HHS Public Access

Author manuscript

Clin Pediatr (Phila). Author manuscript; available in PMC 2015 October 01.

Published in final edited form as:

Clin Pediatr (Phila). 2015 October ; 54(12): 1200–1205. doi:10.1177/0009922815576885.

Physicians' Lack of Adherence to National Heart, Lung, and Blood Institute Guidelines for Pediatric Lipid Screening

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Abstract

Objectives—To determine adherence to the 2011 National Heart, Lung, and Blood Institute lipid screening guidelines and identify patient factors promoting screening.

Methods—Records of children who received well-child care at age 11 years and turned 12 in 2013 were reviewed. Subjects were stratified by guideline-defined dyslipidemia risk based on documented medical or family history risk factors. We defined adherence as the order of a lipid profile when age 11 years or completed lipid screening at 9 to 10 years.

Results—Of 298 subjects, 42% were assigned to the dyslipidemia high-risk subgroup. Records of 27.2% demonstrated adherence. Fifty-six percent of high-risk subjects versus 6% of their non-high-risk counterparts received lipid screening by age 12 ($P < .001$). Among screened subjects, history of obesity and parental history of dyslipidemia were significantly associated with lipid testing.

Conclusions—Lipid screening rates were low. Strategies to increase lipid screening in the primary care setting are needed.

Keywords

children; lipids; primary care; guidelines; obesity

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Author Contributions

CV contributed to conception and design, acquisition, analysis and interpretation, drafted the manuscript, and gave final approval. IB contributed to conception and design, critically revised the manuscript, and gave final approval. HB, MQS, and AP contributed to conception and design, acquisition, analysis and interpretation, critically revised the manuscript, and gave final approval.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Introduction

Cardiovascular disease (CVD) is the leading cause of death among adults in the United States.[1] Abnormal blood lipid levels developed during childhood contribute to the atherosclerotic process underlying CVD.[2-4] A recent analysis of National Health and Nutrition Examination Survey data collected between 1998 and 2010 estimated that 24.6% of US children ages 9 to 11 years had either abnormally low high-density lipoprotein (HDL) cholesterol or elevated non-HDL cholesterol.[5]

In response to these trends, the National Heart, Lung, and Blood Institute (NHBLI) released a comprehensive set of integrated guidelines for cardiovascular health for children in December 2011.[6] The guidelines set criteria to identify children at high dyslipidemia risk and recommended fasting lipid panel screening for these children at ages 2 to 8 years and again at ages 12 to 16 years. The guidelines also recommended universal lipid screening for those identified as not high risk using a nonfasting, non-HDL cholesterol at ages 9 to 11 years and again at ages 17 to 21 years. The recommendation for universal screening of 9 to 11 year olds was received with some resistance by health care providers.[7,8]

Cholesterol testing ordered at health maintenance visits for US children and adolescents over 1995 to 2010 was under 10% for all age groups.[9] Similarly, over the period 2007 to 2010, <10% of children ages 3 to 19 years in community practice had lipid screening.[10] No studies have investigated cholesterol screening rates since publication of the new NHLBI guidelines. The objectives of this study are to (*a*) examine rates of adherence by physicians to the 2011 NHLBI recommendation for lipid screening of children ages 9 to 11 years in the primary care setting and (*b*) identify the effects of select medical risk factors and family history on screening.

Methods

We retrospectively reviewed medical records from 2 pediatric clinics owned by an urban pediatric tertiary care hospital. Both clinics are sites of pediatric resident training, and one site also has periods of care delivery by attending pediatricians without resident involvement. Records selected for review included all patients born in 2001 who received a well-child visit at these sites when age 11 years. Thus, the review at age 11 years for all subjects encompassed 1-year periods overlapping 2012 and 2013, which was after the release of the NHLBI guidelines. The Ann & Robert H. Lurie Children's Hospital of Chicago Institutional Review Board approved the study.

Data were collected via download from the electronic medical record (EMR). These clinics implemented an EMR in April 2007. For each subject, data were collected from the earliest visit recorded in the EMR until the subject reached 12 years of age, within the time period April 1, 2007, through December 31, 2013. Data elements reviewed included sociodemographics, anthropometrics, family and past medical history, and clinical outcomes for each primary care visit (diagnoses, problem lists, laboratory studies, medications, orders). Additionally, to identify information that may have been typed into the record as free text, we used free-text queries (ie, searched for words likely to be used for

documentation purposes, such as “lipid,” “cholesterol,” etc). Content of record pages identified by this method was individually reviewed for family and past medical history as well as care management.

Anthropometric data from primary care visits were used to assign body mass index (BMI) percentiles, which were interpreted using Epi Info 3.5.3 (National Center for Health Statistics, Centers for Disease Control & Prevention [CDC], Atlanta, GA; 2011). History of obesity was defined as BMI ≥ 95% at any point in the past, using the CDC 2000 BMI percentile references.[11] Blood pressure percentiles were interpreted using Health Indicators Analyzer (HIA) software (2003; Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL), which uses age-specific NHLBI references.[12] A history of hypertension was defined in accordance with the algorithm provided in the NHBLI guidelines as blood pressure (BP) ≥95% when averaged over at least 2 consecutive visits, ideally within a 2-week period.

Data were used to assign the presence or absence of medical and family history risk factors (Table 1), as defined by the guidelines.[6] We then stratified subjects into 2 groups in accordance with the 2011 NHLBI guidelines: the “high-risk” group included those with at least one documented risk factor, and the “non-high-risk” group included those with no documented history of any relevant risk factors. Subjects with records lacking specific negative documentation (eg, records that had no documentation on parental total cholesterol or parental dyslipidemia status) were considered not to have the risk factors. Finally, we have interpreted adherence to the guidelines as the documented order of a non- fasting or fasting lipid profile when the subject was age 11 years or completed nonfasting or fasting lipid profile at ages 9 to 10 years, regardless of previous screening. We required only a documented order as opposed to a completed profile for subjects age 11 to allow for future testing.

We generated descriptive statistics to characterize the study population. Univariate analyses were carried out using χ^2 for proportions, Student's *t* test for means, and Mann–Whitney *U* test for nonnormally distributed data (number of visits to primary care provider). All data were analyzed using IBM SPSS Statistics, version 22.0. A *P* value <.05 indicated statistical significance.

Results

The study population consisted of 298 children (Table 2). The population was almost exclusively publicly insured, and the majority of subjects were either Hispanic or African American. Nearly 42% of subjects were classified as high risk. There were no statistically significant differences in sociodemographic factors between the high-risk and non-high-risk groups (Table 2). Of note, subjects in the high-risk group visited their primary care provider more frequently at age 11 than subjects in the non-high-risk group (2.1 vs 1.6 visits on average at age 11, $P < .001$).

The most prevalent risk factor qualifying a child for more selective screening was obesity, with over 67% of high-risk children (84/125) having a documented history of obesity (Table

3). Few children had documentation of having other CVD risk factors. Overall, 42.4% of high- risk subjects (53/125) were classified as high risk solely due to obesity status, 18.4% (23/125) only had a family history risk, and 12.0% (15/125) only had a child medical risk factor or comorbidity other than obesity. There were 8.0% (10/125) of subjects with both family history and child medical history risk factors. Negative status of family history risk factors was infrequently documented in records. Among all subjects, 76.5% had no documentation with regard to early CVD in the family and 83.6% lacked documentation of the status of parental dyslipidemia or elevated total cholesterol.

For all subjects, the overall rate of lipid screening at ages 9 to 11 years was 27.2% (81/298). High-risk group subjects were significantly more likely to have received any lipid screening as compared to non-high-risk group subjects (56% vs 6.4%; $P < .001$).

We further evaluated screening rates before and after publication of the NHLBI guidelines (December 1, 2011). For all subjects, 12.4% (37/298) were screened prior to the guidelines. Of the remaining 261 unscreened subjects, 16.9% (44/261) were screened following publication of the new guidelines. Among the high-risk group, 25.6% (32/125) completed a lipid screen prior to the guidelines, and 40.9% (38/93) of the remaining unscreened subjects had a lipid screen ordered after that date, but before they turned 12 years old ($P = .09$). Among the non-high-risk group, 2.9% (5/173) completed a lipid screen prior to December 2011, and 3.6% (6/168) of the remaining unscreened subjects had a lipid screen ordered after that date, but before they turned 12 years old ($P = .73$).

Overall evaluation of risk factors that might have prompted screening showed that having a history of obesity ($P < .001$) or a family history of dyslipidemia ($P= .007$) was associated with lipid screening. Having a history of hypertension ($P = .13$) or a family history of early CVD ($P = .30$) was not associated with lipid screening.

Discussion

Our data show that prior to the publication of the 2011 NHLBI guidelines, <13% of children ages 9 or 10 years seen in an urban primary care clinic had completed lipid screening. By the completion of their 12th year, which was at least 1 year after release of the NHLBI guidelines, over 27% of subjects had lipid screening. Overall, 17% of previously unscreened children were screened prior to their 12th birthday. A recent, large retrospective study found that 3.2% of children ages 9 to 11 received lipid screening in the years 1995 to 2010 nationwide.[9] The lipid screening rate in our study is much higher and may be driven in part by obesity screening recommendations published in 2007.[13]

Prior to the 2011 NHBLI guidelines, subjects in this study with a history of medical or family risk for dyslipidemia were screened more often in accordance with the prevailing American Academy of Pediatrics–endorsed risk-based strategy.[14] However, we found screening rates were still less than 30% for this higher-risk group. Interestingly, we found that 3% of children with no identifiable risk factors were being screened in these years for unclear reasons. This may reflect clinician response to risk factors not documented in the medical record.

After publication of the 2011 NHBLI guidelines recommending universal screening for children ages 9 to 11, our data show that lipid screening rates remained low. Less than 41% of previously unscreened, high-risk subjects and 3.6% of unscreened, non-high-risk subjects received lipid screening by age 12. Lipid screening rates before and after the 2011 NHLBI guidelines were similar within risk groups.

Importantly, our data demonstrate that adherence to the 2011 NHLBI guidelines is far from universal, as fewer than 30% of all subjects received lipid screening by age 12. Moreover, 44% of children with a higher risk of dyslipidemia and potential CVD burden remained unscreened by the end of our study period. Several iterations of American Academy of Pediatrics and NHBLI guidelines dating back to 1992 have recommended early screening of this subgroup to identify opportunities for lifestyle modification and even pharmacologic intervention in more severe cases.[6,15,16] Nonetheless, a significant portion of this high-risk subpopulation is still not being captured by current screening practices.

We observed that having a history of obesity (BMI>95th percentile) was the most common risk factor present in the portion of the population that received lipid screening. Our findings agree with recent studies evaluating practices prior to the publication of the 2011 NHBLI guidelines that identified increased BMI as a predictor of lipid screening in children.[10,17] Moreover, we identified a documented family history of dyslipidemia as a risk factor that was significantly more prevalent among those tested versus their counterparts who did not receive lipid screening before age 12 years. Interestingly, there were a number of other risk factors named by the NHBLI guidelines that would merit more selective lipid screening, such as a history of hypertension or a family history of early CVD, that were not significantly associated with lipid screening in this population. It is possible that this study was not adequately powered to detect these differences or that the presence of these risk factors is not as likely to prompt a physician to order lipid screening for a child. Moreover, the diagnosis of hypertension and the elicitation of a complete family history can be time-intensive processes, which may make it more difficult for physicians to identify these risks in their patients. In our study, we found that fewer than 25% of subjects had clear documentation of family risk factors. Further education and quality improvement is needed to facilitate assessment and documentation of these specific measures.

A strength of this study is that it assessed lipid screening immediately prior to and following the introduction of the 2011 NHBLI guidelines. Limitations of this study include the relatively small sample size and location of this study at 2 clinics associated with a large tertiary academic setting. These factors limit the generalizability of the findings to other settings. However, the attending pediatricians at these clinics are charged with teaching best practices and should thus be familiar with new guidelines as they are introduced. Additionally, this was a retrospective study that relied on documentation of risk factors and screening in the EMR. Many records lacked documentation related to CVD risk and were, by default, placed in the not high-risk group. Since children at high risk were more often screened, improved documentation of CVD risk factors may be one way to improve lipid screening rates.

In conclusion, adherence to the NHLBI lipid screening guidelines was low. Children with CVD risk factors were more often screened than children without. Future evaluations should continue to assess screening adherence for subgroups of children based on family and medical risks. Provider education and practice-based quality improvement strategies should be implemented to increase lipid screening.

Acknowledgment

We thank George C. Lales, MS, of the Stanley Manne Children's Research Institute for assistance with data extraction from the electronic medical record.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Dr Binns' time for practice-based research was supported in part by Grant UL1RR025741 from the National Center for Research Resources, National Institutes of Health.

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Table 1

Risk Stratification Based on the 2011 NHLBI Guidelines.

Risk Group	Qualifications	Recommended Lipid Screening
High risk	Family history	Nonfasting lipid screening once at ages 9 to 11 and again at ages 17 to 21
Non-high risk	1.Presence of early CVD in parent, grandparent, aunt/uncle, or sibling with myocardial infarction, angina, stroke, coronary artery bypass grafting/stent/angioplasty or sudden cardiac death (<55 years old in male and <65 years old in female) 2.Parent with total cholesterol >240 mg/dL or known dyslipidemia Medical risk factors and comorbidities 1.Child has diabetes, hypertension, body mass index >95th percentile, or smokes cigarettes 2.Child has moderate- or high-risk medical condition[a] No documented presence of any of the above risk factors	AND 2 fasting lipid profiles at ages 2 to 8 and 12 to 16 Nonfasting lipid screening once at ages 9 to 11 and again at ages 17 to 21

Abbreviations: NHLBI, National Heart, Lung, and Blood Institute; CVD, cardiovascular disease.

[a]Moderate and high-risk conditions include chronic kidney disease/postrenal transplan1/end-stage renal disease, nephrotic syndrome, postorthotopic heart transplant, Kawasaki disease, HIV, and chronic inflammatory disease (systemic lupus erythematosus, juvenile rheumatoid arthritis).

Table 2

Characteristics of the Study Population.

Characteristic	All Subjects[a] (N = 298), n (%)	CV Risk Group[b]		P Value
		High Risk (n = 125; 41.9%), n (%)	Non-high risk (n = 173; 58.1%), n (%)	
Gender				.44
Male	171 (57.4)	75 (43.9)	96 (56.1)	
Female	127 (42.6)	50 (39.4)	77 (60.6)	
Race/ethnicity				.27
Hispanic	133 (44.6)	63 (47.4)	70 (52.6)	
African American	107 (35.9)	43 (40.2)	64 (59.8)	
White	27 (9.1)	8 (29.6)	19 (70.4)	
Other	31 (10.4)	11 (35.5)	20 (64.5)	
Insurance				.29
Medicaid insured	273 (91.6)	112 (41.0)	161 (59.0)	
Private	25 (8.4)	13 (52.0)	12 (48.0)	

Abbreviation: CV, cardiovascular.

[a] Column percentages.

[b] Row percentages.

Table 3

Frequency of Medical and Family History Risk Factors in the Population[a].

	All Subjects (n = 298)	High Risk (n = 125)
Medical risk profile, n (%)		
BMI ≥ 95th percentile (obese)	84 (28.2)	84 (67.2)
History of hypertension	22 (7.4)	22 (17.6)
History of other risk factors[b]	6 (2.0)	6 (4.8)
Family history risk profile, n (%)		
Early CVD in first-degree relative	25 (8.4)	25 (20.0)
Dyslipidemia in parent	9 (3.0)	9 (7.2)

Abbreviations: BMI, body mass index; CVD, cardiovascular disease.

[a] Data reported as n (% of subjects in respective group).

[b] Other risk factors include the moderate and high-risk conditions listed in Table 1.