
Income and Racial Patterns of Dietary Vitamin C Intake Among Black and White Girls

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Synopsis

The authors examined the influence of income and race on mean dietary vitamin C intake and the risk of dietary vitamin C intake at levels below the recommended dietary allowance (RDA). They performed a cross-sectional analysis of 2,032 black and white 9- and 10-year-old females, from a wide

range of income groups, who participated in the National Heart, Lung, and Blood Institute Growth and Health Study.

Mean intake of vitamin C, exclusive of vitamin supplements and determined by 3-day diet records, exceeded the RDA of 45 milligrams per day for that age group in all racial and income categories. The investigators found that annual household income was directly associated with mean dietary vitamin C intake ($P < 0.0001$) and that blacks had higher mean dietary vitamin C intakes than whites ($P < 0.01$).

Among both blacks and whites, household income and risk of below-RDA vitamin C intake were inversely correlated, but this trend was statistically significant for blacks only ($P < 0.05$). Except for the lowest level income group (less than \$10,000 per year), black girls from households with incomes less than \$30,000 per year were at increased risk for below-RDA vitamin C intake (relative risk = 1.93 in the \$10,000-\$19,999 per year group and 1.63 in the \$20,000-\$29,999 per year group, $P < 0.05$), compared with black girls in the highest income category. One-quarter of white girls overall and more than 30 percent of white girls in the lowest two income groups had below-RDA vitamin C intakes. If the findings are generalizable, they underscore the importance of public health programs to address the adequacy of dietary vitamin C intake among preadolescent black and white females.

INCOME AND RACIAL DIFFERENCES in patterns of dietary food intake have been noted in national surveys carried out in the United States. Survey data indicate that blacks consume less fresh fruits and vegetables, foods that are rich in vitamin C, than whites (1). Socioeconomic status has been shown to influence vitamin C intake and measured vitamin C status (1-7). Because blacks are overrepresented in lower socioeconomic status groups (8), they may be at higher risk for inadequate vitamin C intake, compared with more affluent segments of the population.

The Ten-State Nutrition Survey found that preadolescent black girls have lower vitamin C intakes than preadolescent white girls living in comparable States and that girls from high income States have higher vitamin C intakes than girls from low income States, regardless of race (9). However, the First Health and Nutrition Examination Survey, in 1971-74 (NHANES I), which stratified by socioeconomic status, generally found vitamin C intakes to be lower among white girls than black girls younger than 15 years (10).

Adequate vitamin C intake is important for the

prevention of scurvy (11). Vitamin C has received attention recently as an antioxidant nutrient associated with a lowered risk of heart disease and some cancers (12-14). Assuring adequate vitamin C intake among children may be of public health importance for the primary prevention of cancer and heart disease.

We analyzed baseline dietary and demographic data from the National Heart, Lung, and Blood Institute Growth and Health Study (NGHS), a prospective cohort study of 9- and 10-year-old black and white schoolgirls, to determine income and racial patterns of dietary vitamin C intake.

Subjects

The subjects were 2,379 females ages 9-10 years, with nearly equal numbers of blacks and whites, drawn from a broad range of family income groups, enrolled in NGHS. We excluded 347 subjects because of missing income or dietary data, leaving 2,032 subjects for analysis. Subjects were located in Richmond, CA, Cincinnati, OH, and Washington, DC, and were recruited for a 5-year longitudinal study. At the Richmond and Cincinnati clinical centers, the subjects were enrolled through their elementary schools. Washington, DC, participants were enrolled primarily, but not exclusively, through Group Health Association, a health maintenance organization. A random sample stratified by race was selected from Group Health Association member families having 9- and 10-year-old girls. For selected schools in Richmond and Cincinnati, we included in the study virtually the entire accessible school population of 9- and 10-year-old black and white girls in the fourth and fifth grades. We obtained informed consent prior to enrollment. We sent an introductory letter and an information sheet to prospective participants. Consent forms were signed by parents or guardians during the first clinic visit. NGHS, the recruitment and selection procedures used, and the sample design have been described (15).

Methods

We collected baseline nutrition information from March 1987 through April 1988 using 3-day diet records for 2 consecutive weekdays and 1 weekend day. A validation study among 60 9- and 10-year-old black and white girls living in Richmond and Cincinnati was performed in January 1986. That study compared data from 24-hour diet recalls, 3-day diet records, and 5-day food frequency

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questionnaires with data from direct observations. As a result, we selected the 3-day diet record as the most accurate instrument for estimating caloric and fat intake in this age group. We trained study subjects to keep their own diet records, which were later reviewed with a nutrition interviewer. We distributed measuring cups and spoons and a series of items of various sizes, shapes, and thicknesses as aids for estimating the quantity of each food consumed. We sent the 3-day diet records to the Nutrition Coding Center at the University of Minnesota in Minneapolis for nutrient composition analysis. We estimated mean daily vitamin C intake from the analysis of the individual 3-day diet records. Since we did not determine the subjects' use of vitamin supplements, their reported vitamin C intakes represent intakes estimated from diet alone.

We obtained before-tax family income data for 1986 from the parents or guardians of study participants by means of questionnaires. We stressed the confidentiality of the information to facilitate obtaining reliable data. We consolidated nine base line income categories, ranging from less than \$5,000 per year to more than \$75,000 per year, into five annual income categories: less than \$10,000, \$10,000-\$19,999, \$20,000-\$29,999, \$30,000-\$49,999, and \$50,000 or more.

We determined race by self-report from the subjects and their parents or guardians. We enrolled girls who declared themselves as either black or white, and whose parents or guardians identified themselves as of the same race as the child.

Statistical methods. We used two-tailed t-tests to determine if the mean vitamin C intake among black girls in a particular income group was significantly different from that of their white counterparts. We used general linear models to examine the independent effects of income, race, and geographic site on mean dietary vitamin C

Table 1. Mean dietary vitamin C intake among 2,032 black and white 9- and 10-year-old girls, by race and annual household income, 1987-88

Income	Blacks			Whites			P value
	Number	Percent	Mean mg per day \pm SD	Number	Percent	Mean mg per day \pm SD	
Less than \$10,000.....	243	25	87.3 \pm 56.9	74	7	70.0 \pm 43.3	0.01
\$10,000-\$19,999.....	177	18	78.6 \pm 52.2	95	9	71.8 \pm 44.0	0.25
\$20,000-\$29,999.....	166	17	87.9 \pm 51.2	167	16	77.0 \pm 48.3	0.05
\$30,000-\$49,999.....	229	23	95.4 \pm 59.7	355	34	85.0 \pm 52.0	0.03
\$50,000 or more.....	164	17	105.5 \pm 64.2	362	34	90.0 \pm 55.4	0.01
All incomes.....	979	...	90.8 \pm 57.7	1,053	...	83.2 \pm 51.8	< 0.01

NOTE: Mg = milligrams. SD = standard deviation.

Table 2. Relative risk of dietary vitamin C intake of less than 45 mg per day among 2,032 black and white 9- and 10-year-old girls, by level of annual household income, 1987-88

Income	Blacks ¹					Whites ²				
	< 45 mg per day		Total	RR	CI	< 45 mg per day		Total	RR	CI
	Number	Percent				Number	Percent			
Less than \$10,000.....	51	21.0	243	1.50	0.95, 2.35	24	32.4	74	1.29	0.89, 1.88
\$10,000-\$19,999.....	48	27.1	177	1.93	1.23, 3.03	30	31.6	95	1.26	0.89, 1.77
\$20,000-\$29,999.....	38	22.9	166	1.63	1.02, 2.61	42	25.1	167	1.00	0.73, 1.38
\$30,000-\$49,999.....	40	17.5	229	1.25	0.78, 2.00	81	22.8	355	0.91	0.70, 1.18
\$50,000 or more.....	23	14.0	164	³ 1.00	...	91	25.1	362	³ 1.00	...
Total.....	200	20.4	979	268	25.5	1,053

¹ Chi-square trend = 5.46, $P < 0.05$.

² Chi-square trend = 1.83, $P > 0.10$.

³ Relative risks (RR) calculated using income level of more than \$50,000 as

reference level.

NOTE: Mg = milligrams. CI = 95 percent confidence interval.

intake. We entered race as a dichotomous variable and income as an ordered discrete variable. We included interaction terms for race and income and for income and geographic site.

The RDA for vitamin C is generally accepted as a standard for assessing risk of nutrient deficiency (11). Children with intakes less than 45 milligrams (mg) per day were classified as having below-RDA intakes. We used chi-square tests (16) to determine if there was an inverse relation between risk of below-RDA vitamin C intake and income level. We calculated relative risks of below-RDA intake for each race-specific income level and determined 95 percent confidence intervals (CIs). We performed all analyses using SAS computer programs (A). We did not adjust alpha for multiple comparisons (17, 18). We considered P values of < 0.05 to be statistically significant.

Results

Black girls reported higher mean vitamin C intakes than white girls overall, and in each income

group (table 1). The difference in mean vitamin C intake was statistically significant overall ($P < 0.01$), and in each income group except \$10,000-\$19,999. Black girls and white girls in each income group had mean intakes above the RDA.

We found that income and race were significantly associated with mean dietary vitamin C intake. Girls from affluent families had higher intakes than girls from poorer families ($P < 0.0001$). Blacks had higher intakes than whites ($P < 0.01$). Income X race and income X geographic site interaction terms were not statistically significant.

We performed an analysis of risk of below-RDA vitamin C intake among blacks and whites (table 2). Chi-square for trend, relating increasing risk of below-RDA intake to decreasing levels of income, was significant for blacks ($P < 0.05$), but not for whites ($P > 0.10$), despite increasing levels of risk related to decreasing levels of income among whites. The relative risk of below-RDA intake was 1.93 among black girls from households with incomes of \$10,000-\$19,999 per year and 1.63 for

incomes of \$20,000–\$29,999 per year ($P < 0.05$), compared with black girls in the highest income category (more than \$50,000 per year). For both black and white girls, a substantial percentage (14.0–32.4 percent) at each income level had below-RDA intakes.

Twenty subjects (1 percent of the cohort) had extremely low vitamin C intakes (less than 12 mg per day), placing them at possible risk for scurvy. We found no statistically significant association between income, race, and scorbutic-range vitamin C intake.

Discussion

We found that annual household income was significantly related to the dietary consumption of vitamin C among 9- and 10-year-old girls. Children from poor households had lower mean intakes of vitamin C than children from more affluent households. Our findings are consistent with other studies and surveys examining the relation between income or socioeconomic status and vitamin C intake (1–7), in which decreasing income was associated with decreased vitamin C status, measured by intake or blood level. Unlike those studies however, we examined preadolescent girls.

We found that black girls had higher mean dietary vitamin C intake than white girls. This finding concurs with NHANES I (10), but is contrary to the results of other studies (1, 9). Obvious explanations for the higher mean dietary vitamin C intake among black girls were not apparent from our data. While income level and vitamin C intake were significantly associated, the public health significance of that observation is uncertain, because even girls from the lowest income levels had mean vitamin C intakes above the RDA. RDA is a guide for nutrient intake levels judged to be adequate for meeting the requirements of most healthy people (11).

While we found that mean dietary vitamin C intakes were adequate, regardless of race and income, we determined that the risk of below-RDA intake was related to income and race. Low income levels among black girls increased risk of below-RDA intake; poor black girls were at 1.5 to 1.9 times the risk of below-RDA intake, compared with their more affluent counterparts. Among white girls, the observed inverse trend between income and risk of below-RDA intake was not statistically significant. However, at each level of household income, a greater percentage of white girls had below-RDA intakes than did black girls.

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While the increased risk of below-RDA intake appeared income-related among blacks, other factors must account for the high percentage of white girls found to have below-RDA intakes.

Interestingly, the poorest black girls from families with incomes less than \$10,000 per year were at less risk of below-RDA intake than black girls with household incomes of \$10,000 to \$29,999 per year. While we did not collect data on receipt of public assistance, one possible explanation may be assistance in the form of food stamps or school lunches provided for members of black families with very low incomes. This, however, may be a chance finding, since we observed no comparable decrease in risk of below-RDA intake among the poorest white girls.

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Our study was limited primarily by the absence of data on vitamin supplement use. Total vitamin C intakes therefore were likely to have been higher than reported in the 3-day diet records. Vitamin supplement use, like dietary vitamin C intake, has been reported to vary with income level. Children in the poorest families use supplements much less often than children from affluent homes (4). Were information available on vitamin supplement use, a magnification of the difference in vitamin C intake between girls from affluent and those from poor families would be the most likely result. A lessening of the difference in vitamin C intake, however, might be expected between blacks and whites, since

whites use vitamin supplements more often than blacks (4).

Although we had no reason to believe that dietary vitamin C estimates were inaccurate, our 3-day diet records were validated only for estimations of fat and calorie intake. The NGHS dietary validation study found 3-day diet records better in estimating dietary intake among 9- and 10-year-old girls than 24-hour recalls or 5-day food frequency questionnaires. While the 3-day diet records we used were not validated specifically for vitamin C intake, that method of dietary assessment has been demonstrated to be reliable in estimating the dietary intake of children (19). Good agreement between 7-day and 3-day diet records for nutrient intake also has been observed (20). It is possible that some girls with below-RDA vitamin C intake would regress toward the mean, resulting in a smaller percentage with low intake values, were additional estimates of dietary vitamin C intake available.

While we used above- and below-RDA intakes as a means of comparison, the finding of a below-RDA intake does not have immediate clinical implications. The RDAs have been specifically designed to provide a margin of safety in preventing deficiency disease (11, 21). A below-RDA intake therefore only suggests the possibility of a public health problem. The margin of safety, however, may be narrow for a large percentage of black and white children.

One in five American children lives in poverty (8). For those children, the resources must be found to insure that adequate margins of nutritional safety are not jeopardized. However, even among the more affluent households in our study, 14 to 25 percent of 9- and 10-year-old girls had vitamin C intakes below the RDA. If our findings are generalizable to other geographic areas and races, and to boys, they would underscore current public health education efforts that promote awareness of the importance of increased consumption of fresh fruits and vegetables.

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Equipment

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