



Published in final edited form as:

J Nutr. 2013 July ; 143(7): 1155–1160. doi:10.3945/jn.113.176289.

Intakes of dairy products and dietary supplements are positively associated with iodine status among U.S. children

Cria G. Perrine^{1,3}, Kevin M. Sullivan^{1,4}, Rafael Flores¹, Kathleen L. Caldwell², and Laurence M. Grummer-Strawn^{1,3}

¹Division of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA

²Division of Laboratory Sciences, Centers for Disease Control and Prevention, Atlanta, GA

³United States Public Health Service Commissioned Corps, Atlanta, GA

⁴Rollins School of Public Health, Emory University, Atlanta, GA

Abstract

Although pregnant women and some groups of reproductive age women in the United States may be at risk for iodine deficiency, data also suggest that iodine intake among many U.S. children may be above requirements. Our objective was to describe the association of iodine sources with iodine status among children. We analyzed 2007–2010 National Health and Nutrition Examination Survey data of urine iodine concentration (UIC) spot tests for children 6–12 y (n=1553), and used World Health Organization criteria for iodine status (median UIC 100–199 µg/L=adequate; 200–299 µg/L=above requirements; 300µg/L=excess). Overall median UIC was above requirements for children 6–12 y (211 µg/L, 95% CI: 194, 228µg/L). Median UIC increased by quartile of previous day dairy intake, ranging from adequate in the lowest quartile (157 µg/L, 95% CI: 141, 170 µg/L) to above requirements in the highest quartile (278 µg/L, 95% CI: 252, 336 µg/L). Median UIC was 303 µg/L (95% CI: 238, 345 µg/L) among the 17% of children who had taken a dietary supplement containing iodine the previous day, compared with 198 µg/L (95% CI: 182, 214 µg/L) among those who had not. In adjusted regression analyses recent dairy intake and recent supplement use were significantly positively associated with UIC levels, while recent grain intake was negatively associated. Adding salt to food at the table was not associated with UIC. Iodine containing supplements are likely not needed by most schoolchildren in the U.S. because dietary iodine intake is adequate in this age group.

Introduction

Iodine is a required component of thyroid hormones and is necessary for growth and development. Because of iodine's critical role in fetal and early childhood neurocognitive development, pregnant and lactating women and children less than 2 years of age are the

Corresponding author: Cria G. Perrine, 4770 Buford Hwy NE, MS K-25, Atlanta, GA 30341, Phone (770) 488-5183; Fax (770) 488-5369, cperrine@cdc.gov.

The authors have no competing financial or conflicts of interest. There is no online supporting material. The findings in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

primary groups targeted by efforts to ensure iodine sufficiency (1). Since the introduction of voluntary salt iodization programs in the 1920s, the overall iodine status of the U.S. population has generally been considered sufficient or even in excess of requirements (2). Urine iodine concentration (UIC) from spot urine samples is the most common indicator used for assessing the iodine status of populations (1). To monitor the iodine status of the U.S. population, the National Health and Nutrition Examination Survey (NHANES) measures UIC among a representative sample of residents aged >6 y. From NHANES I (1971–1974) to the present the iodine levels in NHANES have decreased by approximately 50% (2, 3). Although the median iodine level in the U.S. population is still considered sufficient despite this drop, some data suggest that iodine intake among pregnant women may be insufficient, whereas iodine intake among school-age children (6–12 y) may be above requirements (3, 4). The Recommended Dietary Allowance (RDA) of iodine is 90 µg/d for children 1–8 y and 120 µg/d for children 9–13 y (5).

Sources of iodine in the U.S. include dairy products, due to the use of iodine-containing cleaning products used in the milking process and iodine added to animal feed; grains and breads, as iodine can occur naturally in crops grown in iodine-rich soils or be added through the use of iodate-dough conditioners; table salt, approximately 70% of which is estimated to be iodized by voluntary iodization programs; marine fish, other seafood, and some seaweeds; and some dietary supplements (6–8). However, estimating people's iodine intake is complicated by substantial variation in the iodine content of foods. Because of this variation, the U.S. Department of Agriculture food composition tables, which are frequently used to estimate nutrient intake on the basis of reported food intake, do not contain data on the iodine content of U.S. foods (9). The only national data that can be used to estimate U.S. iodine intake are from the U.S. Food and Drug Administration's Total Diet Study (TDS), which measures iodine in samples of more than 250 foods from three locations in each of four regions. TDS data for 2003–2004 showed that dairy products were the single largest contributor to total iodine intake in all age-sex groups examined, other than infants, accounting for 70% of iodine intake among children aged 6 y and 10 y, and that grains accounted for approximately 15% of iodine intake among these children. However, TDS data do not reflect iodine intake from table salt or dietary supplements (10).

Previously we described dairy products as an important contributor to iodine status among pregnant and reproductive age women in the U.S. (4). Public health interventions that aim to ensure iodine sufficiency among pregnant and reproductive age women must also be aware of the potential for excess intake of iodine among children. In this study, we sought to describe contributors to iodine intake among U.S. children aged 6–12 y, the group whose iodine status the World Health Organization (WHO) has recommended for monitoring (1).

Methods

Sample population

The source of our study sample, NHANES, uses a complex multistage probability sampling design to collect health and nutrition data representative of the civilian, non-institutionalized U.S. population. In 1999, NHANES adopted a continuous data collection methodology, which it uses to report data in 2-year cycles. For this study, we combined data for 2007–

2008 and 2009–2010. During most 2-year cycles, NHANES measures UIC of only a third of participants >6 y; however, in 2007–2008, it measured the UIC of the entire eligible NHANES sample. No ethical approval was required as this was secondary data analysis of publicly available, de-identified NHANES data.

Iodine status

Our estimates of iodine status were based on analyses of spot urine samples obtained from children at the NHANES mobile examination center. UIC was measured with an Inductively Coupled-Plasma Dynamic-Reaction Cell Mass Spectrometer ELAN® DRC Plus (PerkinElmer Instruments, Shelton, CT) (11). WHO recommends assessing the median UIC of spot samples from a large representative group, and provides cut-offs for describing the iodine nutritional status of a population using this measure. Among children, median UIC <100 µg/L indicates insufficient iodine intake, 100–199 µg/L is adequate, 200–299 µg/L is above requirements, and ≥300 µg/L is excess. WHO additionally recommends that no more than 20% of the population should have UIC values below 50 µg/L (1).

Contributors to iodine intake

Since 2003–2004, NHANES has included two 24-h dietary recall interviews: one at the mobile examination center and a second 3–10 days later via telephone. In this analysis, we used data from only the first recall interview because it was conducted at the same time that participants' urine spot specimen was collected, and UIC is an indicator of iodine intake in the previous 1–2 days (1). NHANES conducted proxy-assisted (with help from a parent or guardian) recall interviews for children aged 6–11 y and direct interviews with children aged 12 y. We used food codes to categorize foods into 9 major consumption categories defined by the USDA Food Coding Scheme; these categories included “milk and milk products” (from here on referred to as “dairy products”) and “grain products” (12). We did not include fish consumption in this analysis as fish consumption is generally low among children in the U.S., and in the TDS meat, fish, and poultry together accounted for only 2% of iodine intake among children (10, 13). We summed all foods with a code identifying it as a dairy product in order to obtain total grams of dairy consumed in the previous 24 h; the same process was repeated for grain products. We categorized dairy product consumption as any versus none, as well as by quartile of intake. We were not able to categorize grain product consumptions as any versus none, as 99% of children had consumed grain products in the previous 24 h. Instead we categorized grain product consumption as above or below the median (262 g), as well as by quartile of intake.

Beginning in the 2007–2008 cycle NHANES has included a 24 h supplement recall at the same time as the dietary recall. If children reported taking a supplement in the previous 24 h, product names were obtained and compared to a database containing information about vitamin and mineral content. We categorized participants as having consumed or not consumed a supplement containing iodine in the previous 24 h.

We categorized children's table salt use as never/rarely versus occasionally/very often on the basis of respondents' answers to a question about how frequently children added salt to

food at the table. However, this question did not distinguish between iodized and noniodized salt.

Covariates

The covariates in our study were age (6–8 y or 9–12 y), sex, and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or Other). The “Hispanic” group was a combination of two NHANES racial/ethnic groups, “Mexican-American” and “Other Hispanic.”

Statistical analyses

Of 1,668 NHANES participants aged 6–12 y with UIC data, we excluded from our analyses 4 children who reported having a current thyroid medical condition or taking a thyroid medication and 111 children with missing data on dairy or grain product intake, supplement use, or salt use, leaving us with a final analytic sample of 1,553 children. Children excluded from the analysis did not differ in race/ethnicity, age, sex, or UIC compared to those included in the analysis.

We used SAS 9.2 (SAS Institute Inc, Cary, North Carolina) and SUDAAN version 10 (Research Triangle Institute, Research Triangle Park, North Carolina) to calculate weighted estimates for median UIC and proportion of children with UIC < 50 µg/L. Sample weights for UIC data were used, which account for the complex survey design and difference in UIC sampling. NHANES does not recommend presenting estimates for the “Other” racial/ethnic group, so these data were suppressed, but the “Other” racial/ethnic group is included in the overall and other stratified analyses (14). As recommended by NHANES, a relative standard error of 30% was used to assess estimate reliability (14). SAS and SUDAAN are unable to give p-values for comparing medians of groups while accounting for complex survey design, so we estimated differences in median UIC indirectly by categorizing individuals as above or below the overall median and conducting a chi-square analysis to test the null hypothesis that all subgroups have the same median.

We also conducted linear regression analyses to assess whether consumption of dairy products, grain products, or supplements within the previous 24 h or regular salt use were significant independent predictors of UIC. UIC data were right skewed, but followed a normal distribution after natural log transformation, and we used the transformed variable as the dependent variable. Dairy product and grain product intake were expressed as continuous variables per 100 g per day (the equivalent of ~100 ml of milk or ~3 slices of bread) to aid interpretability (9). All four primary predictors were included in the model, as well as the study covariates (race/ethnicity, age, and sex). We tested two-way interactions between each of the primary predictors and sex and race; however, because no interaction terms had a p-value <0.05, we dropped all interaction terms from the model. We detected no collinearity among predictors or covariates.

Results

Slightly more than half of children were non-Hispanic white, 22.0% Hispanic, and 14.1% non-Hispanic black (Table 1). Most children had consumed some dairy products in the

previous 24 h (87.6%), while nearly all had consumed some grain products (99.2%). Among those who had consumed dairy products, median dairy intake was 331 g, and among those who had consumed grain products, median grain intake was 270 g. Use of a supplement in the previous 24 h that was identified as containing iodine was reported by 16.5% of the sample, and 28.3% reported “occasionally/very often” adding salt to their food at the table.

The estimated median UIC among all children 6–12 y was 211 µg/L (Table 2). Results of our bivariate analyses showed that the median UIC varied significantly by dairy intake, supplement use, race/ethnicity, and age, but not by grain intake, table salt use, or sex. For nearly all subgroups analyzed, median UIC was adequate or above requirements; no subgroups had median UIC values categorized as insufficient, and only the group taking a supplement containing iodine in the previous 24 h had median UIC just above the cut-off for excess intake (median UIC=303 µg/L). The proportion of children with UIC below 50 µg/L was 5.4%. This proportion was higher in females, those not taking a supplement containing iodine, and children 9–12 y. Among all subgroups categorized this proportion was never higher than 10%.

Median UIC increased by quartile of dairy product intake, from 157 µg/L in the lowest quartile to 278 µg/L in the highest quartile ($p<0.001$; Figure 1a). However, median UIC did not vary by quartile of grain intake ($p=0.2$; Figure 1b).

In linear regression analyses adjusting for all primary predictors of interest and covariates (Table 3), dairy product intake and supplement use were positively associated with UIC, while grain product intake and being non-Hispanic black were inversely associated with UIC. Based on this model, for every 100 g/d increase in dairy product intake, there is an increase in UIC of 5%, controlling for all other variables; on the other hand, for every 100 g/d increase in grain intake, UIC decreased by 3%. Taking a supplement containing iodine in the previous 24 h increased UIC by 23%, controlling for all other variables.

Discussion

Our results indicate it is unlikely there is iodine deficiency among children 6–12 y in the U.S. Among all of the sub-groups examined, median UIC was consistently categorized as adequate or above adequate, and the proportion of children with UIC <50 µg/L was always less than 10%. As we found dairy products and dietary supplements to be important sources of iodine among children, we additionally explored the iodine status among children who had consumed neither in the previous 24 h: this included 10.5% of children in our sample, who had adequate iodine status (median UIC=150 µg/L). This is reassuring, for while data are limited, some evidence suggests that even mild iodine deficiency may impair a child’s cognitive development. A recent iodine supplementation trial in New Zealand showed that mildly iodine-deficient children improved their scores on picture concepts and matrix reasoning tests after they began taking iodine supplements (15).

We found several subgroups of children whose median UIC was categorized as above requirements. This meaning of this term is difficult to interpret from the public health perspective. This range of median UIC 200–299 µg/L is generally considered to increase

risk of iodine-induced hyperthyroidism among populations with long-standing iodine deficiency who then experience a rapid increase in iodine intake (1). Given that the U.S. population has had an adequate iodine status since the 1920s, this situation is not applicable in the U.S. Otherwise, median UIC values up to 300 µg/L are generally considered safe (1, 16). Results of a study of children aged 6–12 from five continents showed that although median UIC values >500 µg/L were associated with increased thyroid volume, levels up to 500 µg/L were generally well tolerated by healthy children (17).

The only subgroup of children with a median UIC in the excessive range were those who had consumed a supplement containing iodine during the previous day, and median UIC in this group was just above the cut-off for excess (median UIC 303 µg/L; excess is >300 µg/L). We found that 16.5% of children had consumed a supplement containing iodine in the previous 24 h. We were surprised at this relatively high proportion, which likely would have been even higher with a longer recall period. An analysis of NHANES data for 2003–2006 showed that 43% of children 4–8 y and 29% of children 9–13 y had taken some type of supplement in the previous 30 d and that 32% and 20%, respectively, had taken a multivitamin-multimineral supplement (18). This analysis did not report the type of supplements that children were taking (e.g. children's vitamin, general multivitamin). Among children who had consumed a supplement containing iodine in the previous day in our analysis, median intake was 66 µg, representing 73% of the RDA for children 6–8 y and 55% of the RDA for children 9–12 y. Given current dietary intake patterns of children, particularly dairy consumption, and the use of iodine-containing cleaning agents in the dairy production process, few children in the U.S. are likely to need a supplement containing iodine.

In bivariate analyses grain product intake was not associated with UIC, while in the adjusted model grain product intake was inversely associated with UIC. It is unclear why we found this inverse association. One possible explanation could be that high grain product consumption displaced other better sources of iodine. Additionally, the amount of iodine in grain products can vary substantially (8), and grain product intake from 24-hr dietary recalls may not be a good measure of iodine intake. Regular use of table salt was not associated with UIC. Information on salt use did not necessarily indicate recent intake, and we were unable to determine whether the table salt used was iodized, which may explain why we did not find an association between salt use and iodine status. Iodization of salt in the U.S. is voluntary, and while it has been estimated that approximately 70% of table salt in the U.S. is iodized, it is not clear how valid this estimate is. Additionally, the majority of the salt consumed in the U.S. is from processed and restaurant foods, not from table salt, and this salt is typically not iodized (19–21).

This analysis has several limitations. UIC values and single 24-hour dietary recalls can both be highly variable, and do not capture usual intake. However, since UIC is reflective of recent iodine intake, it was important to use only the 24-hour recall conducted at the time urine samples were collected in order to assess the association between dairy intake and iodine status. Since iodine is not included in the USDA nutrient database we are unable to quantify iodine consumption, so instead quantified consumption of food groups known to be important contributors to iodine intake. However, the iodine content of foods included in

these groups can be variable (8), and it is unknown how well these aggregate food groups capture iodine intake. UIC is generally not used as an indicator of individual iodine status, but here we used it as such in regression models in order to describe dietary factors associated with iodine intake. This was done in order to be able to adjust for other potential contributors to iodine status and demographic characteristics. Findings from the regression models were consistent with findings from bivariate analyses which used UIC as a population level indicator. The strengths of the analysis include that we analyzed recent, nationally representative data of U.S. children, and we were able to describe dietary factors that are associated with iodine status.

We found that the consumption of dairy products and the use of dietary supplements were each positively associated with UIC among U.S. children. Iodine containing supplements are likely not needed by most schoolchildren in the U.S. because dietary iodine intake is adequate in this age group; whether iodine should be included in supplements that are commonly consumed by children should be evaluated. Currently there is no monitoring or regulation of the use of iodine sanitizing agents in the dairy industry, and changes in the dairy production process could lead to changes in iodine levels of dairy products, and consequentially in the iodine status of the population (22). Continued monitoring of iodine status and better understanding of the iodine content in dairy products is warranted.

Abbreviations

NHANES	National Health and Nutrition Examination Survey
RDA	Recommended Dietary Allowance
TDS	Total Diet Study
UIC	Urine iodine concentration
WHO	World Health Organization

Literature Cited

1. WHO/UNICEF/ICCIDD. Assessment of iodine deficiency disorders and monitoring their elimination: a guide for program managers. 3. Geneva: World Health Organization; 2007.
2. Hollowell JG, Staehling NW, Hannon WH, Flanders DW, Gunter EW, Maberly GF, Braverman LE, Pino S, Miller DT, et al. Iodine nutrition in the United States. Trends and public health implications: iodine excretion data from National Health and Nutrition Examination Surveys I and III (1971–1974 and 1988–1994). *J Clin Endocrinol Metab.* 1998 Oct;83:3401–8. [PubMed: 9768638]
3. Caldwell KL, Makhmudov A, Ely E, Jones RL, Wang RY. Iodine Status of the U.S. Population, National Health and Nutrition Examination Survey, 2005–2006 and 2007–2008. *Thyroid.* 2011 Feb 16.
4. Perrine CG, Herrick K, Serdula MK, Sullivan KM. Some subgroups of reproductive age women in the United States may be at risk for iodine deficiency. *J Nutr.* 2010 Aug;140:1489–94. [PubMed: 20554903]
5. Institute of Medicine. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Washington, D.C: National Academy Press; 2001.
6. Gregory CO, Serdula MK, Sullivan KM. Use of supplements with and without iodine in women of childbearing age in the United States. *Thyroid.* 2009 Sep;19:1019–20. [PubMed: 19678748]

7. Dasgupta PK, Liu Y, Dyke JV. Iodine nutrition: iodine content of iodized salt in the United States. *Environmental science & technology*. 2008 Feb 15.42:1315–23. [PubMed: 18351111]
8. Pearce EN, Pino S, He X, Bazrafshan HR, Lee SL, Braverman LE. Sources of dietary iodine: bread, cows' milk, and infant formula in the Boston area. *J Clin Endocrinol Metab*. 2004 Jul.89:3421–4. [PubMed: 15240625]
9. United States Department of Agriculture. National Nutrient Database for Standard Reference, Release 25. 2012. [cited November 5, 2012]; Available from: <http://www.ars.usda.gov/ba/bhnrc/ndl>
10. Murray CW, Egan SK, Kim H, Beru N, Bolger PM. US Food and Drug Administration's Total Diet Study: dietary intake of perchlorate and iodine. *J Expo Sci Environ Epidemiol*. 2008 Nov. 18:571–80. [PubMed: 18167505]
11. Caldwell KL, Maxwell CB, Makhmudov A, Pino S, Braverman LE, Jones RL, Hollowell JG. Use of inductively coupled plasma mass spectrometry to measure urinary iodine in NHANES 2000: comparison with previous method. *Clinical chemistry*. 2003 Jun.49:1019–21. [PubMed: 12766019]
12. United States Department of Agriculture/Agriculture Research Service. Food Surveys Products and Surveys: Food Coding Scheme. [cited January 24, 2013]; Available from: <http://www.ars.usda.gov/Services/docs.htm?docid=12074#overview>
13. Keast DR, Fulgoni VL 3rd, Nicklas TA, O'Neil CE. Food sources of energy and nutrients among children in the United States: National Health and Nutrition Examination Survey 2003–2006. *Nutrients*. 2013 Jan.5:283–301. [PubMed: 23340318]
14. National Center for Health Statistics/Centers for Disease Control and Prevention. NHANES Analytic Guidelines (June 2004 Version). 2004. [cited Feb 14, 2013]; Available from: <http://www.cdc.gov/nchs/data/nhanes/guidelines1.pdf>
15. Gordon RC, Rose MC, Skeaff SA, Gray AR, Morgan KM, Ruffman T. Iodine supplementation improves cognition in mildly iodine-deficient children. *Am J Clin Nutr*. 2009 Nov.90:1264–71. [PubMed: 19726593]
16. Zimmermann MB, Aeberli I, Andersson M, Assey V, Yorg JA, Jooste P, Jukic T, Kartono D, Kusic Z, et al. Thyroglobulin Is a Sensitive Measure of Both Deficient and Excess Iodine Intakes in Children and Indicates No Adverse Effects on Thyroid Function in the UIC Range of 100–299 µg/L: A UNICEF/ICCIDD Study Group Report. *J Clin Endocrinol Metab*. 2013 Mar.98:1271–80. [PubMed: 23345097]
17. Zimmermann MB, Ito Y, Hess SY, Fujieda K, Molinari L. High thyroid volume in children with excess dietary iodine intakes. *Am J Clin Nutr*. 2005 Apr.81:840–4. [PubMed: 15817861]
18. Bailey RL, Gahche JJ, Lentino CV, Dwyer JT, Engel JS, Thomas PR, Betz JM, Sempos CT, Picciano MF. Dietary supplement use in the United States, 2003–2006. *J Nutr*. 2011 Feb.141:261–6. [PubMed: 21178089]
19. Mattes RD, Donnelly D. Relative contributions of dietary sodium sources. *J Am Coll Nutr*. 1991 Aug.10:383–93. [PubMed: 1910064]
20. Centers for Disease C, Prevention. Vital signs: food categories contributing the most to sodium consumption - United States, 2007–2008. *MMWR Morbidity and mortality weekly report*. 2012 Feb 10.61:92–8. [PubMed: 22318472]
21. Pearce EN. National trends in iodine nutrition: is everyone getting enough? *Thyroid*. 2007 Sep. 17:823–7. [PubMed: 17956156]
22. Li M, Ma G, Boyages SC, Eastman CJ. Re-emergence of iodine deficiency in Australia. *Asia Pac J Clin Nutr*. 2001; 10:200–3. [PubMed: 11708309]

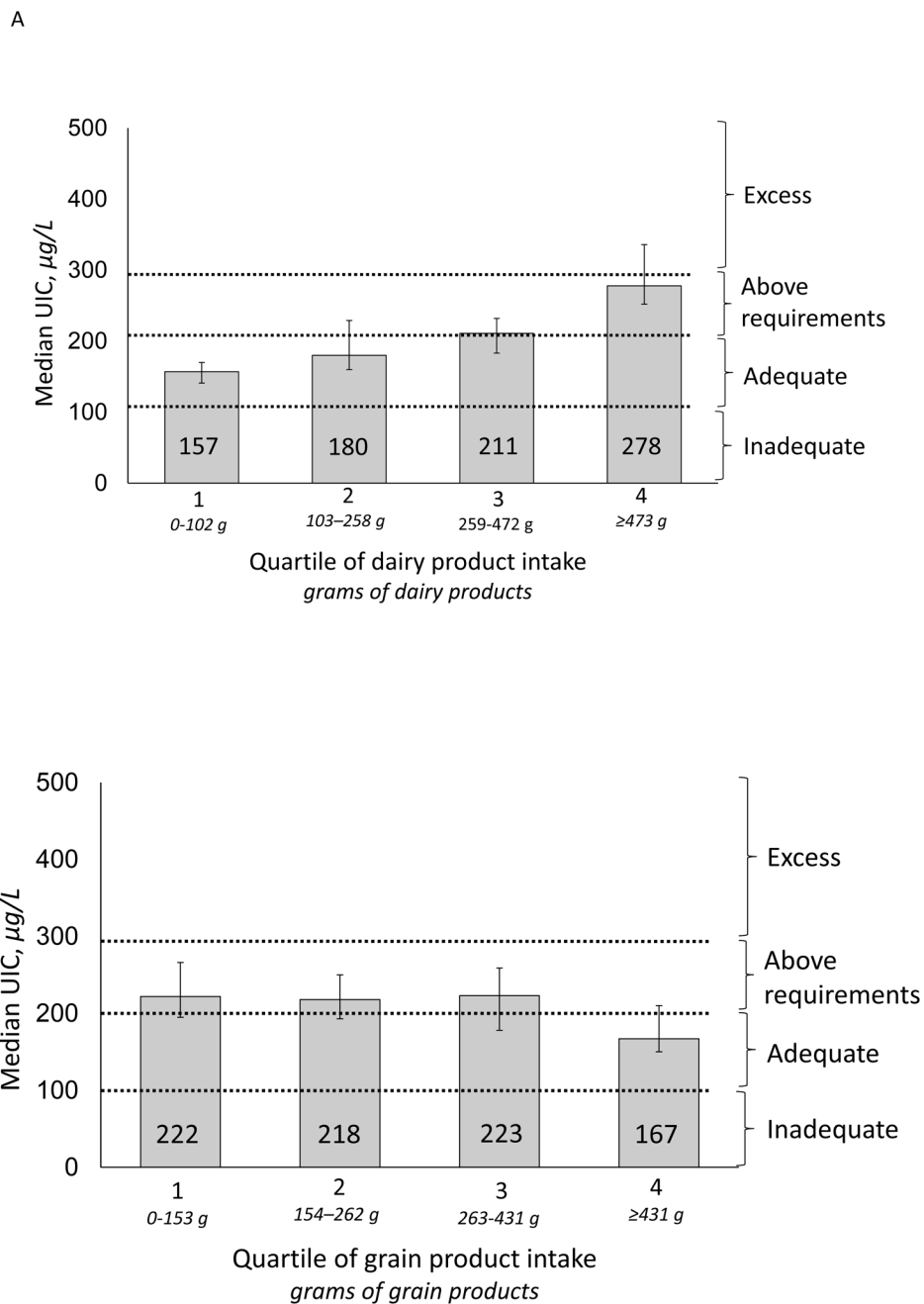


Figure 1. Median urine iodine concentration (UIC) among children 6–12 y by a) quartile of dairy product intake, and b) quartile of grain product intake in the previous 24 h, NHANES 2007–2010. UIC varied by quartile of intake of dairy products ($p < 0.001$), but not by quartile of intake of grain products ($p = 0.2$).

Table 1
 Select sample characteristics, children 6–12 y (n=1553), NHANES 2007–2010¹

Race ethnicity, %	
Non-Hispanic white	56.3
Non-Hispanic black	14.1
Hispanic	22.0
Other	7.6
Males, %	51.3
Any dairy products consumed yesterday, %	87.6
Among consumers, median dairy products consumed, g	331
Any grain products consumed yesterday, %	99.2
Among consumers, median grain products consumed, g	270
Supplement containing iodine yesterday, %	16.5
Occasionally/very often use table salt, %	28.3

¹Data are weighted estimates of prevalence or median

Median urinary iodine concentration (UIC) and prevalence of UIC <50 µg/L among U.S. children 6–12 y, NHANES 2007–2010¹

Table 2

	Median UIC ¹			<50 µg/L ¹			
	n	µg/L	95% CI	p-value ²	%	95% CI	p-value
Total	1553	211	194, 228	—	5.4	3.7, 7.7	—
Dairy intake previous day							
Yes	1341	221	200, 235	0.002	4.9	3.2, 7.2	0.16
No	212	161	142, 200		9.0	4.6, 16.9	
Grain intake previous day							
Median g/d	777	196	171, 223	0.10	6.3	3.8, 10.3	0.26
<Median g/d	776	221	201, 245		4.4	3.0, 6.5	
Supplement with iodine							
Yes	184	303	238, 345	<0.001	1.6 ³	0.6, 4.1	<0.001
No	1369	198	182, 214		6.1	4.3, 8.7	
Table salt use							
Occasionally/very often	360	219	195, 238	0.60	5.0	3.3, 7.3	0.53
Never/rarely	1193	208	182, 230		6.4	3.1, 12.8	
Race/ethnicity ⁴							
Non-Hispanic white	456	230	207, 276	0.001	3.9	2.0, 7.5	0.11
Non-Hispanic black	396	165	148, 182		9.1	6.1, 13.5	
Hispanic	619	208	184, 232		6.3	4.3, 9.2	
Age							
6–8 y	678	234	204, 270	0.04	3.3	2.3, 4.7	0.01
9–12 y	875	194	176, 215		6.9	4.5, 10.5	
Sex							
Males	782	213	193, 238	0.55	3.0	1.8, 4.8	<0.001
Females	771	208	181, 226		7.9	5.5, 11.2	

¹Data are weighted estimates

²P-values for comparison of median UIC by socio-demographic and behavioral characteristics are from a chi-square test comparing whether the proportion above or below the overall median differs by these groups. P-values for comparison of proportion with UIC <50 µg/L are from a chi-square test.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

³ Relative standard error for this estimate is >30% suggesting the estimate may not be stable (14).

⁴ NHANES does not recommend presentation of estimates for the "Other" racial/ethnic group so these data have been suppressed (14).

Association of urinary iodine concentration (UIC) with dietary and demographic factors among children 6–12 y, NHANES 2007–2010

Table 3

	Estimate ¹	95% CI	p-value
Intercept	5.57	4.99, 6.15	<0.001
Dairy products intake (per 100 g/d)	0.05	0.03, 0.07	<0.001
Grain product intake (per 100 g/d)	-0.03	-0.05, -0.01	0.004
Supplement with iodine yesterday			
Yes	0.23	0.14, 0.37	<0.001
No	Reference	—	—
Frequency of table salt use			
Occasionally/very often	0.03	-0.13, 0.15	0.73
Never/rarely	Reference	—	—
Race/ethnicity ²			
Non-Hispanic white	Reference	—	—
Non-Hispanic black	-0.26	-0.40, -0.11	<0.001
Hispanic	-0.07	-0.21, 0.08	0.37
Age			
6–8 y	0.10	-0.08, 0.28	0.28
9–12 y	Reference	—	—
Sex			
Male	Reference	—	—
Female	-0.05	-0.13, 0.03	0.24

¹ Weighted estimates are β -coefficients from a linear regression model in which natural log-transformed UIC was the dependent variable.

² NHANES does not recommend presentation of estimates for the “Other” racial/ethnic group so these data have been suppressed (14).