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SODA CONSUMPTION AND OVERWEIGHT STATUS OF 2-YEAR-OLD MEXICAN-AMERICAN CHILDREN IN CALIFORNIA

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Abstract

Objective—The prevalence of overweight in United States children, 2 – 5 years, has increased two-fold since 1975, with the highest prevalence in Mexican-Americans. The objective of this study was to determine the association between current soda consumption and overweight in 2-year-old Mexican-American children.

Research Methods and Procedures—The CHAMACOS study is a longitudinal study of the health of low-income Latino pregnant women and their children living in the Salinas Valley, California. Six hundred pregnant women were enrolled (October 1999 – October 2000), and their children were followed until 2 years of age. This cross-sectional analysis includes the 354 children who completed the 2-year follow-up interview. Standing height (cm) and weight (g) were measured at 2 years. Overweight was defined as ≥ 95th percentile of the sex-specific body mass index for each child's age.

Results—Fifty-five (15.5%) children were overweight. Over half (56%) reported consuming any soda in the last week. After covariate adjustment, compared to no soda consumption, <1 soda / day was not related to overweight (adj-OR = 0.97, 95% CI 0.47, 1.99), but ≥1 soda / day was

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significantly associated with overweight (adj-OR = 3.39, 95% CI 1.43, 8.07) and the test for trend was significant ($p = 0.02$).

Discussion—At 2 years of age, the prevalence of overweight among the CHAMACOS cohort is higher than the national prevalence estimate for Mexican-American, 2–5 year olds, and is significantly associated with current soda consumption. Interventions to reduce consumption of soda in young Mexican-American children should be considered.

Keywords

child; overweight; diet; beverages; Mexican-American

Introduction

The prevalence of obesity in the United States has increased dramatically in the last 30 years (1). The observed increase has been reported in all age groups, including children. Even among 2 to 5 year olds, the prevalence of overweight has increased two-fold, from 5% in 1980 to 10.4% in 2000, with the highest prevalence (11.1%) reported among Mexican-Americans (1).

Overweight children are at increased risk for many health problems including diabetes, abnormal glucose tolerance, high blood pressure, and altered lipid profiles as well as psychosocial consequences (2–4). In addition, overweight children are at significantly increased risk for adult obesity (5).

Overweight occurs when there is an imbalance between energy intake and energy expenditure (6). In the United States, dietary intake patterns of children have changed dramatically since the 1970s, with increased consumption of energy dense foods. Today the daily food intake of children is excessively high in added sugar and discretionary fat, accounting for 40 percent of total energy intake (7). Sugar-sweetened beverages such as soft drinks and fruit drinks are the primary source of added sugar in a child's daily diet (8). In fact, total energy intake of 2 to 18 year olds was about 10% greater among children who consumed soft drinks than those who did not (9).

The rate of sugar-sweetened soft drink consumption by children has increased in parallel with child obesity in the past 30 years (10). In 1994, while total beverages contributed 20 to 24% of energy intake across all age groups, soft drinks provided an increasing percent of energy intake with age, from 2.4% among 2–5 year olds to 7.9% among adolescents (11). Further, soft drinks contributed a higher proportion of energy for overweight than for non-overweight children. Even among 2–5 year olds, soft drinks contributed 3.1% of energy intake in overweight children compared with 2.4% among non-overweight children (11).

A number of studies have examined the relationship of sugar-sweetened beverages to child overweight, but none have reported the relationship of soda alone. A school-based prospective study of 548 middle-school age ethnically-diverse children found a 60% increased risk for obesity with each additional serving of sugar-sweetened drink (soda, fruit drink, iced tea) per day over a 19-month period (adjusted OR = 1.6; 95% CI 1.1–2.2) (12).

Using data from the Growing Up Today Study, a population-based prospective study, consumption of sugar-added beverages (soda, sweetened iced tea, non-carbonated fruit drinks) over a one-year period was associated with a small increase in body mass index among 9 to 14 year olds (13). A retrospective cohort study of 10,904 primarily Caucasian children, aged 2 to 3 years, reported consumption of naturally- and sugar-sweetened beverages including vitamin-C-containing juices, other juices, fruit drinks, and sodas increased the risk for overweight one year later (14). Regardless of overweight status at baseline, the risk for overweight was increased approximately two-fold with consumption of one or more sweetened beverages per day. Only one small study has examined the relation of sugar-sweetened beverage consumption with prevalence of overweight in Mexican-American children (15). Based on responses from 37 kindergarten-age participants, Mexican-American overweight children were significantly more likely than non-overweight children to consume sugar-sweetened beverages on a daily basis.

In the present study, we investigated the cross-sectional relationship of soda consumption and other dietary and physical activity factors with overweight status in 2-year-old low-income Mexican-American children who are participants in a birth cohort study in the Salinas Valley, California.

Research Methods and Procedures

Sample

The Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) study is a longitudinal birth cohort study of the effects of pesticide and other environmental exposures on the health of pregnant women and their children living in the Salinas Valley, an agricultural region in California. Pregnant women were recruited between October 1999 and October 2000 through six prenatal clinics that serve a predominantly low-income, Spanish-speaking population. Eligible women were 18 years or older, less than 20-weeks gestation at enrollment, English- or Spanish-speaking, Medi-Cal eligible, and planned to deliver at the county hospital.

Of 601 women who were initially enrolled, 526 were followed through delivery of a live birth that survived the neonatal period, and 409 children completed the follow-up at 2 years of age. For this analysis, we excluded children who were preterm (n=30) or very low birth weight (n=1), missing 24-month height data (n=23), or less than 23 months old at follow-up (n=1). The final sample included 354 children. The study was approved by the Institutional Review Boards at participating institutions and written informed consent was obtained from all mothers.

Procedure

Details of the study are presented elsewhere (16). Briefly, after informed consent was obtained, women were interviewed in English or Spanish by trained, bilingual, bicultural interviewers twice during pregnancy (~13 weeks, ~26 weeks gestation), shortly after delivery, and when their children were 6 months, 12 months, and 24 months of age. During each interview, information was collected about family sociodemographic characteristics,

household member work histories, maternal characteristics and personal habits, pregnancy and medical histories, and child-based developmental milestones, diet and behavioral information. The diet information was comprised of a 20-item modified food frequency questionnaire of child's intake of a variety of beverages, meats and other protein sources, fruits, and vegetables. Diet items were selected based on the potential for exposure to pesticides (the primary purpose of the study).

At the 24-month follow-up, standing height (cm) and weight (g) were measured. Barefoot standing height was measured three consecutive times (to the nearest 1 mm) using a standard measuring board and the three measurements were averaged. Standing weight was measured with clothing and diapers removed (to the nearest 0.1 kg) using a pediatric digital scale. In addition, medical records from prenatal visits, delivery, and well-baby checkups were abstracted by a registered nurse.

Exposure Measure

Soda consumption was the primary independent variable of interest. At the 24-month interview, mothers were asked "In the past seven days, how often did your child drink sodas, like Coca Cola or Sprite?" and given the choices: "never, 1–2 per week, 3–4 per week, 5–6 per week, 1 per day, 2 per day, or 3+ per day". We calculated average soda consumption per day for each child by assigning the midpoint of the category for each response.

Additional dietary variables of interest included fast food consumption, sweets consumption, and breastfeeding history. At the 24-month interview, mothers were asked "In the past seven days, how often did your child eat food from a fast food restaurant like McDonalds, Burger King, or KFC?" and " In the past seven days, how often did your child eat sweets like candy, cookies, cake, ice cream, or pan dulce?" For both questions mothers were given the choices: "never, 1–2 per week, 3–4 per week, 5–6 per week, 1 per day, 2 per day, or 3+ per day." For both variables, we then calculated average consumption per day for each child by assigning the midpoint of the category for each response. At the 6-, 12-, and 24-month follow-up interviews mothers were asked if they were still breastfeeding, and if not, how old their baby was when they completely stopped breastfeeding. From these questions we created a variable for total duration (in months) of breastfeeding.

Physical activity (or inactivity) variables of interest were based on the following questions administered at the 24-month interview"In the past seven days, how many hours per day on average has your child spent playing outside?" and "On average, how many hours per day does your child spend watching television or videos?"

Outcome Definition

We calculated body mass index (BMI) at 2 years as weight in kilograms divided by height in meters squared. We then calculated age- and sex-specific BMI percentiles for each child using 2000 Centers for Disease Control and Prevention growth charts (17). Overweight was defined as at or above the 95th percentile of the sex-specific BMI for each child's age. At risk for overweight was defined as at or above the 85th percentile, but less than the 95th percentile of sex-specific BMI for age.

Statistical Analyses

Statistical analyses were performed using Stata 8.0 (Stata Corporation, College Station, TX). Soda consumption and the other dietary variables (time breastfed, fast food, sweets) were analyzed both as continuous and as categorical variables. Measures of physical activity (time spent playing outside, watching television) were also analyzed both as categorical and continuous variables.

We used logistic regression modeling to examine the cross-sectional relation of soda consumption and other dietary and physical activity variables and overweight status. For all regressions, we report nonparametric (Huber, sandwich) standard errors, which are valid even when conventional assumptions for regressions are violated (18). We report the odds ratio (OR) and 95% confidence interval (CI) as the measure of effect.

For the multivariate logistic regression analysis of soda consumption and overweight status, we examined the effect of potential confounding variables identified in the child obesity literature (19). In addition to the dietary and physical activity variables described above, potential confounders considered included family socioeconomic status (≤ poverty level, > poverty level), language spoken in the home (mostly Spanish, English/Spanish equally, mostly English), maternal education level (≤ 6th grade, 7–12th grade, ≥ high school), maternal parity (0, 1, 2+), maternal marital status (not married, married or living as married), number of years mother had lived in the U.S. at the time of pregnancy (≤1, 2–5, 6–10, 11+), maternal country of birth (US, Mexico, other), maternal age (years), maternal pre-pregnancy BMI (report at initial interview), maternal BMI at 24-months (measured), child's age at 24-month interview (months), child's birth weight (grams, abstracted from medical record), child's sex, child's age at developmental milestones including standing, walking, and running (maternal report), and child's intake of various foods and beverages (maternal report). Additionally, the Home Observation for Measurement of the Environment (HOME) score at 12 months, a measure of the home learning environment and parental responsiveness, was also included as a covariate. Covariates were kept in the model if they were statistically significant (p<0.15). We reran the final model including children who were at risk for overweight (≥85th percentile to <95th percentile for age-specific BMI) in the overweight group.

Results

Table 1 presents maternal and child characteristics of the CHAMACOS birth cohort by overweight status at 2 years of age. The majority of mothers were Mexican-born (87.6%), Spanish-speaking (94%) women who were married or living as married (81.9%), had not completed high school (81.6%), and were living in poverty (58.2%). At the time of the pregnancy, mothers were an average of 26.0 (standard deviation (SD) = ± 5.2) years old. Before pregnancy, 64.4% of mothers were overweight or obese (mean BMI = 27.4 (± 5.3) kg/m^2) and, by the 24-month follow-up, this number had increased to 80.5% (mean BMI = 29.6 (± 5.6) kg/m^2).

At birth, children weighed an average of 3,508 (± 448) grams, about one-third were first-born, and 51.1% were female. At the 24-month follow-up, children were on average, 24.6 (± 1.0) months old.

At the 24-month follow-up, 55 (15.5%) of the 354 children were classified as overweight (≥95th percentile for age-specific BMI) and 51 (14.4%) were at risk for overweight (≥85th percentile and <95th percentile for age-specific BMI). Thus, a total of 29.9% of children were overweight or at risk for overweight at 2 years of age. As presented in Table 1, overweight children were more likely to have an obese mother at pre-pregnancy ($p = 0.001$) and 24-month follow-up ($p < 0.01$). There was no difference in overweight status of children by maternal sociodemographic indicators, including mother's country of birth, years lived in the U.S., education, poverty, marital status, or child characteristics such as birth weight, gender, or age at 24-month follow-up.

Soda consumption and other dietary and physical activity characteristics of the children are presented in Table 2. The majority of children (56%) consumed soda, with an average consumption of 0.5 (±0.5; range= 0.2 to 3) sodas per day among consumers (data not shown). Most children ate fast food at least once per week (60%) and almost half (44%) of the children consumed one or more sweets per day. Almost all mothers (96%) initiated breastfeeding and the median length of breastfeeding was 6 months. On average, children played outside 2.1 (± 0.9) hours per day and watched television 2.6 (± 1.1) hours per day. Only 10% of children watched television less than 2 hours per day, as recommended by the American Academy of Pediatrics (20).

Descriptive statistics of children who drank soda are presented below (data not shown)

Children who drank soda were of higher birth weight ($p = 0.05$). They were also older ($p < 0.01$), consumed more fast food ($p = 0.005$), more sweets ($p = 0.01$), and watched more television per day ($p = 0.004$). Children who drank soda consumed less 100 % juice ($p = 0.06$), but there was no difference in consumption of other foods including milk ($p = 0.89$), fruits ($p = 0.40$) or vegetables ($p = 0.59$). Mothers of children who reported drinking soda in the last week had a higher BMI both at pre-pregnancy ($p = 0.001$) and at the 24-month interview ($p = 0.01$), and reported living in the U.S. more than 5 years ($p = 0.10$).

The crude OR and 95% CI for overweight status by dietary and physical activity characteristics are presented in Table 2. In crude analysis, soda consumption and fast food intake, but not sweets intake, were positively associated with overweight status. Children who breastfed longer were less likely to be overweight than children who had breastfed 0 to 2 months, but not significantly. Overweight status, however, was not significantly related to any of the physical activity characteristics including hours of outside play or television watching.

The results of adjusted logistic regression analysis are presented in Table 3. Soda consumption remained significantly positively related to overweight status in adjusted analysis. After adjusting for fast food, breastfeeding, and maternal pre-pregnancy BMI, <1 soda per day compared to no soda consumption, was not related to overweight status (adj-OR = 0.97; 95% CI = 0.47, 1.99), but ≥1 soda per day was significantly associated with a

three-fold increased odds of overweight (adj-OR = 3.39; 95% CI = 1.43, 8.07). The test for trend was significant ($p = 0.02$).

As presented in Table 3, in the adjusted analysis, fast food intake was no longer significantly associated with overweight. Compared to no fast food consumption, 1 – 2 fast food meals per week was associated with a non-significant increased odds of overweight (adj-OR = 1.54; 95% CI = 0.77, 3.10), and ≥ 3 fast food meals per week was associated with a non-significant four-fold increased odds of overweight (adj-OR = 4.08; 95% CI = 0.93, 17.94). The test for trend, however, was significant ($p = 0.02$).

Breastfeeding and maternal pre-pregnancy BMI remained independently associated with child's overweight status in the final multivariate model (see Table 3). The adjusted OR for overweight per month of breastfeeding was 0.96 (95% CI = 0.92, 1.00). Higher maternal pre-pregnancy BMI was significantly related to overweight status of the child at 2 years. Compared to normal/underweight maternal pre-pregnancy BMI, overweight maternal pre-pregnancy BMI was associated with a more than 2-fold increase in odds of overweight (adj-OR = 2.27; 95% CI = 0.99, 5.22), and obese maternal pre-pregnancy BMI was associated with a more than 5-fold increase in odds of overweight (adj-OR = 5.14; 95% CI = 2.13, 12.38).

We repeated the final model including the covariates that had been found to be related to soda consumption (age at follow-up, birth year, birth weight, time spent watching television, consumption of sweets, consumption of 100% juice, and living in the U.S. more than 5 years) and the results were not different (data not shown). When we reran the final model including children who were at risk for overweight in the overweight group, the results for soda consumption were similar, yet diminished. Compared to no soda consumption, consumption of ≥1 soda per day was still significantly associated with an increased odds of overweight (adj-OR = 2.49; 95% CI = 1.17, 5.32).

Discussion

At 2 years of age, we found the prevalence of overweight in the CHAMACOS birth cohort of 354 Mexican-American children living in an agricultural community was 15.5%. This prevalence is higher than that (11.1%) reported for the 259 Mexican-American, 2–5 years olds, in U.S. NHANES, 1999–2000, which is already considerably higher than that reported for other ethnic groups (non-Hispanic whites, 10.1%; non-Hispanic blacks, 8.4%) (1). With more than half of the 2-year-old children consuming soda, and 12% consuming one or more per day, our findings suggest soda consumption could be an important contributory factor to the obesity epidemic even in children as young as 2 years of age. Compared with children who consumed no soda, the odds of being overweight increased more than three-fold among children who consumed at least one soda per day.

Other studies indicate that high soda consumption in children as young as 2 years is not limited to Mexican-American populations. In a study of white and African-American children, 51% of pre-school children consumed any soda and 12% consumed ≥ 9 ounces of soda per day (9). Harnack et al. (9) reported soda consumption differed significantly by race;

white children were two-times more likely than African-American children to consume soda. The findings of this study suggest that soda consumption patterns of Mexican-Americans may be more similar to whites.

Our finding of an increased risk for overweight with higher soda consumption is consistent with previous studies of sweetened beverages including soda in school-age (12, 13) and preschool-age children (9, 14). An advantage of the present study over the previous study of preschool-age children is that we were able to control for other important confounding factors including maternal BMI and breastfeeding (14). Our findings are also consistent with the small but only other study in young Mexican-American children which found an association between sweetened beverage consumption and overweight status (15).

Others have suggested that consumption of soft drinks may also displace more nutritious beverage choices, particularly milk (9, 10). An inverse relationship between soda consumption and healthier options including milk and 100% juice has been reported among pre-school age children (9). In the current study, children who drank soda consumed similar amounts of milk but less 100% juice than children who did not drink soda.

Although we asked about consumption of healthier beverages including milk and 100% juice, a limitation of this study is we did not ask about consumption of fruit drinks (non-100% juice drinks). Thus, we cannot examine the relation of all sugar-sweetened beverages with overweight status in this study. In this young age group, fruit drinks may represent a significant proportion of total sweetened beverage intake. Among pre-school age children, Welsh et al. (14) reported daily consumption of fruit drinks averaged 0.7 drinks per day while soda averaged 0.3 drinks per day. The impact on our estimate of risk for overweight from soda consumption by not measuring fruit drink consumption could go in either direction. If non-consumers of soda consumed more fruit drinks instead, we may have underestimated the risk due to soda. If soda consumers were also more likely to consume fruit drinks, then we may have overestimated the risk due to soda. Another limitation of this study is we did not specifically exclude diet soda consumption in the food frequency question about consumption of soda. If consumers of diet soda were mis-classified as soda consumers, we may have underestimated the risk for overweight from soda consumption in this population.

Although the cross-sectional nature of the data limit interpretation of whether soda consumption preceded overweight status, the observed association is biologically plausible. It is believed that sugar-sweetened beverages such as soft drinks promote energy intake and excessive weight gain because compensation for increased calories consumed in liquid form is less complete than for calories consumed in solid form (12, 21). That is, children who drink sugar-sweetened beverages do not adequately reduce their intake of other foods and beverages, leading to increased caloric intake and subsequent weight gain.

Our findings also suggest that fast food consumption is related to overweight status as young as 2 years of age. To our knowledge, no study has examined the relation of fast food consumption with overweight status of very young children. Since the 1970s, fast food consumption by children in the United States has increased, with 30% of children reporting

consuming fast food on a given day (22). Children who eat fast food have been shown to consume more total energy, more total fat, more total carbohydrates, more added sugar, more sugar-sweetened beverages, less fiber, less milk, and fewer fruits and vegetables (22). We found that children who ate any fast food meals consumed significantly more soda (mean = 0.35 per day) than children who did not eat fast food meals (mean = 0.20 per day) ($p < 0.05$).

Consistent with the growing body of literature suggesting that breastfeeding is protective against child overweight (23, 24), we found a small but significantly decreased risk for overweight with breastfeeding compared to children who were never breast fed. In this Mexican-American population, 96% of the mothers initiated breast feeding; which is much higher than national estimates of between 46% and 69% (25). Continued breastfeeding in this population should be encouraged.

Inconsistent with previous studies in school-age children (26–30), we did not find an association between number of hours children watched television and overweight status. However, the children in this study did watch a lot of television (average, 2.6 hours per day), and 90% of children exceeded the American Academy of Pediatrics recommendation to watch less than 2 hours per day (20). A recent study of 3 to 6 year old children suggested that 6 years was a critical age when television may have a significant affect on BMI (31).

In summary, the results of this study highlight the high prevalence of overweight among low-income Mexican-American children living in an agricultural community in the United States. We found that the prevalence of overweight at 2 years of age among the CHAMACOS cohort is higher than the national prevalence estimate for Mexican-American, 2–5 year olds (1), and that this high rate is significantly related to current soda consumption. Because the CHAMACOS study is a longitudinal study, it will be important to continue to monitor the overweight status and examine the role of total sweetened beverage consumption and physical inactivity such as television and other media use on overweight status as the cohort ages. Our findings suggest that interventions designed to reduce consumption of soda in preschool-age Mexican-American children could be instrumental in reducing childhood obesity in this population. Interventions may need to consider cultural perceptions that the availability of fast foods and soft drinks is a manifestation of improved economic circumstances and even affluence (32).

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References

1. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999–2000. JAMA. 2002; 288:1728–1732. [PubMed: 12365956]

2. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. Pediatrics. 1999; 103:1175–1182. [PubMed: 10353925]
3. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berenson GS. Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. Pediatrics. 2001; 108:712–718. [PubMed: 11533341]
4. Latner JD, Stunkard AJ. Getting worse: the stigmatization of obese children. Obes Res. 2003; 11:452–456. [PubMed: 12634444]
5. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med. 1997; 337:869–873. [PubMed: 9302300]
6. Morrill AC, Chinn CD. The obesity epidemic in the United States. J Public Health Policy. 2004; 25:353–366. [PubMed: 15683071]
7. Munoz KA, Krebs-Smith SM, Ballard-Barbash R, Cleveland LE. Food intakes of US children and adolescents compared with recommendations. Pediatrics. 1997; 100:323–329. [PubMed: 9282700]
8. Guthrie JF, Morton JF. Food sources of added sweeteners in the diets of Americans. J Am Diet Assoc. 2000; 100:43–51. quiz 49–50. [PubMed: 10646004]
9. Harnack L, Stang J, Story M. Soft drink consumption among US children and adolescents: nutritional consequences. J Am Diet Assoc. 1999; 99:436–441. [PubMed: 10207395]
10. French SA, Lin BH, Guthrie JF. National trends in soft drink consumption among children and adolescents age 6 to 17 years: prevalence, amounts, and sources, 1977/1978 to 1994/1998. J Am Diet Assoc. 2003; 103:1326–1331. [PubMed: 14520252]
11. Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the united states: data from the national health and nutrition examination surveys. Am J Clin Nutr. 2000; 72:1343S–1353S. [PubMed: 11063476]
12. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. Lancet. 2001; 357:505–508. [PubMed: 11229668]
13. Berkey CS, Rockett HR, Field AE, Gillman MW, Colditz GA. Sugar-added beverages and adolescent weight change. Obes Res. 2004; 12:778–788. [PubMed: 15166298]
14. Welsh JA, Cogswell ME, Rogers S, Rockett H, Mei Z, Grummer-Strawn LM. Overweight among low-income preschool children associated with the consumption of sweet drinks: Missouri, 1999–2002. Pediatrics. 2005; 115:e223–e229. [PubMed: 15687430]
15. Ariza AJ, Chen EH, Binns HJ, Christoffel KK. Risk factors for overweight in five- to six-year-old Hispanic-American children: a pilot study. J Urban Health. 2004; 81:150–161. [PubMed: 15047793]
16. Eskenazi B, Bradman A, Gladstone E, Jeramillo S, Birch K, Holland N. CHAMACOS, A longitudinal birth cohort study: Lessons learned from the fields. Journal of Children's Health. 2003; 1:3–27.
17. Kuczmarski RJ, Ogden CL, Guo SS, et al. 2000 CDC Growth Charts for the United States: methods and development. Vital Health Stat. 2002; 11:1–190.
18. Huber, PJ. The behavior of maximum likelihood estimates under non-standard conditions. In: LeCam, LM.; Neyman, J., editors. Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Berkeley, CA: University of California Press; 1967. p. 221-233.
19. Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity: public-health crisis, common sense cure. Lancet. 2002; 360:473–482. [PubMed: 12241736]
20. American Academy of Pediatrics: Children, adolescents, and television. Pediatrics. 2001; 107:423–426. [PubMed: 11158483]
21. Mattes RD. Dietary compensation by humans for supplemental energy provided as ethanol or carbohydrate in fluids. Physiol Behav. 1996; 59:179–187. [PubMed: 8848479]
22. Bowman SA, Gortmaker SL, Ebbeling CB, Pereira MA, Ludwig DS. Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. Pediatrics. 2004; 113:112–118. [PubMed: 14702458]

23. Owen CG, Martin RM, Whincup PH, Smith GD, Cook DG. Effect of infant feeding on the risk of obesity across the life course: a quantitative review of published evidence. Pediatrics. 2005; 115:1367–1377. [PubMed: 15867049]
24. Dewey KG. Is breastfeeding protective against child obesity? J Hum Lact. 2003; 19:9–18. [PubMed: 12587638]
25. Newton ER. The epidemiology of breastfeeding. Clin Obstet Gynecol. 2004; 47:613–623. [PubMed: 15326425]
26. Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. Television viewing as a cause of increasing obesity among children in the United States, 1986–1990. Arch Pediatr Adolesc Med. 1996; 150:356–362. [PubMed: 8634729]
27. Robinson TN. Reducing children's television viewing to prevent obesity: a randomized controlled trial. JAMA. 1999; 282:1561–1567. [PubMed: 10546696]
28. Dennison BA, Erb TA, Jenkins PL. Television viewing and television in bedroom associated with overweight risk among low-income preschool children. Pediatrics. 2002; 109:1028–1035. [PubMed: 12042539]
29. Crespo CJ, Smit E, Troiano RP, Bartlett SJ, Macera CA, Andersen RE. Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988–1994. Arch Pediatr Adolesc Med. 2001; 155:360–365. [PubMed: 11231802]
30. Berkey CS, Rockett HR, Gillman MW, Colditz GA. One-year changes in activity and in inactivity among 10- to 15-year-old boys and girls: relationship to change in body mass index. Pediatrics. 2003; 111:836–843. [PubMed: 12671121]
31. Jago R, Baranowski T, Baranowski JC, Thompson D, Greaves KA. BMI from 3–6 y of age is predicted by TV viewing and physical activity, not diet. Int J Obes Relat Metab Disord. 2005; 29:557–564.
32. del Rio-Navarro BE, Velazquez-Monroy O, Sanchez-Castillo CP, et al. The high prevalence of overweight and obesity in Mexican children. Obes Res. 2004; 12:215–223. [PubMed: 14981213]

Table 1

Maternal and child characteristics by overweight status at 2 years of age, CHAMACOS, Salinas, California, 2002–3

Characteristic	N	(%)	Overweight	(%)	Not Overweight	(%)
Total*	354	(100.0)	55	(15.5)	299	(84.5)
Maternal characteristics						
Country of birth						
U.S.	44	(12.4)	8	(14.6)	36	(12.0)
Mexico/Other	310	(87.6)	47	(85.4)	263	(88.0)
Years in United States						
≤ 5	165	(46.6)	22	(40.0)	143	(47.8)
> 5	189	(53.4)	33	(60.0)	156	(52.2)
Education						
≤ 6th grade	161	(45.5)	25	(45.4)	136	(45.5)
7–12th grade	128	(36.2)	19	(34.6)	109	(36.5)
≥ high school	65	(18.4)	11	(20.0)	54	(18.1)
Marital status						
not married	64	(18.1)	14	(25.4)	50	(16.7)
married/living as married	290	(81.9)	41	(74.6)	249	(83.3)
Socioeconomic status						
≤ poverty	206	(58.2)	31	(56.4)	175	(58.5)
> poverty	148	(41.8)	24	(43.6)	124	(41.5)
Age at pregnancy (y)						
mean (SD)	26.0	(5.2)	25.5	(5.1)	26.0	(5.2)
Pre-pregnancy BMI†						
underweight	2	(0.6)	1	(1.8)	1	(0.3)
normal	124	(35.0)	8	(14.6)	116	(38.8)
overweight	142	(40.1)	23	(41.8)	119	(39.8)
obese	86	(24.3)	23	(41.8)	63	(21.1)
BMI at 24 month follow-up†						
underweight	1	(0.3)	0	(0.0)	1	(0.3)

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Characteristic	N	(%)	Overweight	(%)	Not Overweight	(%)
normal	68	(19.2)	6	(10.9)	62	(20.7)
overweight	138	(39.0)	16	(29.1)	122	(40.8)
obese	147	(41.5)	33	(60.0)	114	(38.1)
Child characteristics						
Birth order						
1	105	(29.7)	18	(32.7)	87	(29.1)
2	109	(30.8)	15	(27.3)	94	(31.4)
3+	140	(39.6)	22	(40.0)	118	(39.5)
Birthweight (g)						
mean (SD)	3,508	(448)	3,594	(460)	3,492	(445)
Gender						
male	173	(48.9)	30	(54.6)	143	(47.8)
female	181	(51.1)	25	(45.4)	156	(52.2)
Age at interview (mo)						
mean (SD)	24.6	(1.0)	24.7	(1.2)	24.6	(1.0)

* row percent

† $p < 0.05$

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Table 2

Dietary and physical activity characteristics and crude odds ratios (OR) and 95% confidence intervals (CI) for overweight status at 2 years of age, CHAMACOS, Salinas, California, 2002–3

Characteristic	N	(%)	Overweight	(%)	Not Overweight	(%)	Crude OR	(95% CI)
Soda (/day)								
none	155	(43.8)	18	(32.7)	137	(45.8)	1.00	
< 1	156	(44.1)	22	(40.0)	134	(44.8)	1.25	(0.64, 2.43)
1 +	43	(12.1)	15	(27.3)	28	(9.4)	4.08	(1.84, 9.05)
Fast food (meals/week)								
none	142	(40.1)	15	(27.3)	127	(42.5)	1.00	
1 – 2	200	(56.5)	36	(65.4)	164	(54.8)	1.86	(0.97, 3.55)
3 +	12	(3.4)	4	(7.3)	8	(2.7)	4.23	(1.14, 15.78)
Sweets (/day)								
< 1	198	(55.9)	33	(60.0)	165	(55.2)	1.00	
1	105	(29.7)	14	(25.4)	91	(30.4)	0.77	(0.39, 1.51)
> 1	51	(14.4)	8	(14.5)	43	(14.4)	0.96	(0.40, 2.16)
Breastfeeding (months)								
0 – 2	96	(27.1)	18	(18.8)	78	(81.2)	1.00	
2 – 6	90	(25.4)	16	(17.8)	74	(82.2)	0.94	(0.44, 1.98)
6 – 12	73	(20.6)	10	(13.9)	62	(86.1)	0.69	(0.30, 1.60)
> 12	95	(26.8)	11	(11.6)	84	(88.4)	0.57	(0.25, 1.28)
Play outside (hours/day)								
1	102	(28.8)	14	(25.4)	88	(29.4)	1.00	
2	163	(46.1)	21	(38.2)	142	(47.5)	0.93	(0.45, 1.92)
3 – 4	89	(25.1)	20	(36.4)	69	(23.1)	1.82	(0.86, 3.87)
Watch television (hours/day)								
< 2	36	(10.2)	5	(9.1)	31	(10.4)	1.00	
2 +	318	(89.8)	50	(90.9)	268	(89.6)	1.16	(0.43, 3.12)

Table 3

Adjusted odds ratios (95% CI) for overweight status at 2 years of age, CHAMACOS, Salinas, California, 2002–3

Characteristic	Adjusted OR* (95% CI)	
Soda (drinks/day)		
none	1.00	
<1	0.97	(0.47, 1.99)
1+	3.39	(1.43, 8.07)
Fast food (meals/week)		
none	1.00	
1 – 2	1.54	(0.77, 3.10)
3 +	4.08	(0.93, 17.94)
Breastfeeding (months)		
per month	0.96	(0.92, 1.00)
Pre-pregnancy BMI		
normal/underweight	1.00	
overweight	2.27	(0.99, 5.22)
obese	5.14	(2.13, 12.38)

*Adjusted for all other variables listed.