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Review Article

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Dyslipidemia in Children and Adolescents: Current Insights and Updated Treatment Approaches

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ABSTRACT

The increasing incidence of dyslipidemia among children and adolescents has emerged as a significant public health concern due to its associated risk of long-term cardiovascular complications. The prevalence of dyslipidemia has increased in parallel with rising obesity rates, highlighting the importance of early intervention. In this narrative review, we explore the epidemiology, screening, diagnosis, and treatment of dyslipidemia in pediatric populations, focusing on recent advancements and updates in clinical management. Key diagnostic criteria and risk assessment strategies are discussed, emphasizing the role of lipid profile screening in high-risk groups. Lifestyle and dietary interventions are key for managing dyslipidemia, while pharmacological treatments including statins, cholesterol absorption inhibitors, and emerging therapies are reviewed in cases requiring further intervention. Updated guidelines and evidence-based recommendations from Korean and other international institutions are consolidated to provide a comprehensive overview. These findings underscore the necessity of a multidisciplinary approach combining early detection, tailored treatment, and lifestyle modifications to mitigate the long-term health risks associated with dyslipidemia in younger individuals.

Keywords: Dyslipidemias, pediatrics; Epidemiology; Proprotein convertase 9

INTRODUCTION

The prevalence of overweight and obesity among children and adolescents has steadily increased worldwide in recent decades [1]. This increasing trend, also noted in South Korea [2,3], significantly accelerated during the coronavirus disease (COVID-19) pandemic [4]. Increased weight gain during adolescence leads to a corresponding rise in obesity-related metabolic disorders, including prediabetes, type 2 diabetes, hypertension, fatty liver disease, and dyslipidemia, which have emerged as major health concerns among teenagers in South Korea [5-7]. Adolescence obesity is also correlated with increased incidence of carotid intima thickening (CIMT). Metabolic disorders and factors such as CIMT are significant risk factors for cardiovascular and cerebrovascular diseases [8]. Dyslipidemia is a key risk factor for atherosclerotic cardiovascular disease, and adolescents with dyslipidemia require appropriate screening and management. Childhood-onset dyslipidemia can lead to serious health

complications such as cardiovascular and metabolic diseases in early adulthood [9]. The American Heart Association has highlighted the importance of managing dyslipidemia to promote optimal cardiovascular health in children [10]. Most children and adolescents with dyslipidemia continue to exhibit dysregulated lipid metabolism into their adulthood [11]. In South Korea, a 23-year study tracking blood lipids from adolescence to adulthood showed that elevated total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglyceride (TG), and low high-density lipoprotein cholesterol (HDL-C) levels persist, exacerbating the risk of cardiovascular diseases [12]. Additionally, studies have shown that an increase in risk factors such as obesity, hypertension, dyslipidemia, and smoking is associated with a greater extent of atherosclerotic lesions [13]. The increasing global burden of metabolic diseases among children and adolescents [14] is expected to result in a corresponding increase in mortality due to atherosclerotic cardiovascular diseases, which currently account for 32% of all deaths worldwide and 27.6% of all deaths in South Korea [15,16]. Therefore, appropriate screening and treatment of childhood dyslipidemia are essential for maintaining proper cardiovascular health and preventing cardiovascular diseases in adulthood. In this narrative review, we aimed to examine the epidemiology, definition, screening, diagnosis, and treatment of dyslipidemia in children and adolescents in South Korea.

EPIDEMIOLOGY OF DYSLIPIDEMIA IN KOREAN CHILDREN AND ADOLESCENTS

Data from the Korea National Health and Nutrition Examination Survey (NHANES) from 2007 to 2009 showed that the prevalence of dyslipidemia in Korean children and adolescents was 19.7% [17], and that of hypercholesterolemia (TC ≥200 mg/dL), high LDL-C (≥130 mg/dL), high TG (>150 mg/dL), and low HDL-C (<35 mg/dL) were 6.5%, 4.7%, 10.1%, and 7.1%, respectively. Approximately 0.4% of the total population had LDL-C levels >160 mg/dL and at least one additional metabolic risk factor such as hypertension, obesity, or smoking, indicating the potential need for pharmacological intervention.

DIAGNOSIS OF DYSLIPIDEMIA IN CHILDREN

Normal lipid profiles vary with age, sex, race, and ethnicity. Data collected from the NHANES showed that the lipid profiles of Korean children and adolescents were comparable to those of White American children and adolescents [17,18]. According to Korean data, the 95th percentiles for TC and LDL-C levels are 203 mg/dL and 129 mg/dL, respectively. To date, no global consensus on the unified diagnostic criteria for defining childhood dyslipidemia has been established. In 1992, the National Cholesterol Education Program (NCEP) and the American Academy of Pediatrics (AAP) established diagnostic thresholds for hypercholesterolemia and high LDL-C levels based on the distribution of serum lipid levels in Caucasian children aged 6-19 years [18]. Hypercholesterolemia is defined as serum TC ≥200 mg/dL and high LDL-C as ≥130 mg/dL, both corresponding to the 90–95th percentile. In addition, the modified criteria of the NCEP Adult Treatment Panel III for pediatric use defined hypertriglyceridemia as TG ≥110 mg/dL and low HDL-C as <40 mg/dL [19]. The International Diabetes Federation (IDF) alternatively proposed hypertriglyceridemia as TG ≥150 mg/dL. Moreover, the IDF provides age- and sex-specific criteria for low HDL-C levels; for children and adolescents aged 10–15 years, low HDL-C level is defined as <40 mg/dL.

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Table 1. Definition of dyslipidemia based on NHLBI guideline-recommended cutoff points for lipid levels in children and adolescents

Category	Low (mg/dL)	Acceptable (mg/dL)	Borderline-high (mg/dL)	High (mg/dL)
TC		<170	170–199	≥200
LDL-C		<110	110–129	≥130
Non-HDL-C		<120	120–144	≥145
TG (yr)				
0–9		<75	75–99	≥100
10–19		<90	90–129	≥130
HDL-C	<40	>45	40–45	

NHLBI: National Heart, Lung, and Blood Institute, TC: total cholesterol, LDL-C: low-density lipoprotein cholesterol, Non-HDL-C: non-high-density lipoprotein cholesterol, TG: triglyceride, HDL-C: high-density lipoprotein cholesterol.

For those aged ≥16 years, low HDL-C is defined as <40 mg/dL for males and <50 mg/dL for females [20]. More recent definitions of dyslipidemia provided by the AAP based on the revised consensus statement from the National Heart, Lung, and Blood Institute (NHLBI), use the following cut-off levels: TC ≥200 mg/dL, LDL-C ≥130 mg/dL, non-HDL-C ≥145 mg/dL, TG ≥130 mg/dL, and HDL-C <40 mg/dL. In children <10 years of age, hypertriglyceridemia is defined as TG levels ≥100 mg/dL [21]. The Korean Society of Pediatric Endocrinology developed the "2017 Clinical Practice Guidelines for Dyslipidemia in Korean Children and Adolescents" and the Korean Society of Lipid and Atherosclerosis published "2022 Korean Guidelines for the Management of Dyslipidemia," including definitions of dyslipidemia in children and adolescents [22]. These two guidelines adopt the NHLBI definitions for clinical applications (**Table 1**), although physicians should consider that these standard cut-off levels are not validated as predictors of atherosclerotic or cardiovascular diseases in the Korean population.

SCREENING OF DYSLIPIDEMIA IN CHILDREN

Screening lipid profiles in children and adolescents enables early identification of individuals with dysregulated lipid metabolism. Early intervention in this population can reduce the prevalence of dyslipidemia and prevent the development of cardiovascular diseases later in life. Approximately half of the children with lipid profiles in the ≥75th percentile develop dyslipidemia in early adulthood, and this percentage rises to 90% if their TC levels exceed 200 mg/dL during childhood [23,24]. This highlights the importance of appropriate interventions to delay or prevent disease onset in at-risk groups with dyslipidemia during childhood. General screening for dyslipidemia is recommended in children and adolescents; the primary test suggested for screening is serum non-HDL-C level, which is calculated as TC-HDL-C. LDL-C should be measured in a fasting state, whereas non-HDL-C can be reliably measured even in a non-fasting state. Recent studies have demonstrated that elevated levels of non-HDL-C in childhood is associated with a higher risk of developing atherosclerosis in adulthood [25,26]. Universal screening for dyslipidemia using non-HDL-C is recommended for children and adolescents aged 9–11 years and 17–21 years, respectively. A fasting lipid test should be conducted for people with non-HDL-C ≥145 mg/dL. Individuals with any risk factor for dyslipidemia are recommended to undergo a lipid test with at least 9 h of fasting at ages 2–8 years and 12–16 years. Fasting lipid tests should be conducted twice within 3 months, with an interval of at least 2 weeks, and the average of the two results is considered. In South Korea, all school-aged children and adolescents undergo regular health check-ups organized by the Ministry of Education. Lipid profiles, including TC, TG, HDL-C, and LDL-C levels,

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Table 2. Risk factors of dyslipidemia

Family history*
Any event of myocardial infarction, angina, coronary artery bypass/graft/stent/angioplasty, or sudden death in the family including that of parent, grandparent, aunt, or uncle
High-level risk factors
Hypertension which requires medication
Smoking
BMI ≥97th percentile
Type 1/type 2 diabetes
Chronic kidney disease/end stage renal failure
Kidney transplantation/heart transplantation
Kawasaki disease with aneurysm
Moderate-level risk factors
Hypertension which does not requires medication
95th percentile ≤BMI <97th percentile
HDL-C <40 mg/dL
Kawasaki disease with improved coronary artery aneurysm
Chronic inflammatory disease (systemic lupus erythematous, juvenile rheumatoid arthritis)
Human immunodeficiency virus infection
Nephrotic syndrome

BMI: body mass index, HDL-C: high-density lipoprotein cholesterol.
*Event occurring in males aged <55 years or females aged <65 years.

are assessed in students in the 4th grade of elementary school and the 1st grade of middle school. Students classified as overweight (85th ≤body mass index [BMI] percentile <95th) or obese (BMI ≥95th percentile) are required to undergo annual lipid testing [27]. Screening for dyslipidemia is not recommended in children <2 years of age, as cholesterol levels stabilize after this age. The risk factors for dyslipidemia can be classified as family history, high-level risk factors, and moderate-level risk factors (**Table 2**) [22]. Although a family history of dyslipidemia is an important predictor of future cardiovascular disease, its accuracy and reliability in assessing dyslipidemia risk can be limited. Moreover, the absence of a family history does not rule out the possibility of dyslipidemia in children and adolescents [23].

TREATMENT

Normalizing and maintaining serum cholesterol levels in children and adolescents are crucial for preventing long-term complications, which are described in subsequent sections. The treatment plan for dyslipidemia in children and adolescents varies depending on the individual's situation. Key factors that must be considered include age, BMI, severity and number of cardiovascular risk factors such as hypertension, other chronic diseases such as diabetes, family history of cardiovascular events, and plasma LDL-C and TG levels. Most of these factors are included among the risk factors assessed during the screening stage. In general, the primary intervention for dyslipidemia in children and adolescents involves dietary and lifestyle modifications aimed at improving not only abnormal cholesterol levels, but also cardiovascular health. If the primary intervention fails to achieve normal cholesterol levels, pharmacological therapy may be considered as a secondary option. For children and adolescents with both obesity and dyslipidemia—a condition commonly seen in childhood dyslipidemia—the primary treatment is focused on maintaining or reducing weight to ensure proper physical growth, which in turn helps normalize cholesterol levels. This can be achieved through appropriate dietary interventions and regular exercise. The primary treatment target is LDL-C, while the NHLBI guidelines define TG as an additional treatment target.

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Diet

The 2020–2025 Dietary Guidelines for Americans provide dietary recommendations for the general population, including children and adolescents, aiming to provide guidance for adequate nutrient supplementation for growth while reducing the risk of cardiovascular diseases by avoiding nutritionally poor foods [28]. For children and adolescents with dyslipidemia, transitioning to a low-fat diet is recommended to reduce LDL-C levels. The basic principles of diet and nutrition for childhood dyslipidemia follow the 'Cardiovascular Health Integrated Lifestyle Diet' (CHILD),' as suggested by the NHLBI guideline in 2011 [21]. For children and adolescents with newly diagnosed dyslipidemia, the first step of dietary treatment (CHILD 1) is recommended for 3–6 months to reduce LDL-C levels. CHILD 1 limits total fat intake to 25–30% of total calories, saturated fat to <10%, and cholesterol to <300 mg per day. A more detailed description of CHILD 1 is provided in **Table 3**.

CHILD 2 should be considered if target goals are not achieved after implementing CHILD 1. There are two types of CHILD 2, determined using the etiology of dyslipidemia (**Table 4**). CHILD 2–LDL is intended for patients with hyperlipidemia characterized by elevated LDL-C, which limits total fat intake to 25–30% of total calories, saturated fat to <7%, cholesterol to <200 mg/day, and trans-fat to <1%. CHILD 2–TG is indicated for patients with hypertriglyceridemia. This approach focuses on reducing simple carbohydrates, while increasing the amount of complex carbohydrates. CHILD 2–TG also recommends consuming dietary fish to increase omega-3 fatty acid intake.

Table 3. Detailed descriptions of CHILD1 diet

	0–6 mo	6–12 mo	12–24 mo	2–21 yr
Fat content	Exclusive breastfeeding should be practiced for the first 6 mo of life. In cases where direct breastfeeding is not feasible, expressing breast milk through a pump is recommended. If breastfeeding is not possible at all, iron-fortified infant formula should be provided as an alternative.	Breastfeeding should be continued for at least the first 12 mo, while gradually introducing solid foods. If breastfeeding is reduced, iron-fortified formula should be used until the infant reaches 12 mo of age. Infants under 12 mo should not have their fat intake restricted unless there is a specific medical indication.	Total fat intake should be limited to 30% of total daily calories, with saturated fatty acids comprising 8–10% of total calories. Monounsaturated and polyunsaturated fatty acids should account for up to 20% of total caloric intake. Cholesterol consumption should be restricted to <300 mg per day, and trans fatty acids should be avoided as much as possible. Switching to non-sugared, low-fat milk options, such as fat-free or 2% fat milk is recommended.	Total fat intake should be maintained at 25–30% of total daily calories, with saturated fatty acids constituting 8–10% of total calories. Monounsaturated and polyunsaturated fatty acids should account for up to 20% of total caloric intake. Cholesterol consumption should be restricted to <300 mg per day, and trans fatty acids should be avoided whenever possible. Consumption of unsweetened, low-fat milk is recommended.
Sugar intake		The intake of 100% juice should be limited to approximately 120 mL per day, and other beverages should be avoided. Water should be encouraged as the primary fluid.	The consumption of sugar-sweetened beverages should be limited, and water intake should be encouraged.	The intake of sugar-sweetened beverages should be limited, and water consumption should be promoted.
Others				Dietary fiber intake through food sources is preferred. Consumption of fiber-rich natural foods, such as fruits, vegetables, and whole grains is recommended, while avoiding fiber supplements. The intake of refined carbohydrate foods, including sugar, white rice, and white bread, should be limited.
Expert recommendations			If there is a family history of obesity, heart disease, or dyslipidemia, it is advisable to consult a healthcare provider regarding the intake of low-fat milk after 12 mo of age.	

CHILD: Cardiovascular Health Integrated Lifestyle Diet.

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Table 4. Detailed descriptions of CHILD 2 diet

	CHILD 2-LDL (2–21 yr)	CHILD 2-TG (2–21 yr)
Consult	Seek consultation with a clinical dietitian for nutritional therapy for family members.	
Fat content	Total fat intake should be maintained at 25–30% of total daily calories, with saturated fatty acids comprising no more than 7% of total calories. Monounsaturated fatty acids should contribute up to 10% of total caloric intake. Cholesterol consumption should be restricted to <200 mg per day, and trans fatty acids should be avoided as much as possible.	
Sugar intake		Simple carbohydrate intake should be reduced, while the consumption of complex carbohydrates should be increased. Beverages containing simple sugars should be avoided.
Others		Fish consumption should be increased to enhance omega-3 fatty acid intake.
Expert recommendations	In children aged >2 yr with familial hypercholesterolemia, vegetable sterols or stanols may be incorporated into the diet, replacing other fats, up to a maximum of 2 g per day. Water-soluble fiber can be added to a low-fat, low-saturated fat diet, with a recommended intake of up to 6 g per day for children aged 2–12 yr, and up to 12 g per day for children aged ≥12. All children are encouraged to engage in at least 1 h of moderate physical activity per day, while limiting television viewing, computer use, and cell phone use to <2 h/day.	In cases of obesity, it is important to limit caloric intake and increase physical activity levels.

CHILD: Cardiovascular Health Integrated Lifestyle Diet, LDL-C: low-density lipoprotein cholesterol, TG: triglycerides.

Dietary strategies for dyslipidemia should be initiated early in infancy. Breastfeeding is strongly recommended, with exclusive breastfeeding for the first 6 months of life. Although there is no substantial evidence directly linking breastfeeding to lipid profiles in later life [29,30], it has been shown to reduce cardiovascular risk, which is the primary complication of dyslipidemia in adulthood [31]. As fat is a crucial nutrient for brain and cognitive development during infancy, fat intake should not be restricted in infants <12 months of age without medical indications.

Milk is rich in proteins, calcium, magnesium, and vitamin D that are difficult to obtain from other dietary sources. Fat-free or low-fat milk helps reduce fat and calorie intake without compromising these nutrients, and is therefore recommended from 2 years of age [28,32]. Minimizing the consumption of simple carbohydrates such as sugar-sweetened beverages and sweets, refined grains, and processed foods is recommended. Foods high in saturated fats such as fatty meats and high-fat dairy products should be avoided, whereas the intake of whole fruits, whole grains, and non-starchy vegetables is encouraged. Plant-based fats, including those derived from nuts and seeds, are recommended because they lower the absorption of dietary cholesterol. In particular, foods enriched with dietary fiber are highly encouraged because increased fiber intake is associated with a reduced risk of cardiovascular disease [33].

Life style modification

The increasing prevalence of dyslipidemia among Korean children and adolescents correlated with the rising prevalence of childhood obesity during the COVID-19 pandemic [34]. Western dietary patterns and decreased physical activity are considered major contributing factors. All youths are recommended to engage in at least 60 minutes of moderate-to-vigorous aerobic activity daily. In addition, screen time, including television and internet use, should be limited to a maximum of 2 hours. Maintaining a healthy lifestyle is essential to keep the BMI below the 85th percentile, the threshold for overweight. Finally, smoking should be strongly discouraged, as it can significantly harm cardiovascular health.

Pharmacologic agents

Despite healthy lifestyle changes and dietary steps (CHILD 1 through CHILD 2-LDL), physicians and healthcare providers should consider initiating pharmacological treatment

if there is no clinical improvement. Current guidelines for childhood dyslipidemia in Korea recommend using pharmacologic agents for children and adolescents aged ≥10 years [22]. Before initiating treatment, children with dyslipidemia should be re-evaluated for a family history of cardiovascular events and additional risk factors. Pharmacological agents are generally not prescribed before the age of 10 years but may be exceptionally considered for children aged 8–9 who have certain risk factors: 1) a family history of early cardiovascular disease, 2) one or more high-risk factors, or 3) two or more intermediate-risk factors. In this particular group, statin therapy can be considered when high LDL-C levels (>190 mg/dL) persist despite lifestyle modifications and dietary changes [35]. Drug therapy is also considered for severe primary hyperlipidemia, or when risk factors such as homozygous familial hypercholesterolemia, LDL-C ≥400 mg/dL, primary hypertriglyceridemia ≥ 500 mg/dL, cardiovascular disease, or heart transplantation are present, predisposing individuals to medical complications [36].

Children and adolescents aged 10–21 years with an average LDL-C ≥250 mg/dL or TG ≥500 mg/dL should be promptly referred to a lipid specialist. If LDL-C is <250 mg/dL or TG are <500 mg/dL, dietary interventions (CHILD 1 to CHILD 2-LDL or CHILD 2-TG) should be implemented, and lifestyle modifications should be strongly encouraged for 3–6 months. For youths who are overweight or obese (BMI >85th percentile), behavioral changes to maintain a healthy lifestyle should be commenced. This goal can be achieved by increasing physical activity, reducing sedentary behavior, and consuming fewer calories. Physicians can consider drug treatment if the lipid levels do not reach the target goals despite these non-pharmacological efforts. Statins, fibrates, or niacin may be considered as treatment options for children aged ≥10 years who achieve LDL-C targets but fail to maintain non-HDL-C levels <145 mg/dL. In such cases, referral to a lipid specialist is advisable. For fasting TG levels of 200-499 mg/dL and non-HDL-C levels ≥145 mg/dL, omega-3 fatty acids may be considered if non-pharmacologic efforts (i.e., dietary interventions from CHILD 1 to CHILD 2-TG) do not show clinical improvement. However, clinical studies on this treatment are still limited [37,38].

Hydroxymethylglutaryl-coenzyme A (HMG-CoA) reductase inhibitor

Statins inhibit HMG-CoA reductase, a key enzyme in endogenous cholesterol synthesis, and reduce intracellular cholesterol levels and upregulate LDL receptors, which leads to a decrease in LDL-C levels [39,40]. Statins are Food and Drug Administration (FDA)-approved for use in children and adolescents aged ≥10 years, and are authorized for use in children of this age group in Korea. Statins are the first-line treatment for hypercholesterolemia with elevated LDL-C and non-HDL-C levels. They effectively lower cholesterol levels by 20–50% and have minimal side effects in children and adolescents.

The different types of statins exhibit varying degrees of potency. The choice of statins should be based on the patient's age, cholesterol level, and other medical conditions [41]. Lovastatin, simvastatin, and pravastatin can be administered at doses of 10–40 mg, whereas atorvastatin and rosuvastatin can be administered at doses of 5–20 mg. Treatment typically begins with the lowest possible dose of the selected statin, which is administered once daily before bedtime. Some statins, such as rosuvastatin and pravastatin, have recently been approved for use in younger children (aged 7–8 years), and clinical data on their use in younger age groups continue to accumulate [42]. Although the efficacy of statins in children is comparable to that in adults, no significant issues have been reported regarding dose escalation in children and adolescents, and the side effects of the drugs are generally tolerable.

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Although rare, relatively common side effects of statins at standard doses include myopathy and elevated liver enzyme levels. Therefore, regular monitoring of liver enzyme and creatinine kinase levels is recommended for assessing muscle toxicity. Lipoprotein profiles and liver enzyme levels should be assessed every 3–4 months during the first year of treatment, and subsequent follow-up every 6 months is recommended. The target LDL-C level should be <130 mg/dL with the optimal goal of maintaining LDL-C <110 mg/dL [43].

Bile acid-binding agents

Bile acid-binding agents such as cholestyramine and colestipol are a class of medications primarily used to lower LDL-C levels in the blood. Their mechanism of action involves binding to bile acids in the intestine and forming an insoluble complex resistant to enterohepatic reabsorption in the terminal ileum [44]. This process reduces the reabsorption of bile acids in the liver, prompting the liver to increase the conversion of LDL-C into bile acids. The depletion of the bile acid pool also upregulates LDL receptors in the liver, further enhancing the clearance of LDL-C from the serum. Bile acid-binding agents have been proven safe and effective and are often chosen as an alternative first-line therapy in children who are not candidates for statin therapy because of their age (e.g., familial hypercholesterolemia) [45]. However, these agents may cause gastrointestinal symptoms, such as abdominal discomfort and constipation, and are often poorly tolerated [46].

Cholesterol absorption inhibitors

Cholesterol absorption inhibitors selectively block cholesterol absorption in the small intestine [47]. Consequently, the liver compensates for the reduced cholesterol levels by increasing the uptake of circulating LDL-C from the blood, thereby lowering serum LDL-C levels. Therefore, cholesterol absorption inhibitors are effective in reducing overall cholesterol levels, particularly when used in combination with other lipid-lowering therapies, such as statins. In adults, cholesterol absorption inhibitors can be added when LDL-C levels fail to meet the target despite escalating statin doses. These inhibitors act independent of statins and provide additional benefits. Ezetimibe, a cholesterol absorption inhibitor, has demonstrated both efficacy and safety in children and adolescents and has been approved by the FDA for use in children aged ≥10 years [48]. However, long-term data on the efficacy and safety of ezetimibe in children remain lacking.

Proprotein convertase subtilisin/kexin type 9 (PCSK9) inhibitors

PCSK9 inhibitors are emerging drugs that effectively lower LDL-C levels. PCSK9 binds to LDL receptors on the surface of liver cells, promoting their degradation, thereby reducing the ability of the liver to clear LDL-C [49]. Although data are limited in children and adolescents, two PCSK9 inhibitors, evolocumab and alirocumab, have been approved by the FDA for patients aged ≥8 and ≥10 years, respectively [50,51]. Both drugs are approved in Korea for patients aged ≥12 years.

Fibrate and niacin

Fibrates are considered a treatment option for hypertriglyceridemia because they decrease TG levels and increase HDL-C levels. Niacin reduces LDL-C and TG and is used as an adjunctive therapy to statins. Due to limited experience with fibrates and niacin in children and adolescents and insufficient data on their efficacy and safety, fibrates or niacin should be used in youths after consultation with a specialist [21]. The medications approved for use in childhood dyslipidemia in Korea are summarized in **Table 5**.

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Table 5. Medications for dyslipidemia in children and adolescents

Type of medication	Major effects	Adverse reactions	Generic names	Daily dose
HMG-CoA reductase inhibitors	Mainly lowers LDL-C Some decrease in TG Modest increase in HDL-C	Elevated liver enzyme Elevated creatine kinase Myopathy, rhabdomyolysis	Atorvastatin Simvastatin Pravastatin Lovastatin Rosuvastatin	5–20 mg 10–40 mg 5–40 mg 10–40 mg 5–20 mg
Bile acid-binding agents	Mainly lowers LDL-C Increases HDL-C and TGM	GI dysfunction, bloating, constipation, cramps	Cholestyramine Colestipol	2–8 g 2.5–12 g
Cholesterol absorption inhibitors	Mainly lowers LDL-C Lowers TG Increases HDL-C	Myopathy GI dysfunction Headache	Ezetimibe	10 mg
PCSK9 inhibitors*	Lowers LDL-C	Injection-site reaction Diarrhea Elevated liver enzyme	Evolocumab Alirocumab	140–420 mg every 2 wk 150–300 mg every 4 wk
Fibrate and niacin	Mainly lowers TG Increases HDL-C	Dyspepsia, constipation Myositis Anemia	Fenofibrate Niacin	40–200 mg 100–2,250 mg

HMG-CoA: 3-hydroxy-3-methylglutaryl coenzyme A, LDL-C: low-density lipoprotein cholesterol, TG: triglyceride, HDL-C: high-density lipoprotein cholesterol, GI: gastrointestinal, PCSK9: protein convertase subtilisin/kexin type 9.
*Injected subcutaneously.

CONCLUSION

The prevalence of dyslipidemia in children and adolescents has steadily increased, particularly in conjunction with rising rates of obesity. This trend has resulted in an increased risk of developing metabolic complications, including insulin resistance, type 2 diabetes, hypertension, and fatty liver disease. Dyslipidemia in youth is a major risk factor for developing cardiovascular diseases, including myocardial infarction and stroke, later in life. Long-term exposure to high LDL-C and TG levels can significantly increase the likelihood of atherosclerosis, leading to reduced life expectancy and decreased quality of life.

Given the substantial long-term health risks associated with untreated dyslipidemia, early diagnosis and intervention are critical. Advances in treatment options, including newer medications, such as PCSK9 inhibitors and cholesterol absorption inhibitors, have expanded the therapeutic landscape and provided more effective ways to manage dyslipidemia in children and adolescents. Lifestyle modifications are as important as pharmacological treatments and should not be deprioritized in the management of dyslipidemia as they work together to improve long-term health outcomes. Dietary modifications, regular physical activity, and other healthy lifestyle practices are essential for managing dyslipidemia and preventing cardiovascular diseases. Therefore, a comprehensive approach that combines early detection, medical treatment, and lifestyle modifications is necessary to mitigate the long-term complications of dyslipidemia in youths.

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