Brief Report

The Healthy Eating Assessment Tool (HEAT): A Simplified 10-Point Assessment of CHILD-2 Dietary Compliance for Children and Adolescents with Dyslipidemia

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Abstract: Traditional dietary assessment tools used to determine achievement of cholesterol-lowering dietary targets, defined in the Cardiovascular Health Integrated Lifestyle Diet (CHILD-2), are time intensive. We sought to determine the utility of the Healthy Eating Assessment Tool (HEAT), a simplified 10-point dietary assessment tool, in relation to meeting dietary cut points of the CHILD-2, as well as its association with markers of adiposity and lipid variables. We performed a 2-year single-center, prospective cross-sectional study of pediatric patients with dyslipidemia. HEAT score associations with meeting CHILD-2 fat targets were modest. Only patients with the highest HEAT scores (good 43%, excellent 64%) met the CHILD-2 cut point of <25% total fat calories ($p = 0.03$), with a non-significant trend for limiting the percentage of daily saturated fat to <8% (excellent 64%), and no association with cholesterol intake. There were more consistent associations with markers of adiposity (body mass index z-score r = −0.31, $p = <0.01$ and waist-to-height ratio r = −0.31, $p = <0.01$), and there was no independent association with lipid levels. While fat-restricted diets are safe, they are not particularly effective for treatment of dyslipidemia or for weight management alone. The HEAT may be a more useful and simplified way of assessing and tracking broader dietary goals in clinical practice.

Keywords: dyslipidemia; diet; obesity; nutritional status

1. Introduction

Dietary therapy, along with physical activity prescription, are the key lifestyle modifications and first line of therapy for the treatment of dyslipidemia. Lipid-lowering dietary therapy is considered the cornerstone of treatment because it is a safe and effective way to lower lipid levels in children and adolescents [1]. A low-fat, low-sugar, and high-fiber diet that relies primarily on vegetables and fruits, whole grains, lean meats, fish, lentils and legumes, and low- and non-fat dairy products is recommended. The two-stage dietary approach of the Cardiovascular Health Integrated Lifestyle Diet (CHILD), composed of the CHILD-1 and CHILD-2, provides dietary goals for children and adolescents, aged 2–21 years, with dyslipidemia [1]. The CHILD-1 is the first stage in dietary change and recommends total fat intake be limited to 25–30% of daily calories. Of the total fat intake, saturated fat is to be limited to 8–10% of daily kcal/EER, while mono and polyunsaturated fat consumption is encouraged up to 20% of daily kcal/EER. Trans fat is to be avoided as much as possible, and dietary cholesterol is to be limited to <300 mg/day. The remaining 70% of dietary energy should be composed of 15–20% proteins and 50–55% carbohydrates, with a focus on fiber-rich foods such as vegetables, fruit, and whole grains. If dyslipidemia persists after 3 months, the CHILD-2 is recommended, which suggests a further restriction of saturated fat to <7% of daily kcal/EER, monounsaturated fat to 10% of daily kcal/EER,

and limitation of dietary cholesterol to <200 mg/day (Table 1). A referral to a registered dietitian (RD) for family medical nutrition therapy is strongly recommended.

Table 1. Dietary Components of the Cardiovascular Health Integrated Lifestyle Diet (CHILD)-2.

Dietary Components of the Cardiovascular Health Integrated Lifestyle Diet (CHILD)-2
(1) Total fat 25–30% of daily kcal intake
(2) Saturated fat $\leq$ 7% daily kcal intake
(3) Avoid trans fat
(4) Monounsaturated fat ~10% daily kcal intake
(5) Cholesterol < 200 mg/day
(6) Reduce sugar [1]
(7) Replace simple carbohydrates with complex carbohydrates [1]
(8) Avoid sugar-sweetened beverages [1]
(9) Increase dietary fish to increase omega-3 fatty acid intake [1]

[1] Specifically for triglyceride lowering. Adapted from [1].

Traditional dietary assessment tools, such as 24 h dietary recalls, food records, or food frequency questionnaires, are unable to provide rapid and accurate assessment of dietary fat, cholesterol, or fiber intake for timely assessment and nutrition care plan formulation during routine clinical visits. In addition, they do not incorporate eating behaviors such as skipping meals. There is a need for a dietary assessment tool that can quickly determine adherence to cholesterol-lowering diets as outlined by the CHILD-2. The simplified 10-point Healthy Eating Assessment Tool (HEAT) was created by the RDs in the Lipid Clinic at The Hospital for Sick Children as a means to assess a patient's overall dietary quality and behaviors during time-limited individual clinic counselling sessions.

The aims of this study were (1) to determine the association between HEAT scores and components of the CHILD-2, (2) to determine the association between HEAT scores and markers of adiposity, and (3) to determine the association between HEAT scores and lipid biomarkers.

2. Materials and Methods

2.1. Study Design and Population

This was a single-center, prospective cross-sectional study conducted at The Hospital for Sick Children in Toronto, Canada over a 2-year period. All of the patients that were monitored in the Lipid Clinic for dyslipidemia were screened for eligibility. Inclusion criteria were those from ages 2 to 18 years who had completed food records, were assessed by an RD, and were assigned a HEAT score during any follow-up visit. Exclusion criteria were those who had only attended an initial Lipid Clinic visit, had not met with the RD in the past 2 years, or had never completed food records for any of their previous appointments. Those who had a diagnosis that significantly impacted dietary intake or those following a ketogenic diet were also excluded. Eligible participants were approached, and written informed consent was obtained by the study team. This study received institutional ethics approval by The Hospital for Sick Children's Research Ethics Board.

2.2. Healthy Eating Assessment Tool (HEAT)

The HEAT is based on a RD-led interview that uses a 10-point assessment tool to assess a patient's overall dietary quality during the Lipid Clinic's time-limited counselling sessions (Figure 1 and Appendix A—Lipid Clinic Assessment Form—HEAT tool component highlighted in yellow). During the RD-led interview, patients/caregivers are asked specific questions on 10 different subcategories of their diet, as shown in Figure 1. Each diet subcategory is given either a score of 1 point, 0.5 points, or 0 points depending on the patient's consumption habits and the quality of the foods consumed, based on dietary recommendations for dyslipidemia and healthy eating [2–4]. The HEAT score is tallied through addition of the points awarded for each of the 10 subcategory scores. Appendix B

provides a detailed description of how points are assessed and awarded for each diet subcategory. A total score of 0–4.5 out of 10 indicates a poor score, 5–6.5 fair, 7–8.5 good, and 9–10 indicates an excellent score.

Healthy Eating Assessment Tool (HEAT)

CHOOSES/CONSUMES	0	½	1	Additional comments
1. Daily breakfast, lunch & dinner. Overall, diet varied and balanced?				
2. Minimum of 2-3 servings of fruits/day				
3. Minimum of 2-3 servings of vegetables/day				
4. Low fat meat & alternative products				chicken - nuts- lentils/legumes- organ/shellfish - fish - egg yolks-
5. 2-4 servings of milk &/or milk products/day				milk - yogurt - cheese -
6. Whole grain products & high fibre grains				bread- rice- pasta- cereal-
7. Avoid refined starch products				cereal- gran. bars- cookies- chips- pastries- popcorn- icecream -
8. Limits refined sugar products & candies to < 1-2/week				choc/candy – BBQ sauce- Nutella - ketchup-
9. Limits sugary drinks to <8oz/day				juice – pop - other- water-
10. Limits fast food/restaurant food to < 1/month				
Overall Diet Compliance Score 0-4.5 poor, 5-6.5 fair, 7-8.5 good, 9-10 excellent	/10			
NUTRITION GOALS:				

Figure 1. The Healthy Eating Assessment Tool (HEAT).

2.3. Data Collection

Collected data included age, sex, anthropometrics (weight, height, body mass index (BMI), and waist circumference), fasting serum lipid levels (total cholesterol, LDL-C, HDL-C, and triglycerides), fasting serum glucose, blood pressure, medications, nutritional supplements, physical activity and screen time (hours per week), and dietary intake. To assess dietary intake for this study, patients/caregivers completed 7-day food records prior to their clinic visit. These 7-day food records were used instead of the 4-day food records routinely used in the Lipid Clinic as some food items on the HEAT are assessed by their weekly consumption rather than their daily consumption (e.g., egg yolks, restaurant/fast-food) and a 7-day timeframe reflects a more comprehensive dietary intake. The 7-day

food records were reviewed and verified in detail by the RD/nutrition research student during the clinic study visit. If portion sizes or food items on the food records were unclear, patients/caregivers were asked to clarify the amount consumed using food models and visual images to help estimate accurate portion sizes.

2.4. Dietary Analysis

Content from the 7-day food records was inputted electronically into the nutrition analysis software program, ESHA Research Food Processor SQL (version 10.12.2), by the RD/nutrition research student for analysis of the macronutrient content (i.e., total calories, total fat, saturated fat, trans fat, unsaturated fat, omega-3 and -6, cholesterol, total carbohydrates, sugar, fiber (soluble and insoluble), and protein), as well as for the micronutrient content (vitamins and minerals). The 7-day food records were also analyzed to determine consumption from the four food groups on Canada's Food Guide to Healthy Eating (vegetables and fruit, grain products, dairy and alternatives, and meat and alternatives) [5]. All relevant data extracted from the ESHA nutrient data reports were inputted into the secure, web-based data management program, Research Electronic Data Capture (REDCap), prior to analysis.

2.5. Outcomes

The primary outcome of this study was the association between HEAT scores and dietary component targets of the CHILD-2. The secondary outcomes of this study were the association between HEAT scores and measures of adiposity, as well as the association between HEAT scores and lipid biomarkers.

2.6. Statistical Analysis

Data analysis was performed using SAS software v9.3 (The SAS Institute, Cary, NC, USA). Descriptive data were expressed as means (standard deviation) and frequencies according to the level of measurement of the variable. To determine the association of HEAT score as a continuous variable with average daily nutrient breakdown from food record analysis, Pearson's correlation coefficients were derived. To determine the association of HEAT score categories and the achievement of CHILD-2 dietary targets, the Mantel–Haenszel chi-squared test for trends was used. To determine the association between HEAT score categories and markers of adiposity, ANOVA was used. To determine the association of HEAT score as a continuous variable with lipid profile variables, generalized linear regression models incorporating relevant covariates were used. p-values < 0.05 were considered statistically significant.

3. Results

3.1. Study Population

Characteristics of the 70 enrolled participants are shown in Table 2. Participants were recruited across the whole spectrum of HEAT scores. The underlying dyslipidemia was heterogeneous across the study population, and as some were treated with lipid-lowering medication, the lipid values were likewise heterogeneous. The underlying dyslipidemia was heterozygous familial hypercholesterolemia for 33 (47%) patients (19 treated with a statin), combined dyslipidemia for 16 (23%) patients (2 treated with medication), mild dyslipidemia with elevated LDL-C for 14 (20%) patients, isolated low HDL-C for 4 (13%) patients, and elevated lipoprotein(a) for 3 (10%) patients. All patients were recommended for dietary management aimed at achieving the CHILD-2 dietary targets.

Table 2. Baseline Characteristics (n = 70 participants).

	Mean (±SD) or Total (%)
Age (years)	12.6 (±3.8)
Female gender	29 (41%)
HEAT score	6.7 (±2.0)
Poor (score 0–4.5)	8 (11%)
Fair (score 5–6.5)	28 (40%)
Good (score 7–8.5)	23 (33%)
Excellent (score 9–10)	11 (16%)
BMI (kg/m^2)	23.5 (±5.9)
BMI z-score	+1.05 (±0.92)
BMI percentile (%)	78 (±24)
Waist-to-height ratio (%)	53 (±7)
Fasting blood glucose (mmol/L)	5.1 (±1.9)
Fasting lipid biomarkers	
Total cholesterol (mmol/L)	5.08 (±1.26)
HDL-C (mmol/L)	1.21 (±0.30)
LDL-C (mmol/L)	3.29 (±1.22)
Triglycerides (mmol/L)	1.34 (±0.94)
Non-HDL-C (mmol/L)	3.87 (±1.22)

BMI, body mass index; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol.

3.2. HEAT Score and Components of CHILD-2

Correlations between HEAT scores and CHILD-2 dietary components as continuous variables are listed in Table 3. A higher HEAT score was significantly associated with a lower total fat percent of total daily calories, and with a higher dietary fiber and fruit and vegetable intake. There was no significant correlation between HEAT score and the remaining dietary intake variables or the weekly total of moderate-to-vigorous physical activity.

The association between HEAT score categories and the achievement of CHILD-2 recommendations is shown in Figure 2. The association of HEAT score category with the proportion meeting the recommendation to limit total fat to <25% of total daily calories was significant but non-linear, with the greatest proportions meeting the cut point only with the highest HEAT score categories ("good" and "excellent"). A similar non-linear trend was noted for the proportion meeting the recommendation to limit saturated fat to <8% of total daily calories ("excellent"), although it was not statistically significant ($p = 0.08$). There was no association of the proportion meeting the recommendation to limit total cholesterol to <200 mg per day with HEAT score category.
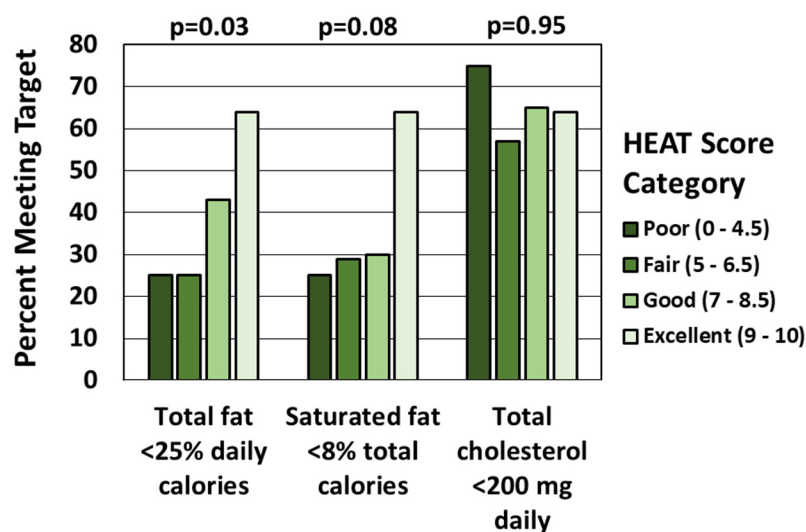

Figure 2. Percent of Patients Within Each HEAT Score Category Who Meet CHILD-2 Targets for Fat and Cholesterol Intake.

Table 3. Association Between HEAT Score and CHILD-2 Average Daily Dietary Intake and Physical Activity.

Average Components of CHILD-2	Mean (SD)	Pearson's Correlation with HEAT Score (r)	*p*-Value
Total fat percent of total daily calories (%)	29.2 (±11.8)	−0.27	0.02
Saturated fat percent of total daily calories (%)	9.9 (±5.0)	−0.17	0.14
Trans fat percent of total daily calories (%)	1.0 (±1.4)	−0.09	0.44
Total dietary cholesterol (mg)	218 (±182)	−0.03	0.78
Dietary fiber intake			
Average daily dietary fiber (g)	18.6 (±9.3)	0.46	<0.01
Average daily vegetables intake (servings)	1.8 (±2.4)	0.32	<0.01
Average daily fruit intake (servings)	1.7 (±1.8)	0.31	<0.01
Mono and polyunsaturated fats			
Monounsaturated fat percent of total daily calories (%)	6.9 (±4.6)	−0.18	0.13
Polyunsaturated fat percent of total daily calories (%)	3.3 (±2.2)	−0.19	0.10
Weekly total of moderate-to-vigorous physical activity (hours)	8.2 (±5.4)	0.01	0.90

3.3. HEAT Score and Markers of Adiposity

The association between HEAT score category and markers of adiposity is shown in Figure 3. The HEAT score categories of "poor" and "fair" were significantly associated with both higher BMI z-scores and higher waist-to-height ratios. Using the HEAT score as a continuous variable, there was a significant negative correlation between HEAT score and BMI z-score (r = −0.31, *p* = <0.01), as well as a significant negative correlation between HEAT score and waist-to-height ratio (r = −0.31, *p* = <0.01).
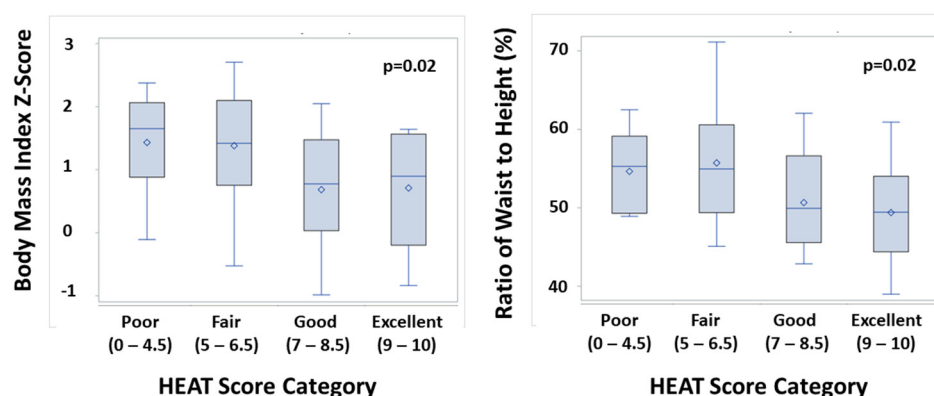
Figure 3. Association of HEAT Score Category with Markers of Adiposity. Box plots with boxes enclose the 25th–75th percentiles, with the line indicating the median and the diamond indicating the mean values, and the whiskers indicating the minimum and maximum values.

3.4. HEAT Score and Lipid Variables

In generalized linear regression models adjusted for age, sex, hours of moderate-to-vigorous physical activity, hours of screen time, lipid-lowering medication, BMI z-score, and waist-to-height ratio, no lipid variable was significantly associated with HEAT score (LDL-C *p* = 0.42, R^2 = 0.33; HDL-C *p* = 0.22, R^2 = 0.36; triglycerides *p* = 0.20, R^2 = 0.28; non-HDL-C *p* = 0.37, R^2 = 0.33). Details of the full regression models are provided in Table 4.

Table 4. Covariate-Adjusted General Linear Models for Association of Lipid Variables with HEAT Score.

Low Density Lipoprotein-Cholesterol (LDL-C, mmol/L; model R^2 = 0.33):

	PE (SE)	***p* value**
Intercept	7.14 (2.26)	
HEAT score	**−0.065 (0.078)**	**0.42**
Age (years)	−0.200 (0.043)	<0.001
Females	0.268 (0.302)	0.38
Body mass index Z-score	0.279 (0.339)	0.42
Waist to height ratio as percent	−0.023 (0.044)	0.61
Weekly moderate-vigorous physical activity (hours)	−0.015 (0.026)	0.58
Weekly screen time (hours)	0.009 (0.011)	0.42
Taking lipid lowering medication	−0.286 (0.284)	0.32

High Density Lipoprotein-Cholesterol (HDL-C, mmol/L; model R^2 = 0.36):

	PE (SE)	***p* value**
Intercept	1.930 (0.552)	
HEAT score	**−0.023 (0.018)**	**0.22**
Age (years)	−0.012 (0.010)	0.27
Females	−0.027 (0.073)	0.72
Body mass index Z-score	−0.164 (0.083)	0.06
Waist to height ratio as percent	−0.002 (0.011)	0.84
Weekly moderate-vigorous physical activity (hours)	−0.005 (0.006)	0.41
Weekly screen time (hours)	0.001 (0.003)	0.69
Taking lipid lowering medication	−0.177 (0.069)	0.02

Non-High Density Lipoprotein-Cholesterol (Non-HDL-C, mmol/L; model R^2 = 0.33):

	PE (SE)	***p* value**
Intercept	6.491 (2.271)	
HEAT score	**−0.069 (0.075)**	**0.37**
Age (years)	−0.199 (0.043)	<0.001
Females	0.166 (0.302)	0.59
Body mass index Z-score	0.246 (0.342)	0.48
Waist to height ratio as percent	0.000 (0.045)	0.99
Weekly moderate-vigorous physical activity (hours)	−0.026 (0.026)	0.32
Weekly screen time (hours)	0.016 (0.011)	0.15
Taking lipid lowering medication	−0.228 (0.283)	0.43

Triglycerides (mmol/L; model R^2 = 0.28):

	PE (SE)	***p* value**
Intercept	−0.242 (1.801)	

Table 4. *Cont.*

Low Density Lipoprotein-Cholesterol (LDL-C, mmol/L; model R^2 = 0.33):		
	PE (SE)	*p* value
HEAT score	**−0.078 (0.060)**	**0.20**
Age (years)	−0.006 (0.034)	0.86
Females	0.026 (0.240)	0.92
Body mass index Z-score	−0.057 (0.271)	0.84
Waist to height ratio as percent	0.037 (0.035)	0.31
Weekly moderate-vigorous physical activity (hours)	−0.021 (0.020)	0.30
Weekly screen time (hours)	0.024 (0.009)	0.01
Taking lipid lowering medication	−0.049 (0.225)	0.83

Bold highlights adjusted association of HEAT score with individual lipid variables; PE, paramater estimate; SE, standard error.

4. Discussion

In this prospective cross-sectional study of pediatric patients with dyslipidemia, we noted that the HEAT score was modestly associated with CHILD-2 daily fat percentage targets and was more consistently associated with the markers of adiposity, specifically BMI z-score and waist-to-height ratio. These results suggest that the HEAT may be a pragmatic tool to assess and track broader dietary goals in children, particularly useful for identifying children with suboptimal dietary patterns that may put them at risk of obesity and dyslipidemia and who might benefit from targeted dietary counselling.

Atherosclerotic cardiovascular disease (ASCVD) is the predominant cause of death in developed countries [2]. Atherosclerosis starts in childhood and is associated with risk factors, such as obesity and dyslipidemia, that continue into adulthood [3,6]. Conventional cardiovascular risk factors, such as obesity and dyslipidemia, have been linked to the development of early markers of atherosclerosis, specifically fatty streaks and fibrous plaques, in children [7]. Childhood obesity, defined as a BMI percentile greater than the 95th percentile, is a global health crisis that has been steadily worsening over the past decades with large population-based studies showing a tenfold increase in the past four decades [4]. Lifestyle interventions are the cornerstone of the treatment and prevention of childhood obesity, and our study aimed to assess the HEAT as a time-efficient tool to assess dietary compliance with a low-fat diet alongside achievement of broader healthy eating dietary goals.

Excessive intake of dietary fats, specifically in the form of saturated fat, trans fat, and cholesterol, is a contributor to dyslipidemia and obesity. Children over the age of 12 months can safely follow a fat-restricted diet under the supervision of an RD [1], although the long-term efficacy and safety of a dietary intervention beginning at 7 months of age were noted, along with a number of favorable outcomes [8–10]. Dietary intervention studies have shown the safety and efficacy of low-fat and low-cholesterol diets in children [11,12]. The Dietary Intervention Study in Children (DISC) was a randomized control trial that studied American children aged 8–11 years (n = 663) with modest LDL-C elevation by comparing a 3-year intensive dietary intervention that limited dietary fat (28% total fat of total daily calories and 10% saturated fat of total daily calories) and cholesterol (95 mg per day) with the standard of care [13,14]. There were greater reductions in dietary total fat, saturated fat, and cholesterol in the intervention group, as well as a statistically significant adjusted relative reduction in LDL-C of 0.08 mmol/L (*p* = 0.02). There were no differences between groups in height, serum ferritin, sexual maturation, or BMI. Based on the small effect size, one might question the efficacy of such a diet in reducing LDL-C levels, particularly since both groups showed similar increases over time in their BMIs. Similar results were found in the Special Turku Coronary Risk Factor Intervention Project for Babies (STRIP)

randomized control trial that followed children from age 7 months to adulthood (n = 1062), with an intervention group that received dietary counselling biannually until 7 years and annually until 20 years, aiming to achieve a low-fat (<30–35% total fat of total daily calories and unsaturated-to-saturated-fat ratio of 2:1) and low-cholesterol (<200 mg per day) diet [8]. They achieved a reduced dietary intake of saturated fat and an increased intake of polyunsaturated fat when comparing the intervention and control groups. Additionally, the dietary intervention group had greater baseline-adjusted reductions in HDL-C, non-HDL-C, and apolipoproteins A1 and B, although the effect size for non-HDL-C was modest. The cohort continues to be followed now up to 20 years with favorable results [10]. Given the modest effect size on LDL-C and non-HDL-C levels, together with reductions in HDL-C, the utility of dietary intervention for pediatric dyslipidemia management, while safe, was suggested to be limited.

The limits to dietary assessment and counselling are the time intensiveness, particularly in the setting of healthcare systems with limited resources for prolonged dietary encounters, and sometimes even the availability of a qualified RD. We identified a need for a time-efficient and accurate tool to assess dietary compliance with the CHILD-2 and achievement of broader nutritional goals that could quickly identify targets for dietary intervention and could be used to monitor a patient's progress over time. We found that a higher HEAT score was weakly correlated with a lower total fat percentage of total daily calories, as well as a higher-fiber fruit and vegetable intake. However, there was no significant association with intake of saturated fat, trans-fats, and cholesterol. These results suggest that the HEAT tool may have limited utility in the assessment of compliance with and attainment of the specific targets of the CHILD-2 diet. It is also suggested that dietary adequacy was only achieved when patients achieved the highest HEAT scores. This was true for the association with markers of adiposity. The association of HEAT score with waist-to-height ratio and BMI z-score could be harnessed to identify patients with childhood obesity that may benefit from potential dietary targets. Although the use of the HEAT tool in specialty pediatric lipid clinics may be limited, its use in the primary care setting, where there is a need to efficiently assess diet in a time-constrained encounter, may offer a potential future area of research.

A limitation of this study is the reliance on a patient and/or their caregiver's dietary recall to inform the HEAT score. Although this is paired with other methods of analyzing dietary intake, such as food records, food frequency questionnaires, and 24 h dietary recall, there is an inherent recall bias with a dietary assessment tool administered by a healthcare professional during a clinic visit, especially given a patient/caregiver's desire to improve the diet, which may lead them to falsely recall a better version of the diet than is correct. Additionally, the study took place in a single specialty lipid clinic, so generalizability to other lipid clinics and to primary care practices is unknown. We were also unable to assess potential intra- and inter-observer variability. A further limitation is the cross-sectional nature of this study. Future research is needed to address whether changes in HEAT score are associated with changes in lipid values and measures of adiposity.

5. Conclusions

Given that the HEAT tool assesses broad dietary goals, associations with nutrient breakdown and achievement of fat and cholesterol intake targets were modest, with more consistent associations with markers of adiposity. There was no independent association with lipid levels, given the underlying heterogeneity of the pediatric population with both untreated and treated dyslipidemia. While fat-restricted diets are safe, they have not been particularly effective for treatment of pediatric dyslipidemia or for weight management alone. Our results suggest that the HEAT tool may have limited utility in the assessment of compliance with and attainment of the specific targets of the CHILD-2 diet. Instead, the HEAT tool may offer a pragmatic and simplified way of assessing and tracking broader dietary goals in clinical practice.

Appendix A Lipid Clinic Assessment Form with the HEAT Tool Highlighted in Yellow

LIPID CLINIC ASSESSMENT

Name:_____ Health Record #: _____

Allergies: _____   Food Record Completed: Yes ☐ No☐

Date of Visit ➝			CHOOSES/CONSUMES	0	½	1	Additional comments
Age			Daily breakfast, lunch & dinner (Overall, diet varied & balanced)				
Height (cm) & %ile			Minimum of 2-3 servings of fruits/day				
Weight (kg) & %ile			Minimum of 2-3 servings of fruits/day				
IBW (kg) & % IBW							
BMI & %ile			Minimum of 2-3 servings of vegetables/day				
Waist Circumference		W/Ht=					
Blood Work			Low fat meat & alternative products				chicken - nuts- lentils/legumes- organ/shellfish - fish - egg yolks-
Cholesterol (<4.8)							
LDL Cholesterol (<3.0)							
HDL Cholesterol (>1.0)			2-4 servings of milk &/or milk products/day				milk - yogurt - cheese -
Triglycerides (<1.39)							
Non-HDL			Whole grain products & high fibre grains				bread- rice- pasta- cereal-
TG/HDL ratio							
Liver function							
CRP			Avoid refined starch products				cereal- gran. bars- cookies- chips- pastries- popcorn- icecream -
Thyroid Function							
Glucose & Insulin			Limits refined sugar products & candies to < 1-2/week				choc/candy – BBQ sauce- Nutella - ketchup-
Other Blood Work			Limits sugary drinks to < 8oz/day				juice – pop - other- water-
BP, ECG, ECHO							
Cardiac Assessment	Physician ☐ CNS/NP ☐		Limits fast food &/or treats to < 1/month				

Medications		Overall Diet Compliance Score 1-4.5 poor, 5-6.5 fair, 7-8.5 good, 9-10 excellent	/10
Supplements		NUTRITION GOALS:	
	Compliance: /7		

SLEEP	PHYSICAL ACTIVITY	SCREEN TIME	PA/SCREEN TIME GOALS
Bedtime=	Gym @ school=	TV= Computer= Video Games=	PA=
Wakeup time=	Low impact=	IPAD/ I Phone/IPod= Total Wk day screen time=	Screen time=
Sleep time=	Moderate= High impact=	Screen time on weekend = Total screen time=	Sleep=
		Signatures NP:	RD:

Appendix B HEAT Tool Scoring

Detailed description of how to score the 10-point Healthy Eating Assessment Tool (HEAT) during dietitian-led interview in Lipid Clinic at the Hospital for Sick Children

During the dietitian led interview, patients and/or their families are asked specific questions on 10 different subcategories of their diet; (1) meal patterns and overall dietary variety and balance, (2) fruit consumption, (3) vegetable consumption, (4) meat and alternatives type and consumption, (5) milk and alternatives type and consumption, (6) grain products type and consumption, (7) refined starch and snack food product consumption, (8) refined sugar products, chocolate and candy consumption, (9) sweetened beverage consumption, and (10) frequency and type of meals/snacks prepared outside of the home (take-out, order-in and restaurant dining).

Each diet subcategory is given either a score of 1 point, 0.5 points or 0 points depending on the patient's consumption habits and quality of foods consumed (see below descriptions for detailed information on how points are awarded for each diet subcategory). The total dietary assessment score is tallied from addition of the points awarded for each of the 10 subcategory scores. A total dietary score of 1–4.5 out of 10 indicates a poor score, 5–6.5 indicates a fair score, 7–8.5 indicates a good score, and 9–10 indicates an excellent score.

Scoring of Diet Subcategories

(1) **Meal patterns and overall dietary variety and balance** Does the patient eat 3 meals a day—breakfast, lunch and dinner, −/+ snacks, all of which are appropriate portion sizes? Does the patient follow a high fibre, low fat, low added sugar diet? Does the patient meet Canada's Food Guide to Healthy Eating (CFGHE) recommendations for all four food groups? How often does the patient eat foods or drink beverages high in added sugar? How often does the patient eat high fat, high sugar, high sodium foods prepared outside of the home? Rated the same for all ages and sexes.

    (a)   1 point—the patient consistently eats 3 meals a day, +/− snacks, all of appropriate portion size. Overall diet is well balanced and patient consistently follows a diet high in fibre, low in saturated and trans fat, and low in added sugar. Patient consistently meets, or comes very close to meeting, all of the CFGHE recommendations for fruit and vegetable intake, low fat milk and alternatives, lean meat and alternatives and whole grains. Patient limits egg yolk consumption to no more than 3 yolks in a week and limits high cholesterol-containing meat products such as organ meats, shrimp and shellfish, to no more than 2 times in a month. Patient is not drinking more than 8 oz a day of sweetened beverages nor eating an excessive amount of refined starch and snack foods, or refined sugar products.

    (b)   0.5 points—consistently eats 3 meals a day, +/− snacks, all of appropriate portion sizes. Overall diet is fairly well balanced and patient often follows a diet high in fibre, low in saturated and trans fat, and low in added sugar. Patient may be meeting, or come close to meeting all of the CFGHE recommendations for fruit and vegetable intake, low fat milk and alternatives, lean meat and alternatives and whole grains, but could make some improvements. Patient may or may not be drinking more than 8 oz a day of sweetened beverages or eating an excessive amount of refined starch and snack foods, or refined sugar products.

    (c)   0 points—patient misses or skips meal(s) on a regular basis. Portion sizes are inappropriate (too large or too small). Overall diet is not well-balanced and patient does not meet the majority of the CFGHE recommendations for fruit and vegetable intake, low fat milk and alternatives, lean meat and alternatives and whole grains. Patient may or may not be drinking more than 8 oz a day of sweetened beverages or eating an excessive amount of refined starch and snack foods, or refined sugar products.

(2) **Fruit consumption** Does the patient consistently consume fruit on a daily basis? How many CFGHE servings (1 serving = 1 medium sized fruit or 125 mL or $\frac{1}{2}$ cup) does the patient consume daily? Fruit juice of any kind is not considered a fruit serving in Lipid Clinic. Scoring varies per age based on the CFGHE recommendations. Goal is to consume 1/3 to $\frac{1}{2}$ of CFGHE recommendations for vegetables and fruit through fruit daily.

   (a)   1 point—patient consistently consumes 1/3 to $\frac{1}{2}$ of their recommended vegetable and fruit servings through fruit on a regular basis (1–2 servings per day for ages 2–3 years, 1.5–2.5 servings per day for ages 4–8 years, 2–3 servings per day for ages 9–13 years, 2.5–3.5 servings for females aged 14–18 years, and 2.5–4 servings for males aged 14–18 years).

   (b)   0.5 points—patient consumes less than 1/3 of their recommended vegetable and fruit servings through fruit on a regular basis, but has a minimum of 2 servings per day (ages 4 -18 years), or a minimum of 1 serving per day (ages 2–3 years)

   (c)   0 points—patient on average consumes 1 or less servings of fruit per day (ages 4–18 years), or does not consume fruit at all (ages 2–18 years)

(3) **Vegetable consumption** Does the patient consistently consume vegetables on a daily basis? How many CFGHE servings (1 serving = 125 mL or $\frac{1}{2}$ cup) does the patient consume daily? Tomato sauce and/or salsa (1/2 cup serving size) are considered a vegetable serving in Lipid Clinic. Scoring varies per age based on the CFGHE recommendations. Goal is to consume 1/3 to 1/2 of CFGHE recommendations for vegetables and fruit through vegetables.

   (a)   1 point—patient consistently consumes 1/3–$\frac{1}{2}$ of their recommended vegetable and fruit servings through vegetables on a daily basis (1–2 servings per day for ages 2–3 years, 1.5–2.5 servings per day for ages 4–8 years, 2–3 servings per day for ages 9–13 years, 2.5–3.5 servings for females aged 14–18 years, and 2.5–4 servings for males aged 14–18 years).

   (b)   0.5 points—patient consumes less than 1/3 of their recommended vegetable and fruit servings through vegetables on a regular basis, but has a minimum of 2 servings per day (ages 4–18 years), or minimum of 1 serving per day (ages 2–3 years)

   (c)   0 points—patient on average consumes 1 or less servings of vegetables per day (ages 4–18 years), or does not consume vegetables at all (ages 2–18 years)

(4) **Meat and alternatives type and consumption** How often does the patient consume lean meat products such as skinless white poultry meat, lean cuts of red meat such as beef, pork, lamb, goat, etc.? How often does the patient consume fatty meats such as pork ribs, ribbed steak, etc., and fatty processed meats such as bacon, bologna, salami, mortadella, hot dogs, sausages, etc.? Which type of cooking method is used most often when preparing meat and alternatives? How often does the patient consume gravies or other high fat sauces? How many egg yolks does the patient consume weekly? How often does the patient consume high cholesterol-containing meat products such as organ meats, shrimp and shellfish? How often does the patient consume fish, especially oily fish high in omega 3 fatty acids such as salmon, trout, char, herring, mackerel, sardines? How often does the patient consume legumes such as baked beans, kidney beans, lentils, chickpeas, etc.,? How often does the patient eat nuts or nut butter products (ideally nuts are unsalted and unflavoured, and nut butters are natural nut butters with no additives such as sugar, oils, sodium or preservatives).

   (a)   1 point—patient consistently consumes lean meats and limits consumption of fatty meats and processed meats to no more than 1 time a week. Meat consumed is prepared using low-fat cooking methods such as baking, broiling, grilling, roasting or poaching. Patient limits the use of gravies or other high fat sauces. Patient limits egg yolk consumption to no more than 3 yolks per week

and limits high cholesterol-containing meat products such as organ meats, shrimp and shellfish, to no more than 1 to 2 times in a month. Patient may or may not consume fish or legumes. Patient eats nuts or nut products in moderation (limits to $\frac{1}{4}$ cup/day of nuts or 2 tablespoons/day of nut butters).

(b)　0.5 points—patient consumes both lean meats and fatty meats, but consumes lean meats more often. Patient may eat the skin on poultry and/or consume fatty and/or processed meats 1–2 times a week. Meat consumed is not always prepared using low-fat cooking methods. Patient may or may not use gravies or other high fat sauces. Patient may or may not consume more than 3 egg yolks per week. Patient may or may not consume high cholesterol-containing meat products such as organ meats, shrimp and shellfish, more than 2 times in a month. Patient may or may not consume fish or legumes. Patient may or may not eat nuts or nut products and may or may not limit portion sizes.

(c)　0 points—patient may consume both lean meats and fatty meats, but consumes fatty meats more often. Patient may eat the skin on poultry and/or consume fatty and/or processed meats more than 2 times per week. Meat consumed may often be prepared using high-fat cooking methods, such as pan-frying or deep-frying. Patient may or may not use gravies or other high fat sauces Patient may or may not consume more than 3 egg yolks per week. Patient may or may not consume high cholesterol-containing meat products such as organ meats, shrimp and shellfish, more than 2 times in a month. Patient may or may not consume fish or legumes. Patient may or may not eat nuts or nut products but may or may not limit portion sizes.

(5)　Milk and alternatives type and consumption Does the patient consistently consume the CFGHE recommended servings of milk and alternatives for their age daily? How many CFGHE servings (1 serving = 1 cup of milk or $\frac{3}{4}$ cup yogurt, 50 g of cheese) does the patient consume daily? Are milk and alternative products consumed low-fat or fat-free (skim or 1% milk, yogurt < 1.5% milk fat, cheese < 20% milk fat)? How often does the patient consume cheese? Scoring varies per age based on the CFGHE recommendations for age.

(a)　1 point—patient consistently consumes their recommended servings of dairy and alternatives based on CFGHE recommendations for age on a daily basis (2 servings a day for ages 2–8 years, 3 to 4 servings a day for ages 9–18 years). The patient consistently consumes low-fat or non-fat dairy products and patient limits their consumption of cheese to no more than 2 to 3 times per week.

(b)　0.5 points—patient consumes $\frac{1}{2}$ of their recommended servings of dairy and alternatives based on CFGHE recommendations for age on a daily basis (1 serving a day for ages 2–8 years, 1 to 2 servings a day for ages 9–18 years). The patient may consume a combination of low-fat, non-fat and/or regular fat dairy products. Patient may or may not consume cheese more frequently than the recommended 2 to 3 times per week.

(c)　0 points—patient does not consume dairy or alternatives on a daily basis.

(6)　Grain products type and consumption Does the patient consume whole grain products, or refined grains more often? What type of bread, rice and/or other grains, pasta, cereal, and crackers does the patient consume most often? Are appropriate portion sizes of grain products being consumed?

(a)　1 point—patient consumes whole grain products more often than refined grain products. Patient consumes whole grain bread, brown rice and/or other whole grains such as quinoa, whole wheat couscous, bulgar, barely, oats, etc., whole grain pasta, whole grain low-sugar cereal, and whole grain crackers. Portion sizes are appropriate for meals and/or snacks.

(b)　0.5 points—patient consumes a combination of whole grain and refined grain products, but has whole grain products slightly more often. Bread may be

whole grain and/or white, rice may be brown and/or white, other whole grains such as quinoa, whole wheat or regular couscous, bulgar, barely and oats, may or may not be consumed, pasta may be whole grain or regular, cereal may be whole grain or refined grain, and crackers may or may not be whole grain. Portions sizes are appropriate for meals and/or snacks.

    (c)   0 points—patient does not consume whole grain products, or does so infrequently. Patient consumes refined grain products such as white bread, white rice, regular pasta, refined grain cereals and refined grain crackers on a regular basis. Portion sizes may or may not be appropriate for meals and/or snacks.

(7) **Refined starch and snack food product consumption** What type of foods does the patient regularly consume for snacks? How often does the patient consume refined starch products and snack foods that are high in sugar and/or fat such as cookies, granola bars, sugary cereals, ice cream, popsicles, chips, buttered popcorn, and refined grain crackers? Does the patient make healthy choices when choosing snack foods?

    (a)   1 point—patient limits high sugar and/or high fat snack foods to 1–2 x week. Patient makes healthy choices when choosing snack foods, and snacks on low sugar, low fat, high fibre foods like fruit and vegetables and whole grain products more often.

    (b)   0.5 points—patient consumes high sugar and/or high fat snack foods 2–4 x week but will also consume healthy snack foods that are low in sugar and/or low in fat, and high in fibre.

    (c)   0 points—patient consume high sugar and/or high fat snack foods on a regular basis (>2 times a week) and rarely makes healthy choices when choosing snack foods.

(8) **Refined sugar products, chocolate and candy consumption** How often does the patient consume chocolate and candy? How often does the patient consume refined sugar products such as ketchup, barbeque sauce, nutella, chocolate syrup, etc.?

    (a)   1 point—patient limits consumption of refined sugar products, chocolate and/or candy to no more than 1 to 2 times per week. Patient may or may not consume refined sugar products, but if does consume, will use in moderation.

    (b)   0.5 points—patient consumes chocolate and/or candy or refined sugar products 2 to 3 times in a week, but limits portion sizes.

    (c)   0 points –patient consumes chocolate and/or candy or refined sugar products more than 4 times in a week, and may or may not limit portion sizes.

(9) **Sweetened beverage consumption** How often does the patient consume sweetened beverages and naturally sweet beverages, such as fruit juice, fruit punch, ice tea, pop, flavoured milks, flavoured water, specialty coffees and teas, hot chocolate, sports drinks, energy drinks, etc.? Does the patient add sugar to beverages, such as coffee or tea? Does the patient consume artificially sweetened beverages, such as diet pop or Crystal Light? Does the patient consume water on a daily basis?

    (a)   1 point—patient may or may not consume sweetened beverages. If patient consumes sweetened beverages, patient limits consumption to under 4 to 6 oz per day (ages 1 to 6 years), and under 8 oz per day (ages 7 to 18 years). Patient regularly consumes water for hydration.

    (b)   0.5 points—patient consumes sweetened beverages and often limits to 4 to 6 oz per day (ages 1 to 6 years), and under 8 oz per day (ages 7 to 18 years), but may exceed this volumes on a weekly basis. Patient may or may not consume water for hydration.

    (c)   0 points—patient consumes greater than 8 oz of sweetened beverages in a day regardless of age. Patient may or may not consume water for hydration.

(10) **Frequency and type of meals/snacks prepared outside of the home** How frequently does the patient consume foods prepared outside of the home, such as dining at a family style restaurant or fast-food restaurant, ordering take-out/delivery, or ordering

foods during school lunchtime (purchases from cafeteria or pizza lunches)? Does the patient make healthy choices and consume appropriate portion sizes when eating foods prepared outside of the home?

(a) 1 point—patient eats foods prepared outside of the home once a month or less. Patient may eat foods prepared outside of the home more than once per month, up to 2 times per month, but makes healthy choices which include low fat, low sugar, high fibre options and consuming appropriate portion sizes.

(b) 0.5 points—patient eats foods prepared outside of the home up to 2 to 4 times per month, but makes healthy choices which include low fat, low sugar, high fibre options and consuming appropriate portion sizes.

(c) 0 points—patient eats food prepared outside of the home regularly, greater than 4 times per month, and rarely makes healthy choices and/or does not control portion sizes.

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