Changing WIC Changes What Children Eat

M. A. Chiasson,[1] S.E. Findley,[2] J.P. Sekhobo,[3] R. Scheinmann,[1] L.S. Edmunds,[3] A.S. Faly,[1] N.J. McLeod,[2]

[1]Public Health Solutions

[2]Columbia University, Mailman School of Public Health

[3]New York State Department of Health

Corresponding author:

Mary Ann Chiasson, DrPH

Vice President Research and Evaluation

Public Health Solutions

40 Worth Street

New York, NY 10012

Running Head: Changing WIC Changes What Children Eat

ABSTRACT

Objective: This study assessed the impact of revisions to the USDA Special Supplemental Nutrition Program for Women, Infants and Children (WIC) food packages on nutritional behavior and obesity in children 0-4-years-old participating in the New York State (NYS) WIC program. In January 2009, NYS was the first to implement these revisions which added fruits, vegetables, and whole grains, and replaced whole milk with low(1%)-/non-fat milk for children 2-4-years-old.

Design and Methods: In this cross-sectional study, more than 3.5 million administrative records in the NYS WIC Statewide Information System (WICSIS) were analyzed at six month intervals from July-December 2008 (pre-implementation) through July-December 2011. Behavioral data in WICSIS were obtained from parent interview by WIC staff at mandatory certification and recertification visits.

Results: Comparing July-December in 2008 and 2011, increases were observed in: breastfeeding initiation (72.2-77.5%); delaying introduction of solid foods until after 4 months of age (90.1-93.8%); daily fruit (87.0-91.6%), vegetable (78.1-80.8%), and whole grain consumption (59.0-64.4%) by children aged 1-4 years; and switches from whole milk to low-/non-fat milk by children aged 2-4 years (66.4-69.4%). In 1-year-old children, the proportion $\geq 95^{th}$ percentile weight-for-recumbent length decreased from 15.1 to 14.2%; the proportion of children 2-4-years-old with body mass index (BMI) $\geq 95^{th}$ percentile decreased from 14.6 to 14.2%.

Conclusions: These findings demonstrate that positive changes in dietary intake and reductions in obesity followed implementation of the USDA mandated cost neutral revisions to the WIC food package for the hundreds of thousands of young children participating in the NYS WIC program.

INTRODUCTION

Childhood overweight is highly prevalent in the United States, with 31.8% of children 2-19-years-old overweight or obese (BMI $\geq 85^{th}$ percentile) in 2009- 2010 (1). Overweight begins early in life, with 26.7% of 2-5-year- olds already overweight or obese (1). Children growing up in poverty are at particularly high risk for overweight from a very early age (2). Further, there is evidence for a cumulative impact of weight gain and attendant increases in hypertension, diabetes and other cardiovascular risk factors (3, 4), and fatty liver (5). Excessive weight gain before 6-12 months of age is associated with overweight at age three years (6-8) and childhood overweight tracks into adulthood (9, 10). Therefore, the Institute of Medicine recently urged the development of more obesity prevention programs that would target infants and young children (11).

WIC, the Special Supplemental Nutrition Program for Women, Infants, and Children, is just such a program. WIC provides nutritious foods to supplement diets, nutrition education, breastfeeding promotion and support, education around healthy lifestyles with young children, and referrals to health care. It reaches nearly half of all infants born in the United States and serves approximately nine million low-income pregnant and postpartum women, infants, and children below age five per month (12). WIC is well-positioned to reach the low-income children at greatest risk for early weight gain because only those with family income $\leq$ 185 percent of the Federal poverty guidelines are eligible to participate.

WIC was originally established to prevent under-nutrition and micronutrient deficiencies in those consuming inadequate calories and continues to support adequate nutrition. However, in 2005 the Institute of Medicine (IOM) report *WIC Food Packages: Time for a Change* challenged WIC to offer a more balanced approach to malnutrition, namely to reduce the elements of the

food package that contribute to overweight and obesity without compromising key nutrients/micronutrients often absent in the diet (13). In 2008 the United States Department of Agriculture (USDA) proposed its first major revisions to food packages provided by WIC since the program's inception in the 1970s (14). The changes reflected recommendations from the 2005 IOM report almost in their entirety and aligned with the American Academy of Pediatrics recommendations and the US Dietary Guidelines (15). For the first time, the food packages were required to include fruits, vegetables, and whole grains. For children 2 -4 years of age, low (1%)-non-fat milk replaced whole milk. WIC programs also were encouraged to offer healthy lifestyle educational programs focused on increasing physical activity and reducing television viewing for children and their families in addition to WIC's core nutrition education function. The new food packages were designed to be cost neutral by balancing additions with a reduction in allotments of some dairy products and fruit juices (16).

On January 5, 2009, New York (NYS) was the first state to implement the new WIC food package. Fruits, vegetables, and whole grains were added to the package and children 2-4 years old were limited to low-(1%) or non-fat milk. At the same time, NYS introduced breastfeeding peer counseling and client-centered counseling as part of the WIC Healthy Lifestyle Initiative. This multi-faceted, comprehensive initiative provides caregivers participating in WIC throughout the state with education on ways to help their families increase healthy eating and physical activity and reduce screen time. The Healthy Lifestyle Initiative was built on programs that have been progressively implemented by NYS WIC since 1997 as part of the statewide initiative for childhood obesity prevention (17, 18).

This study was undertaken as part of a comprehensive evaluation of the innovative NYS WIC program obesity prevention policies and implementation of the new WIC food package.

Using cross-sectional data abstracted from the NYS WIC administrative data system, the objective of the study was to examine trends over time in prevalence of: infant feeding practices; daily consumption of fruits, vegetables, whole grains, and low-/non-fat milk; screen time; and obesity in children 1-4 years of age.

METHODS AND PRECEDURES

This study consisted of multiple cross-sections of records for infants and children through 4 years of age who were enrolled in the NYS WIC program between July 1, 2008 and December 31, 2011. Participant records were obtained from data extracts of WICSIS, an automated database housed within the NYS Department of Health in Albany that captures administrative data for the NYS WIC program. Behavioral data were obtained by WIC staff through parent/caregiver interview during mandatory certification (initial enrollment) and mid-certification visits and entered into WICSIS. There was, on average, a six-month interval between each child certification and mid-certification visit. Records for infants and children enrolled during the study period were extracted quarterly from the WICSIS database. All personal identifiers were removed, potentially identifying data elements were re-coded to further protect anonymity of participants, and each record was assigned a unique code prior to delivery of data to research staff. Data were then combined into seven, six-month intervals that started with July 1- December 31, 2008 and ended with July 1-December 31, 2011. If more than one data measurement existed for an individual infant/child in any six month period, the first data record was retained to ensure that an infant /child appeared only once in a six month period. However, because the data were cross-sectional, the same child may have been included in more than one six month period.

Each child/infant record contained the following demographic information: gender, age, and race/ethnicity (categorized as Hispanic, non-Hispanic black [black], non-Hispanic white [white], Asian, and other). Height or length and weight were measured by trained WIC staff according to standard protocol (19) or at physicians' offices within 60 days of WIC certification. Height or length was recorded to the nearest 1/4 inch and weight to the nearest 1/4 pound. For children two years of age and older, recorded measures of height and weight were converted to metric equivalents and BMI was computed as weight in kilograms divided by height in meters squared. Age- and sex-specific percentiles for BMI were computed based on the reference population for the 2000 CDC growth charts for US children. Overweight was defined as a sex-specific-BMI-for-age $\geq$ 85th and <95th percentile and obesity as sex-specific-BMI-for-age $\geq$ 95th percentile (20). For infants and children less than two years of age, sex-and age-specific percentiles for weight-for-recumbent length were computed based on the 2000 CDC growth charts for U.S. children (21).

Parents/caregivers were asked about the following behavioral outcomes during certification and recertification visits: the child's daily consumption of any fruits excluding juice (Y, N), any vegetables (Y, N), and whole grains (Y, N); if the child was ever breastfed or fed breast milk (Y, N); the type of milk the child drank most often (15 choices, collapsed into 4 categories: low (1%)-/non- fat, whole milk, other, and none); age infant was introduced to solid foods (<4, $\geq$4 months-for infants >4 and <12 months only); the daily number of hours the caregiver /child sat and watched TV, videos, DVDs (categorical 0 to 5+ hours/day); the daily number of hours the caregiver /child sat and used the computer and/or played computer video games (categorical 0 to 5+ hours/day). Screen time was calculated as time spent watching TV, videos, DVDs or using the computer. Screen time was presented as the proportion of children

meeting the age-specific guidelines for screen time: ≤2 hours/day for 2-4-year-olds and no screen time for 0<2-year-olds. Breastfeeding questions were asked until the child stopped breastfeeding. Physical activity measures were excluded from this analysis because data were collected by family activity and not at the individual level.

Data were analyzed using SPSS 14 and SAS version 9.2. Biologically implausible values for height or weight (approximately 1% of the sample) based on CDC criteria (22) were excluded. The analysis primarily involved the calculation of prevalence proportions for behaviors of interest and BMI categories. Proportions (%) reporting behaviors of interest and in specific BMI categories were calculated for children in each of the seven, six month intervals. Relative (not absolute) percent change was calculated by comparing values for the six month period before implementation of the new WIC food program and Healthy Lifestyles Initiative on January 5, 2009 with values in the July 1-December 31, 2011 interval. Statistical significance tests were not conducted because bi-annual WIC data represented a census of all children who participated in WIC.

This study was approved by the Institutional Review Boards of Public Health Solutions, Columbia University, and the NYS Department of Health.

RESULTS

A total of 3,562,184 participant records were included in the analysis. WIC enrollment fluctuated in the seven six-month study intervals, averaging 508,883 infants and children per interval. The distribution of demographic characteristics remained nearly constant over time (Table 1). The proportion of participants by gender was 51% male and 49% female throughout. More than one-third of participants (36%) were infants (<1 year) with the proportion by age dropping to 12% for four- year-olds. Nearly 38% of participants were Hispanic followed by 28%

white and 24% black. The proportion of Asian participants increased slightly during the study period from 7.5% to 8.3%.

Between July-December 2008 (pre-implementation of the WIC food package) and July-December 2011 positive changes, as measured by relative percent increase, were observed in all reported behaviors (Table 2). The largest increases in most behaviors occurred in the first year after implementation but continued throughout the study period. The proportions of mothers who initiated breastfeeding increased by 7.3% from 72.2 to 77.5%, and proportions of mothers who waited to introduce solid foods to infants until after 4 months of age increased by 4.1%.

Overall, 2-4-year-olds increased consumption of low/nonfat milk by 4.5% (66.4 to 69.4%) (Table 2), but changes varied by year of age. While two-year-olds showed no increase in consumption of low-/non-fat milk over time, 3 and 4-year-olds did. Four-year-olds showed the largest increase from 75.2 to 83.8% (Figure 1). Low/nonfat milk consumption in children aged two and older also varied by race/ethnicity in 2011 from a low of 64.8% in Asians to a high of 71.7% in whites (data not shown). Approximately, one-quarter of children aged two and older continued to drink whole milk and less than 1% of children drank no milk (data not shown).

Steady increases in daily consumption of any fruits (5.3%), vegetables (3.5%) and whole grains (9.1%) were observed in 1-4-year-olds (Table 2). The increases over time were similar across all age groups (data not shown). However, proportions varied by race/ethnicity with the highest levels of daily consumption in 2011 of fruits (93.8%), vegetables (87.4%) and whole grains (77.5%) reported by white children, while the lowest levels of fruit consumption (89.1%) were reported by black, of vegetables (76.1%) by Hispanic, and of whole grains (38.9%) by Asian children.

In addition to healthier dietary behaviors, the proportion of children who met age-pecific screen time guidelines during the study period also gradually increased. Proportions of 2-4-year-olds who reported ≤ 2 hours of screen time increased by 2.5%, while the proportion of children under two who reported no screen time increased by 33.3% from 23.4 to 31.2% (Table 2).

Proportions of children overweight or obese (BMI ≥85th percentile) gradually decreased by 2.9% over the study period. Overall, 31.4% of children age 2-4 were overweight/obese at pre-implementation, compared to 30.5% in the last half of 2011. Proportions of overweight children (BMI ≥85th and < 95th percentile) fluctuated during the study period, but declined by 3.0 % from 16.6% at pre-implementation to 16.3% in the last half of 2011. The proportion of obese children (BMI ≥95th percentile) showed similar fluctuations over time; declining by 2.7% from 14.6% at pre-implementation to 14.2% in the last half of 2011 (Table 2).

These patterns differed when trends in overweight/obesity were examined separately by age group and race/ethnicity. Overall, 4-year-olds were more likely to be overweight/obese than 2- or 3-year-olds, but declines in proportions of children overweight and obese were observed in all three age groups. Comparing the last six months of 2008 with the last six months of 2011, the largest relative percent decrease in overweight/obesity was 4.2% in 2-year-olds followed by 3.4% in 4-year-olds and 3.0% in 3-year-olds (Figure 2). A larger decrease of 6.0% from 15.1% to 14.2% was observed in proportions of one-year-old children with weight-for-recumbent length ≥ 95th percentile (Table 2).

Variations were also seen in decreases in prevalence of overweight/obesity by race/ethnicity comparing the two time periods (Figure 3). Overweight/obesity was most prevalent in Hispanic, similar in white and black, and least prevalent in Asian children. More than one third of Hispanic children 2-4-years-old were overweight/obese and they showed the

smallest relative percent decline (1.6%) between the last six months of 2008 and the last six months of 2011. In 2008, 29% of black and white children were overweight/obese. The largest relative percent decrease in prevalence over time, 4.5%, was observed in black children, followed by a 3.8% decrease in white children. Nearly one-quarter of Asian children were overweight/obese but that proportion decreased by 3.3% by the last half of 2011.

DISCUSSION

Positive changes in behavior and reductions in weight were observed in WIC participants following implementation of the revised NYS WIC food packages and the Healthy Lifestyles Initiative in January 2009. Analyses at six-month intervals from July-December 2008 (pre-implementation) through July-December 2011 of more than 3.5 million active records in the NYS WIC administrative database showed rapid, consistent increases in: breastfeeding initiation; delayed introduction of solid foods to infants; daily fruit, vegetable, and whole grain consumption by children aged 1-4 years; low (1%)-/non-fat milk consumption by children aged 2-4 years; and meeting age-specific screen time guidelines. The magnitude of the relative percent changes between the last half of 2008 and the last half of 2011 varied from 2.5 to 33.3%. However, even when the magnitude of change was small, the number of children positively impacted was large given that approximately 500,000 children from birth through age 4 participated in the NYS WIC program in any given study year, and nearly one-half of all infants born in NYS were reached by the WIC program. We estimate, for example, that in the last half of 2011 about 8,200 more children participating in WIC were consuming vegetables daily and 18,000 more were consuming whole grains than would have occurred if consumption rates had remained at 2008 levels.

Changes in dietary behavior were directly related to specific changes to the WIC food package. Increases in whole grain, fruit and vegetable consumption began after these items were added to the food package, while decreases in whole milk consumption occurred after it was eliminated from the food package for 2 - 4 year olds. An increasing proportion of mothers delayed introduction of solid foods until after four months of age when eligibility for infant cereal in the infant food package was changed from four months to six months of age.

In accordance with Dietary Guidelines for Americans (15), daily consumption of fruits and vegetables by 1-4-year-olds increased following the addition to the NYS WIC program of a $6 fruit and vegetable voucher per month per child enrolled. These WIC population changes confirm the findings of previous intervention studies that targeted subsidies increased the availability (23) and consumption of fruits and vegetables (24, 25). Nevertheless, while daily consumption of any fruits and vegetables increased following implementation of the new voucher system, nearly 10% of children in WIC were not eating fruit daily and 20% were not eating vegetables daily in 2011. This indicates the need for continued exploration of new ways to introduce healthy foods to families enrolled in WIC. The success of targeting the family environment for the promotion of healthy eating behaviors has been well described (26) and population-level interventions in settings such as WIC are likely to be the most cost-effective (27).

By limiting children 2-4-years-old to low-/non- fat milk checks, the NYS WIC Program achieved a 4.5% relative increase in the proportion of children consuming low/non-fat milk with a concomitant reduction in consumption of whole milk. However, this overall number obscured age-specific differences: increased low-/non-fat milk consumption was observed in 3- and 4-year-olds but not in 2-year-olds. These differences in age-specific behavior illustrate the

importance of examining milk consumption by year of age. A transition period appears to be needed for children to shift from whole milk at age one to low-/non-fat milk at age two. Switching from whole milk to low-fat milk is important because it results in a 30% reduction in calories (from 146 to 102) and a 75% reduction in fat (from 8 grams to 2 grams) per 8 ounce serving of milk (28).

The findings of our NYS WIC study, in which nearly 70% of children 2-4 years old consumed low-/non-fat milk, stand in sharp contrast to 2007-2008 National Health and Nutrition Survey (NHANES) data. Among a nationally representative sample of children, only 13% of those aged 2-5 years reported usually consuming low-/non-fat milk (29). Additional interventions, similar to the NYS WIC program restrictions and removal of whole milk from all public school cafeterias in New York City (28), that affect children at the population level are needed to reduce daily fat and calorie consumption.

In contrast to stabilizing national obesity trends at about 12% in children 2-5 years of age seen in NHANES in 2009-2010 (1), obesity in 1-4-year- old NYS WIC participants plateaued in 2006-2007 (30) followed by a proportional decline over the study period. The largest decrease (6%) in obesity was seen in 1 year olds, but the proportion of children 2-4-years-old who were obese also declined by 2.7% to 14.2% over the 7 six-month intervals of the study. Nationally, 26.7% of children ages 2-5 years were overweight or obese in 2009-2010 (1). While the proportion of children 2-4-years-old participating in NYS WIC who were overweight or obese in the last half of 2011 (30.5%) was higher than the national level, it was 0.9% lower than it was in the last half of 2008 (31.4%). This means that about 2,300 fewer children in NYS WIC were overweight or obese in 2011 compared to 2008.

The goal of preventing overweight and obesity in young children is particularly important given that childhood overweight tracks into adulthood (6, 7, 9, 10), and in light of growing evidence that excess BMI-years are associated with an increased incidence of diabetes among ever younger U.S. birth cohorts (31). Of the many chronic diseases associated with overweight and obesity in children, the development of type 2 diabetes is of particular concern given the results of a recent study showing that, unlike adults, a majority of youth with type 2 diabetes may require combination treatment or insulin therapy within a few years after diagnosis (32, 33).

The changes in diet and behavior observed in this study were likely supported and enhanced by breastfeeding (34) and parental education counseling available through the WIC Healthy Lifestyles Initiative as evidenced by the increase in the proportion of NYS WIC participants meeting age-specific screen time guidelines (17). Excessive screen time, primarily television viewing, in young children has been associated with a variety of negative consequences including cognitive and language delays (35), higher measures of body fatness, and reduced physical activity (36, 37). Excessive screen time is one of many factors contributing to the current obesity epidemic either directly, by limiting time available for physical activity, or indirectly, by exposing young children to aggressive food and beverage marketing (38) and/or promoting consumption of energy dense snacks (36).

The findings from our cross-sectional study demonstrated a strong temporal relationship between NYS WIC program changes, implemented in January 2009, and positive changes in dietary behaviors, weight, and screen time at the NYS WIC population level. However, these findings should be interpreted within their limitations. While use of the WICSIS administrative database, which included information on all infants and children actively participating in NYS WIC, had many advantages including responses to a broad array of questions asked in exactly

the same way of the of all parents/caregivers at six month intervals, the data collected were limited to those required for program administration and evaluation. Other than heights and weights most other information was self-reported by the parent/caregiver. Only crude measures of dietary intake for a limited number of items such as type of milk and daily fruit and vegetable consumption, breastfeeding initiation, other infant feeding practices, and screen time were collected. Collection of more detailed information on these behaviors may have demonstrated an even greater programmatic impact. Lastly, no information was available on the intensity of exposure of individual parents/caregivers to nutritional, breastfeeding, or other health behavior educational messages from WIC, healthcare providers, media, or other sources. Additional studies which compare behavior change in WIC and non-WIC participants such as NHANES are needed to confirm and quantify the impact of changes to the WIC food package on a national level.

Nonetheless, the findings from this study suggest that, within the context of the WIC Healthy Lifestyle Initiative which includes breastfeeding peer and client-centered counseling on ways parents can help their families increase healthy eating and reduce screen time, the USDA mandated changes to the WIC food package have resulted in positive changes in dietary intake, weight, and screen time for the hundreds of thousands of young children participating in the NYS WIC program. While our findings are limited to NYS, they imply that WIC has enormous potential to positively influence nutrition and diet, both now and in the future (39), through revenue neutral changes to a nutritional program that reaches one-half of all children born in in the U.S. A national focus on evidence-based, population-level obesity prevention programs such as WIC, *Let's Move! Child Care,* various components of the Affordable Care Act 9 (Public Law

111-248) and the Healthy, Hunger-Free Kids Act (Public Law 111-296) that target children from the earliest ages is essential to combat the obesity epidemic in the U.S (40).

ACKNOWLEDGEMENTS

This project was supported by grants from The Robert Wood Johnson Foundation Statewide Evaluations of Childhood Obesity Prevention Policies and the New York State Health Foundation.

Competing interests: the authors have no competing interests.

REFERENCES

1. 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 Feb 1;307(5):483-90.
2. Freedman DS, Ogden CL, Flegal KM, Khan LK, Serdula MK, Dietz WH. Childhood overweight and family income. MedGenMed. 2007;9(2):26.
3. Sorof J, Daniels S. Obesity hypertension in children: a problem of epidemic proportions. Hypertension. 2002 Oct;40(4):441-7.
4. Steinberger J, Daniels SR, Eckel RH, Hayman L, Lustig RH, McCrindle B, et al. Progress and challenges in metabolic syndrome in children and adolescents: a scientific statement from the American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing; and Council on Nutrition, Physical Activity, and Metabolism. Circulation. 2009 Feb 3;119(4):628-47.
5. Schwimmer JB, Deutsch R, Kahen T, Lavine JE, Stanley C, Behling C. Prevalence of fatty liver in children and adolescents. Pediatrics. 2006 Oct;118(4):1388-93.
6. Dennison BA, Edmunds LS, Stratton HH, Pruzek RM. Rapid infant weight gain predicts childhood overweight. Obesity (Silver Spring). 2006 Mar;14(3):491-9.
7. Taveras EM, Rifas-Shiman SL, Belfort MB, Kleinman KP, Oken E, Gillman MW. Weight status in the first 6 months of life and obesity at 3 years of age. Pediatrics. 2009 Apr;123(4):1177-83.
8. McCormick DP, Sarpong K, Jordan L, Ray LA, Jain S. Infant obesity: are we ready to make this diagnosis? J Pediatr. 2010 Jul;157(1):15-9.
9. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. Am J Clin Nutr. 1999 Jul;70(1):145S-8S.
10. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. Obes Rev. 2008 Sep;9(5):474-88.
11. Committee on Obesity Prevention Policies for Young Children. Institute of Medicine. Early Childhood Obesity Prevention Policies. Birch LL, Parker L, Burns A, editors: The National Academies Press; 2011.
12. Frequently Asked Questions about WIC. Food & Nutrition Service; Available from: http://www.fns.usda.gov/wic/faqs/faq.htm, accessed August 15, 2012.
13. WIC Food Packages: Time for a Change. Washington, DC: Institute of Medicine April 2005.
14. "Special Supplemental Nutrition Program for Women, Infants and Children (WIC): Revisions in the WIC Food Packages, Interim Rule." *Code of Federal Regulations* Title 7, Pt. 246. 2007 ed.
15. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th ed. Washington, D.C.: U.S. Government Printing Office; December 2010.
16. Hanson K. Economic linkages between the WIC Program and the farm sector. Oliveira VJ, editor. [Washington, D.C.] :: U.S. Dept. of Agriculture, Economic Research Service; 2009.
17. Davison KK, Edmunds LS, Wyker BA, Young LM, Sarfoh VS, Sekhobo JP. Feasibility of increasing childhood outdoor play and decreasing television viewing through a family-based intervention in WIC, New York State, 2007-2008. Prev Chronic Dis. 2011 May;8(3):A54.

18. Sekhobo JP, Egglefield K, Edmunds LS, Shackman G. Evidence of the adoption and implementation of a statewide childhood obesity prevention initiative in the New York State WIC Program: the NY Fit WIC process evaluation. Health Educ Res. 2012 Apr;27(2):281-91.
19. Crespi CM, Alfonso VH, Whaley SE, Wang MC. Validity of child anthropometric measurements in the Special Supplemental Nutrition Program for Women, Infants, and Children. Pediatr Res. 2012 Mar;71(3):286-92.
20. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. Pediatrics. 2007 Dec;120 Suppl 4:S164-92.
21. Grummer-Strawn LM, Reinold C, Krebs NF. Use of World Health Organization and CDC growth charts for children aged 0-59 months in the United States. MMWR Recomm Rep. 2010 Sep 10;59(RR-9):1-15.
22. A SAS Program for the CDC Growth Charts. Centers for Disease Control and Prevention; Available from: http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm, accessed August 15, 2012.
23. Hillier A, McLaughlin J, Cannuscio CC, Chilton M, Krasny S, Karpyn A. The impact of WIC food package changes on access to healthful food in 2 low-income urban neighborhoods. J Nutr Educ Behav. 2012 May-Jun;44(3):210-6.
24. Herman DR, Harrison GG, Afifi AA, Jenks E. Effect of a targeted subsidy on intake of fruits and vegetables among low-income women in the Special Supplemental Nutrition Program for Women, Infants, and Children. Am J Public Health. 2008 Jan;98(1):98-105.
25. Whaley SE, Ritchie LD, Spector P, Gomez J. Revised WIC food package improves diets of WIC families. J Nutr Educ Behav. 2012 May-Jun;44(3):204-9.
26. Pearson N, Timperio A, Salmon J, Crawford D, Biddle SJ. Family influences on children's physical activity and fruit and vegetable consumption. Int J Behav Nutr Phys Act. 2009;6:34.
27. Cobiac LJ, Vos T, Veerman JL. Cost-effectiveness of interventions to promote fruit and vegetable consumption. PLoS One. 2010;5(11):e14148.
28. Effects of switching from whole to low-fat/fat-free milk in public schools - New York city, 2004-2009. MMWR Morb Mortal Wkly Rep. 2010 Jan 29;59(3):70-3.
29. Kit B, Carroll MD, Ogden CL. Low-fat milk consumption among children and adolescents in the United States, 2007-2008. In: brief Nd, editor. Hyattsville, MD: National Center for Health Statistics. 2011.
30. Sekhobo JP, Edmunds LS, Reynolds DK, Dalenius K, Sharma A. Trends in prevalence of obesity and overweight among children enrolled in the New York State WIC program, 2002-2007. Public Health Rep. 2010 Mar-Apr;125(2):218-24.
31. Lee JM, Gebremariam A, Vijan S, Gurney JG. Excess body mass index-years, a measure of degree and duration of excess weight, and risk for incident diabetes. Arch Pediatr Adolesc Med. 2012 Jan;166(1):42-8.
32. Zeitler P, Hirst K, Pyle L, Linder B, Copeland K, Arslanian S, et al. A clinical trial to maintain glycemic control in youth with type 2 diabetes. N Engl J Med. 2012 Jun 14;366(24):2247-56.
33. Allen DB. TODAY--a stark glimpse of tomorrow. N Engl J Med. 2012 Jun 14;366(24):2315-6.

34. Wilde P, Wolf A, Fernandes M, Collins A. Food-package assignments and breastfeeding initiation before and after a change in the Special Supplemental Nutrition Program for Women, Infants, and Children. Am J Clin Nutr. 2012 Sep;96(3):560-6.
35. Tomopoulos S, Dreyer BP, Berkule S, Fierman AH, Brockmeyer C, Mendelsohn AL. Infant media exposure and toddler development. Arch Pediatr Adolesc Med. 2010 Dec;164(12):1105-11.
36. Marshall SJ, Biddle SJ, Gorely T, Cameron N, Murdey I. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. Int J Obes Relat Metab Disord. 2004 Oct;28(10):1238-46.
37. Hinkley T, Salmon J, Okely AD, Hesketh K, Crawford D. Correlates of Preschool Children's Physical Activity. Am J Prev Med. 2012 Aug;43(2):159-67.
38. Harris JL, Graff SK. Protecting young people from junk food advertising: implications of psychological research for First Amendment law. Am J Public Health. 2012 Feb;102(2):214-22.
39. Craigie AM, Lake AA, Kelly SA, Adamson AJ, Mathers JC. Tracking of obesity-related behaviours from childhood to adulthood: A systematic review. Maturitas. 2011 Nov;70(3):266-84.
40. Trust for America's Health and the Robert Wood Johnson Foundation. F as in Fat: How Obesity Threatens America's Future — 2012: Available from: http://healthyamericans.org/assets/files/2012_f_as_in_fat_FINAL%20ES%209-22-12.pdf.

Table 1 – Demographic Characteristics of Children Enrolled in New York State WIC

Characteristics	2008	2009		2010		2011	
	July - December	January - June	July - December	January - June	July - December	January - June	July - December
N[a]	494,311	506,660	515,360	511,405	512,429	509,012	513,007
	%	%	%	%	%	%	%
Gender							
Male	50.7	50.8	50.8	50.8	50.8	50.8	50.8
Female	49.3	49.2	49.2	49.2	49.2	49.2	49.2
Age (Year)							
<1	36.4	36.8	36.6	36.5	36.3	36.2	35.8
1 (≥ 1 < 2)	21.4	21.0	20.7	20.5	20.5	20.2	20.1
2 (≥ 2 < 3)	16.3	16.5	16.8	16.8	16.8	16.7	16.8
3 (≥ 3 < 4)	14.0	14.2	14.3	14.6	14.7	14.8	14.9
4 (≥ 4 < 5)	11.9	11.5	11.6	11.6	11.7	12.1	12.4
Race/Ethnicity							
Black, NH[b]	24.8	24.7	24.4	24.4	24.3	24.2	24.3
White, NH[b]	27.9	27.9	28.0	28.0	27.9	27.9	27.8
Hispanic	37.5	37.6	37.7	37.8	37.8	37.6	37.5
Asian	7.5	7.5	7.6	7.6	7.8	8.1	8.3
Other	2.3	2.3	2.3	2.3	2.2	2.2	2.1

[a] Individual N's vary due to missing data.

[b] Non-Hispanic

TABLE 2 – Trends in Behavior and Weight among WIC Participants Following Implementation[a] of a Revised WIC Food Package in New York State

Behavior	2008[a] July - December %	2009 January - June %	2009 July - December %	2010 January - June %	2010 July - December %	2011 January - June %	2011 July - December %	% Change[b] 2008-11 %
Breastfeeding								
Initiation	72.2	73.0	73.9	74.8	75.7	76.6	77.5	7.3
Introduction of Solids								
After 4 months of age[c]	90.1	91.2	92.7	93.2	93.0	93.2	93.8	4.1
Low/Non-fat Milk Consumption								
≥ 2 - 4 year olds	66.4	69.4	70.7	70.0	69.6	69.4	69.4	4.5
Daily consumption: 1 - 4 Year olds								
Fruits	87.0	88.4	90.4	91.2	91.5	91.2	91.6	5.3
Vegetables	78.1	79.4	80.3	80.5	80.5	80.3	80.8	3.5
Whole/grains	59.0	59.1	62.1	63.8	64.3	64.4	64.4	9.1
Screen Time[d] ≤ 2 hours								
≥ 2 - 4 year olds	68.2	68.7	70.2	70.6	70.7	69.8	69.9	2.5

TABLE 2 continued – Trends in Behavior and Weight among WIC Participants Following Implementation[a] of a Revised WIC Food Package in New York State Behavior

	2008[a]	2009		2010		2011		
	July - December %	January - June %	July - December %	January - June %	July - December %	January - June %	July - December %	% Change[b] 2008-11 %
No Screen Time[d]								
0 < 2 year olds	23.4	26.1	28.1	29.1	30.0	30.6	31.2	33.3
Weight								
BMI ≥ 2 - 4 years old								
85th - < 95th percentile	16.8	17.1	16.7	17.2	16.4	16.9	16.3	- 3.0
≥ 95th percentile	14.6	14.7	14.5	14.8	14.3	14.6	14.2	- 2.7
Weight for Recumbent Length								
≥ 1 – 2 years								
≥ 95th percentile	15.1	15.6	15.5	15.9	14.8	15.2	14.2	- 6.0

[a] 6 months before January 5, 2009 implementation

[b] Comparing July-December 2011 and July-December 2008 by relative percent change.

[c] For all infants > 4 months old

[d] Time spent watching TV, videos, DVDs or using the computer

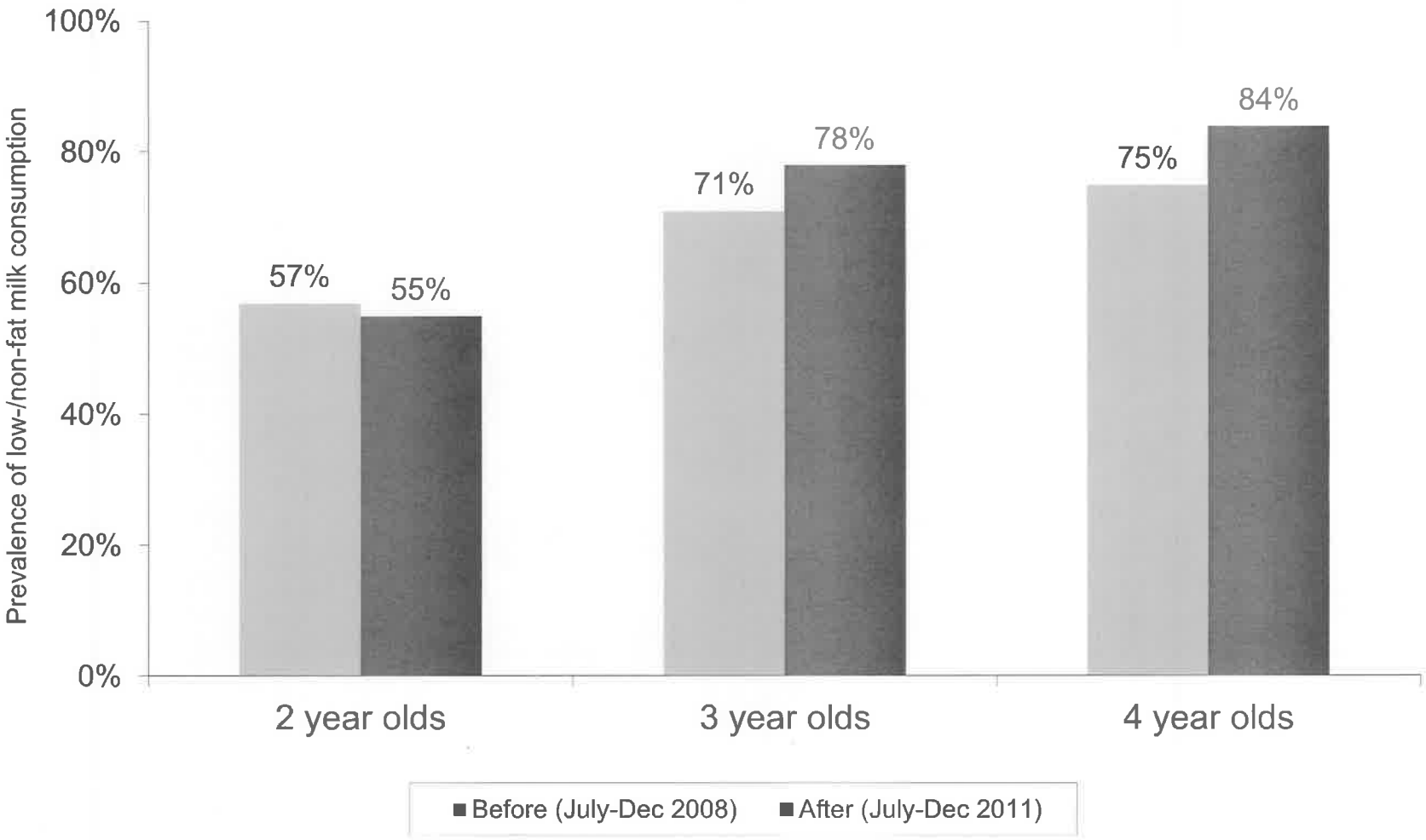

Figure 1. Prevalence of low-/non-fat milk consumption by year of age before and after changes in the New York State WIC program

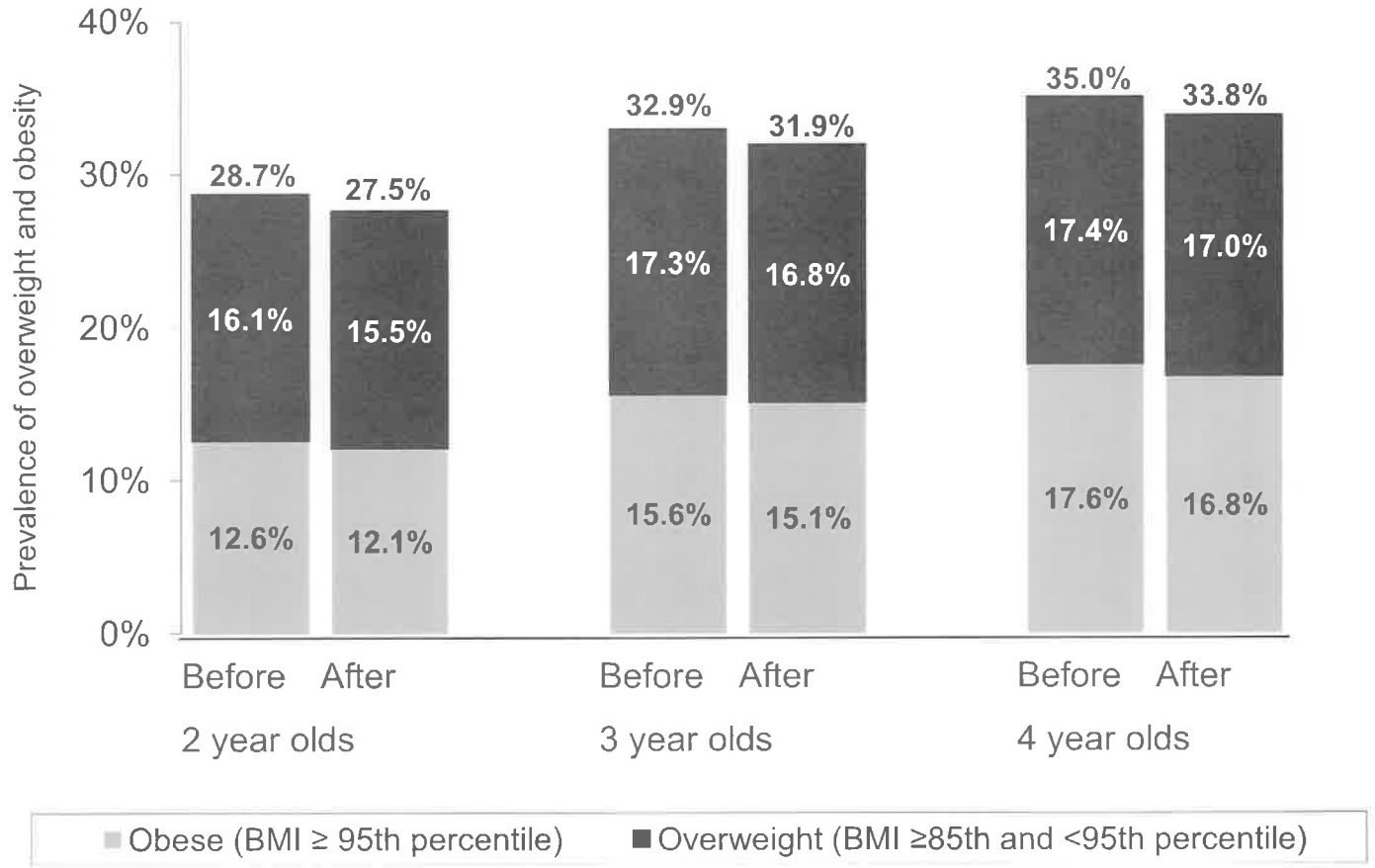

Figure 2. Declines in overweight and obesity by age after changes in the New York State WIC program. Before: July-December 2008; After: July-December 2011

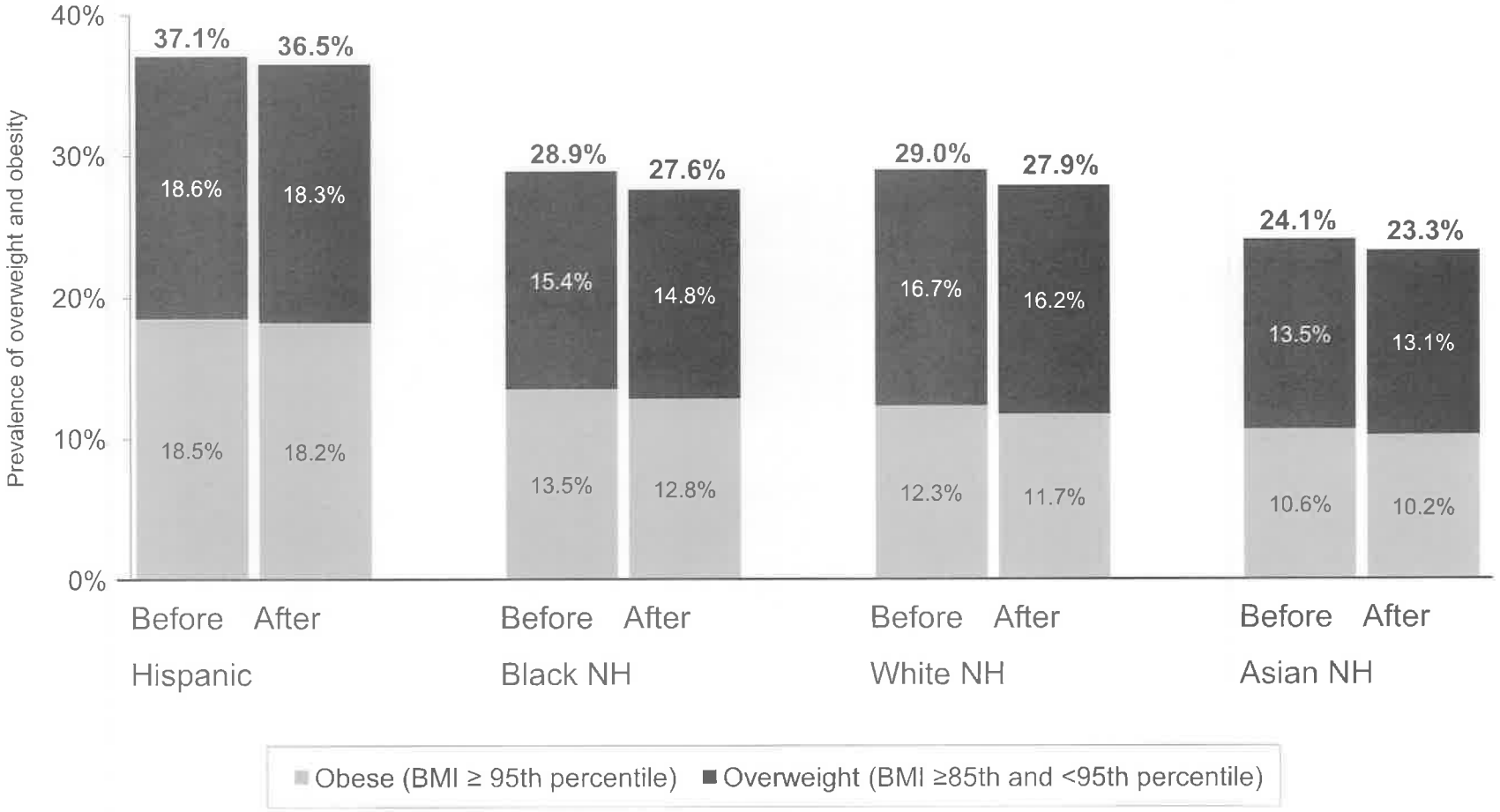

Figure 3. Prevalence of overweight and obesity in children 2 to 4 years of age by race/ethnicity before and after changes to the New York State WIC program. NH= Non-Hispanic; Before: July-December 2008; After: July-December 2011