Research Articles

Who Is Leading the Change?

U.S. Dietary Quality Comparison Between 1965 and 1996

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Background: Many studies have examined rapidly changing trends in U.S. dietary intake, but not as they correspond to other health inequalities among black and white Americans. The purpose of this study was to explore 30-year trends in diet quality and to examine whether income or education is the key socioeconomic factor linked with these shifts.

Methods: The 1965 Nationwide Food Consumption Survey and the 1994–1996 Continuing Survey of Food Intake by Individuals were used and included, respectively, 6476 and 9241 respondents who were aged ≥18 years. The Revised Diet Quality Index (DQI-R), an instrument that provides a summary assessment of a diet's overall healthfulness, was also used.

Results: Between 1965 and 1996, improvements were found in both the overall DQI-R and its components across all education levels, with the exception of calcium intake. Conversely, improvements linked with income effects were inconsistent and less clear. In 1965, the effect of college attendance resulted in a 1.8 point higher DQI-R, higher calcium intake, and increased servings of fruits and vegetables. In 1994–1996, there were consistently improved diets for the overall DQI-R and its components, particularly among college attendees.

Conclusions: Diet quality has improved across both race and socioeconomic status groupings between 1965 and 1994–1996; however, education provides a much clearer differentiation. Education efforts must be emphasized to eliminate disadvantages in diet quality.
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Introduction

Reducing race/ethnic and socioeconomic disparities in health is a major component of U.S. public policy.[1,2] Not only do large disparities exist, but these disparities have expanded in the past several decades for selected dimensions of health (e.g., black versus white infant mortality).[2] This paper explores 30-year trends in diet quality and examines how the various dimensions of diet quality have changed with respect to shifts in income and education. The underlying motivation was to understand whether income or education limitations have more to do with the continually increasing differences between higher and lower socioeconomic status Americans.

Income and education are two of the largest components of policy that the U.S. government systematically can address. Nonetheless, surprisingly little is understood about the differential role of income and education in health disparities facing race/ethnic subpopulations in the United States, or even among all Americans. For example, a recent review of 20 years of U.S. cardiovascular disease studies concluded that only a small percentage included both socioeconomic status and ethnicity in their analyses.[3] For some health outcomes, studies have shown that once differences in income, education, and other factors such as access to health care are taken into account, race/ethnic differences disappear, suggesting little or no biological basis for the differences.[4,5] In contrast, race/ethnic disparities in other outcomes remain even after socioeconomic status differences are taken into account,[3,6–9] suggesting genetic/biological or cultural differences, differential responses to socioeconomic status variables, or inadequate measurement of socioeconomic status and/or race–ethnic status.[10]

Often social class, which incorporates prestige-based relative position in society as well as access to resources (informational, financial),[11,12] is used to analyze health inequality. For instance, the Whitehall studies[13] used occupation, which incorporates resource- and prestige-based factors that have been shown to be an exceptional measure of inequality differentials and trends. At its most powerful, social class measures incorporate relevant social psychological factors related to social position/social environment, as well as command over

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goods and services and knowledge. Such a broad measure provides important explanatory power but is difficult to utilize in policy work.

In the area of diet quality, few nationally representative U.S. studies describe black/white or income/education diet differentials.[7,14–16] Earlier research has shown that in 1965, there were large differences among groups in dietary quality, with whites of high socioeconomic status eating the least healthful diet (as measured by the index) and blacks of low socioeconomic status eating the most healthful in 1965.[17] By the 1989–1991 survey, the diets of all groups had improved and were relatively similar, and the direction of the change seemed to indicate that a gap in diet quality would grow and contribute to the gap in health disparity as related to nutrition-related noncommunicable diseases. Even within the same socioeconomic status group, there were some important differences between Hispanics and non-Hispanic blacks and whites.[18]

Few studies have systematically explored patterns over time and have been limited by the use of aggregate food group categories that miss important patterns linked to diet quality and health. Using food frequency and ecologic data rather than 24-hour diet recall data has also limited the interpretability of previous work in this field.[19–23] This paper extends the analysis of socioeconomic and ethnic/racial dietary differences one step further by asking: Does income or education explain more of the dietary trend differentials between 1965 and 1996, using individual dietary data from a representative sample of the U.S. population?

Methods

Survey Design and Sample Description

This sample was based on subjects from two U.S. Department of Agriculture (USDA) surveys: the 1965 Nationwide Food Consumption Survey (NFCS65) and the 1994–1996 Continuing Survey of Food Intake by Individuals (CSFII96). For this analysis, there were 6476 and 9241 respondents from the NFCS65 and the CSFII96, respectively, who were aged ≥18 years. These USDA surveys were based on a multistage, stratified area probability sample of non-institutionalized individuals. Previous publications have detailed information on the methodology pertaining to each survey.[24,25]

Dietary Measures Description

Information from the NFCS65 and CSFII96 was used to compare respondents' diets with the Revised Diet Quality Index (DQI-R), an instrument that provides a summary assessment of a diet's overall healthfulness. The DQI-R is based on ten different aspects, including recommendations for both nutrient and food types. Regarding nutrients, there are components specifically for intakes of cholesterol, iron, calcium, fat, and saturated fat in relation to total energy. Intakes are then compared to recommendations specific for each nutrient. Unlike previous work done with the DQI-R, iron intake has been compared to age- and gender-specific estimated average requirement (EAR) values for iron, which were released in 2001.[26] Three components capture consumption of fruits, vegetables, and grains. The last two components reflect the Dietary Guidelines for Americans (developed jointly by the USDA and the U.S. Department of Health and Human Services) recommendations of dietary diversity and moderation. A diversity score was developed to reflect consumption of 23 different broad food group categories. Three groups (grain-based products, vegetables, and animal-based products) consist of seven categories each, whereas fruit and juices consist of two categories. To be considered as a "consumer" of one of these categories, survey respondents needed to report consuming one-half serving, as defined by the Food Guide Pyramid. Four elements (added sugar, discretionary fat, sodium intake, and alcohol consumption) were considered part of the dietary moderation score. All four components reflect "discretionary" behavior on the part of the participant; more specifically, participants can regulate the quantity of sugar, alcohol, and salt from processed foods they consume. As separate components of the DQI-R, total fat, saturated fat, and cholesterol were not included in the moderation score. A more thorough description of these two components is described by Haines et al.[27] Each of the components of the DQI-R is worth ten points, and higher scores represent healthier diets.

Food consumption data for constructing the DQI-R were from both surveys, whereas food composition data were from the latest survey. The 1965 survey collected data on individual diets in a single sample in the spring. The type of dietary data collected was 24-hour recall, and the homemaker in the family usually gave information on all members of the household being studied.[3] In the 1994–1996 survey, the dietary data were collected from each respondent by means of 24-hour recall on two nonconsecutive days (3 to 10 days apart). Interviews for the 24-hour recalls for the 1994–1996 survey were different from the previous survey in that multiple passes through the list of all foods and beverages recalled by the respondent were used. The multiple-pass approach has been described previously.[28,29] The degree to which the changes in the collection of dietary data influence these results has not been explored in a systematic manner.

In order to examine the consumption of fruits, vegetables, and grains compared to recommendations in the USDA's Food Guide Pyramid, pyramid food servings were developed at the University of North Carolina (UNC) for the 1965 survey using the present database and extrapolating backward. The USDA's Pyramid Servings Database was used for 1994–1996. Nutrient intakes of cholesterol, iron, calcium, fat, and saturated fat in relation to total energy were calculated using a linking system developed at UNC Chapel Hill. To ensure comparability between the two surveys, we developed a system to link foods coded and collected in the 1994–1996 survey with foods consumed by respondents in the 1965 survey. Values from the 1994 nutrient database were applied to the 1965 food consumption values to provide high-quality nutrient intake estimates.[30] In the 1994–1996 survey, the nutrient database specific to each survey year was used to calculate nutrient values to reflect changes in foods on the market. This approach allowed for the use of newer measures of nutrients (e.g., fiber) and accounted for shifts in food descriptors. The drawbacks of this approach were that true changes in the actual nutrient content of foods over time were not captured and trends may be either overstated or understated.

Education and Income Description

Individual level of educational attainment was categorized into no high school degree, high school degree, and attended college. The number of individuals who completed college in 1965 was too small to create a separate college degree category. To more accurately represent income level, household income was expressed as a percentage of the federal poverty thresholds (provided by the U.S. Bureau of the Census) and adjusted for inflation; therefore, each household's income was expressed as a percentage of the poverty thresholds of the appropriate size. Percent of poverty values was categorized into 0% to 185%, 186% to 350%, and >350%. In this study, 185% was used as a cutoff because it is used by USDA to establish eligibility for the Supplemental Nutrition Program for Women, Infant, and Children Program, and is the highest value used for eligibility in food assistance programs. Also, race/ethnicity was defined as white or black, as small sample sizes prohibited examining other races/ethnicities.

Statistical Analysis

Using Stata version 7 (College Station TX, 2001), survey design corrections and weights were incorporated into all of the reported means, standard errors, and modeling results. Response rates for each survey differed at the level of the primary sampling unit. Thus, weights based on response rates for each sample unit unique to each survey were used to permit inferences applicable to the total non-institutionalized U.S. population.

To examine the effect of education and income on the DQI-R and its components, ordinary least squares (OLS) regression was used to control for age, household size, gender, race, rural/urban, and region of residence. Models for each survey were run separately with their respective sample weighting and survey design corrections. The potential for effect modification by income between the association of education on DQI-R scores and on DQI-R components was assessed with interaction terms in the models. Statistical significance of interactions was determined with an adjusted Wald test. Interaction terms were defined as significant at the 0.10 level. The referent category for education was no high school degree, and for income, 0% to 185% of poverty.

Adjusted DQI-R scores were developed in order to statistically test differences between DQI-R values from 1965 and 1994–1996. Adjusted DQI-R scores were derived from OLS models based on age equal to 45, household size equal to 2.9, West region of residence, and urban residence. The highest value of income (>350%) was used when DQI-R scores were adjusted for education levels, and the highest value of education (some college) was used when DQI-R scores were adjusted for income levels. For each respective education or income grouping, t -tests were used to compare adjusted DQI-R scores between 1965 and 1994–1996.

Table 1. Socioeconomic characteristics of adults in USDA's 1995 NFCS and 1994–1996 CSFII

Characteristic	1965 NFCS	1994–1996 CSFII
	Average (standard error)	
Age	44.4 (0.3)	45.1 (0.4)
Household size	3.7 (0.04)	2.9 (0.03)
	Percent[a]	
Education		
No HS	45	15
HS	38	36
Attended college	17	50
Income[b]		
0–185	48	24
186–350	35	31
>350	18	44
Male	46	48
Black	11	12
Urban	69	79
U.S. region[c]		
Northeast	23	20
Midwest	29	25
South	33	36
West	14	18

[a]May not add to 100% due to rounding.
[b]To more accurately represent income level, household income is expressed as a percentage of the federal poverty thresholds adjusted for inflation; poverty thresholds are provided by the U.S. Bureau of the Census. Each household's income is expressed as a percentage of the poverty threshold of the appropriate size.
[c]Regions defined by U.S. Department of Commerce for the Census of Population.
CSFII, Continuing Survey of Food Intake of Individuals; HS, high school; NFCS, National Food Consumption Survey; USDA, U.S. Department of Agriculture.

Results

Socioeconomic characteristics for adults ≥18 years in the 1965 and 1994–1996 samples are presented in Table 1. These characteristics were used in the subsequent modeling of the DQI-R and components of the DQI-R. There was a shift toward higher levels of income and education in the population as well as a shift toward residence in the South and West and in urban areas between 1965 and 1996.

Table 2 shows the proportion of respondents in the scoring breakdown for each component of the DQI-R for each education level. Only the education levels are presented here. The income groupings presented a similar, although less differentiated, pattern and trend and thus are not presented. Between 1965 and 1996, improvements were found in both the overall DQI-R and its components for all education groups except for calcium intake, which declined considerably for all education groups. The education gradient was positive for diet quality for all components of the DQI-R except the moderation score. In general, a stronger improvement among college-educated adults was found compared with the other two groups. In 1965, there was not a clear positive education gradient for diet quality and, for many components, there was an inverse gradient

Table 2. Distribution of population in each survey year by scoring for DQI-R components by education

		No HS		Completed HS		Attended college	
		1965 n=3023	1994–1996 n=1873	1965 n=2333	1994–1996 n=3300	1965 n=1120	1994–1996 n=4068
Components of DQI-R	**Scoring values**	% of population in subgroup					
% Daily energy intake from fat	Mean % Kcal (SE)	38.7 (0.3)	34.1 (0.3)	39.6 (0.2)	33.7 (0.2)	39.3 (0.3)	32.4 (0.2)
	>40%	44.9	24.1	48.6	21.1	46.3	17.5
	>30%–≤40%	39.0	45.7	38.8	49.8	40.7	47.1
	≤30%	16.1	30.2	12.6	29.1	13.0	35.4
% Daily energy intake from saturated fat	Mean % Kcal (SE)	14.1 (0.1)	11.5 (0.2)	14.7 (0.1)	11.4 (0.1)	14.5 (0.2)	10.7 (0.1)
	>13% Kcal	57.5	30.5	64.8	29.9	64.2	25.2
	11%–13% Kcal	25.9	35.0	23.7	34.9	24.1	34.4
	≤10% Kcal	16.6	34.5	11.5	35.2	11.7	40.4
Dietary cholesterol	Mean mg (SE)	429 (7.5)	277 (8.6)	464 (7.3)	277 (4.8)	450 (8.9)	253 (3.4)
	>400 mg	46.1	21.6	50.1	19.9	48.2	16.1
	300–400 mg	15.2	14.1	14.4	14.1	17.0	14.6
	≤300 mg	38.7	64.3	35.5	66.0	34.8	69.3
Recommended fruit servings	Mean servings (SE)	1.1 (0.04)	1.2 (0.05)	1.3 (0.05)	1.2 (0.04)	1.7 (0.08)	1.7 (0.05)
	<50% of rec	70.5	64.7	64.9	63.1	53.8	50.9
	50%–99% of rec	15.3	19.3	18.9	20.4	23.2	24.6
	≤100% of rec	14.2	16.0	16.2	16.6	22.9	24.5
Recommended vegetable servings	Mean servings (SE)	2.6 (0.06)	3.1 (0.07)	3.0 (0.07)	3.4 (0.05)	3.0 (0.07)	3.8 (0.05)
	<50% of rec	41.6	25.9	33.3	22.3	31.4	16.6
	50%–99% of rec	35.3	38.0	38.1	37.2	39.6	37.3
	≥100% of rec	19.1	21.0	14.4	23.0	12.1	27.6
Calcium intake as % of AI for age	Mean mg (SE)	684 (13)	676 (30)	752 (16)	723 (12)	760 (16)	800 (7)
	<50% of rec	0.4	31.6	0.1	24.2	0.1	16.4
	50%–99% of rec	1.2	43.2	0.7	44.3	0.4	44.3
	≥100% of rec	98.4	25.2	99.2	31.5	99.5	39.3
Iron intake as % of 2001 EAR for age	Mean mg (SE)	12.5 (0.19)	13.8 (0.57)	13.3 (0.19)	14.7 (0.21)	13.3 (0.19)	16.2 (0.14)
	<50% of rec	1.9	1.7	1.4	0.9	0.8	0.9
	50%–99% of rec	10.4	8.1	8.6	8.5	8.0	6.2
	≥100% of rec	87.6	90.3	90.0	90.6	91.2	92.9
Dietary diversity score	Mean (SE)	2.5 (0.0)	4.0 (0.1)	2.8 (0.0)	4.2 (0.0)	2.9 (0.0)	4.7 (0.0)
	<3	67.0	26.9	58.9	19.9	49.8	12.6
	3–5	33.0	64.9	40.8	68.8	50.1	66.6
	≥6	0.0	8.2	0.3	11.3	0.1	20.7
Moderation score	Mean (SE)	5.9 (0.1)	6.3 (0.1)	5.4 (0.1)	5.7 (0.1)	5.5 (0.1)	5.6 (0.0)
	<4	15.5	13.3	21.5	18.1	20.1	17.8
	4–6	54.1	47.6	55.4	54.1	55.4	56.3
	≥7	30.4	39.1	23.1	27.8	24.6	25.9
Total DQI-R score	Mean (SE)	49.0 (0.3)	60.4 (0.5)	49.9 (0.3)	61.4 (0.3)	50.7 (0.5)	66.3 (0.3)

AI, adequate intakes (set when sufficient scientific evidence is not available for calculating an estimated average requirement; expected to meet or exceed the amount needed to maintain a defined nutritional state or criterion of adequacy in essentially all members of a specific apparently healthy population); EAR, estimated average requirement (the median usual intake that is estimated to meet the requirement of half the healthy individuals in a life stage and gender group); DQI-R, Revised Diet Quality Index; HS, high school; rec, recommendation; SE, standard error.

(e.g., saturated fat), which shifted completely in 1996. The one exception was the moderation score, which resulted in a lower score for more educated adults.

The Table 3 results, adjusted for the key socioeconomic status measures noted in Table 1, provide a sense of the effects of changes in education and income in the two time periods in a model that controls for the other measure. Interaction terms between income and education were tested for all the models presented in Table 3. There was a significant interaction only for the model predicting fruit pyramid servings, so income–education interactions were excluded from the final results. In Table 3, the effects of income and education on diet quality were rarely significant in 1965, except for a college attendance effect that resulted in a 1.8-point higher DQI-R, higher calcium intake, and increased servings of fruits and vegetables. The 1965 income effects were consistently insignificant except for a large iron intake and increased fruit servings effect among higher-income adults. In contrast, in 1994–1996 there were consistently improved diets for the overall DQI-R and its components among college attendees and a few improved components for higher-income adults. Again, the education effects are much clearer and generally seem stronger. Often, no statistically significant income effect was found; moreover, the gradients for income were less steep than those for education.

Table 4 highlights the overall effects of income and education on diet quality. Adjusted DQI-R values for white and black men and white and black women at

Table 3. Comparison of effect of education and income on DQI-R and components: 1965 vs 1994–1996

Education and income	DQI-R Beta	DQI-R (95% CI)	% Energy from fat Beta	% Energy from fat (95% CI)	Cholesterol intake Beta	Cholesterol intake (95% CI)	Calcium intake Beta	Calcium intake (95% CI)
1965								
Education								
Completed HS	0.4*	(−0.4–1.1)	0.5	(−0.1–1.0)	26.3*	(9.9–42.7)	2.9*	(−0.2–6.0)
Attended college	1.8*	(0.8–2.9)	−0.0	(−0.6–0.7)	10.2*	(−8.5–29.0)	4.7*	(0.9–8.5)
Percent of poverty								
186–350	−0.1	(−0.8–0.7)	0.4	(−0.2–0.9)	16.7	(−1.4–34.7)	1.3	(−1.3–3.8)
>350	0.6	(−0.4–1.6)	0.3	(−0.5–1.1)	16.2	(−6.2–38.6)	−1.4	(−4.7–2.0)
1994–1996								
Education								
Completed HS	2.1*	(0.9–3.3)	−0.5*	(−1.2–0.2)	0.9*	(−14.2–16.0)	0.0*	(−0.0–0.1)
Attended college	6.4*	(5.1–7.7)	−1.7*	(−2.5–−0.9)	−20.2*	(−35.1–−5.3)	0.1*	(0.0–0.2)
Percent of poverty								
186–350	0.8*	(0.1–1.6)	0.5	(−0.1–1.0)	−7.2	(−22.1–7.7)	0.0	(−0.0–0.1)
>350	1.5*	(0.6–2.4)	0.2	(−0.3–0.7)	−14.1	(−27.2–−1.0)	0.0	(−0.0–0.0)

Education and income	Iron intake Beta	Iron intake (95% CI)	% Energy from saturated fat Beta	% Energy from saturated fat (95% CI)	No. of fruit servings Beta	No. of fruit servings (95% CI)	No. of vegetable servings Beta	No. of vegetable servings (95% CI)
1965								
Education								
Completed HS	2.6	(−5.6–10.8)	0.3	(0.0–0.6)	0.2*	(0.1–0.3)	0.3*	(0.1–0.4)
Attended college	1.2	(−7.9–10.3)	0.2	(−0.2–0.5)	0.5*	(0.3–0.7)	0.2*	(0.1–0.4)
Percent of poverty								
186–350	7.0*	(−0.9–14.9)	0.2	(−0.1–0.5)	0.3*	(0.2–0.4)	−0.0*	(−0.2–0.1)
>350	14.6*	(4.3–24.8)	0.1	(−0.2–0.5)	0.4*	(0.3–0.6)	0.3*	(0.1–0.5)
1994–1996								
Education								
Completed HS	8.1*	(−10.1–26.3)	−0.2*	(−0.6–0.1)	0.2*	(0.1–0.3)	0.1*	(−0.1–0.3)
Attended college	22.0*	(4.5–39.6)	−0.8*	(−1.2–−0.5)	0.7*	(0.6–0.9)	0.4*	(0.2–0.6)
Percent of poverty								
186–350	2.2	(−7.9–12.2)	0.1*	(−0.1–0.3)	0.1*	(−0.0–0.2)	0.2*	(0.0–0.3)
>350	−2.4	(−11.7–6.8)	−0.2*	(−0.4–−0.0)	0.2*	(0.1–0.3)	0.3*	(0.1–0.5)

Education and income	No. of grain servings Beta	No. of grain servings (95% CI)
1965		
Education		
Completed HS	−0.3*	(−0.5–−0.0)
Attended college	−0.3*	(−0.6–−0.0)
Percent of poverty		
186–350	−0.1*	(−0.3–0.2)
>350	−0.4*	(−0.6–−0.1)
1994–1996		
Education		
Completed HS	−0.1*	(−0.6–0.3)
Attended college	0.2*	(−0.3–0.6)
Percent of poverty		
186–350	0.0	(−0.3–0.2)
>350	0.0	(−0.2–0.3)

*Denotes statistically significant terms at the 0.05 level.
[a]No HS degree and 0–185% of poverty were used as the referent categories; models for each survey were run separately with their respective sample weighting and survey design corrections; models also adjusted for age, gender, region, race, household size, and urbanization. Models included dummy variables for both education and income that were tested with an adjusted Wald test within each survey for DQI-R and selected components.
CI, confidence interval; DQI-R, Revised Diet Quality Index; HS, high school.

each income and education level are presented. For each four race/ethnic, status–gender grouping, there was a larger gradient of education than income for total diet quality. Moreover, the changes between 1965 and 1996 were dramatic. Among both white and black men, the final gradients for education and income were not as steep. That is, extra years of schooling were related to small upward shifts in diet quality for men. The highest

Table 4. Comparison between 1965 and 1994–1996 adjusted DQI-R for men and women by race

	DQI-R (SE)			
	White		Black	
Component	1965	1994–1996[a]	1965	1994–1996[a]
Men				
Education				
No HS	50.5 (0.6)	61.9 (0.7)*	49.7 (0.9)	57.9 (0.7)*
Completed HS	50.8 (0.6)	64.0 (0.5)*	60.0 (0.9)	60.1 (0.7)*
Attended college	52.3 (0.6)	68.3 (0.5)*	51.5 (0.9)	64.4 (0.7)*
Percent of poverty				
0–185	51.7 (0.6)	66.9 (0.7)*	50.9 (0.8)	62.9 (0.7)*
186–350	51.6 (0.5)	67.7 (0.7)*	50.8 (0.8)	63.7 (0.8)*
>350	52.3 (0.6)	68.3 (0.5)*	51.5 (0.9)	64.4 (0.7)*
Women				
Education				
No HS	50.9 (0.6)	64.5 (0.7)*	50.5 (0.9)	60.5 (0.7)*
Completed HS	51.3 (0.6)	66.6 (0.5)*	50.1 (1.0)	62.6 (0.7)*
Attended college	52.8 (0.8)	70.9 (0.5)*	52.0 (0.9)	66.9 (0.7)*
Percent of poverty				
0–185	52.2 (0.5)	69.4 (0.7)*	51.3 (0.8)	65.5 (0.9)*
186–350	52.1 (0.5)	70.3 (0.7)*	51.3 (0.9)	66.3 (0.8)*
>350	52.8 (0.6)	70.9 (0.5)	52.0 (0.9)	66.9 (0.7)*

*Denotes significant difference at the 0.001 level between 1965 and 1994–1996 values.
[a]Models for each survey were run separately with their respective sample weighting and survey design corrections. Predictions are based on age = 45, household size = 2.9, West region, urban residence, and highest value of either education or income.
DQI-R, Revised Diet Quality Index; HS, high school; SE, standard error.

diet quality level was found among white women who attended college and for those with income ≥350% the poverty line. The difference or gap in diet quality between lower and higher education groups expanded significantly between 1965 and 1996. This difference was greater for men, particularly white men, in 1996 than in 1965 compared to women.

Discussion

These results show that diet quality improved across ethnic and socioeconomic status groupings between 1965 and 1996. Overall mean diet quality, as well as the proportion that consume lower fat and cholesterol, higher grain, higher vegetable, and greater dietary diversity, have increased. From a public health standpoint, these results indicate that Americans are consuming better diets, yet this may seem paradoxical because of the increasing prevalence of obesity in the United States. However, the DQI-R was constructed to reflect proportion, variety, and moderation, rather than absolute quantities of food consumed. For example, the percent of calories from the fat component, which is examined proportionately, does not reflect the upward trend in total energy intake. Total energy intake has been shown to be increasing; however, the consumption of fat has been constant.[31–33] This would result in a lower percentage of calories coming from fat despite an increase in total calories.

Because of the focus on proportion, variety, and moderation, the DQI-R was purposely designed not to be highly correlated with total energy intake. The accuracy of self-reported energy intake and the variability in individuals' energy intake were issues that compelled us not to include total energy intake in an overall diet quality index. Reporting errors of energy and food intakes has been related to self-perceived weight, gender, age, lifestyle, and social class.[34,35] Furthermore, ecologic data, contrary to dietary survey data, suggest that the per capita consumption of energy has been increasing over the past several decades.[36] Another limitation of the data set was the lack of information on physical activity. Energy balance, the determinant of weight status, is dependent on both energy intake and energy expenditure.

Although the overall dietary quality score increased, some components of the index indicated that Americans are not consuming diets as healthy as previously reported. The most striking area of concern was the decline in calcium adequacy, most likely precipitated by a drop in milk consumption.[32,37] This decline in calcium adequacy was not an artifact of a change in measurement, because the same adequacy criteria was used for both surveys. The inadequacy of American diets to provide optimal calcium intake in the 1990s was noted previously by a NIH Consensus Panel,[38] which recommended the development of effective programs to change dietary behavior with respect to calcium intake. Thus, the results of the current study are quite alarming given the NIH recommendation and the subsequent public health campaigns describing the importance of calcium. Obviously more research is needed to determine appropriate strategies to improve inadequate calcium intake.

Other areas of concern include the very small improvements in fruit intake and the small shifts in the moderation component, which included the consumption of added sugar, salt, alcohol, and discretionary fat. The increase in the consumption of added sugar, including all sweeteners that are eaten separately or used as ingredients in processed or processed foods, measured by the DQI-R has also been demonstrated by ecologic data. Food supply per capita estimates show that consumption of sugars and sweeteners has increased dramatically between the 1960s and the 1990s.[39]

Results of this study cannot be compared with others due to limited research on dietary trends and patterns for racial/ethnic, education, and income groupings. In general, the dietary trends examined by income and education for the total adult population and for black and white adults indicate that levels of education provide a much clearer differentiation of the trends in diet quality. In addition, the strength of the gradient in education was constant between racial subgroups. The mechanism through which higher education promotes healthier diets has not been fully elucidated but may be caused by a diffusion of knowledge, skills, attitudes, and beliefs that occur while individuals are participating in the education system. For example, education may promote higher self-esteem and self-efficacy. Although no research has examined dietary information in this manner, other researchers have shown education to be more strongly associated with disease than income or occupation.[40]

Socioeconomic status is a complex phenomenon encompassing actual resources and prestige (i.e., rank-related characteristics).[11] Although the dimensions of socioeconomic status are interrelated, each one reflects different individual, familial, and societal forces. The reliance on only one measure was considered to be inadequate in determining the effect of socioeconomic status on diet behavior. Therefore, information on income and education were examined simultaneously. Having only income and education as measurements of socioeconomic status may actually limit these findings regarding the effect of socioeconomic status. Another drawback of this work is the cross-sectional nature of these surveys. With these data sets, we were unable to evaluate a cohort effect of education. Lastly, because of the lack of health outcome data, we were unable to assess the DQI-R's ability to predict subsequent health outcomes.

There are several advantages to using USDA's dietary surveys. One obvious advantage is that these surveys are nationally representative. With these large data sets, we were able to examine dietary differences among various socioeconomic groups and between black and white subjects. Another advantage is that the dietary data were collected with 24-hour recalls. Twenty-four hour recalls are open ended and thus collect information on specific food items, including ethnic foods, and serving size amounts. Repeated 24-hour recalls also allow for the determination of intra-individual variation and thus adequacy, which is important when using the new DRIs.[41] Because of interest in making subgroup comparisons over time, we consider 24-hour recall data as the most suitable.

The improvements in mean DQI-R scores over time reflect changing consumption practices and, in some cases, an increasing adoption of recommended dietary guidance, particularly regarding cholesterol and total and saturated fat. However, some aspects of the DQI-R, particularly inadequate calcium intakes, clearly show that the American diet has become less healthy and could be improved. The socioeconomic status results from this study indicate that improving the education system in the United States may help to eliminate disadvantages in diet quality.

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