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Snacking frequency and dietary intake in toddlers and preschool children

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Abstract

Understanding the relationship between snacking and dietary intake in early life years is one key but understudied area. In this study, we examined snacking patterns in toddlers and preschool

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CONFLICT OF INTEREST

Dr. Kollins reports personal fees from Aevi, grants and personal fees from Akili, personal fees from Arbor, grants from Bose, grants and personal fees from Ironshore, personal fees from Jazz, other from Kashiv, grants and personal fees from KemPharm, personal fees and non-financial support from News, personal fees from Otsuka, grants and personal fees from Rhodes, personal fees from Shire, personal fees from SK Life Sciences, grants and personal fees from Sunovion, personal fees from Tris, other from Behavioral Innovations Group, outside the submitted work.

children and the associations between snacking frequency and daily energy intake. We analyzed data from children aged 12–72 months (N=1186) in the Newborn Epigenetic STudy (NEST). We used Bonferroni multiple comparison methods to examine the differences in snacking patterns across subgroups. Linear and quantile regression models were fit to investigate the association between dietary intake and snacking frequency. Our estimates suggest that Non-Hispanic blacks had the highest total daily energy intake from snacks (334 kcal/day) compared to non-Hispanic whites (270 kcal/day) and Hispanics (274 kcal/day) in 12-to-24-month-olds. In 2-to-6-year-olds, mean energy intake from snacks was 296 kcal/day without a significant racial/ethnic difference. Carbohydrate, fat and protein from snacks contributed about 17%, 9% and 4% respectively of the total energy intake in 12-to-24-month-olds while they contributed about 15%, 7% and 2% respectively of the total energy intake in the other age group. Snacking frequency was positively and significantly associated with total daily energy intake in both 12-to-24-month-olds and 2-to-6-year-olds as indicated by regression coefficient estimates of snacking frequency (β = 31.3 kcal/day with P = 0.027 and β = 175.4 kcal/day with P<0.0001, respectively, indicating a higher snacking frequency was associated with a greater total daily energy intake). In conclusion, snacking frequency was positively associated with daily energy intake. Carbohydrates and fats from snacks are significant energy contributors. Age differentiation was apparent regarding the relationship between snacking frequency and dietary intake. Differentiated interventions that are age-specific and focus on the dietary quality of snacks instead of quantity are needed.

Keywords

Dietary intake; Diet quality; Preschooler; Snacking; Toddler

INTRODUCTION

Over 1/3 of US children are now overweight/obese (Hales, Carroll, Fryar, & Ogden, 2017; Cynthia L Ogden, et al., 2016). Studies have shown that the incidence of obesity is more likely to occur at younger ages and the relative risk of adult obesity decreases with increased age of childhood obesity onset (Cunningham, Kramer, & Narayan, 2014; Ward, et al., 2017), suggesting that early childhood is a critical life stage to target for effective childhood and adult obesity prevention. Understanding the relationship between snacking which are eating occasions outside of main meals and dietary intake in early life years is one key area in such prevention efforts, given the significant increase of the prevalence of snacking and the portion of total energy intake from snacking in US children over the past four decades (E. Dunford & Popkin, 2017).

Nevertheless, most of the existing studies have focused on school-aged children and adolescents, for example, children aged 4–5 years (Rudy, et al., 2017), 6–19 years (Murakami & Livingstone, 2016), 9–14 years (Field, et al., 2004), fourth- and eighth-graders (Vader, Walters, Harris, & Hoelscher, 2009), and 12–18 years (Keast, Nicklas, & O'neil, 2010). There is one recent study that examined the association between snacking frequency and weight status among toddlers and preschoolers (aged 12–71 months) (Fisher, Davey, Kachurak, & Bailey, 2017) and two studies that used the Guelph Family Health Study data to examine the patterns of snacking (Hutchinson, et al., 2017) and effects of genetics of taste

on snacking patterns of children aged 1.5–5 years (Chamoun, et al., 2018). However, in general, studies about young children, especially under 2 years of age, are lacking. Infants are usually introduced to solid foods after six months, and the American Academy of Pediatrics recommends to give 2–3 healthy snacks per day for children 12–36 months (American Academy of Pediatrics, 2017). US national data suggests that about 8% of children under the age of two have high weight-for-height (at or above 97.7th percentile of World Health Organization 2006 growth charts) (C. L. Ogden, Carroll, Kit, & Flegal, 2014), an indicator of excess weight and high risk for overweight and obesity in later life stages (Ward, et al., 2017). Few studies have examined snacking in young children and how this relates to their overall calorie intake and diet quality, and the lack of relevant research in this age group contributes to the dearth of evidence from which to mount interventions focused on snacking.

Racial/ethnic differences in the prevalence of overweight or obesity are evident in early childhood. Between birth to 2 years, recent National Health and Nutrition Examination Survey (NHANES) data suggest that 8.8% of Hispanic children are at or above the 97.7th percentile of WHO 2006 growth charts compared to 7.3% and 5.5% in Black children and White children respectively (C. L. Ogden, et al., 2014). Similarly, in 2-to-5-year-olds, 16.7% of Hispanic children have a body mass index (BMI) at or above the 95th percentile of CDC 2000 growth charts, followed by Black (11.3%) and White children (3.5%) (C. L. Ogden, et al., 2014). The differences in energy balance-related behaviors including dietary intake between racial/ethnic groups from birth to two years of age could be potential risk factors (Bernard F. Fuemmeler, et al., 2015). As snacking has become an increasingly important component of children's diet, a good understanding of the snacking patterns and relevant racial/ethnic differences among young children is urgently needed to guide caregivers' practice and inform interventions to reduce racial/ethnic disparities.

In addition, the association estimates from existing studies are primarily based on conditional mean regression. However, such methods are not sufficient because the effects of explanatory variables at different levels of dietary intake may have very different implications (Kan & Tsai, 2004). For example, positive association between snacking and fat intake at the upper quantiles of the fat intake distribution may suggest snacking as a risk factor for obesity, while such relationship at the lower quantiles may be considered as protective for underweight. Therefore, results reported in the prior studies may only provide a partial view of snacking.

We need a better understanding of the role that snacking plays in early childhood to inform effective interventions for healthy child growth and childhood obesity prevention. Previous studies that have looked at this relationship have had mixed findings with methodological limitations. To fill these gaps, using data from the Newborn Epigenetic STudy (NEST) cohort, this study 1) examined the snacking patterns of children 1–6 years of age and related gender, and racial/ethnic disparities, 2) assessed the association between snacking frequency and total energy intake 3) employed both conditional mean regression and quantile regression models to assess the differential impacts of snacking frequency on macronutrient and food intake.

METHODS

Data

Data collected from the participants in the Newborn Epigenetic STudy (NEST) was used. NEST is an ongoing prospective study of women and their children designed to identify early exposures associated with stable epigenetic alterations in infants that may alter chronic disease susceptibility later in life. The participants were recruited in three contiguous counties in central North Carolina (NC); Durham, Orange and Wake. The Institutional Review Board approved this study, and informed written consent was obtained from all participants. Participant identification and enrollment procedures are described elsewhere (Hoyo, et al., 2011). We used the data collected in the first wave of data collection in order to capture early life dietary patterns. Our sample included 1186 children aged between 12 months and 6 years with dietary assessment data. Non-Hispanic whites, non-Hispanic blacks, and Hispanics accounted for 35%, 42%, and 19% of our sample, respectively. 40% of the mothers had a high school or less education, while more than half had a college or some college education.

Technical information

Dietary Intake and Snacking Frequency: The primary caregiver (in most cases the mother) reported on their child's diet. The dietary intake of the children was assessed by telephone, using the Nutrition Data System for Research (NDSR, University of MN), a valid and established method for assessing energy intake(B. F. Fuemmeler, Lovelady, Zucker, & Ostbye, 2013). Snacking frequency was defined as eating occasions that were reported by parents as "snacks" based upon a defined list in the NDSR system. The list includes meal names in each eating occasion such as Breakfast, Brunch, Lunch, Dinner/supper, Snack, Beverage only (just a drink), and School lunch. The American Academy of Pediatrics recommends 2–3 healthy and nutritious snacks per day for infants (after 9 months) and toddlers (12–36 months), and 2 healthy and nutritious snacks per day for preschoolers (36 – 60 months) (American Academy of Pediatrics, 2017).

Demographic and socioeconomic data: At the enrollment survey, parents reported on their level of educational attainment and age. Children's race/ethnicity was based on maternal race/ethnicity.

Statistical analysis

We conducted descriptive analysis and used Bonferroni multiple comparison methods to examine the differences in snacking patterns across gender and racial/ethnic groups. Linear regression was used to generate conditional mean estimates of the mean effects of snacking frequency on dietary intake for both age groups with adjustment of age, gender, maternal education level. Previous studies have suggested that snacking behaviors may differ by age and gender (Evans, Jacques, Dallal, Sacheck, & Must, 2015; Wang, van der Horst, Jacquier, Afeiche, & Eldridge, 2018). For example, older children may make less healthy choices about snacking, consuming more energy from savory snacks than younger children (Barquera, et al., 2010) and consuming fewer fruits (Wang, et al., 2018). NHANES data suggested that female toddlers consumed slightly more macronutrients from snack

occasions, though the differenced were not significant (U.S. Department of Agriculture, 2016). NHANES data also suggested that race/ethnicity was associated with sweet snack and salty snack consumption (Bleich & Wolfson, 2015). Maternal education is also associated with feeding style and children's snacking patterns (Saxton, Carnell, Van Jaarsveld, & Wardle, 2009; Wijtzes, et al., 2013) Therefore, we included these variables as covariates in our analyses. Sensitivity analyses were conducted to examine the robustness of estimates by controlling the percentage energy of fat, carbohydrate, and protein from snacks. Quantile regression models with same-model specifications as linear regression models were fit to assess the differential impacts of snacking at different points in the dietary intake distributions (Koenker & Bassett Jr, 1978).

RESULTS

Snacking patterns

Table 1 through linear regression with maternal education, gender and age controlled. As shown in Table 1, on average, children 12 to 24 months old had snacks 2.6 times per day as compared to 2.2 times per day in children aged 2 to 6 years. There is no significant difference between boys and girls. In Bonferroni multiple comparisons across racial/ethnic groups, maternal education, gender and age were adjusted by producing conditional mean estimates from linear regression with these variables controlled. Non-Hispanic whites had the highest snacking frequency, followed by Hispanics, and non-Hispanic blacks in children aged 2–6 years. There is no significant racial/ethnic gradient in 12-to-24-month-olds.

In 12-to-24-month-olds non-Hispanic Blacks had the highest energy intake from snacks (334 kcal/day) compared to Whites (270 kcal/day) and Hispanics (274 kcal/day). The difference was statistically significant (significance level = 0.05) after controlling for age, gender, and socioeconomic status indicated by maternal education. There was no significant difference between Hispanics and Whites in energy intake from snacks. In children aged 2 to 6 years, mean energy intake from snacks was about 387 kcal/day, with no statistically significant differences across gender and racial/ethnic groups. Expressed as a percentage of total daily energy intake, approximately 29% and 25% of the total daily energy intake was from snacks in children aged 12 to 24 months and 2 to 6 years, respectively.

Carbohydrate from snacks was the major source of snack energy. The 2-to-6-year-olds consumed an average of 59.6 g/day of carbohydrate from snacks, contributing about 15% of their total daily energy intake. In the 12-to-24-month-olds, there is significant gender difference, with boys having a higher mean snack carbohydrate intake compared to girls (44.9 g/day vs. 39.8 g/day, P =0.017). Mean daily fat intake from snacks was about 10–13 g/day in both age groups, accounting for 7%−9% of total daily energy intake. Protein from snacks only contributed about 2–4% of the total daily energy. The non-Hispanic Black group had the highest fat intake from snacks, compared to whites and Hispanics.

Associations between snacking frequency and dietary intake

Table 2 depicts the linear regression estimates of the relationships between snacking frequency and dietary intake controlled for age, gender, ethnicity, and maternal education

level. In the group of 12-to-24-month-olds, snacking frequency was positively associated with total daily energy intake. One more eating occasion defined as snacking was associated with 31.3 kcal/day total energy increase (P =0.027). There was also a positive association between snacking frequency and total carbohydrate intake in boys (β = 7.1 g/day, P = 0.011). On the other hand, a higher snacking frequency was also associated with a higher fruit intake (β = 0.18 cup/day, P = 0.013) in 12-to-24-month boys only. In addition, maternal education level was not significantly associated with snacking outcomes based on the regression.

Similarly, in the age group of 2 to 6 years, snacking frequency was also positively associated with total daily energy intake. One more eating occasion defined as snacking was associated with about 175 kcal more total energy intake per day (P < 0.0001). The association was significant in both boys (β = 165.2 kcal/day, P = 0.001) and girls (β = 181.8 kcal/day, P = 0.001). Daily carbohydrate and fat intakes were significantly positively associated with snacking frequency with one more snacking occasion contributing about 23.2 g/day and 7.2 g/day of carbohydrate and fat respectively. These associations were significant in both gender groups. Due to a small portion of the sample that had a snacking frequency greater than 5 times a day (<5%), we were not able to examine if such negative association existed in snackers with a snacking frequency much higher than the recommended levels.

In the descriptive analyses, among the 2-to-6-year-olds, Non-Hispanic Whites had the highest snacking frequency, while energy intake was not significantly different across racial/ethnic groups. These estimates suggest evident differences across race/ethnic groups. Our regression estimates further indicate the within-race/ethnic-group relationship between snacking frequency and dietary intake. As the estimates suggest, a higher snacking frequency was associated with a higher energy intake in each racial/ethnic group.

Quantile estimates of the association between snacking frequency and dietary intake

In addition to the conditional mean regression to evaluate the relationships between snacking frequency and dietary intake, we also conducted quantile regression to analyze the associations across the whole intake distributions (Table 3).

We estimated the associations at 25th, 50th, and 75th percentiles in the distribution of daily intake of energy, carbohydrate, fat, protein, sugar, fruit, and vegetable with adjustment of age, gender, ethnicity, and maternal education level. Generally, the quantile regression provided similar but more detailed information about the relationship between snacking frequency and dietary intake.

In 12-to-24-month-olds, the effect of the snacking frequency on total energy intake was significant at the middle of the distribution (50th percentile, β =36.7 kcal/day, P = 0.004). The association between the snacking frequency and the daily carbohydrate intake was only significant at the higher end of the distribution (75th percentile, β =7.41, P = 0.031).

For children aged 2–6 years, quantile estimates suggested significant associations between the dietary intake and snacking frequency from 25^{th} to 75^{th} percentiles with the highest impact at 75^{th} percentile (β =186.0 kcal/day, P < 0.0001). Similarly, for fat intake and

protein intake, the association between snacking occasion and the intake was more pronounced at the higher end of the intake distributions. In contrast, snacking may contribute more to carbohydrate intake for those at the lower end of the carbohydrate intake distribution with the lowest percentile having the highest snack carbohydrate intake (β at 25th percentile =19.9 g/day, P = 0.002).

Sensitivity analyses were also conducted by controlling for snack quality measured by daily energy intake of carbohydrate, fat, and protein from snacks as percentages of total daily energy intake. The results are similar (not reported).

DISCUSSION

The current study examined snacking patterns and their associations with dietary intake and weight status among preschool children. Our results suggest that snacking frequency was positively associated with total daily energy intake in children and snacks were a significant source of energy in toddlers and preschoolers.

The mean snacking frequency was higher in the 12-to-24-month age group compared to the 2-to-6-year group. This may be attributable to feeding practice as children age. This finding is in line with a study comparing snacking patterns between children aged 2–5 years with children aged 6–12 years, which found that parents of younger children gave more snacks than parents of older children (Blaine, et al., 2015). Demographic characteristics were also associated with snacking frequency. Non-Hispanic Whites had the highest snacking frequency, followed by Hispanics and Non-Hispanic Blacks, in children aged 2-to-6 years. The reasons for these differences deserve further study, but could reflect the availability of snacks in the home or cultural differences in feeding practice. Despite the variations across age and racial/ethnic groups, however, the mean snacking frequency was in line with the stated recommendation from the American Academy of Pediatrics.

We found that snacks accounted for about 25–30% of total daily energy. This is in line with the finding from a study using the Guelph Family Health Study data (Hutchinson, et al., 2017). Carbohydrate and fat from snacking were major contributors of energy in toddlers and preschoolers. Our estimates suggested that carbohydrate and fat from snacks combined accounted for approximately one-quarter of total daily energy intake in this population. In addition to confirm the findings from previous studies which found similar patterns in the US children aged 2-to-5 years (Shriver, et al., 2018) or 2-to-18 years (E. K. Dunford & Popkin, 2018), our results provide insight of the quality of snacks consumed by children aged 1-to-2 years. This is of particular concern because this period is critical for children to develop healthy dietary habits. While children in this age group are introduced to a wide variety of new foods for the first time, the over-consumption of high energy snacks may lead to the onset of unhealthy dietary habits and subsequent risk of obesity and chronic diseases later in life (Grummer-Strawn, Li, Perrine, Scanlon, & Fein, 2014).

Our results suggest that snacks play an important role in children’s daily food and nutrient intakes. Healthy snacking is thus essential in influencing diet quality. Consuming snacks with smaller portion size and lower energy density is effective to reduce energy intake from

snacks. Consumption of snacks containing high solid fat and added sugars should be limited to reduce empty energy intake. Additionally, providing fruits and vegetables as snacks could also reduce energy intake, promote overall healthier diet quality, and improve children's dietary behavior. Moreover, despite the lack of a clear consensus regarding the health effects of snacking, healthy snacking should focus on balanced dietary intake instead of focusing on a single food or nutrient.

Our linear regression estimates suggested that snacking frequency was positively associated with total energy intake. Compared to the previous studies that identified such relationship in adults (Bertéus Forslund, Torgerson, Sjöström, & Lindroos, 2005), adolescents (Sebastian, Cleveland, & Goldman, 2008) and school-age children (Vader, et al., 2009), the present study focused on toddlers and preschoolers adding additional data about snacking during an earlier phase in childhood. Our analyses on the components of energy intake indicated that the increased consumption of snacks rich in carbohydrate and fat due to increased frequency of snacking was the major cause of increased energy intake, especially in the 2-to-6-year-olds. Interestingly, another study on adolescent snacking behavior suggested that fat intake was negatively associated with snacking frequency (Sebastian, et al., 2008). The comparison between our study and the previous study reveal potential age differentiation with respect to the quality of dietary intake from snacks that deserve further study. Moreover, one recent study identified the association between the genetics of taste and the snacking patterns of children (Chamoun, et al., 2018). For example, genetic variation in taste receptors may influence the total energy density of snacks and the intake of sugar. Therefore, the interactions between the genetics of taste and age differentiation should be examined in future research.

Our quantile regression method provided additional details regarding the relationship between snacking frequency and dietary intake. In the 12-to-24-month-olds, snacking frequency was positively associated with carbohydrate intake in those with relatively higher carbohydrate intake. In contrast, snacking frequency was positively associated with carbohydrate intake for those at the lower end of the carbohydrate intake distribution in the 2-to-6-years-olds. This finding indicates that encouraging more snacking may help increase carbohydrate intake in those with low carbohydrate intake in 2-to-6-years-olds, while leading to an undesired increase of carbohydrate intake for those who have high carbohydrate already in 12-to-24-month olds. Therefore, differentiated age-specific snacking recommendations should be implemented to avoid unintended consequences.

Our study has a number of strengths. First, the dietary intake data analyzed in the study was from 24-hour dietary recall administered using the NDSR system, a rigorous method for assessing dietary intake. The multiple-pass interview methodology and detailed search algorithms implemented in the NDSR help to ensure the accuracy of food intake recall, which is lacking in the dietary studies using other methods, such as food frequency questionnaires. Second, our study included a large sample of children between 12 and 24 months of age – a period of development where snacking is quite common but has been overlooked in the larger research literature. Moreover, the use of quantile regression techniques allowed us to examine further the relationships between snacking and dietary intake, in addition to conditional mean estimates, which provided a bigger picture and more

relevant evidence for interventions. Nevertheless, the findings here should be interpreted within the context of the limitations. For instance, although our sample included children from a diverse range of demographic and socioeconomic environments and allows us to evaluated correlations between snacking intake, caloric intake and dietary quality, a larger nationally representative sample would be needed to inform national nutrition policies. The study also did not evaluate long-term consequences which would provide greater insight into what impact poor dietary intake from snacks during early development might relate to later unhealthy eating and obesity. As we follow this cohort, we hope to provide additional data on these outcomes.

CONCLUSIONS

Snacking frequency was positively associated with daily energy intake. Carbohydrates and fats from snacks are significant energy contributors. Age differentiation was apparent regarding the relationship between snacking frequency and dietary intake. Differentiated interventions that are age-specific and focus on the dietary quality of snacks instead of quantity are needed.

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Table 1:

Snacking Patterns by Age, Gender, and Ethnicity

	Gender			Ethnicity			
	Boys (N=639)	**Girls (N=547)**	**P-value**	**Non-Hispanic White (N=418)**	**Non-Hispanic Black (N=494)**	**Hispanic (N=220)**	**Significant group comparisons[†]**
	Mean (SD) or %	**Mean (SD) or %**		**Mean (SD) or %**	**Mean (SD) or %**	**Mean (SD) or %**	
12-to-24 months (N=769)							
Total daily energy intake (Kcal/day)	1066.39(373.75)	1003.49(377.34)	0.021	1002.74(301.9)	1178.44(402.42)	917.83(377.14)	Black>White, Black>Hispanic[*]
Snacking frequency /day	2.68(1.61)	2.55(1.47)	0.244	2.74(1.54)	2.47(1.32)	2.52(1.68)	NS[≠]
Snack energy (Kcal/day)	306.58(206.65)	282.48(194.59)	0.099	270.31(166.28)	334.44(216.93)	274.05(214.68)	Black>White, Black>Hispanic[*]
Snack Fat (g/day)	10.49(9.03)	10.23(8.36)	0.681	10(7.73)	11.91(9.42)	8.57(8.53)	Black>Hispanic[*]
Snack Carbohydrate (g/day)	44.92(30.3)	39.79(28.89)	0.017	37.45(24.19)	48.26(31.85)	41.64(32.58)	Black>White[*]
Snack Protein (g/day)	9.58(8.17)	9.04(7.16)	0.342	8.93(6.68)	9.77(7.8)	9.27(8.96)	NS
Snack Sugar (g/day)	29.51(21.12)	26.21(19.89)	0.027	24.5(17.82)	31.27(20.76)	28.3(23.44)	Black>White[*]
Snack Fruit (cup/day)	0.54(0.89)	0.42(0.7)	0.053	0.43(0.72)	0.39(0.69)	0.68(1.07)	Hispanic>White, Hispanic>Black[*]
Snack Vegetable (cup/day)	0.1(0.27)	0.07(0.23)	0.067	0.05(0.19)	0.09(0.28)	0.12(0.29)	Hispanic>White[○]
% total fat from snack	28%	28%	0.64	28%	28%	27%	NS
% total carbohydrate from snack	31%	30%	0.196	28%	30%	34%	Hispanic>White[*]
% total protein from snack	24%	24%	0.883	23%	23%	25%	NS
% total sugar from snack	35%	35%	0.496	33%	35%	37%	NS
% total fruit from snack	35%	33%	0.517	26%	31%	50%	Hispanic>White, Hispanic>Black[*]
% total vegetable from snack	10%	7%	0.159	5%	9%	12%	Hispanic>White[○]
% total energy from snacks	29%	28%	0.525	27%	28%	30%	NS
% total energy intake from snack fat	9%	9%	0.651	9%	9%	8%	NS

	Gender			Ethnicity			
	Boys (N=639)	Girls (N=547)	P-value	Non-Hispanic White (N=418)	Non-Hispanic Black (N=494)	Hispanic (N=220)	Significant group comparisons†
	Mean (SD) or %	Mean (SD) or %		Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	
% total energy from snack carbohydrate	17%	16%	0.126	15%	16%	18%	Hispanic>White *
% total energy from snack protein	4%	4%	0.768	4%	3%	4%	NS
2–6 years (N=417)							
Total daily energy intake (Kcal/day)	1610.18(467.58)	1479.35(491.37)	0.006	1517.48(484.07)	1607.56(476.72)	1312.01(509.82)	NS
Snacking frequency /day	2.21(1.14)	2.2(1.12)	0.896	2.62(1.12)	1.89(1.02)	2.10(0.85)	White>Black, White>Hispanic *
Snack energy (g/day)	395.32(240.6)	379.17(277.76)	0.525	402.1(222.66)	385.93(288.25)	298.24(184.1)	NS
Snack Fat (g/day)	13.28(10.74)	13.49(13.26)	0.857	13.11(9.77)	13.81(13.54)	9.5(8.13)	NS
Snack Carbohydrate (g/day)	61.61(38.67)	57.31(35.82)	0.24	64.11(36.11)	57.84(39.27)	48.46(27.98)	NS
Snack Protein (g/day)	9.73(8.24)	9.29(11.06)	0.643	9.66(6.91)	9.61(11.6)	6.64(5.02)	NS
Snack Sugar (g/day)	35.73(26.94)	32.63(21.35)	0.195	38.37(25.09)	32.17(24.35)	28.83(20.55)	NS
Snack Fruit (cup/day)	0.57(1.19)	0.44(0.73)	0.202	0.61(1.3)	0.39(0.72)	0.68(0.67)	NS
Snack Vegetable (cup/day)	0.11(0.34)	0.09(0.29)	0.553	0.09(0.29)	0.11(0.35)	0.08(0.21)	NS
% total fat from snack	23%	24%	0.32	24%	22%	20%	NS
% total carbohydrate from snack	28%	28%	0.936	30%	26%	29%	White>Black *
% total protein from snack	16%	16%	0.666	17%	15%	14%	NS
% total sugar from snack	32%	32%	0.962	35%	29%	37%	White>Black *
% total fruit from snack	28%	28%	0.999	26%	25%	57%	Hispanic>White, Hispanic>Black *
% total vegetable from snack	6%	7%	0.552	6%	6%	7%	NS
% total energy from snacks	24%	25%	0.791	26%	23%	23%	White>Black *
% total energy intake from snack fat	7%	8%	0.442	8%	7%	6%	NS
% total energy from snack carbohydrate	15%	15%	0.978	17%	14%	16%	White>Black *
% total energy from snack protein	2%	2%	0.686	3%	2%	2%	NS

Note:

†Bonferroni multiple comparisons.

*The difference is still significant (significance level = 0.05) after controlling for maternal education level, gender and age.

oThe difference became insignificant (significance level = 0.05) after controlling for maternal education level, gender and age.

‡Non-significant.

Table 2:

Conditional Mean Regression Estimates of the Association between Dietary Intake and Snacking Frequency

	Full Sample		Boys		Girls	
	Coefficient of snacking frequency	**P-value**	**Coefficient of snacking frequency**	**P-value**	**Coefficient of snacking frequency**	**P-value**
12 -to-24 months						
Total daily energy (kcal/day)	31.29	0.027	41.19	0.029	21.4	0.329
Daily carbohydrate intake (g/day)	6.04	0.004	7.13	0.011	4.83	0.129
Daily fat intake (g/day)	0.64	0.304	0.86	0.29	0.46	0.636
Daily protein intake (g/day)	0.41	0.535	1.26	0.153	−0.4	0.698
Daily Sugar intake (g/day)	3.36	0.008	4.04	0.02	2.43	0.204
Daily Fruit intake (cup/day)	0.14	0.003	0.18	0.013	0.08	0.193
Daily Vegetable intake (cup/day)	−0.02	0.658	−0.03	0.574	0	0.937
2–6 years						
Total daily energy (kcal/day)	175.41	<0.0001	165.22	0.001	181.75	0.001
Daily carbohydrate intake (g/day)	23.17	<0.0001	24.31	<0.0001	21.76	0.003
Daily fat intake (g/day)	7.24	<0.0001	6.29	0.008	7.79	0.002
Daily protein intake (g/day)	5.01	0.002	3.61	0.078	6.43	0.017
Daily Sugar intake (g/day)	12.73	<0.0001	16.14	<0.0001	8.64	0.027
Daily Fruit intake (cup/day)	0.24	0.026	0.28	0.087	0.21	0.147
Daily Vegetable intake (cup/day)	0.09	0.285	0.06	0.665	0.11	0.363

Note: Separated regression models were fit with total daily energy intake, daily carbohydrate intake, daily fat intake, daily protein intake, daily sugar intake, daily fruit intake, and daily vegetable intake as dependent variables, and snacking frequency as independent variables, controlled for age, gender, race/ethnicity, and maternal educational level.

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Table 3:

Quantile Regression Estimates of the Association between Dietary Intake and Snacking Frequency

		Full Sample		Boys		Girls	
		Coefficient of Snacking Frequency	**P value**	**Coefficient of Snacking Frequency**	**P value**	**Coefficient of Snacking Frequency**	**P value**
12 -to-24 months							
Total daily energy (kcal/day)	β at 25th	−1.63	0.927	4.51	0.844	−10.24	0.748
	β at 50th	36.71	0.04	18.41	0.456	38.57	0.217
	β at 75th	30.42	0.134	54.01	0.065	−13.9	0.651
Daily carbohydrate intake (g/day)	β at 25th	1.81	0.438	3.08	0.343	−2.88	0.482
	β at 50th	3.24	0.203	2.85	0.445	2.82	0.512
	β at 75th	7.41	0.031	9.86	0.034	5.6	0.263
Daily fat intake (g/day)	β at 25th	0.16	0.865	0.08	0.948	−0.25	0.86
	β at 50th	0.84	0.3	0.23	0.834	0.97	0.507
	β at 75th	0.92	0.245	0.77	0.472	1.34	0.318
Daily protein intake (g/day)	β at 25th	0.39	0.663	0.16	0.901	−0.27	0.86
	β at 50th	0.58	0.536	1.65	0.224	−0.64	0.663
	β at 75th	1.36	0.125	1.8	0.155	0	>0.999
Daily Sugar intake (g/day)	β at 25th	1.39	0.299	4.34	0.02	0.77	0.72
	β at 50th	2.39	0.141	2.51	0.251	0	0.81
	β at 75th	4.03	0.038	4.46	0.09	3.04	0.346
Daily Fruit intake (cup/day)	β at 25th	0	>0.999	0.09	0.171	0	>0.999
	β at 50th	0.06	0.255	0.15	0.034	−0.05	0.498
	β at 75th	0.13	0.11	0.2	0.099	0.14	0.218
Daily Vegetable intake (cup/day)	β at 25th	0.01	0.73	0.01	0.899	0	0.934
	β at 50th	−0.02	0.65	−0.06	0.382	−0.01	0.929
	β at 75th	−0.05	0.397	−0.05	0.503	0.03	0.671

		Full Sample		Boys		Girls	
		Coefficient of Snacking Frequency	P value	Coefficient of Snacking Frequency	P value	Coefficient of Snacking Frequency	P value
2–6 years							
Total daily energy (kcal/day)	β at 25th	103.11	0.019	61.53	0.38	111.85	0.089
	β at 50th	136.17	0.004	142.18	0.043	133.97	0.081
	β at 75th	186.02	<0.0001	205.54	0.003	210.33	0.019
Daily carbohydrate intake (g/day)	β at 25th	19.92	0.002	21.66	0.028	23.6	0.011
	β at 50th	16.5	0.016	23.88	0.025	15.37	0.141
	β at 75th	14.13	0.042	18.73	0.112	22.48	0.044
Daily fat intake (g/day)	β at 25th	4.87	0.037	6.06	0.088	3.38	0.313
	β at 50th	8.06	<0.0001	7.16	0.033	6.98	0.068
	β at 75th	8.22	<0.0001	8.25	0.007	10.77	0.018
Daily protein intake (g/day)	β at 25th	3.83	0.053	0.46	0.886	3.74	0.26
	β at 50th	3.52	0.107	4.38	0.177	1.7	0.626
	β at 75th	5.38	0.035	5.05	0.128	4.62	0.202
Daily Sugar intake (g/day)	β at 25th	10.38	0.003	12.54	0.018	7.47	0.162
	β at 50th	13.36	0.002	15.56	0.011	9.74	0.122
	β at 75th	12.03	0.014	16.15	0.034	8.06	0.214
Daily Fruit intake (cup/day)	β at 25th	0.03	0.78	0	>0.999	0	>0.999
	β at 50th	0.21	0.087	0.41	0.029	0.12	0.523
	β at 75th	0.49	0.001	0.49	0.014	0.42	0.068
Daily Vegetable intake (cup/day)	β at 25th	0.12	0.175	0.18	0.206	0.06	0.68
	β at 50th	0.1	0.374	0.17	0.284	0.05	0.777
	β at 75th	0.06	0.674	−0.03	0.866	0.18	0.499

Note: Separated quantile regression models were fit with total daily energy intake, daily carbohydrate intake, daily fat intake, daily protein intake, daily sugar intake, daily fruit intake, and daily vegetable intake as dependent variables, and snacking frequency as independent variables, controlled for age, gender, race/ethnicity, and maternal educational level.