Postprint: Meta-Analysis of Dyslipidemia Prevalence in Chinese Children and Adolescents

Authors: Zhou Zitong, Jia Yu, Yan Hong, Xu Jialan, Wen Jun, Wang Siyu, Yan Hong

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Abstract

Cardiovascular disease (CVD) is the leading cause of mortality in China and worldwide, and lipid metabolism disorders are important risk factors for CVD. Understanding the prevalence of dyslipidemia during childhood and adolescence facilitates early prevention of dyslipidemia in adulthood.

Objective To systematically evaluate the current prevalence of dyslipidemia among children and adolescents in China.

Methods A computerized search was conducted in the Chinese Biomedical Literature Database, China National Knowledge Infrastructure, Wanfang Data Knowledge Service Platform, VIP Database, Embase, PubMed, Web of Science, and The Cochrane Library for cross-sectional studies published from January 2015 to July 2023 regarding the prevalence of dyslipidemia among Chinese children and adolescents. Literature screening, data extraction, and risk of bias assessment of included studies were independently completed by two researchers. Meta-analysis was performed using Stata 17.0 software.

Results A total of 34 cross-sectional studies comprising 134,438 children and adolescents were ultimately included. Meta-analysis results demonstrated that the overall prevalence of dyslipidemia among Chinese children and adolescents was 19% (95%CI=16%~21%), with the prevalence of hypercholesterolemia, hypertriglyceridemia, elevated low-density lipoprotein cholesterol, and reduced high-density lipoprotein cholesterol being 6% (95%CI=5%~7%), 9% (95%CI=6%~12%), 4% (95%CI=3%~5%), and 10% (95%CI=7%~13%), respectively. Temporal distribution revealed that the overall prevalence of dyslipidemia exhibited a declining trend with fluctuations; the prevalence of hypercholesterolemia and elevated low-density lipoprotein cholesterol showed an upward trend over time, though data from 2023 indicated a slight decline; the prevalence of hypertriglyceridemia and reduced high-density lipoprotein cholesterol demonstrated considerable fluctuation, with hypertriglyceridemia

prevalence gradually decreasing from 2018 to 2022 and slightly rebounding in 2023. Subgroup analysis results indicated: Regarding age, the overall prevalence of dyslipidemia and hypertriglyceridemia in children and adolescents increased with age (10% and 2% for ages 3~6 years, 17% and 10% for ages 7~11 years, 27% and 14% for ages 12~18 years), the prevalence of reduced high-density lipoprotein cholesterol in ages 12~18 years (20%) was higher than in ages 7~11 years (9%), and the prevalence of hypercholesterolemia in ages 3~6 years (9%) was higher than in ages 7~11 years and 12~18 years (4% and 3%). Regarding region, the prevalence of hypertriglyceridemia and reduced high-density lipoprotein cholesterol in western regions (15% and 15%) was higher than in eastern regions (5% and 7%), while the prevalence of hypercholesterolemia and elevated low-density lipoprotein cholesterol in eastern regions (7% and 6%) was higher than in western regions (3% and 2%). Regarding BMI, the prevalence of dyslipidemia, hypercholesterolemia, hypertriglyceridemia, and elevated low-density lipoprotein cholesterol in obese children and adolescents (48%, 18%, 25%, and 7%) was higher than in overweight (27%, 6%, 9%, and 4%) and normal-weight children and adolescents (15%, 4%, 3%, and 3%).

Conclusion The prevalence of dyslipidemia among Chinese children and adolescents is relatively high, with variations in prevalence across different age groups, survey regions, and BMI categories. Due to limitations in the number and quality of included studies, the aforementioned findings warrant validation through additional high-quality research.

Full Text

Preamble

Evidence-Based Medicine: Meta-Analysis of the Prevalence of Dyslipidemia in Chinese Children and Adolescents

Zhou Zitong, Jia Yu, Yan Hong*, Xu Jialan, Wen Jun, Wang Siyu

School of Nursing, Chengdu University of Traditional Chinese Medicine, Chengdu 610075, China

*Corresponding author: Yan Hong, Professor; E-mail: yhcq2@163.com

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Abstract

Background: Cardiovascular disease (CVD) is the leading cause of death in China and worldwide, and lipid metabolism disorders represent a critical risk factor for CVD. Understanding the epidemiology of dyslipidemia during childhood and adolescence is essential for the early prevention of dyslipidemia in adulthood.

Objective: To systematically evaluate the current prevalence of dyslipidemia among Chinese children and adolescents.

Methods: A comprehensive computer-based literature search was conducted across Chinese biomedical databases (CBM, CNKI, Wanfang, VIP), Embase, PubMed, Web of Science, and The Cochrane Library to identify cross-sectional studies on dyslipidemia prevalence in Chinese children and adolescents published between January 2015 and July 2023. Two researchers independently performed literature screening, data extraction, and bias risk assessment for included studies. Meta-analysis was performed using Stata 17.0 software.

Results: Thirty-four cross-sectional studies involving 134,438 children and adolescents were ultimately included. Meta-analysis results showed that the overall prevalence of dyslipidemia in Chinese children and adolescents was 19% (95%CI=16%~21%). The prevalence rates of hypercholesterolemia, hypertriglyceridemia, elevated low-density lipoprotein cholesterol (LDL-C), and low high-density lipoprotein cholesterol (HDL-C) were 6% (95%CI=5%~7%), 9% (95%CI=6%~12%), 4% (95%CI=3%~5%), and 10% (95%CI=7%~13%), respectively. Temporal analysis revealed a fluctuating but declining trend in overall dyslipidemia prevalence. Hypercholesterolemia and elevated LDL-C showed upward trends over time, though 2023 data showed a slight decline. Hypertriglyceridemia and low HDL-C exhibited greater fluctuations, with hypertriglyceridemia prevalence gradually decreasing from 2018–2022 before rebounding slightly in 2023. Subgroup analyses demonstrated that overall dyslipidemia and hypertriglyceridemia prevalence increased with age (10% and 2% for ages 3–6, 17% and 10% for ages 7–11, and 27% and 14% for ages 12–18). Low HDL-C prevalence was higher among 12–18-year-olds (20%) compared to 7–11-year-olds (9%), while hypercholesterolemia was highest in 3–6-year-olds (9%) compared to older groups (4% and 3%). Regionally, western China showed higher prevalence of hypertriglyceridemia and low HDL-C (15% and 15%) than eastern regions (5% and 7%), while eastern regions had higher hypercholesterolemia and elevated LDL-C (7% and 6%) compared to western areas (3% and 2%). By BMI status, obese children and adolescents exhibited the highest prevalence of dyslipidemia, hypercholesterolemia, hypertriglyceridemia, and elevated LDL-C (48%, 18%, 25%, and 7%) compared to overweight (27%, 6%, 9%, and 4%) and normal-weight youth (15%, 4%, 3%, and 3%).

Conclusion: The prevalence of dyslipidemia among Chinese children and adolescents is relatively high, with significant variations across age groups, geographic regions, and BMI categories. Due to limitations in the number and quality of included studies, these findings require validation through additional high-quality research.

Keywords: dyslipidemia; child; adolescent; prevalence; meta-analysis

1. Methods

1.1 Inclusion and Exclusion Criteria

1.1.1 Study Design: Cross-sectional studies.

1.1.2 Participants: (1) Chinese children and adolescents aged 2–18 years; (2) those meeting diagnostic criteria for dyslipidemia.

1.1.3 Outcome Measures: Prevalence of dyslipidemia, including overall prevalence and prevalence of hypercholesterolemia, hypertriglyceridemia, elevated LDL-C, and low HDL-C.

1.1.4 Exclusion Criteria: (1) Studies not clearly reporting diagnostic criteria for dyslipidemia; (2) duplicate publications from the same sample; (3) studies with unavailable data; (4) low-quality studies.

1.2 Literature Search Strategy

A systematic computer search was conducted across Chinese biomedical literature databases (CBM, CNKI, Wanfang, VIP), Embase, PubMed, Web of Science, and The Cochrane Library for cross-sectional studies on dyslipidemia prevalence in Chinese children and adolescents published from January 2015 to July 2023. A combination of subject headings and free-text terms was adapted for each database to ensure comprehensive retrieval. Chinese databases were searched using terms including: “blood lipid,” “lipid level,” “dyslipidemia,” “lipid metabolism abnormality,” “hyperlipidemia,” “child,” “adolescent,” “primary school student,” “secondary school student,” “minor,” “detection rate,” “prevalence,” “incidence,” and “epidemiology.” English databases used terms including: “hyperlipemia,” “lipidemia,” “dyslipidemia,” “adolescent,” “teens,” “teenager,” “youth,” “child,” “children,” “prevalence,” “epidemiology,” “China,” and “Chinese.” The PubMed search strategy is detailed in Table 1. Additional manual searches of reference lists were performed to enhance completeness.

Table 1. PubMed Search Strategy

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"Adolescent" [Mesh] OR "Adolescence" [TIAB] OR "Teen" [TIAB] OR "Teenager" [TIAB] OR "Youth"
"Prevalence" [Mesh] OR "Epidemiology" [Mesh] OR "Period Prevalence" [TIAB] OR "Point Prevale
"Hyperlipidemias" [Mesh] OR "Hyperlipidemia" [TIAB] OR "Dyslipidemias" [Mesh] OR "Dyslipiden
"China" [Mesh] OR "Chinese" [TIAB]
#1 AND #2 AND #3 AND #4
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1.3 Literature Screening and Data Extraction

Literature screening and data extraction were conducted independently by two researchers, with cross-checking performed subsequently. Any discrepancies were resolved through discussion with a third researcher. During the review process, EndNote X20 software was used to eliminate duplicates, reviews, non-Chinese/English publications, conference abstracts, and case reports. Titles and abstracts were screened to exclude obviously irrelevant studies, followed by

full-text review for final inclusion. A pre-designed form was used to extract relevant data including first author, publication year, study region, sample size, age range, measurement tools, number of dyslipidemia cases, and prevalence rates.

1.4 Quality Assessment of Included Studies

Two researchers independently assessed the risk of bias using the Agency for Healthcare Research and Quality (AHRQ) recommended quality assessment tool for cross-sectional studies. This 11-item tool scores each item as "yes" (1 point), "no," or "unclear" (0 points). Total scores of 0–3 indicate low quality, 4–7 moderate quality, and 8–11 high quality.

1.5 Statistical Analysis

Meta-analysis was performed using Stata 17.0 software, with subgroup analyses conducted by age group, gender, region, and BMI. Heterogeneity was assessed using the ^{2} test (α=0.1) and quantified with I^2 statistics. When P>0.1 and $I^2$$ 50^{2}$>50% (indicating substantial heterogeneity), a random-effects model was applied, with subgroup or sensitivity analyses performed to explore heterogeneity sources. The significance level for meta-analysis was set at α=0.05. Publication bias was evaluated using Egger's test.

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2. Results

2.1 Literature Screening Process and Results

The initial database search yielded 984 relevant articles. After systematic screening, 34 articles were ultimately included. The screening flowchart is presented in Figure 1.

Figure 1. Literature Screening Process and Results

[Flowchart description: Initial retrieval (n=984) from CBM (n=230), CNKI (n=178), VIP (n=142), Wanfang (n=146), PubMed (n=48), Embase (n=135), Web of Science (n=79), and Cochrane Library (n=26). After duplicate removal (n=753), title/abstract screening excluded 681 articles (514 irrelevant topics, 167 wrong publication types). Full-text review of 72 articles excluded 38 (22 inappropriate outcomes, 8 age mismatches, 6 tool mismatches, 2 duplicates), yielding 34 final included studies.]

2.2 Characteristics and Quality Assessment of Included Studies

The basic characteristics, diagnostic criteria, and quality assessment results of included studies are summarized in Table 2. The AHRQ quality scores ranged from 6–8, indicating moderate to high quality across all included studies.

Table 2. Basic Characteristics of Included Studies

[Table content shows: First author, year, region, sample size, age range, diagnostic criteria (A-E), and prevalence rates for various dyslipidemia types. Diagnostic standards: A=2009 Expert Consensus on Dyslipidemia Prevention in Children and Adolescents; B=2006 Hainan Expert Consensus; C=2011 NHLBI Integrated Guidelines; D=NCEP; E=Practical Pediatrics 7th Edition.]

2.3 Meta-Analysis Results

2.3.1 Prevalence of Dyslipidemia in Chinese Children and Adolescents

Twenty-nine articles reported overall dyslipidemia prevalence. Due to high heterogeneity, a random-effects model was applied. The pooled prevalence of dyslipidemia among Chinese children and adolescents from 2015–2023 was 19% (95%CI=16%~21%). The prevalence rates of hypercholesterolemia, hypertriglyceridemia, elevated LDL-C, and low HDL-C were 6% (95%CI=5%~7%), 9% (95%CI=6%~12%), 4% (95%CI=3%~5%), and 10% (95%CI=7%~13%), respectively (Figures 2–6).

Figure 2. Prevalence of Dyslipidemia in Chinese Children and Adolescents

Figure 3. Prevalence of Hypercholesterolemia in Chinese Children and Adolescents

Figure 4. Prevalence of Hypertriglyceridemia in Chinese Children and Adolescents

Figure 5. Prevalence of Elevated LDL-C in Chinese Children and Adolescents

Figure 6. Prevalence of Low HDL-C in Chinese Children and Adolescents

2.3.2 Temporal Trends in Dyslipidemia Prevalence

Overall dyslipidemia prevalence showed a fluctuating downward trend. Hypercholesterolemia and elevated LDL-C demonstrated upward trends over time, with a slight decline in 2023. Hypertriglyceridemia and low HDL-C showed greater variability, with hypertriglyceridemia decreasing gradually from 2018–2022 before rebounding slightly in 2023.

Figure 7. Temporal Trends in Detection Rates of Dyslipidemia in Children and Adolescents

2.3.3 Subgroup Analyses

2.3.3.1 Age: Meta-analysis revealed that overall dyslipidemia and hypertriglyceridemia prevalence increased with age (10% and 2% for ages 3–6, 17% and 10% for ages 7–11, and 27% and 14% for ages 12–18). Low HDL-C prevalence

was higher in 12–18-year-olds (20%) than in 7–11-year-olds (9%). Hypercholesterolemia was highest in 3–6-year-olds (9%) compared to older groups (4% and 3%). No significant age-related differences were observed for elevated LDL-C prevalence (P>0.05). Results are detailed in Table 3.

Table 3. Meta-Analysis of Dyslipidemia Prevalence by Age Group

Age Group	Studies (n)	Heterogeneity (I^2)	Prevalence (95%CI)	P-value
Overall dyslipidemia (3–6y)	3	<0.001	0.10 (0.10–0.11)	<0.001
Overall dyslipidemia (7–11y)	5	<0.001	0.17 (0.14–0.20)	<0.001
Overall dyslipidemia (12–18y)	9	<0.001	0.27 (0.21–0.32)	<0.001
Hypercholesterolemia (3–6y)	2	<0.001	0.09 (0.08–0.09)	<0.001
Hypercholesterolemia (7–11y)	8	<0.001	0.04 (0.02–0.07)	<0.001
Hypercholesterolemia (12–18y)	12	<0.001	0.03 (0.02–0.04)	<0.001

2.3.3.2 Gender: No statistically significant differences were observed between genders for overall dyslipidemia, hypercholesterolemia, hypertriglyceridemia, elevated LDL-C, or low HDL-C prevalence (all P>0.05). See Table 4.

Table 4. Meta-Analysis of Dyslipidemia Prevalence by Gender

Gender	Studies (n)	Heterogeneity (I^2)	Prevalence (95%CI)	P-value
Overall dyslipidemia (Male)	26	<0.001	0.20 (0.17–0.22)	<0.001
Overall dyslipidemia (Female)	26	<0.001	0.19 (0.17–0.22)	<0.001
Hypercholesterolemia (Male)	26	<0.001	0.05 (0.04–0.06)	<0.001
Hypercholesterolemia (Female)	26	<0.001	0.06 (0.05–0.07)	<0.001

2.3.3.3 Region: Western China showed higher prevalence of hypertriglyceridemia and low HDL-C (15% and 15%) compared to eastern regions (5% and 7%). Eastern China demonstrated higher hypercholesterolemia and elevated LDL-C (7% and 6%) than western areas (3% and 2%). No significant regional differences were found for overall dyslipidemia or hypertriglyceridemia prevalence (P>0.05). See Table 5.

Table 5. Meta-Analysis of Dyslipidemia Prevalence by Region

Region	Studies (n)	Heterogeneity (I^2)	Prevalence (95%CI)	P-value
Hypercholesterolemia (East)	12	<0.001	0.07 (0.06–0.09)	<0.001
Hypercholesterolemia (West)	7	<0.001	0.03 (0.02–0.05)	<0.001
Hypertriglyceridemia (East)	13	<0.001	0.05 (0.03–0.06)	<0.001
Hypertriglyceridemia (West)	9	<0.001	0.15 (0.05–0.31)	<0.001

2.3.3.4 BMI: Obese children and adolescents showed the highest prevalence of overall dyslipidemia, hypercholesterolemia, hypertriglyceridemia, and elevated

LDL-C (48%, 18%, 25%, and 7%) compared to overweight (27%, 6%, 9%, and 4%) and normal-weight youth (15%, 4%, 3%, and 3%). No significant BMI-related differences were observed for low HDL-C prevalence (P>0.05). See Table 6.

Table 6. Meta-Analysis of Dyslipidemia Prevalence by BMI Status

BMI Status	Studies (n)	Heterogeneity (I^2)	Prevalence (95%CI)	P-value
Overall dyslipidemia (Normal)	10	<0.001	0.15 (0.11–0.19)	<0.001
Overall dyslipidemia (Overweight)	11	<0.001	0.27 (0.21–0.32)	<0.001
Overall dyslipidemia (Obese)	13	<0.001	0.48 (0.25–0.70)	<0.001

2.4 Sensitivity Analysis and Publication Bias

Sensitivity analysis demonstrated that the pooled dyslipidemia prevalence remained stable at 16%–22% when each study was sequentially excluded, indicating robust results. The funnel plot showed basic symmetry, and Egger's test (t=1.56, P=0.131) revealed no significant publication bias.

Discussion

This meta-analysis synthesized 34 studies from 23 provinces (autonomous regions, municipalities) covering 134,438 participants. The overall dyslipidemia prevalence of 19% among Chinese children and adolescents from 2015–2023 was lower than the 25.3% reported in a previous meta-analysis covering 1974–2014. The prevalence of hypercholesterolemia, hypertriglyceridemia, and low HDL-C (6%, 9%, and 10%) were higher than in the earlier study (4.1%, 8.5%, and 6.8%), while elevated LDL-C prevalence (4%) was lower (5.3%). The pattern of dyslipidemia types, particularly high hypertriglyceridemia and low HDL-C, aligns with that observed in Chinese adults.

Temporal trend analysis revealed a fluctuating decline in overall dyslipidemia prevalence. The American Heart Association's 2020 Impact Goals, promoting tobacco-free status, BMI<25 kg/m^2, physical activity, and dietary recommendations, may have contributed to this improvement. Increased health information accessibility through internet and media, coupled with community and school health education programs, likely facilitated these positive trends. However, rising hypercholesterolemia and elevated LDL-C warrant attention, though the significance of 2023's slight decline requires further investigation.

Age-stratified analysis showed increasing dyslipidemia and hypertriglyceridemia prevalence with age, peaking at 27% and 14% among 12–18-year-olds. This likely reflects adolescence as a "second growth spurt" period with increased energy demands, lifestyle changes, and higher obesity risk. Notably, 3–6-year-olds

exhibited the highest hypercholesterolemia prevalence (9%), suggesting early screening from age 2 is warranted for at-risk children.

Regional differences revealed distinct dyslipidemia patterns: western China showed higher hypertriglyceridemia and low HDL-C, while eastern regions had higher hypercholesterolemia and elevated LDL-C. Despite no significant difference in overall prevalence, these variations suggest region-specific prevention strategies are needed.

BMI status strongly influenced dyslipidemia risk, with obese youth showing 48% overall prevalence—significantly higher than overweight (27%) and normal-weight (15%) groups. This underscores the critical importance of weight control through dietary modifications (e.g., fat-free milk, limiting sugar-sweetened beverages and sodium, reducing saturated/trans fats, increasing fruits/vegetables/whole grains) and lifestyle interventions.

Limitations: (1) High heterogeneity in some outcomes; (2) Small numbers of studies in some subgroups affecting robustness; (3) Non-significant gender differences require further investigation with larger samples.

Conclusion: Dyslipidemia prevalence among Chinese children and adolescents remains high, with significant variations by age, region, and BMI. These findings require validation through additional high-quality studies.

Author Contributions

Zhou Zitong: conceptualization, methodology, statistical analysis, interpretation, writing-original draft. Jia Yu: data extraction, analysis, visualization. Yan Hong: validation, supervision, writing-review & editing. Xu Jialan, Wen Jun, Wang Siyu: literature review, data curation.

Conflict of Interest: None declared.

ORCID: Zhou Zitong: https://orcid.org/0009-0001-6072-7207

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