Nutrient Intake Patterns in Preschool Children from Inner City Day-Care Centers

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Abstract: An elevated body mass index (BMI) early in childhood is known as a predictor for adult obesity and obesity related comorbidities. Three year old obese children have exhibited inflammatory biomarkers linked to chronic diseases, so childhood obesity prevention efforts should start during early years of life. The current study, conducted in the U.S., collected 24 hour nutrient intake through dietary records and compared body weight and intake patterns of children from two daycare centers differing in racial and income levels. Anthropometric and dietary measures were obtained from 74 caregivers (CG) and their children. Each child's food intake at preschool was observed and recorded by direct observation by graduate students. The home food intake was recorded by the CG. Fifty one CG returned all the dietary records and completed the study. Both center and at home records were combined together to produce the daily nutrient intake data. The mean BMI percentile for both boys and girls were in the healthy BMI range, although a higher percent of girls had BMI greater than 85 percentile. All macronutrients were significantly higher than the Dietary Recommended Intake (DRI) or estimated average requirement (EAR). Children from low income families consumed more protein, total fat, saturated fat, higher percentage of energy from saturated fat and had higher sodium intake. Elevated intake of fat and protein may predispose children to weight gain. Nutrition education to teach CG, especially those with low income, to reduce energy density in meals is warranted.

Keywords: Childhood obesity, energy intake, high fat diet, dietary pattern, household income.

INTRODUCTION

Childhood obesity is an epidemic in the United States and a world-wide public health concern [1]. An elevated BMI early in childhood is known as a strong predictor of adult obesity and obesity-related comorbidities [2, 3]. The adverse effects of obesity appear in children as early as three years of age, including inflammatory biomarkers linked to risk of heart disease [4]. Children may also have other immediate health consequences such as elevated blood lipid levels and blood pressure [5].

The United States National Health and Nutrition Examination Survey from 2009 to 2010 [6] identified that 12.1% of children 2-5 years old met the obesity criteria, defined by body mass index (BMI) ≥95th percentile and 26.7% were either obese or overweight (identified by BMI ≥85th percentile for age).This rate had increased from that observed in 2007-2008 (21.2%). Even though more recent obesity and overweight rates have shown a plateau or slight decline in 2- 5 year old children (22.8%) in the 2011-2012 survey [7], the prevalence of childhood obesity and overweight at one in five children is still a great health concern.

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Obesity causes are complex but, at the most basic level, obesity is the result of an imbalance in energy intake and energy expenditure. According to the 2008 Feeding Infants and Toddlers Study (FITS), the average energy intake of young children was consistently greater than their estimated needs [3]. In addition, there are significant racial/ethnic differences in the prevalence of obesity in early childhood [2], with disproportionately more African-American children being overweight and obese and exhibiting obesity-relate disease compared to other racial/ethnic groups [8].

Nutrition and physical activity practices within childcare sites impact 61% of US children under the age of 6 years [4], although very few studies have assessed dietary intake from 24-hour recalls and food preferences in preschool aged children. Using a 24-hour dietary recall and direct observation, the Healthy Bodies Pilot Study collected and compared the nutrient intake patterns of children in two diverse inner city daycare centers, one serving mostly African American preschoolers and the other serving mostly Caucasian preschoolers.

METHODS

Study Enrollment

Two preschools/daycare centers in a Midwest metropolitan area in the US were recruited for this

E-ISSN: 1929-4247/15

study. In order to obtain a diverse sample of families, the two schools selected for inclusion were located in the same district within 2 miles from each other, with one center owned by a university (MP) serving mainly student parents diverse in cultural/ethnicity, and the other one located next to and serving employees of a hospital (HF). Both centers were full day programs and met the state standards that provide breakfast, lunch and afternoon snack while children are at the center. The meals of both centers followed the dietary guidelines of the USDA Child and Adult food program, with one center (MP) having its own kitchen to prepare food and the other (HF) providing food by a contracting catering company. Children between ages 3-4 years were recruited from these two child centers. Researchers spoke to caregivers (CG) of the children in the target age individually and obtained signed consent forms. Assent was not required because the children were under 6 years of age. This research was approved by the Institutional Review Boards of Wayne State University, Henry Ford Health System and the two daycare centers.

Participants

A total of 74 CG consented to have their children participate in the study. The completion rate was 69%, with 51completing all study requirements. The main reason for not completing this study was that the CG did not return the home dietary records. The average age of the children was 3.4± 0.5 years and 60.8% were girls. All children were classified into 3 racial/ethnic groups: African American, Caucasians and Other (including Asian, Hispanic, or mixed). The racial distribution of the 2 centers is shown in Table **1**. Anthropometric data such as height and weight were measured using a portable digital scale (Tanita Model, BC551) and a stadiometer (Seca 214, Seca North America East, Hanover, MD).

Food Diary

Data for the children's 7 day food diary, which included two weekend and 5 week days, were collected in two ways (i.e. CG and researcher collection). The CG recorded all the food eaten by their child when the child was at home, including food eaten before and

Table 1: Demographic Data of the 2 Centers Based on Racial Distribution

	African American	Caucasian	Other	Total
Race				
MP	21 (61.8%)	4 (11.8%)	9 (26.4%)	34 (66.7%)
HF	6 (35.3%)	7 (41.2%)	4 (23.5%)	17 (33.3%)
Total	27 (52.9%)	11 (21.6%)	13 (25.5%)	51 (100%)
Income				
MP				
<$22,050	3 (9.7%)	14 (45.2%)	0 (0%)	17 (54.8%)
$22,051-49,999	1 (3.2%)	4 (12.9%)	4 (12.9%)	9 (29.0%)
>$50,000	3 (9.7%)	0 (0%)	2 (6.5%)	5 (16.1%)
HF				
<$22,050	0 (0%)	0 (0%)	0 (0%)	0 (0%)
$22,051-49,999	0 (0%)	2 (13.3%)	0 (0%)	2 (13.3%)
>$50,000	4 (26.7%)	7 (46.7%)	2 (13.3%)	13 (86.7%)
Education				
MP				
<College	1 (3.2%)	0 (0%)	0 (0%)	1 (3.2%)
>College	20(64.5%)	4 (12.9%)	6 (19.4%)	30 (96.8)
HF				
<College	0 (0%)	0 (0%)	0 (0%)	0 (0%)
> College	6 (40%)	7 (46.7%)	2 (13.3%)	15 (100%)

after preschool and during weekends and sick days. Each CG was given detailed instructions of how to record different foods into the food diary, and a child's portions chart from Nick Jr. (http://www.nickjr.com) was provided to the family as a consulting tool for portion sizes. CG were asked to record each food item on the record sheets along with the amount eaten or drunk, and the details such as how it was prepared, which brand or which restaurant from which it came.

The second data collection type was completed by trained nutrition and food science graduate students who observed and recorded each child's food type and intake at preschool meal times. The preschool menu for each month was collected ahead of time for researchers to write down food items before observation. For children who brought their own food, CG and teachers' permissions were obtained to check items that were in the lunch box before meal time. Each graduate student observed a maximum of 5 children at a time and recorded the amount of food eaten. Validity training was conducted before commencement of the observation. Since there were multiple classrooms and the same lunch hours, observation was completed sequentially, one classroom at a time.

Dietary Records Analysis

Food diaries recorded by CG and graduate students were combined and entered into a diet analysis software (ESHA Food Processor SQL, ESHA Research, Salem, Oregon), to complete a whole day's food intake. Each food item was entered separately for each day. The EHSA diet analysis software contains a large database of food items and nutrients, including many mixed dishes with brand name and generic versions so that energy and nutrient intake can be calculated. If a mixed dish was not in the EHSA Food Processor SQL database, then the ingredients used, how much, and cooking methods were obtained from the CG, although this did not occur often. Daily intake of total calories and nutrients was calculated. Data were only used if there were complete records for at least 2 weekdays and 1 weekend day. For participants with all 5 weekday data, the highest and lowest weekday totals were deleted in order to better estimate a regular weekday meal intake.

Statistical Analyses

Data were analyzed using IBM SPSS version 21 (IBM Corp, Armonk, NY). The one sample t test was used to compare average daily intakes of different macro and micro nutrients with the dietary recommended intakes (DRI) for children. Student's t-tests and factorial analysis were conducted to compare the intake patterns between the 2 preschools and the interaction of the 2 preschools with income levels or race. Chi square analysis was used to compare the racial and income distributions between the two preschools. One way ANOVA was used to compare the dietary intake patterns among different racial groups or income levels. The statistical significance level was set at $p \leq 0.05$.

RESULTS

Demographic Data

Table **1** depicts the demographic data of the 2 preschools. The racial distribution was significantly different between the two preschools ($p<0.05$). MP was predominately African-American while HF was predominately Caucasian. Based on the poverty guidelines from the US Department of Health and Human Services, poverty is defined as annual income of $22,050 for a household of 4 in 2010 (http://aspe.hhs.gov/poverty/10poverty.shtml). More than half of the CG in MP had family income below the poverty line compared to none in HF, and the difference in family income was significant ($p<0.05$). All but one CG in MP had some college education (1/31).

BMI Data

The BMI and BMI percentile according to gender are presented in Table **2**. There was no difference in BMI percentile distributions between the 2 preschools. Twenty percent of the preschoolers were above the 85th percentile, with 10% were above the 95th percentile. Moreover, 13.2% and 30% of the 3 and 4 years old children had BMI percentile above 85th respectively. The mean BMI percentiles were within the healthy BMI range although girls had a significantly higher mean BMI percentile than boys. More girls tended to have BMI percentiles in the overweight and obese range (> 85 percentile) than boys but the difference failed to reach statistical significance ($p=0.09$).

Nutrient Intake Data

Nutrient intakes of 3 year olds and 4 year old children were calculated and, within each age group, mean daily intake of each nutrient was compared to the Dietary Reference Intake (DRI), if applicable. In 3 year

Table 2: Children' Body Weight, BMI and BMI Percentile According to Gender (mean±SD)

	Body weight (Kg)	BMI (kg/m^2)	Mean BMI percentile	MI percentile	
				range	> 85 percentile
Boys (n=28)	17.1±0.50	15.8±0.30	47.8±5.8	1 – 99	14.3%
Girls (n=41)	16.7±0.48	16.3±0.25	62.9±4.4[a]	3 – 99	30.4%

a: Girls significantly different from boys at p<0.05.

old children, the following nutrients were significantly higher than the DRI: protein, carbohydrates, vitamins A and C, folate, iron, magnesium, phosphorus and sodium (p<0.0001) whereas, intakes of the following nutrients were significantly lower than the DRI: fiber, vitamin D, potassium, and servings of vegetables, fruit, milk and meat (p<0.05 to <0.0001). Intake of calcium and servings of grain were not different from DRI and the mean percent of energy from fat was within the DRI recommended macronutrient range.

For 4 year old children, intakes of protein, carbohydrates, vitamins A and C, folate, magnesium, phosphorus and sodium were significantly higher than DRI (p<0.005 to <0.0001) while intakes of fiber, vitamin D, calcium, potassium and servings of vegetables, fruits, milk and meat were significantly lower than DRI (p<0.05 to <0.0001). The servings of grain for 4 year old children were the same as DRI and the mean percent of energy from fat was within the DRI recommended range [9].

Table **3** presents the DRI, acceptable macronutrient distribution range (AMDR) if applicable, intake percentiles, and comparisons of intake percentiles with DRI for 3 and 4 year old children combined together. Mean intakes of carbohydrates, protein, saturated fat percent, vitamin A, vitamin C, folate, phosphorus, magnesium, iron and sodium were significantly higher than the DRI (p's < 0.0001). Meanwhile, intakes of dietary fiber, vitamin D, calcium and potassium were significantly lower than the corresponding DRI (p<0.05 to p<0.0001) [9].

Comparison of Two Centers

Children in MP had higher intakes of saturated fat (SAT) (17.8±5.4 g (MP) *vs.* 15.1±3.3 g, p=0.056), percent of energy from total fat (33.8±6.4% (MP) *vs.* 29.6±4.0%, p<0.05) and percent energy from SAT (11.7±2.3% (MP) *vs.* 9.8±1.5%, P<0.01) compared to children in HF (Table **4**). On the other hand, MP children had significantly lower intake of vitamin A (844±434µg (MP) *vs.* 1391±1153, p<0.05) and vitamin C (75.8±41 mg *vs.* 109.7±57, p<0.05) than HF children.

Since all the families in the HF center had an annual income above the poverty level, data from the MP center with income above poverty levels were compared with HF and there was no difference in nutrient intake between the 2 centers.

Comparison by Race/Ethnicity

Combining dietary intake data from 2 centers, African American children had significantly higher intake of SAT than those from the Other group; Caucasian children were not different from African American or Other race (Table **5**). Children in the Other group had significantly lower intakes of sodium and servings of milk as compared to African American or Caucasian children (p <0.05). The vitamin D intake in the Other group was the same as African American, and both were significantly lower than that of the Caucasian group.

Within each center, the effect of race/ethnicity on nutrient intake differed. At the MP center, Caucasian children had higher fiber intake (African American: 9.9±0.5 g; Caucasian: 15.6±2.9; Other: 10.5±2.0, p<0.05) and magnesium intake (African American: 156±8.8 mg; Caucasian: 221±41.3; Other: 135 ±9.4, p<0.05) than the other 2 groups of children. On the other hand, children in the Other group had the lower intakes of sodium (African American: 2230±135 mg; Caucasian: 2232±171; Other: 1375±184, p<0.01) and milk (African American: 1.56±0.19; Caucasian: 2.25±0.41; Other: 0.75±0.20, p<0.05) than the African American and Caucasian children. There was no difference in any of the nutrient intakes across the 3 racial groups in HF center.

Family Annual Income Levels

There were significant negative correlations between household annual income and total SAT intake (r=-0.37, p<0.05), percent SAT intake (r=-0.36, p<0.05), phosphorus (r=-0.31, p<0.05) and sodium (r=-0.33, p<0.05). Children from families with annual income below the poverty line (all in MP center) had significantly higher SAT intakes (19.3±1.3 g *vs.*

Table 3: Nutrient Intakes for 3 and 4 Years Old Children*

	DRI			Intake percentiles				Difference from DRI		Deficient/Excess	
	EAR/AMDR	AI	UL	10th	25th	Median	Mean±SD	75th	90th	% <EAR	% > UL
Macronutrients											
Energy (kcal)				1048	1168	1352	1378±39	1564	1779		
Fat (g/d)				34.4	40.5	47.4	49.2±1.7[a]	57.4	67.5		
Saturated fat (g/d)				11.3	13.4	15.2	16.8±0.7	20.8	24.7		
Carbohydrate (g/d)		130		128	150	181	188±7	228	252	57.8[ƒ]	
Protein (g/d)	16			35.1	43.6	47.0	49.6±1.6[b]	59.4	66.7	33.6[ƒ]	
Dietary fiber (g/d)		19		6.84	8.46	10.14	10.8±0.5	12.33	14.60	-8.16[ƒ]	
As % of total energy											
Fat (%)	30-40	25.0	29.5	32.5	32.4±0.8[a]	34.6	39.2	25.5	5.9		
Saturated fat (%)	<10	8.6	9.2	11.1	11.0±0.3[c]	12.0	13.6	1.0[ζ]	29.4	70.6	
Carbohydrate (%)	45-65	44.9	50.4	53.9	54.3±0.9	57.4	64.7	9.8	7.8		
Protein (%)	10-20	10.8	13.1	13.9	14.6±0.4[c]	16.0	19.0	7.8	5.9		
Vitamins											
Vitamin A (µg)	350	750	407	527	826	1029±113	1277	1767	679[ƒ]	2.0	56.9
Vitamin D (µg)	15	69	1.15	1.74	2.90	3.51±0.40[d]	4.31	6.30	-11.49[ƒ]	98.0	0
Vitamin C (mg/d)	20	525	20.3	59.0	77.9	86.7±6.9	117	175	66.7[ƒ]	7.8	60.8
Folate (µg/d)	175	350	152	243	341	349±22[d]	411	544	174[ƒ]	7.8	49.0
Minerals											
Calcium (mg/d)	850	2500	439	521	706	741±45[d]	898	1147	-91[ζ]	45.1	0
Phosphorus (mg/d)	480	3000	608	703	879	894±34[c]	1084	1239	444[ƒ]	0	0
Potassium (mg/d)	3400	**	1122	1369	1578	1679±70[c]	2045	2338	-1721[ƒ]	98.0	**
Magnesium (mg/d)	109	87.5	111	127	156	166±7	183	234	57[ƒ]	7.8	100
Sodium (mg/d)	1100	1700	1234	1571	1931	2008±96	2276	3072	908[ƒ]	5.9	68.6
Iron	8.5	40	7.1	8.4	10.2	11.8±0.7	13.9	20.3	3.3[ƒ]	0	0

a: significantly higher than that reported by Butte *et al.* (2010), p<0.05 or p<0.01.
b: significantly higher than EAR/AMDR, p<0.001.
c: significantly lower than that reported by Butte *et al.* (2010), p<0.05.
d: significantly lower than that reported by Butte *et al.* (2010), p<0.0001.
ƒ: significantly different from DRI at p<0.0001.
ζ; significantly different from DRI at p<0.05.
*: The mean DRI for each nutrient for the 3-year old and 4-year old children were calculated and labelled as AI.
**: UL not established.
AMDR: acceptable macronutrient distribution ranges, DRI: Dietary Recommended Intake, EAR: estimated average requirement.

Table 4: Comparison between 2 Centers (mean±SD)

	MP (n=34)	HF (n=18)	p
Total daily energy intake (kcal)	1380±310	1393±218	ns
Protein (g)	50.3±11.8	48.9±11.7	ns
Carbohydrate (g)	183±52	200±38	ns
Total fat (g)	51.1±13.1	45.9±10.0	ns
TotalSAT (g)	17.8±5.4	15.1±3.3	=0.056
Total monounsaturated fat (g)	18.6±5.8	17.0±4.1	ns
Total polyunsaturated fat (g)	9.5±3.3	9.2±303	ns
% kcal from fat	33.8±6.4	29.6±4.0	<0.05
% kcal from SAT	11.7±2.3	9.8±1.5	<0.01
Cholesterol (mg)	184±97	143±55	ns
Vitamin A (μg)	844±434	1391±1153	<0.05
Vitamin C (mg)	75.8±41	109.7±57.1	<0.05
Vitamin D (mg)	3.66±3.29	3.42±3.03	ns
Calcium (mg)	757±368	725±223	ns
Iron (mg)	12.3±5.4	10.8±3.8	ns
Potassium (mg)	1652±544	1783±445	ns
Sodium (mg)	2054±639	1921±752	ns
Grain (oz)	4.9±1.7	4.8±2.1	ns
Vegetable (cup)	0.50±0.26	0.54±0.36	ns
Fruit (cup)	1.03±0.55	1.27±0.66	ns
Milk (cup)	1.52±0.88	1.54±0.83	ns
Meat (oz)	2.70±1.37	2.23±1.22	ns

SAT: saturated fatty acids.
ns: not significantly different.

15.8±0.8 g, p<0.05), percent energy from SAT (11.9±0.5% *vs.* 10.5±0.4%, p<0.05), phosphorous (991±69 *vs.* 837±39 mg, p<0.05) and sodium (2358±153 mg *vs.* 1851±128 mg, p<0.05) than those with above poverty level incomes from both centers.

When only MP data were analyzed according to income levels, children from families with income below $22,050had significantly higher intakes of protein (54.5±3.2 g *vs.* 46.0±2.3 g, p<0.05), magnesium (177±14 mg *vs.* 140±6.8, p<0.05), and sodium (2358±153 mg *vs.* 1708±126, p<0.005)than children from families with income above poverty level after controlling for race/ethnicity.

At the MP center, African American children had similar nutrient intakes regardless of income levels. For the non-African American (Caucasian plus Other), low income was associated with higher intake of SAT (20.1±1.3g *vs.* 14.1±1.2, p<0.05); intakes of protein (62±5.5 g *vs.* 46±1.2, p<0.005); sodium (2291±227 mg *vs.* 1472±183, p<0.05) plus milk (2.45±0.51 servings *vs.* 0.88±0.21, p<0.01).

DISCUSSION

In the current study, 20% of children from 2 urban US childcare centers had BMI above the 85th percentile (overweight plus obese), while 10% were above in 95th percentile (obese).These percentages are similar to those observed in NHANES 2011-2012for 2-5 years old children, 22.8% and 8.4% respectively [7]. Odgen *et al*. [7] have reported that from 2003-2004 to 2011-2012, there was a reduction in overweight/obese rates in 2-5 years old children. In their report, boys (23.9%) and girls (21.7%) had similar rates. In the current study, we observed that more than twice the girls had BMI above the 85th percentile as compared to boys. Our data also showed that at 3 years of age, 13.2% of the children were overweight or obese but this number

Table 5: Nutrient Intakes According to Race in 2 Centers Combined (mean±SD)

	African American (27)	Caucasian (11)	Other (8)	p
Total kcal	1417±54	1470±89	1222±75	ns
Kcal from fat	484±24	434±36	377±28	ns
Kcal from SAT	166±10a	148±10ab	119±7b	=0.028
% kcal from fat	34.3±1.2	29.5±1.6	31.1±2.0	ns
% kcal from SAT	11.7±0.5	10.2±0.6	9.9±0.4	=0.053
Protein	51.9±2.4	48.9±3.8	47.6±1.6	ns
CHO	187±8.3	216±17.3	163±17	=0.058
Fiber	10.2±0.6	12.5±1.3	11±1.5	ns
Total fat	53.0±2.3	48.2±4.0	41.9±3.1	=0.065
SAT	18.4±1.1a	16.4±1.1ab	13.3±0.8b	=0.032
MUFA	19.4±1.0	18.0±2.0	15.7±1.2	ns
PUFA	9.9±0.5	9.2±1.0	9.3±1.7	ns
Cholesterol	182±15	147±21	198±51	ns
Vitamin A	1073±195	1070±133	776±190	ns
Vitamin D	3.1±0.4ab	4.4±0.6a	2.0±0.5b	=0.031
Vitamin C	90±9.7	95.0±17.1	64.6±15.5	ns
Folate	360±29.6	374±32.7	273±44.5	ns
Calcium	706±46.5	860±83.6	721±216	ns
Iron	11.8±0.9	12.9±1.8	10.2±1.6	ns
Magnesium	165±10.1	192±20.7	133±7.2	=0.066
Phosphate	911±48.8	971±77.9	752±52.7	ns
Potassium	1629±85	1731±166	1831±264	ns
Sodium	2279±136a	1950±136a	1339±139b	=0.002
Grain	4.74±0.29	5.66±0.77	3.88±0.63	ns
Vegetable	0.51±0.06	0.55±0.06	0.49±0.16	ns
Fruit	1.10±0.11	1.09±0.20	0.96±0.19	ns
Milk	1.54±0.16a	1.96±0.29a	0.81±0.18b	=0.014
Meat	2.85±0.27	2.00±0.27	2.92±0.54	ns

CHO: carbohydrates; SAT: saturated fatty acids; MUFA: Monounsaturated fatty acids; PUFA: Polyunsaturated fatty acids.
ns: not significantly different.

more than doubled to 30% at 4 years of age. All the 3 year old children consumed more nutrients and energy than recommended with the only exception of calcium and grain. Similar over-intake was noted for 4 year olds, with only grain intake in the recommended range.

It should be noted that even though the overweight/obesity rates in the current sample were similar to the national average and the mean BMI percentiles were in the healthy range, the mean energy and nutrient intakes were significantly higher than the recommended amount. Butte *et al*. [10] estimated that the calculated energy expenditures in children with low and active physical activity levels were 1086 and 1223 kcal/day, respectively. We observed significantly higher energy intakes ranging from 150-300 extra calories per day (1378±39 kcal/day) than the estimated energy expenditure reported by Butte [10] but similar to those observed by Butte *et al*. in another study [11]. Should this positive energy intake balance pattern continue, it is expected that the trajectory of the body weight in these young children would lead to the development of obesity, of concern to many who have tracked development of overweight from childhood to later years.

The distributions of the 3 macronutrients were within the acceptable macronutrient distribution range (AMDR), but the total energy intake was higher than the estimated requirement. Therefore, strategies to reduce energy intake while still maintaining adequate nutrient intake for growth are needed. One such strategy is to reduce the energy content by adding more vegetables in the entrée during lunch to reduce energy density [12]. Another strategy is to use smaller but age-appropriate portions for each entrée [13]. In the current study, children in both centers had lunch at the center, thus the daycare centers could be an ideal place to start changing children's eating behaviors. Both strategies could be easily adopted to reduce energy density in the entrée and reduce daily energy intake.

Family demographics play a part in lifestyle and food choices of children. In the current study, children in one center had significantly higher intake of SAT and percent energy from total fat and from SAT. Crawford *et al*. [14] reported that for 9 or 10 year old girls, two measures of household socioeconomic status, parental education and income level, were most significantly associated with nutrient intake, including intake of fat, percent of fat in the diet, and intake of vitamin C. In the current study, parental income levels of participants from the two centers differed and likely contributed to the differences in nutrient intake across center. This conclusion is based on the fact that when only children from families with income above the poverty level were compared between the 2 centers, there was no difference in nutrient intake.

All the data were collected from the children but their CG was responsible for purchasing and preparing food, so the children's fat and SAT intake reflected what the household consumed. It has been reported that individuals living in low income neighborhoods had high intake of meat (including cured meats) and low intakes of fruits, vegetables and fish [15]. Our data support these earlier findings indicating that individuals with low income may consume more cured meats and less fresh fruits and vegetables than more affluent individuals. This may help explain our findings that children from lower income families had higher fat, SAT and sodium intake. There are many environmental factors, such as access to grocery stores, that may contribute to this intake pattern but it was not in the scope of this study to investigate such factors.

The 24-hour dietary recall is cost-effective and has low respondent burden. Using this approach, our study identified a higher than recommended intake of calories or energy. However, the accuracy of this approach is dependent on the primary caregivers' recollection of the types and quantities of all items consumed by their children, and over-reporting is a concern [11]. In a recent study testing the 24-hour recall validity, energy intake was overestimated by 29% in toddlers compared with a 3-day weighed food record which was within 5% of Estimated Energy Requirement [11]. In the current study, the daily food intake record was a combination of observation of food intake during the school hours by graduate students; and CGs' recording of food intake outside the school hours. All the CG's were given detailed instruction sheet with serving size in colored pictures (Nick Jr). The food intake recording sheet was organized with detailed column headings to remind the CG's what should be recorded. Even though repeated efforts were made to encourage CG's to return the food diary, only 51 CG's were able to complete the study. Identification of effective incentives to encourage CG's to complete and return the dietary records is urgently needed.

Recruitment for study participants aimed for diversity in young children and families. One of the two recruitment centers belongs to an urban university (MP) with proportionally more student parents, bringing diversity in enrollment from the nearby communities. More than half of the MP households had annual income below the poverty line and African Americans composed the majority of the sample. The other center belongs to a medical center at which a majority of parents are employed with all families' income above the poverty line, and the numbers of participating African Americans and Caucasian children were similar. Both centers had small numbers of the "Other" race/ethnicity category, mostly Asians. The differences between the two centers in nutrients were with SAT, percent of energy from SAT, vitamin A and vitamin C, sodium and milk. These differences could be the results of cultural food preparation and choice differences for greater numbers of African Americans and low income families in the MP center. Statistical analyses revealed that race/ethnicity was a factor for the differences in total SAT and percent energy from SAT intakes between the 2 centers. On the other hand, the analyses also revealed that regardless of race, those children from low income families consumed more SAT, % energy from SAT, phosphorus and sodium. However, within center, there were small numbers of children within each race-ethnicity and income category, thus inferences from these models should be viewed cautiously.

Early years and preschool years are the period when children's eating habits and preferences are established [16]. Many of the children in the current study were not exposed to many fresh fruits and vegetables over the duration of collection, thus, it was not surprising that children in the MP center had significantly lower intakes of vitamins A and C. Birch [16] has reported that young children learn to accept new foods when being repeatedly exposed to them.

Since one third of the daily energy and nutrient intakes are obtained during school hours, this suggests an important opportunity to introduce healthy food to the children while they are in preschools or daycare centers.

In conclusion, children from 2 urban daycare centers showed higher intakes in energy and nutrients than the DRI. While mean body weights were within the healthy BMI percentile, about 1 in 5 children had BMI above 85^{th} percentile. On average, children were consuming 150-300 more calories than recommended, which could contribute to the overweight challenges in our country. Children from low income families consumed significantly higher amount of SAT than children from higher income families. In order to prevent exposure to unhealthy amounts of foods linked to cardiovascular disease and weight gain during the school age or adolescent periods, nutrition education to the minority population, especially CG from low income families, is needed. Further, based on our study, health and nutrition education should be part of training for providers in early education programs, including ways to reduce dietary fat and sodium intakes and techniques to introduce healthy foods to children, with the goal of starting healthy dietary patterns early in children's lives.

ACKNOWLEDGEMENT

This study was funded by the Institute for Population Sciences, Health Assessment, Administration, Services, and Economics (INPHAASE) – a joint program of Wayne State University and Henry Ford Health System.

REFERENCES

[1] Ogden C, Troiano R, Briefel RK, RJ, Flegal K, Johnson C. Prevalence of overweight among preschool children in the United States, 1971 through 1994. Pediatrics 1997; 99: e1.

[2] May A, Dietz W. The Feeding Infants and Toddlers Study 2008: Opportunities to assess parental, cultural, and environmental influences on dietary behaviors and obesity prevention among young children. J Am Dietetic Assoc 2010; 110: S11-S5.

[3] Saavedra J, Deming D, Dattilo A, Reidy K. Lessons from the Feeding Infants and Toddlers Study in North America: Waht children eat, and implications for obesity prevention. Ann Nutr Metab 2013; 62 (Suppl 3): 27-36. http://dx.doi.org/10.1159/000351538

[4] Nader P, Huang T, Gahagen S, Kumanyika S, Hammond R, Christoffel K. Next steps in obesity prevention: altering early life systems to support healthy parents, infants, and toddlers. Child Obes 2012; 8: 195-204.

[5] Ogden C, Carroll M, Curtin L, Lamb M, Flegal K. Prevalence of high body mass index in US children and adolescents, 2007-2008. JAMA 2010; 303: 242-9. http://dx.doi.org/10.1001/jama.2009.2012

[6] Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among us children and adolescents, 1999-2010. JAMA 2012; 307: 483-90. http://dx.doi.org/10.1001/jama.2012.40

[7] Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA 2014; 311: 806-14. http://dx.doi.org/10.1001/jama.2014.732

[8] Ogden C, Carroll M, Curtin L, McDowell M, Tabak C, Flegal K. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA 2006; 295: 1549-55. http://dx.doi.org/10.1001/jama.295.13.1549

[9] Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (2002/2005).www.nap.edu

[10] Butte N, Wong W, Wilson T, Adolph A, Puyau M, Zakeri I. Revision of dietary reference intakes for energy in preschool-age children. Am JClin Nutr 2014; 100: 161-7. http://dx.doi.org/10.3945/ajcn.113.081703

[11] Butte N, Fox M, Briefel R, *et al*. Nutrient intakes of US infants, toddlers, and preschoolers meet or exceed dietary reference intakes. J Am Dietetic Assoc 2010; 110 (Suppl 12): 27-37. http://dx.doi.org/10.1016/j.jada.2010.09.004

[12] Leahy K, Birch L, Rolls B. Reducing the energy density of an entree decreases children's energy intake at lunch. J Am Dietetic Assoc 2008; 108: 41-8. http://dx.doi.org/10.1016/j.jada.2007.10.015

[13] Savage J, Fisher J, Marini M, Birch L. Serving smaller age-appropriate entree portions to children aged 3-5 y increases fruit and vegetable intake and reduces energy density and energy intake at lunch. Am J Clin Nutr 2012; 95: 335-41. http://dx.doi.org/10.3945/ajcn.111.017848

[14] Crawford P, Obarzanek E, Schreiber G, *et al*. The effects of race, household income, and parental education on nutrient intakes of 9- and 10-year-old girls. NHLBI Growth and Health Study. Ann Epidemiol 1995; 5: 360-8. http://dx.doi.org/10.1016/1047-2797(95)00033-4

[15] Diez-Roux A, Nieto F, Caulfield L, Tyroler H, Watson R, Szklo M. Neighborhood differences in diet: the Altherosclerosis Risk in Communities (ARIC) Study. J Epidemiol Community Health 1999; 53: 55-63. http://dx.doi.org/10.1136/jech.53.1.55

[16] Birch L. Development of food preferences. Ann Rev Nutr 1999; 19: 41-62. http://dx.doi.org/10.1146/annurev.nutr.19.1.41

Received on 14-04-2015 Accepted on 27-04-2015 Published on 01-06-2015

http://dx.doi.org/10.6000/1929-4247.2015.04.02.6