Top Clin Nutr
Vol. 25, No. 3, pp. 191–201

PRACTICE PROJECTS AND PERSPECTIVES

Beverage Consumption Patterns of a Low-Income Population

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High-energy-dense foods provide an inexpensive source of calories. *Healthy Aging in Neighborhoods of Diversity across the Life Span* study participants (n = 1987), low- to low-middle-income, urban African American and white adults, consumed between 17% and 20% of their daily energy intake from beverages. Of all beverages consumed, calorically sweetened beverages ranked second among African Americans and third among whites. Calorically-sweetened beverage consumption was not influenced by weight status. Increasing awareness of risks for adverse health outcomes associated with selected beverages may improve dietary choices. **Key words:** *energy intake*, *obesity*

KNOWLEDGE of beverage consumption patterns of the US adult population is increasing. It has been estimated that about 20% of a person's daily energy intake is contributed by beverages.[1] Like food, beverage consumption is influenced by several factors. These factors include but are not limited to food availability, preferences, culture, age, and knowledge of nutrition and health. Researchers have reported differences in beverage consumption between age, sex, and race/ethnicity.[2-4] For example, cultural and physiological differences have been linked to a reduced consumption of milk beverages by African Americans (AA) compared with whites.[2,5]

Sugar-sweetened beverage consumption of US adults examined in the National Health and Nutrition Examination Surveys (NHANESs) significantly increased between 1988-1994 and 1999-2004.[6] According to the 1999-2004 NHANES data, sugar-sweetened beverages were drunk by 63% of US adults, contributing a daily average of 294 kcal.[6] The consumption of sweetened beverages seemed to be linked to less healthful dietary patterns, such as those defined by high-fat foods and fast foods.[1] Sugar-sweetened beverage consumption has been linked to such adverse health conditions as weight gain and increased risk for developing type 2 diabetes.[3,7] It has been suggested that residents in low-socioeconomic status (SES) urban

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This study was funded by the Intramural Research Program, National Institute of Aging, National Institute of Health.

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neighborhoods have less access to healthier foods than residents in higher-SES neighborhoods.[3,8,9] Block et al[9] note that food preferences may partly be dictated by availability and that because of limited resources, low-income populations may seek out the most calories for the lowest cost.

Beverage choices can influence energy intake because energy consumed in the form of fluids may not have a significant effect on satiety.[10-13] Consumption of sugar-sweetened beverages has been linked to obesity.[6,14] Yet, evidence from 4 nationally representative US surveys has shown that populations who frequently consume sugar-sweetened beverages do not have a higher obesity rate or risk than populations who infrequently consume these beverages.[15] The prevalence of obesity among AA and persons with low SES is higher than that among whites and affluent individuals, respectively.[16-18] A key variable that may predict obesity is a low-diet cost because low-cost foods and beverages tend to be energy dense and nutrient poor.[19]

Data from the NHANES have provided us the majority of knowledge on beverage as well as food consumption patterns. However, knowledge of food and beverage consumption patterns of low-income urban populations is more limited. The Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study, a prospective longitudinal study, was designed to examine the influence of race and SES on health disparities focusing on the incidence and severity of age-related diseases. The HANDLS study evaluates genetic, biologic, demographic, psychosocial, and psychophysiological parameters on the risk of developing impaired cognitive function, and cardiovascular and cerebrovascular diseases, in white and AA residents of Baltimore, Maryland.[20] The HANDLS sample is unique in that it is representative of the predominantly low- to low-middle-income individuals in an urban city.

The purpose of this study is to determine the beverage intake patterns of AA and white participants in the HANDLS study by their weight status. This study may be the first to focus on the beverage consumption of low- to low-middle-income urban individuals related to their weight status.

METHODS

Background on HANDLS study

Data collection for the baseline HANDLS study occurred in 2 phases. The first phase was done in the participant's home and consisted of a 24-hour dietary recall and an interview about their health status, health services, psychosocial factors, and personal and neighborhood characteristics. The second phase was completed usually 3 to 10 days after the first phase on a mobile research vehicle. This phase included a medical history, a second 24-hour dietary recall, physical examination, cognitive measures, and physiology assessments including heart rate variability, arterial thickness, assessments of muscle strength and bone density, and laboratory measurements including fasting blood chemistries and hematology. The baseline data collection for this study occurred between August 2004 and March 2009. Participants of HANDLS were compensated monetarily.

Subject recruitment

Subjects were recruited as a fixed cohort of participants by household screenings from an area probability sample of 13 neighborhoods defined by contiguous US Census tracts in the city of Baltimore. These tracts were selected because they are likely to yield representative distributions of individuals who were 30 to 64 years old, AA and whites, men and women, and had an SES either less than 125% or 125% or more of the federal poverty level. Multiethnic individuals were included provided they strongly identified themselves as AA or whites. To be included in the HANDLS study, participants must (1) be within age range of 30 to 64 years at baseline; (2) be able to give informed consent; (3) be able to perform at least 5 measures of the following evaluations: laboratories' evaluation, medical history, physical examination, physical performance, cognitive testing, dietary recall, audio questionnaire, body composition, carotid Doppler, or pulse wave velocity assessment; (4) have valid picture identification; and (5) have a verifiable address at the time of entry. Exclusions included participants who were pregnant at the time of entry, had a diagnosis of AIDS, and were within 6 months of active treatment of cancer (chemotherapy, biologic, or radiation). After the baseline examination, participants will be reexamined every 3 years with 7 follow-ups. The study protocol was approved by the human investigation review boards at both MedStar Research Institute and the University of Delaware. All participants provided written informed consent.

Study participants

Only men and women interviewed and examined between August 2004 and November 2008 who completed 2 dietary recalls were included in this study. During this time period, 2436 AA and white adults completed all baseline examinations. Of these individuals, 1987 adults had 2 reliable recalls. Just more than half (53.7%) of the respondents had an income above 125% of the federal poverty level; among this percentage, additional analyses found that about half of these respondents were below 150% of the federal poverty level.

Dietary collection method

For the HANDLS study, US Department of Agriculture's (USDA's) Automated Multiple-Pass Method, versions 2.3-2.6, dietary recall survey was used to collect both dietary recalls.[21] The survey was supplemented with measurement aids, such as measuring cups, spoons, ruler, and an illustrated Food Model Booklet to assist in estimating accurate quantities of foods and beverages consumed. Both 24-hour dietary recalls were administered by trained interviewers. The USDA 5-step multiple-pass method has been validated as an accurate methodology for assessing intake of protein, carbohydrate, fat, and energy in obese and nonobese men and women.[22-24] In version 2.3 of the Automated Multiple-Pass Method, tap, bottled, and carbonated water consumption was collected with a short postrecall questionnaire rather than during the recall. These intakes were coded and included in the analyses. The dietary recalls were coded using Survey Net, and nutrients from USDA's Food and Nutrient Database for Dietary Studies version 3.0 were linked to each food consumed.[25] Means of macronutrient and alcohol intakes as well as mean beverage consumption were calculated using the data from both recalls.

Beverage classification and diet quality

For this article, beverages were categorized by the guidance system proposed by Popkin and colleagues.[26] The categories and their components are as follows: category 1—water (eg, unsweetened tap, bottled or carbonated water, and propel fitness water), category 2—unsweetened coffee and tea, category 3—low-fat and skim milk and soy beverages, category 4—noncalorically sweetened beverages (eg, diet soft drinks, low-calorie lemonades, and coffee or tea with low-calorie sweeteners), category 5—caloric beverages with some nutrients (such as 100% fruit and vegetable juices, whole-fat milk, sports drinks, and alcoholic beverages), and category 6—calorically sweetened beverages including carbonated and noncarbonated beverages (such as soft drinks, sports drinks, fruit drinks, fruit juices < 100% fruit, and presweetened teas and coffees like lattes and frappuccinos). Beverages fortified with vitamins or minerals were classified by major beverage category. For instance, Kool-Aid (Kraft Foods Inc Modesto, California) fortified with vitamin C would be placed into category 6.

Diet quality was assessed using the USDA's Health Eating Index (HEI)-2005.[27] This index reflects the *Dietary Guidelines for Americans, 2005* and the standards for each component are now based on an energy density approach.[27] The HEI-2005 includes 12 components and is measured on a scale of 0 to 100; that is, the higher the total HEI-2005 score, the better the diet.

Body weight status

At the mobile research vehicle visit, fasting participants were weighed without shoes and coats using a calibrated Health O Meter digital scale (Pelstar, LLC, Alsip, Illinois). Height was obtained with the subject's heels and back against a height meter by Novel Products, Inc (Rockton, Illinois). Body mass index (BMI) was used to classify people as normal, overweight, or obese. *Normal weight (NW)* was defined as BMI (kg/m^2) from 18.5 to 24.9; *overweight (OW)* was defined as BMI from 25 to 29.9; and *obese (OB)* was defined as BMI 30 or more.[28] The number of underweight (UW) individuals BMI (<18.5) was small (n = 56). There were no statistically significant differences (α =.01) between the UW and NW for the sample proportions within each category of beverage consumed or energy contributed by each beverage category. Thus UW adults were grouped with NW persons.

Socioeconomic status

The poverty income ratio (PIR, the ratio of household income to a family's appropriate poverty threshold) was based on self-reported household income. For the HANDLS study, PIR was dichotomized into 2 groups: poor (PIR < 125% of the federal poverty level), and nonpoor (PIR $\geq$ 125% of the federal poverty level).[29] Education was categorized as either less than a high school education or a high school degree or equivalent or higher.

Statistical analysis

Generalized linear models were used to analyze associations among beverage classifications consumption, nutrient consumption, energy intake, and HEI with BMI and race. Bonferroni multiple comparisons tests were employed for exploratory analyses. Statistical significance was set to $P < .05$. Statistical analyses were performed with SAS statistical software (version 9.1) (SAS Institute, Cary, North Carolina).

RESULTS

Characteristics of sample

The sample consisted of 1117 women (39% whites and 61% AA) and 870 men (38% whites and 62% AA). The mean (standard error of the mean [SEM]) age for the total sample was 48.1 (0.2) years (AA, 48.2 [0.3] and whites, 47.9 [0.3]). The participants below 125% of the poverty income level equaled 1067 (31% whites and 69% AA). The remaining participants (45% whites and 55% AA) had incomes above 125% of the poverty level. One-third of the total sample did not complete high school (Table 1).

Table 1. Characteristics of HANDLS Participants by Race

	Race	
Characteristic	African American (n = 1220)	White (n = 767)
Sex		
Female	682	435
Male	538	332
Poverty delimiter[a]		
Below 125%	638	282
Above 125%	582	485
Weight status[b]		
Normal	365	224
Overweight	334	223
Obese	521	320
Education		
Below high school	419	247
High school or above	801	520

Abbreviations: BMI, body mass index; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span; HHS, Department of Health and Human Services.
[a]Poverty income level was defined by 2003 HHS poverty guidelines.[29]
[b]Weight status is defined on the basis of BMI (kg/m^2). Normal weight was defined as BMI from 18.5 to 24.9; overweight was defined as BMI from 25 to 29.9; and obese was defined as BMI $\geq$ 30.

The body weight status of the sample population by sex and race is presented in Table 1. Overall, 30% of the total sample was NW, 28% was OW, and the remaining 42% was OB. Over half (54%) of the AA women were OB, while only about 28% of the AA men were OB. Among the white adults in the sample, 46% of the women, and 37% of the men were OB.

Table 2. Percentage of HANDLS Participants Consuming Beverages by Day of Recall and Mean Energy Intake by Beverage Category

Beverage Classification[a]	Total Population (n = 1987)		
	Consumption by Sample for Day 1 (%)	**Consumption by Sample for Day 2 (%)**	**Energy, mean (SEM), kcal/d[b]**
Category 1	72.0	75.6	0.0 (0.0)
Category 2	45.1	44.1	3.6 (0.3)
Category 3	6.2	6.5	7.3 (0.7)
Category 4	13.2	13.4	2.0 (0.2)
Category 5	50.2	52.2	162 (6)
Category 6	62.8	61.3	193 (5)

Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span; SEM, standard error of the mean.

[a]Category 1, water; category 2, unsweetened coffee and tea; category 3, low-fat and fat-free milk and soy beverages; category 4, noncalorically sweetened beverages; category 5, caloric beverages with nutrients; category 6, calorically sweetened beverages.

[b]1 kcal = 4.185 kJ.

The overall quality of the diets consumed by HANDLS participants was based on HEI-2005. Scores ranged from 46.3 to 51.1. The HEI-2005 scores were significantly higher for NW- white participants (51.3 [0.8]) than for NW-AA participants (46.3 [0.6]) ($P < .0001$). Obese AA participants (50.5 [0.5]) had a significantly higher score than OB-white participants (48.3 [0.6] y) ($P = .0069$).

Reported beverage usage and energy contribution by beverage category

The reported percentage of consumption of beverages by category was similar for the 2 recall days (Table 2). For the total population, water was the most frequently reported beverage consumed on both days. Calorically sweetened beverages ranked second in consumption. Overall the mean (SEM) energy contributed from calorically sweetened beverages was 193 (5) kcal and from caloric beverages with nutrients was 162 (6) kcal, totaling 96.5% of the total energy provided by beverages (Table 2).

Within racial groups, there were differences in the types of beverages consumed. The top 3 beverage categories ranked by the percentage of consumption for whites were water (66%), unsweetened tea and coffee (61%), followed by calorically sweetened beverages (56%). For AA, the top 3 rankings were water (79%), calorically sweetened beverages (66%) and caloric beverages with nutrients (50%).

For both the AA and whites, approximately 83% of the calorically sweetened beverages were obtained from a store. Only 8% of these beverages were acquired from a fast-food restaurant. About 10% of the total sample consumed calorically sweetened beverages at breakfast, 24% at lunch, and 33% at dinner.

Beverage consumption by weight status

A comparison of beverage consumption of the total HANDLS population by weight status revealed that there were no significant differences for water, unsweetened tea and coffee, and calorically sweetened beverages (Table 3). Overweight individuals consumed significantly more low-fat and fat-free milk and soy beverages ($P = .0306$) and caloric beverages with nutrients ($P < .0001$) than OB individuals. However, they consumed significantly less noncalorically sweetened

Table 3. Beverage Intake by Weight Status of HANDLS Participants Compared With Beverage Guidance[a]

Beverage Classification[b]	Beverage Consumption, mean (SEM), fl oz, by Weight Classification[c] Normal (n = 589)	Overweight (n = 557)	Obese (n = 841)	Suggested Guidance for Beverage Consumption with 10% Energy from Beverages, fl oz[d]
Category 1	33.1 (1.5)	34.1 (1.6)	35.0 (1.3)	20-50
Category 2	9.6 (0.7)	9.5 (0.7)	9.3 (0.6)	0-40
Category 3	0.6 (0.1)	0.8 (0.1)[e]	0.5 (0.1)[e]	0-16
Category 4	2.2 (0.5)[f]	3.1 (0.5)[g]	5.7 (0.4)[f,g]	0-32
Category 5	13.6 (0.7)[f]	12.0 (0.7)[h]	8.0 (0.6)[f,h]	0-8, 100% fruit juices 0-1 alcoholic drink for women, 0-2 alcoholic drinks for men
Category 6	20.6 (0.9)	19.3 (0.9)	18.4 (0.8)	0-8

Abbreviations: BMI, body mass index; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span; SEM, standard error of the mean.
[a]1 oz = 29.574 mL.
[b]Category 1, water; category 2, unsweetened coffee and tea; category 3, low-fat and fat-free milk and soy beverages; category 4, noncalorically sweetened beverages; category 5, caloric beverages with nutrients; category 6, calorically sweetened beverages.
[c]Weight status defined on the basis of BMI (kg/m^2). Normal weight was defined as BMI from 18.5 to 24.9; overweight was defined as BMI from 25 to 29.9; and obese was defined as BMI $\geq$ 30.
[d]From Popkin et al.[26]
[e]Means with significant (Bonferroni) differences for $P = .0306$.
[f,h]Means with significant (Bonferroni) differences for $P < .0001$.
[g]Means with significant (Bonferroni) differences for $P = .0002$.

beverages ($P = .0002$). Normal weight individuals, in comparison with OB individuals, consumed significantly more caloric beverages with nutrients ($P < .0001$) and significantly less noncalorically sweetened beverages ($P < .0001$) (Table 3).

Within each weight status group, the white HANDLS participants consumed significantly more beverages from the unsweetened coffee and tea, the low-fat and fat-free milk and soy beverage, and the noncalorically sweetened beverage categories (categories 2, 3, and 4, respectively) than their AA counterparts. Obese-white HANDLS participants consumed more calorically sweetened beverages (category 6) than OB-AA participants. In contrast, AA participants in the HANDLS study consumed significantly more water than their white counterparts in the OW and OB classification (category 1). There were no significant differences in the consumption of caloric beverages providing nutrients (category 5) between races by weight status (Table 4).

Energy and nutrient intake from beverages by weight status

The mean energy intake of the total sample based on 2 dietary recalls was 2010 (22) kcal (AA, 2000 [28] kcal; whites, 2026 [35] kcal). The mean total energy intake of the study participants by race and weight status is presented in Table 5. It is interesting to note that the energy intake of OB participants was less than that of the NW or OW participants. Among the OB participants, AA consumed significantly less energy than whites. On average, beverages contributed between 17% and 20%

Table 4. Beverage Consumption (in grams) Classified by Category for African American and White HANDLS Participants by Weight Status[a]

	Normal			Overweight			Obese		
Beverage Classification[b]	**African American (n = 365)**	**White (n = 224)**	***P***	**African American (n = 334)**	**White (n = 223)**	***P***	**African American (n = 521)**	**White (n = 320)**	***P***
Category 1	1009.1 (57.0)	836.4 (72.8)	.0664	1055.6 (57.6)	852.3 (70.5)	.0260	1101.7 (44.2)	836.8 (56.4)	.0002
Category 2	137.6 (23.8)	495.3 (30.4)	<.0001	151.4 (25.2)	451.6 (30.8)	<.0001	157.4 (17.5)	442.0 (22.4)	<.0001
Category 3	5.8 (3.7)	39.0 (4.7)	<.0001	9.0 (5.0)	46.0 (6.1)	<.0001	9.0 (2.5)	21.0 (3.2)	.0033
Category 4	22.7 (14.0)	127.0 (17.8)	<.0001	25.5 (14.8)	184.1 (18.1)	<.0001	69.4 (17.3)	314.4 (22.0)	<.0001
Category 5	398.8 (31.3)	372.0 (39.9)	.5981	343.8 (26.7)	340.9 (32.7)	.9444	227.5 (16.7)	232.7 (21.3)	.8474
Category 6	580.2 (34.0)	595.9 (43.4)	.7758	576.0 (32.4)	511.3 (39.7)	.2075	492.2 (27.5)	582.3 (35.0)	.0433

Abbreviations: BMI, body mass index; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span.

[a]Weight status was defined on the basis of body mass index (kg/m^2). Normal weight was defined as BMI from 18.5 to 24.9; overweight was defined as BMI from 25 to 29.9; and obese was defined as BMI $\geq$ 30; values are mean (standard error of the mean).

[b]Category 1, water; category 2, unsweetened coffee and tea; category 3, low-fat and fat-free milk and soy beverages; category 4, noncalorically sweetened beverages; category 5, caloric beverages with nutrients; category 6, calorically sweetened beverages.

Table 5. Energy, Fat, Sugar, and Alcohol Intakes by Race and Weight Status and Healthy Eating Index-2005 Scores[a]

	Normal			Overweight			Obese		
	African American (n = 365)	White (n = 224)	*P*	African American (n = 334)	White (n = 223)	*P*	African American (n = 521)	White (n = 320)	*P*
Total energy, kcal/d[b]	2283 (59)	2143 (75)	.1407	2110 (55)	2008 (67)	.2379	1731 (35)	1957 (45)	.0001
Energy from beverages, kcal/d	424 (19)	418 (25)	.8274	397 (19)	394 (23)	.9211	301 (12)	329 (16)	.1594
Beverage, % of total energy	18.7 (0.6)	19.1 (0.8)	.7197	18.6 (0.7)	19.5 (0.9)	.4659	17.2 (0.5)	16.8 (0.7)	.6726
Total fat, g/d	90.1 (2.7)	79.5 (3.5)	.0176	83.5 (2.6)	76.8 (3.1)	.0983	68.4 (1.7)	79.3 (2.1)	<.0001
Fat from beverages, g/d	2.3 (0.4)	4.5 (0.4)	.0001	2.0 (0.4)	4.3 (0.5)	.004	1.8 (0.2)	3.0 (0.2)	<.0001
Beverage, % of total fat	2.7 (0.3)	5.3 (0.4)	<.0001	2.7 (0.4)	5.4 (0.5)	<.0001	3.0 (0.3)	4.2 (0.4)	.0093
Total Sugar, g/d	124.2 (4.2)	132.6 (5.4)	.2206	121.8 (4.1)	119.6 (5.1)	.7428	103.1 (3.0)	112.9 (3.8)	.0462
Sugar from beverages, g/d	64.1 (3.1)	67.5 (3.9)	.4993	63.5 (3.0)	60.9 (3.7)	.5800	55.5 (2.4)	58.5 (3.1)	.4477
Beverage, % of total sugar	50.6 (1.3)	43.9 (1.6)	.0014	48.8 (1.5)	44.8 (1.8)	.0797	49.2 (1.2)	43.4 (1.5)	.0027
Alcohol, g/d	12.8 (1.4)	8.7 (1.7)	.0665	11.6 (1.6)	9.9 (1.9)	.4929	4.6 (0.7)	4.5 (0.8)	.9097

Abbreviation: BMI, body mass index.

[a]Values are means (standard error of the mean) and %. Weight status was defined on the basis of body mass index (kg/m^2). Normal weight was defined as BMI from 18.5 to 24.9; overweight was defined as BMI from 25 to 29.9; and obese was defined as BMI $\geq$ 30.

[b]1 kcal = 4.185 kJ.

of total energy intake. There were no significant differences between energy from beverages expressed as a percent of total energy intake by race within a weight status group.

The mean daily fat intake from foods and beverages combined was significantly higher for normal weight AA than for their white counterparts, but the reverse was true for the obese where whites consumed significantly more fat. However, the mean fat intake from beverages was significantly higher for whites than for AA for all weight status groups. For sugar, mean intake within weight status was only significantly higher in OB-W when comparing races. The proportion of sugar contributed by beverages to the mean daily sugar intake from foods and beverages was significantly higher for NW and OW-AA than for their white counterparts. There were no significant differences in alcohol consumed within each weight status group by race (Table 5).

Discussion

The findings of this study enhance the knowledge of beverage consumption in relation to weight status in a relatively large low-income urban sample, a population that is difficult to recruit and consequently often understudied. Unlike other publications on beverage consumption,[1,2,4,6] this study's findings are based on 2 dietary recalls. Similar to other studies, water is the most commonly consumed beverage and the overall energy contribution of beverages to total energy is 17% to 20%.[2,4,22] The findings from the HANDLS study revealed that approximately 66% of the AA sample and 56% of the white sample drank calorically sweetened beverages daily, contributing between 189 and 195 kcal/d. This percentage was similar to that reported by Bleich et al.[6] However, the energy contribution reported by Bleich et al[6] was higher than that found for HANDLS participants (294 kcal vs 189-195 kcal) despite the high prevalence of obesity. It is possible that the participants in the Bleich et al study overestimated portions consumed or that the HANDLS participants underestimated their portions.

Energy-dense foods are not only least expensive but also most resistant to inflation.[30] Unfortunately, soft drinks and fruit drinks are not satiating.[10-13] Thus consumption of these beverages may not be compensated by reducing the intake of other foods. The net effect of this lack of compensation would be an increase in energy intake that has been linked to the obesity epidemic.[10] In this sample of urban white and AA adults, there is no relationship between weight status and consumption of calorically sweetened beverages. Similar results have been reported for children, adolescents, and adults.[12,13,31,32] It has been suggested that high consumption of soft drinks may be a marker of overall unhealthy dietary patterns.[31] Thus, dietary behaviors along with other lifestyle choices and economics may contribute more to weight status than calorically sweetened beverages.[13,19]

The results of this study also indicate no significant differences between energy from beverages expressed as a percent of total energy intake by race within a weight status category. These findings suggest that among the poor and lower middle class, energy provided by fruit and vegetable juices, fruit drinks, and soft drinks may be providing calories to meet energy requirements. Unfortunately, the consumption of soft and fruit drinks does not contribute to a high diet quality. In fact, the quality of the diets consumed by HANDLS participants, measured by the HEI-2005, was lower than those reported from low-income participants interviewed in NHANES 2003-04.[33]

The recommendations of the Beverage Guidance Panel suggested at most 10% of total energy from beverages with 14% of total energy as an acceptable pattern.[26] At either percentage, the range of intake for calorically sweetened beverages is 0 to 8 fl oz/d and for water is 20 to 50 fl oz/d for an intake of 2200 kcal. HANDLS participants on average consumed between 17 and 21 fl oz of calorically sweetened beverages. Although their consumption of calorically sweetened beverages was 2 to 3 times the upper limit of the recommendation, the intake of water by HANDLS participants was within the guidelines, ranging from 30 to 38 fl oz/day depending on race or BMI categorization (overall mean [SEM] = 34.2 [0.8]). In comparison, Popkin et al[4] reported that 87% of the NHANES 1999-2001 sample consumed water, with an average daily consumption of 51.9 oz per consumer. Although Duffey and Popkin[1] found higher water intake to be associated with better diet quality, this observation was not consistently found among HANDLS participants.

The higher proportion of fat contributed by beverages of white participants compared with AA participants may reflect differences in intakes of dairy beverages. The greater consumption of low-fat and fat-free milk and soy beverages by white participants compared with AA participants was not unexpected because of physiological and cultural differences. African Americans have higher rates of lactose intolerance or believe that they are not at risk for osteoporosis.[5] In addition, AA do not consider dairy products as a dinner beverage.[2] For HANDLS participants, only 7% in both race groups consumed dairy beverages at dinner time.

Limitations

Despite its many strengths, including the use of 2 dietary recalls collected by a validated method and BMI based on measured weights and heights, this study has a few limitations. Dietary recalls may be inaccurate and biased because of misreporting, primarily underreporting, and errors associated with converting reported beverage intake to energy intake if assumptions were made about serving size. If people added milk and/or sugar to their coffee or tea, the milk and coffee would be captured by the proposed beverage categorization. However, under the present coding system, the added solid sugar would not be captured so total energy from beverages would be underestimated. Another limitation is the change in the collection of water as a beverage that may have affected its estimation. However, preliminary analyses by USDA researchers have found that despite differences in collection method, the only significant differences they observed were for persons 71 years and older.[34] Thus, if any differences do exist for the study sample, aged 30 to 64 years, they may be insignificant.

CONCLUSION

The findings of this study show that the HANDLS sample are consumers of calorically sweetened beverages. However, in this sample there were no differences in intake of sweetened beverages by weight status. Acquiring low-energy yet nutrient-dense food requires several resources including income, time, and transportation, in addition to the availability of healthy food. Increasing the awareness of the role of beverages in overall energy intake and risks for adverse health outcomes associated with some types of beverages may elicit changes in the types of beverages consumed. Yet, the rising cost of low-energy density foods may present a challenge for this urban population.

REFERENCES

1. Duffey KJ, Popkin BM. Adults with healthier dietary patterns have healthier beverage patterns. *J Nutr*. 2006;136:2901-2907.
2. Storey ML, Forshee RA, Anderson PA. Beverage consumption in the US population. *J Am Diet Assoc*. 2006;106:1992-2000.
3. Rehm CD, Matte TD, Van Wye G, Young C, Frieden TR. Demographic and behavioral factors associated with daily sugar-sweetened soda consumption in New York City adults. *J Urban Health*. 2008;85:375-385.
4. Popkin BM, Barclay DV, Nielsen SJ. Water and food consumption patterns of US adults from 1999-2001. *Obes Res*. 2005;13(12):2146-2152.
5. O'Neil CE, Nicklas TA, Liu Y, Franklin FA. Impact of dairy and sweetened beverage consumption on diet and weight of a multiethnic population of head start mothers. *J Am Diet Assoc*. 2009;109:874-882.
6. Bleich SN, Wang YC, Wang Y, Gortmaker SL. Increasing consumption of sugar-sweetened beverages among US adults: 1988-1994 to 1999-2004. *Am J Clin Nutr*. 2009;89:372-381.

7. Schulze MB, Manson JE, Ludwig DS, et al. Sugar-sweetened beverages, weight gain, and incidence of type 2 diabetes in young and middle-aged women. *JAMA*. 2004;292(8):927-934.
8. Black JL, Macinko J. Neighborhoods and obesity. *Nutr Rev*. 2008;66(1):2-20. doi:10.1111/j.1753-4887.2007.00001.x. PubMed PMID: 18254880.
9. Block JP, Scribner RA, DeSalvo KB. Fast food, race/ethnicity, and income: a geographic analysis. *Am J Prev Med*. 2004;27(3):211-217.
10. DiMeglio DP, Mattes RD. Liquid versus solid carbohydrate: effects on food intake and body weight. *Int J Obes Relat Metab Disord*. 2000;24:794-800.
11. Monsivais P, Perrigue MM, Drewnowski A. Sugars and satiety: does the type of sweetener make a difference? *Am J Clin Nutr*. 2007;86:116-123.
12. Forshee RA, Storey ML, Allison DB, et al. A critical examination of the evidence relating high fructose corn syrup and weight gain. *Crit Rev Food Sci Nutr*. 2007;47:561-582.
13. Dennis EA, Flack KD, Davy BM. Beverage consumption and adult weight management: a review. *Eat Behav*. 2009;10:237-246.
14. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr*. 2006;84:274-288.
15. Sun SZ, Empie MW. Lack of findings for the association between obesity risk and usual sugar-sweetened beverage consumption in adults—a primary analysis of databases of CSFII-1989-1991, CSFII-1994-1998, NHANES III, and combined NHANES 1999-2000. *Food Chem Toxicol*. 2007;45:1523-1536.
16. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*. 2006;295(13):1549-1555.
17. Ogden CL, Carroll MD, McDowell MA, Flegal KM. Obesity among adults in the United States—no statistically significant change since 2003-2004. *NCHS Data Brief*. 2007;1:1-3.
18. Wang Y, Beydoun MA. The obesity epidemic in the United States—gender, age, socioeconomic, race/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiol Rev*. 2007;29:6-28
19. Drewnowski A. Obesity, diets, and social inequalities. *Nutr Rev*. 2009;67:S36-S39.
20. National Institute on Aging, National Institutes of Health. Healthy aging in neighborhoods of diversity across the life span. http://handls.nih.gov/. Updated 2009. Accessed October 21, 2009.
21. Raper N, Perloff B, Ingwersen L, Steinfeldt L, Anand J. An overview of USDA's dietary intake data system. *J Food Composition Anal.* 2004;17:545-555.
22. Moshfegh AJ, Rhodes DG, Baer DJ, et al. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. *Am J Clin Nutr*. 2008;88:324-332.
23. Conway JM, Ingwersen LA, Moshfegh AJ. Accuracy of dietary recall using the USDA five-step multiple-pass method in men: an observational validation study. *J Am Diet Assoc.* 2004;104(4):595-603.
24. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *Am J Clin Nutr*. 2003;77(5):1171-1178.
25. USDA Food and Nutrient Database for Dietary Studies, 3.0. Beltsville, MD: Agricultural Research Service, Food Surveys Research Group; 2008. http://www.ars.usda.gov/Services/docs.htm?docid=12089. Accessed June 10, 2009.
26. Popkin BM, Armstrong LE, Bray GM, Caballero B, Frei B, Willett WC. A new proposal guidance system for beverage consumption in the United States. *Am J Clin Nutr*. 2006;83:529-542.
27. Guenther PM, Reedy J, Krebs-Smith SM. Development of the Healthy Eating Index-2005. *J Am Diet Assoc*. 2008;108:1896-1901.
28. National Heart Lung and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. http://www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.htm. Published 1998. Accessed June 10, 2009. Report reference No. 98-4083.
29. Department of Health and Human Services. Annual update of the HHS poverty guidelines. *Fed Reg* 2003;68(26):6456-6458. http://aspe.hhs.gov/poverty/03poverty.htm. Accessed June 10, 2009.
30. Monsivais P, Drewnowski A. The rising cost of low-energy-density foods. *J Am Diet Assoc*. 2007;107:2071-2076.
31. Johnson L, Mander AP, Jones LR, Emmett PM, Jebb SA. Is sugar-sweetened beverage consumption associated with increased fatness in children? *Nutrition*. 2007;23:557-563.
32. Gomez-Martinez S, Martin A, Romeo J, et al. Is soft drink consumption associated with body composition? A cross-sectional study in Spanish adolescents. *Nutr Hosp*. 2009;24(1):97-102.
33. US Department of Agriculture, Center for Nutrition Policy and Promotion. Diet quality of low-income and higher income Americans in 2003-04 as measured by the Healthy Eating Index-2005. *Nutrition Insight 42.* http://www.cnpp.usda.gov/Publications/NutritionInsights/Insight42.pdf. Published December 2008. Accessed June 10, 2009.
34. Sebastian RS, Wilkinson EC, Goldman JD. Water intakes similar in What We Eat in *America/NHANES 2003-2004 and 2005-2006 despite change in data collection method.* Paper presented at: 7th International Conference on Diet and Activity Methods. http://www.icdam.org/ICDAM_Program_Abstracts_Book.pdf. Published 2009. Accessed February 14, 2010.