensure everyone was represented only once, we excluded cases with multiple measurements ($n=791$). The Institutional Review Board and Ethics Committee (IRB&EC), Shifa Tameer-e-Millat University, Islamabad, Pakistan approved the study (IRB&EC number 0323–22).

Lipid profile testing and dyslipidaemia criteria

The lipid profile was analysed biochemically using homogenous enzymatic methods on two separate analysers: the Cobas 8000 c502 module (Roche Diagnostics, Basel, Switzerland) at Shifa International Hospital and the Abbott Alinity ci analyser (Abbott Laboratories, Chicago, United States) at Chughtai Laboratory. Children and adolescents were classified as having normal

or abnormal test results according to the Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents [8]. Dyslipidaemia was defined as: TC levels ≥ 200 mg/dL (5.17 mmol/L), LDL-C levels ≥ 130 mg/dL (3.36 mmol/L), TG levels ≥ 100 mg/dL (1.13 mmol/L) for children ≤ 8 years old, TG levels ≥ 130 mg/dL (1.47 mmol/L) for children ≥ 9 years old, non-HDL-C < 120 mg/dL (3.11 mmol/L) and HDL-C levels < 40 mg/dL (1.03 mmol/L) [8].

Statistical analysis

The data was initially organised by using Microsoft Excel and statistical analysis was conducted using SPSS-27 and Python version 3.1.1.0. For age categorization, the World Health Organization (WHO) classification was adopted, which defines children as 0–9 years and adolescence as the period between 10 and 19 years of age [24, 25]. To provide a more detailed analysis, these age ranges were further subdivided into the following groups: 0–2, 3–5, 6–8, 9–11, 12–16, and 17–19 years. We calculated the percentage of children and adolescents undergoing lipid testing, categorising them by age at initial testing, sex, and province/administrative areas. Categorical variables were presented as frequencies and percentages, while numerical variables were presented as mean and standard deviation (mean ± SD). An independent t-test was used to evaluate significant differences in lipid parameters (LDL-C, TC, TG, and HDL-C) between genders, while a one-way ANOVA was applied to assess differences across age groups and areas of residence. A generalised logistic regression model was employed to analyse the relationships between various demographic factors and lipid profile parameters. The model examined sex (using males as the reference group), age (with the 9–11 years age group as the reference category), and provinces (using Azad Kashmir as the reference category). The response variables were the lipid profile components: TC, LDL-C, TG, and HDL-C. Each of these lipid parameters was categorised as either normal or abnormal. Odds ratio (OR) and 95% confidence interval (CI) of each variable were presented using forest plots.

Results

General characteristics of the cohort

The cohort had a mean age of 13.8 ± 5.1 years with an age range from neonates to 19 years. Boys made up 59.7% ($n = 5,841$) of the tested group, while girls accounted for 40.3% ($n = 3,946$). A statistically significant difference was observed in the testing proportions between boys and girls, with boys representing a significantly larger share of the tested group ($p < 0.0001$). This gender disparity in lipid testing was observed across all age groups and regions/provinces of Pakistan, consistently showing a higher number of tests performed on boys compared to girls. Most of the tests were conducted in the age groups of 17–19 years ($n = 4182$, 42.7%) followed by 12–16 years ($n = 2975$, 30.4%) and 9–11 years ($n = 913$, 9.3%). Punjab province represented 81.2% ($n = 7,945$) of the tested population (Table 1, Fig. 1).

Table 1 Demographic distribution of lipid testing among children and adolescents of Pakistan

Category	Total Tests ($n = 9,787$) n (%)	Boys ($n = 5,841$, 59.7%) n (%)	Girls ($n = 3,946$, 40.3%) n (%)	*p*-value
Age Groups				
0–2 years	385 (3.9)	243 (65.1)	142 (34.9)	0.826
3–5 years	655 (6.6)	380 (58.0)	275 (42.0)	0.999
6–8 years	677 (6.9)	396 (58.0)	281 (42.0)	0.290
9–11 years	913 (9.3)	525 (58.0)	388 (42.0)	0.554
12–16 years	2,975 (30.4)	1,740 (58.4)	1,235 (41.6)	0.573
17–19 years	4,182 (42.7)	2,557 (61.1)	1,625 (38.9)	0.727
Region/ Province				
Punjab	7,945 (81.2)	4,756 (59.9)	3,189 (40.1)	0.488
Islamabad	696 (7.1)	419 (60.2)	277 (39.8)	0.440
Khyber Pakhtunkhwa	569 (5.8)	325 (57.1)	244 (42.8)	0.846
Sindh	347 (3.5)	193 (55.6)	154 (44.4)	0.431
Balochistan	48 (0.5)	28 (58.3)	20 (41.6)	0.038
Gilgit Baltistan	33 (0.3)	22 (66.6)	11 (33.3)	0.407
Azad Kashmir	149 (1.5)	98 (65.7)	51 (34.2)	0.839

P-values represent comparisons between boys and girls within each category (age groups and regions/provinces) using the chi-square test

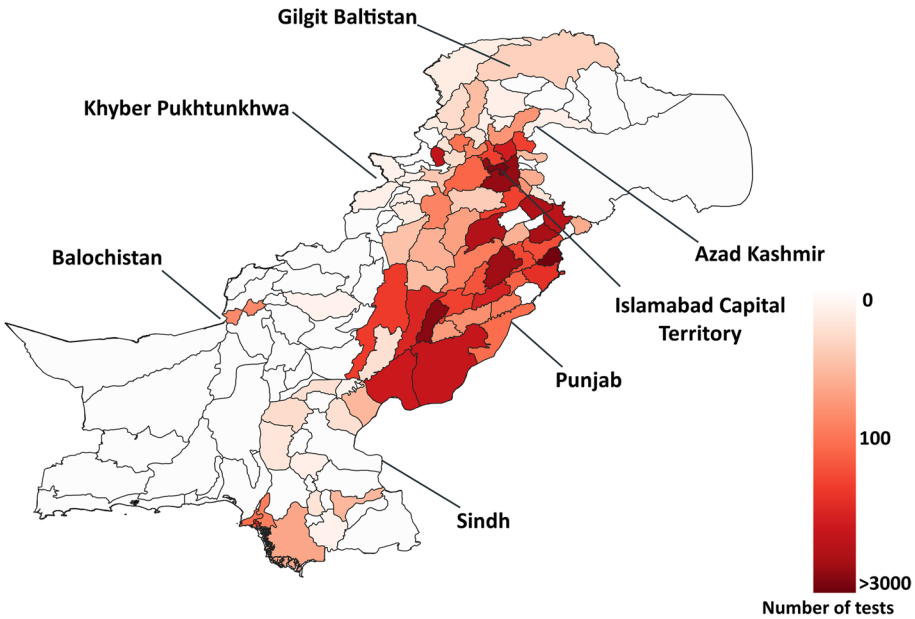

Fig. 1 Distribution of lipid testing in children and adolescents across Pakistan's regions; Color-coded gradient represents number of tests, white areas (0 tests) to dark red (> 3000 tests)

Dyslipidaemia burden

TC showed abnormal results (≥200 mg/dL) in 33.3% of all tests, with boys slightly more affected than girls (35.5% vs. 32.8%, $p=0.479$). Notably, the youngest age groups 0–2 years (63.3%) and 3–5 years (52.4%) had the highest percentages of abnormal TC results. Children aged 3–5 years exhibited the highest TC levels (417.1 ± 222.1 mg/dL) among all age groups ($p<0.001$, Supplementary Table 1). Regional variations were observed in TC levels, with Islamabad showing the highest percentage of abnormal TC levels at 91.9% and Sindh the lowest at 13.3% (Fig. 2). Elevated LDL-C levels (≥130 mg/dL) were observed in 25.4% of all tests, with boys showing a slightly higher prevalence of abnormal results compared to girls (26.0% vs. 24.6%, $p=0.085$).

Among those tested for HDL-C, 46.6% had abnormal results (<40 mg/dL). Boys showed a significantly higher percentage of low HDL levels than girls (54.4% vs. 38.3%, $p<0.001$). The highest proportion of abnormalities was observed in the 3–5 years age group (52.6%), while the lowest was in the 9–11 years age group (43%; $p<0.001$, Fig. 2). Non-HDL cholesterol levels were analysed which showed that 48.0% had abnormal levels (≥120 mg/dL). Boys generally showed a higher prevalence of abnormal results (49.2%) compared to girls (46.1%, $p=0.004$, Table 1).

TG levels were analysed separately for two age groups. Among children ≤8 years, 70.6% of all tests showed abnormal results (≥100 mg/dL), with boys slightly more affected than girls (71.4% vs. 69.6%, $p=0.473$). For children and adolescents ≥9 years, 36.6% of tests had abnormal results (≥130 mg/dL). In this group, boys were more affected than girls, with 40.3% of boys and 31.2% of girls showing elevated TG levels ($p<0.001$, Table 1). The interaction effects were found significant for low HDL-C, with gender and age ($p=0.013$, OR = 1.105). The three-way interaction effect among gender, age and province ($p=0.023$, OR = 0.911) showed the low HDL-C levels are influenced by this factor (Supplementary Table 2).

Regional disparities in lipid testing and abnormal cholesterol levels

Our findings reveal significant regional disparities in lipid testing rates and the prevalence of abnormal TC levels (≥200 mg/dL). Punjab accounted for the majority of tests (81.2%), yet the proportion of abnormal results was relatively lower (25.7%) compared to other regions. Notably, regions with lower testing rates often displayed a disproportionately higher prevalence of abnormal TC levels. For instance, Gilgit Baltistan, despite contributing only 0.3% of the total tests, reported the highest percentage of abnormal results (72.7%). Similarly, KPK demonstrated a high prevalence of abnormal results (65.2%) with only 5.8% of the total tests conducted, while Islamabad had an abnormal result rate of 91.9%, the highest among all regions.

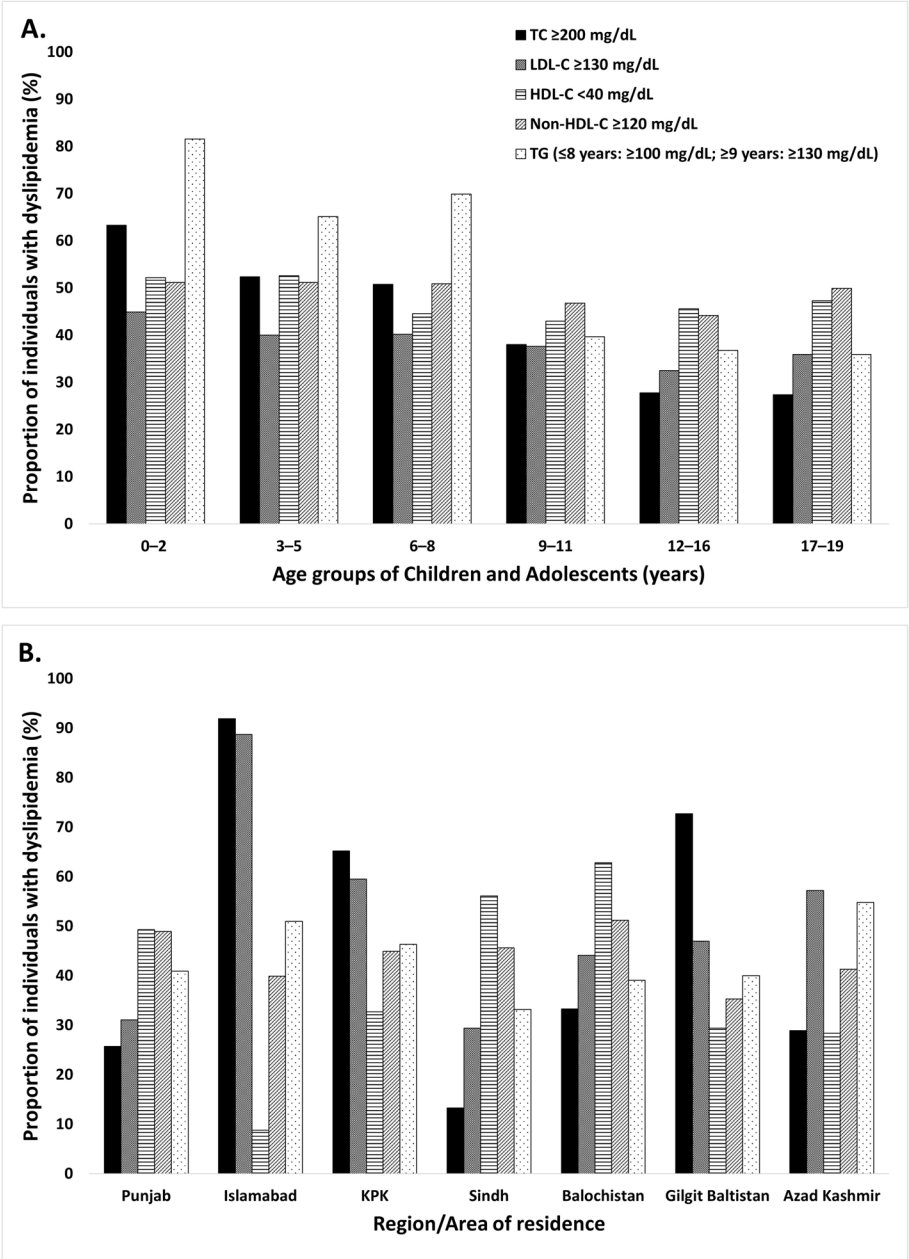

Fig. 2 Age group and region wise patterns of dyslipidemia; **A** shows the prevalence of dyslipidemia among different age groups, **B** shows the prevalence of dyslipidemia among children and adolescents of different regions/ provinces of Pakistan; KPK, Khyber Pakhtunkhwa

Age, gender and residential areas/provinces showed an association with abnormal lipid results

Girls demonstrated lower odds of abnormal HDL-C (OR 0.6, 95% CI 0.5–0.6, $p < 0.001$) and TG (OR 0.7, 95% CI 0.6–0.8, $p < 0.001$) compared to boys. Infants and toddlers (0–2 years) exhibited an increased likelihood of abnormal TG levels compared to the reference group (OR 6.6, 95% CI 4.8–9.1, $p < 0.001$). While children aged 6–8 years demonstrated a higher probability of abnormal TC levels relative to the 9–11 years age group (OR 1.5, 95% CI 1.2–2.0, $p = 0.002$). Regional differences were also observed, with Islamabad displaying higher odds for abnormal TC (OR 5.2, 95% CI 3.3–8.1, $p < 0.001$) and LDL-C (OR 5.9, 95% CI 3.6–9.5, $p < 0.001$, Fig. 3).

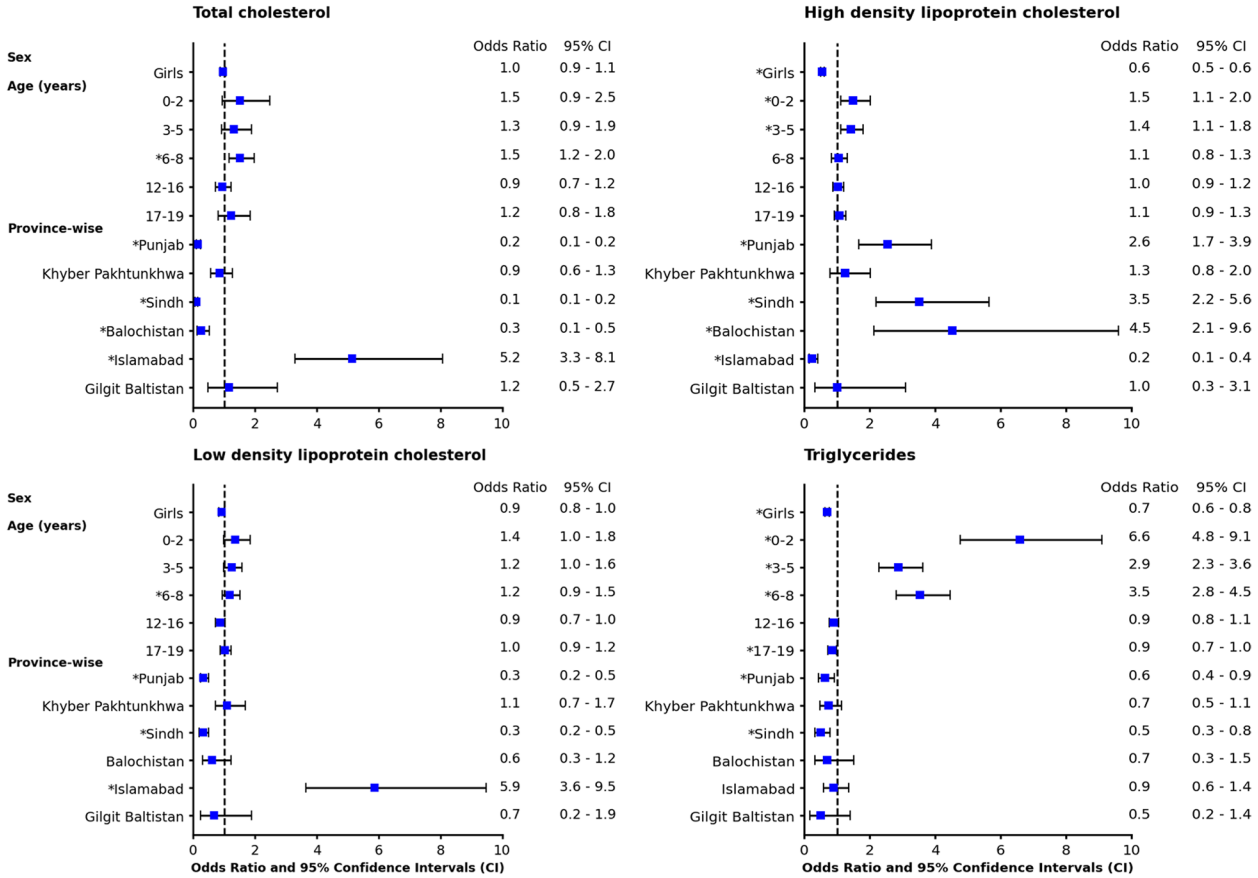

Fig. 3 Forest Plot of Odds Ratios for Abnormal Lipid Parameters by Sex, Age, and Province/ Region; Figure presents a forest plot illustrating the odds ratios (ORs) and 95% confidence intervals (CIs) for abnormal lipid parameters derived from multivariate logistic regression models. The plot is divided into four panels, each representing a different lipid parameter: total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), and high-density lipoprotein cholesterol (HDL-C). Within each panel, the ORs are grouped by sex, age categories, and regions. The x-axis displays the OR on a logarithmic scale, with a vertical line at OR = 1 representing no association. ORs to the right of this line indicate increased odds, while those to the left indicate decreased odds of abnormal lipid levels. Points represent the OR point estimates, with horizontal lines depicting the 95% CIs. Statistically significant associations ($p < 0.05$) are highlighted with steric *

Discussion

Prevention of atherosclerosis can translate into an overall reduction of CVD burden through lifestyle modifications, medical interventions, and regular health screenings [26]. Studies have shown that assessing the risk of atherosclerosis early in life is the best predictor of subclinical atherosclerosis later in life [27]. Much attention is needed for screening dyslipidaemia in children because it can lead to CVD in youth [28]. To the best of our knowledge, no study has been conducted thus far in Pakistan to investigate the results of lipid testing in children. Our study also analysed neonatal lipid testing in Pakistan to assess early screening practices and dyslipidemia prevalence across paediatric age groups. Neonatal lipid profiling is crucial for detecting inherited disorders like FH, which significantly increases the risk of premature cardiovascular disease[29]. By evaluating lipid testing frequency in all paediatric age groups, our study provides valuable insights into current practices, highlighting the need for early detection strategies to mitigate long-term cardiovascular risks.

In our study, the overall prevalence of abnormal TC levels was 33.3%, abnormal LDL-C was 25.4%, and abnormal HDL-C was 46.6%. Additionally, 41.7% of children and adolescents had abnormal TG levels. These results demonstrate the widespread nature of dyslipidaemia in the Pakistani paediatric population. Another small-scale study conducted on 85 school children (6–12 years old) in Pakistan reported that 35% had high TC, 20% had abnormal LDL-C, 75% had low HDL-C, and 19% had high TGs [30]. These findings align with our study, which also highlights the high prevalence of dyslipidaemia among tested children and adolescents. While large-scale studies on the prevalence of paediatric hyperlipidaemia in the neighbouring populations are lacking, smaller cohort studies on the Indian population suggest that the

prevalence can be as high as 19–23% [20, 21]. Another study in Korea conducted on school children aged 10–18 years showed that the prevalence of high TC, LDL-C, TG and low HDL-C was 6.5%, 4.7%, 10.1% and 7.1%, respectively [23]. In the US 20% of children and adolescents were found to have dyslipidaemia [18], while another study conducted in Brazil showed that about 30% of children and adolescents had abnormal lipid levels [31].

The higher prevalence of dyslipidaemia observed in boys across all lipid parameters (TC, LDL-C, HDL-C, non-HDL-C, and TG) in this study aligns with findings from Kashmiri children, where boys similarly exhibited a greater prevalence of dyslipidaemia compared to girls of the same age [32]. This pattern may help explain the higher incidence of coronary heart disease commonly reported in men [15]. Contrary to our current study, in the Brazilian population, girls appeared to be more dyslipidemic as compared to boys [31].

The analysis of lipid testing among Pakistani children and adolescents reveals notable disparities across regions and genders. A clear gender imbalance was observed, with males accounting for approximately 60% of the tests, compared to 40% for females, suggesting unequal access to diagnostic services. Similarly, a study reported that 58% of lipid testing in Pakistan was performed on males, reflecting a comparable trend [33]. Cultural and social norms in Pakistan often create barriers that limit women's access to healthcare, resulting in a noticeable gender gap in testing and treatment. In many families, men's health is given priority, especially when resources are scarce. Women may also face stigma around certain medical conditions and often lack the independence to seek care on their own [34]. This gender disparity raises concerns about equitable healthcare access and the potential underdiagnosis of lipid disorders in female children. The observed geographical distribution of lipid testing in children and adolescents across Pakistan reveals regional disparities. These differences may be influenced by several factors, including socio-economic conditions, healthcare infrastructure, and regional access to medical services. For example, areas like Punjab, Islamabad, and parts of KPK show a higher concentration of testing, likely due to better healthcare facilities and greater awareness of dyslipidaemia. In contrast, regions such as Balochistan, Gilgit Baltistan, and certain areas of Sindh exhibit lower testing rates, which could be attributed to factors such as limited healthcare access, fewer specialized medical centres, and socio-economic barriers preventing families from seeking or affording lipid testing.

In Pakistan, where approximately 5 million children are born each year, data from two large nationwide diagnostic laboratories highlight that lipid testing was not commonly performed on individuals aged 0 to 19 years old ($n=9787$), despite the high population and high burden of CVD in Pakistan. This number is quite low considering that the population of children (aged 0–19 years) in Pakistan is approximately 69,326,650 [35]. Several leading international organisations recommend universal screening for blood cholesterol levels at ages 9 to 11 years and 17 to 21 years, with targeted screening for those at higher risk [8, 36, 37]. The current data, though limited to these laboratories, offer valuable insight into existing gaps in paediatric lipid screening practices and serve as a foundation for improving screening and management strategies in Pakistan.

In high-income countries, lipid screening in children is part of routine paediatric care, focusing on early detection and management of lipid disorders [13, 38–41]. Universal screening, which involves testing all children regardless of risk factors, has shown effectiveness in identifying more cases of lipid disorders compared to selective screening [3]. In low- and middle-income countries like Pakistan, where the burden of CVDs is high, increased focus on lipid screening in children is essential. To enhance lipid screening practices in Pakistan, it is crucial to implement universal screening guidelines that specify regular lipid testing intervals for children across healthcare settings [16]. Concurrently, raising awareness among healthcare providers through targeted training programs and public health campaigns will ensure comprehensive understanding and adherence to screening protocols. These measures collectively aim to screen the children early in their lives which can mitigate cardiovascular risks early in life and improve long-term health outcomes for Pakistani children.

Policy implications and feasibility of universal screening programs

Implementing universal screening for FH and other rare lipid disorders in Pakistan, requires a strategic approach. Adopting a model like Slovenia's FH screening in children could be effective, ensuring early detection and intervention through integration with primary healthcare services and culturally appropriate public awareness campaigns [13, 42]. This involves making the best use of limited healthcare resources by focusing on high-risk populations, integrating screening into existing primary healthcare services, and creating culturally appropriate public awareness campaigns [3, 43]. Collaborations with international health organizations and pilot programs can help establish a practical framework tailored to Pakistan's healthcare system.

Several factors influence feasibility and implications of universal screening programs. Age is a critical factor, as early screening improves detection and intervention before complications arise [10]. Genetic predisposition

plays a major role, with South Asians exhibiting a higher prevalence of FH-related mutations, making targeted screening in high-risk families essential [44, 45]. Maternal obesity and diabetes increase lipid disorder risks in offspring, underscoring the need to include maternal indicators [46]. Environmental shifts, including urbanization and sedentary lifestyles, contribute to dyslipidemia, requiring public health interventions [47]. Socioeconomic barriers hinder widespread screening, necessitating integration into primary healthcare with government and NGO support. A phased, well-structured program with international collaboration can improve early detection and cardiovascular outcomes in Pakistan.

Limitations

Our study has several limitations. The data was sourced exclusively from hospital records and diagnostic centres, resulting in the absence of critical information such as patient BMI, co-morbidities, and family medical history. The study utilized standardized cutoff values for dyslipidaemia; however, the influence of comorbidities such as diabetes mellitus or a family history of dyslipidaemia on lipid levels was not accounted for due to the absence of detailed clinical information, which may have impacted the classification of dyslipidaemia in some cases. Additionally, as lipid testing is not a routine part of healthcare in Pakistan, patients who undergo testing are often those with underlying conditions or a personal/family history of dyslipidaemia, introducing a selection bias into the study. The lack of clarity on whether lipid tests were performed for screening or diagnostic purposes represents a limitation. Potential variability in lipid measurements between the two study sites due to differences in equipment models, calibration protocols, or operational practices, despite the use of standardized spectrophotometric enzymatic analysis, may have influenced the classification of dyslipidaemia. In regression analyses and other statistical models, the use of the 9–11 age group as the reference category, while consistent with guideline recommendations for lipid screening, may not fully capture the lipid changes associated with puberty. This may lead to an underestimation of the age-related differences in lipid profiles, particularly those influenced by pubertal development. Furthermore, since our data was derived from the largest private diagnostic setup, it likely excluded low-income individuals who generally seek care in government hospitals. These factors together limit the generalizability of our findings to the broader Pakistani population, potentially affecting the accuracy of conclusions about nationwide lipid screening practices.

Future perspective

While our study has certain limitations, it serves as a pioneering effort in understanding lipid abnormalities among children and adolescents in Pakistan. It provides a foundational basis for future research in this area. Future studies should focus on incorporating data on dietary patterns and personal clinical and family history of dyslipidaemia and other comorbidities to better understand the environmental and genetic factors influencing lipid abnormalities in children and adolescents. Further research is needed to investigate how children's lipid levels are influenced by their dietary choices and physical activity.

Future studies should aim to include data from both private and public healthcare networks, as well as rural and underserved populations, to ensure a more representative sample and improve the generalizability of findings. Our study highlights Punjab's overrepresentation, emphasizing the need for future research with balanced regional representation to improve generalizability across Pakistan. To build upon the findings of this study, future research should focus on investigating the genetic factors contributing to dyslipidaemia within the Pakistani population. Understanding the genetic basis could help identify specific risk variants and improve early detection. Additionally, longitudinal studies monitoring the long-term health outcomes of children diagnosed with dyslipidaemia would provide valuable insights into disease progression and its potential impact on cardiovascular health in adulthood. These steps would greatly enhance our understanding of dyslipidaemia and its management in Pakistan.

Conclusion

This study underscores the high prevalence of dyslipidaemia among Pakistani children and adolescents, with significant gender and regional disparities in testing and abnormal lipid levels. Boys exhibited a higher prevalence of dyslipidaemia across all lipid parameters. The gender imbalance in testing, with fewer females tested, reflects sociocultural barriers to healthcare access. Given the high number of children in Pakistan and the importance of early screening, adopting a universal lipid screening program, improving access to healthcare, and raising awareness among healthcare providers are critical steps toward early detection and management of dyslipidaemia.

Abbreviations

CVDs	Cardiovascular diseases
CAD	Coronary artery disease
FH	Familial hypercholesterolemia

LDL-C	Low-density lipoprotein cholesterol
TG	Triglycerides
HDL-C	High-density lipoprotein cholesterol
TC	Total cholesterol
IRB&EC	Institutional Review Board and Ethics Committee
WHO	World Health Organization
SD	Standard deviation
OR	Odds ratio

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12944-025-02529-2.

Supplementary Material 1

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Authors' contributions
FS and UG conceptualized the study. QA, MK, and HB contributed to data collection. AN, QA and MK performed data analysis and interpretation. JS, FS, MA and UG provided technical expertise and supervised the study. QA, RZ, MK, FS, and UG drafted the manuscript. MIK, JS and MA reviewed the manuscript critically for important intellectual content. FS and UG provided funding and final approval of the manuscript. All authors read and approved the final version.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The Institutional Review Board and Ethics Committee (IRB&EC), Shifa Tameer-e-Millat University, Islamabad, Pakistan approved the study (IRB&EC number 0323–22).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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