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Breakfast Consumption Is Positively Associated with Usual Nutrient Intakes among Food Pantry Clients Living in Rural Communities

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ABSTRACT

Background: Breakfast consumption has declined over the past 40 y and is inversely associated with obesity-related diet and health outcomes. The breakfast pattern of food pantry clients and its association with diet is unknown.

Objective: The objective is to investigate the association of breakfast consumption with diet quality and usual nutrient intakes among food pantry clients ($n = 472$) living in rural communities.

Methods: This was an observational study using cross-sectional analyses. English-speaking participants ≥18 y (or ≥19 y in Nebraska) were recruited from 24 food pantries in rural high-poverty counties in Indiana, Michigan, Missouri, Nebraska, Ohio, and South Dakota. Participants were surveyed at the pantry regarding characteristics and diet using 24-h recall. A second recall was self-completed or completed via assisted phone call within 2 wk of the pantry visit. Participants were classified as breakfast skippers when neither recall reported breakfast ≥230 kcal consumed between 04:00 and 10:00; breakfast consumers were all other participants. The Healthy Eating Index-2010 was modeled with breakfast pattern using multiple linear regression. Mean usual intake of 16 nutrients was estimated using the National Cancer Institute Method and compared across breakfast pattern groups. Usual nutrient intake was compared with the Estimated Average Requirement (EAR) or Adequate Intake (AI) to estimate the proportion of population not meeting the EAR or exceeding the AI.

Results: A total of 56% of participants consumed breakfast. Compared with breakfast skippers, breakfast consumers had 10–59% significantly higher usual mean intakes of all nutrients ($P \leq 0.05$), and had 12–21% lower prevalence of at-risk nutrient intakes except for vitamin D, vitamin E, and magnesium.

Conclusions: Adult food pantry clients living in rural communities experienced hardships in meeting dietary recommendations. Breakfast consumption was positively associated with usual nutrient intakes in this population. This trial was registered at clinicaltrials.gov as NCT03566095. *J Nutr* 2020;150:546–553.

Keywords: breakfast, eating pattern, usual intake, nutrient inadequacy, Healthy Eating Index, food pantry, emergency food assistance, food insecurity, low income

Introduction

Breakfast is generally defined as either the first meal of the day eaten within 2 h of waking (usually before 10:00) contributing 20–35% of total energy intake, or any food/beverage (excluding water) consumed between 05:00 and 09:00 (1). Despite the recommendation from the 2010 Dietary Guidelines for Americans to consume a nutrient-dense breakfast (2), the proportion of American adults consuming breakfast has declined significantly over the past 40 y based on findings from NHANES data

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from 1971–1974 to 2009–2010 (3). Decreasing frequency of breakfast consumption has occurred concomitantly with the rising obesity epidemic (4) and is associated with greater risk of overweight and obesity, metabolic risk profile, type 2 diabetes, cardiovascular disease, and hypertension (5). The chronic disease burden is high, especially among low-resource households relying on emergency food assistance (6). These households are also vulnerable to dietary patterns where skipping meals is prevalent because of limited or uncertain access to adequate food, also known as food insecurity (7). Approximately 96% of adults living in very low food-secure households (the most severe situation of food insecurity) reported skipping meals or cutting the size of meals because there was not enough money for food (7). Skipping breakfast and selecting low-nutritional-quality foods for breakfast has been observed among low-income children (8, 9). The prevalence of breakfast consumption among adult emergency food pantry clients is currently unknown but may be pervasively low due to the high prevalence of food insecurity among this population, where diet quality is known to be poor and intake of key nutrients and food groups often do not meet recommendations (10, 11). Characterizing breakfast patterns and their relation to diet quality and nutrient intakes may help inform interventions to promote healthy eating patterns in this extremely low-resource population.

The present study sought to characterize breakfast habits among adult food pantry clients living in rural communities and to quantify the association between breakfast consumption and diet quality, quality of dietary components, and usual intake of total energy and 16 selected nutrients based on two 24-h dietary recalls. We hypothesized that diet quality, quality of dietary components, and usual intake of total energy and 16 selected nutrients would be higher among breakfast consumers compared with breakfast skippers. The proportion of breakfast consumers and skippers meeting the Estimated Average Requirement (EAR) or exceeding the Adequate Intake (AI) was also determined.

Methods

Study design

This observational study included cross-sectional secondary analyses of baseline data from a multi-state intervention, "Voices for Food", which was a longitudinal integrated research and extension-based intervention to improve food security and dietary intake among rural food pantry clients from Indiana, Michigan, Missouri, Nebraska, Ohio, and South Dakota (12). Two matched treatment and comparison counties defined as nonmetro (13) with poverty rates >16% in 2011 (14) were selected in each state to participate in the study based on community and food pantry attributes (12). Institutional Review Board approval was obtained for this study prior to all intervention activities. The study was registered as a clinical trial at clinicaltrials.gov as NCT03566095.

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Abbreviations used: AI, Adequate Intake; ASA24-2014, Automated Self-Administered 24-h recall; ATE, α-tocopherol equivalents; EAR, Estimated Average Requirement; HEI-2010, Healthy Eating Index-2010; NCI, National Cancer Institute; RAE, retinol activity equivalents.

Participants

From August to November 2014, a convenience sample of participants was recruited through flyers that advertised the study during pantry operation hours and by approaching clients while they waited in line to receive food at selected pantries. Participants were screened by trained research staff. Eligible participants were English speaking, aged ≥18 y (or ≥19 y in Nebraska where the legal age criteria classifying adult status is 19 y), having visited the food pantry ≥1 time prior to recruitment, and having received foods from the pantry on the recruitment day. A total of 613 pantry clients were confirmed eligible and recruited at baseline; 472 (77%) participants were included in the analyses and exclusions were due to incomplete dietary and food security data. Participants who completed multiple recalls were more likely to be 45 y and older ($P = 0.02$), white ($P = 0.03$), and recruited from Michigan and Nebraska ($P < 0.00$), and were less likely to participate in 1 or more food assistance programs ($P = 0.01$), including the Supplemental Nutrition Assistance Program, the Special Supplemental Nutrition Program for Women, Infants, and Children, Meals on Wheels, soup kitchens, free or reduced price meal at school, and free or reduced price meal at summer program.

Survey instrument and dietary assessment

Participants completed an electronic or paper version of a questionnaire in a semiprivate area. The questionnaire elicited information on sociodemographic and pantry use characteristics: sex (men, women), race (white, black, others that included American Indian, Asian, Hawaiian, Hispanic or Latino or Spanish origin, and any combination of races), age (18–44 y, 45–64 y, ≥65 y), highest level of education (high school or less, above high school), employment (working last week, not working last week), frequency of food pantry visits in the last 12 mo (1 per mo, 2–3 per mo, >3 per mo), and state of recruitment (Indiana, Michigan, Missouri, Nebraska, Ohio, South Dakota), household size (1, 2, ≥3), annual household income (≤$10,000, $10,001–$15,000, ≥$15,001), household food security status (food secure, food insecure), and participation in ≥1 food assistance program (yes, no). Food assistance programs included the Supplemental Nutrition Assistance Program, the Special Supplemental Nutrition Program for Women, Infants, and Children, Meals on Wheels, free or reduced price meal at school, free or reduced price meal at summer program, and soup kitchens. The validated 18-item US Household Food Security Survey Module (15) was also included in the questionnaire. Upon completion of this questionnaire, participants completed the Automated Self-Administered 24-h recall [ASA24-2014, National Cancer Institute (NCI), Bethesda, MD, USA], an internet-based 24-h recall tool (16), with optional staff assistance. An additional dietary recall was self-completed or completed through an assisted phone call within 2 wk of the pantry visit. Participants received $10 as compensation in the form of a grocery store gift card upon completion of the initial questionnaire and the first recall, and an additional $10 gift card for completing the second recall.

The 18-item US Household Food Security Survey Module was used to evaluate household food access in the last 12 mo (15). Unanswered items were imputed using previously described methods recommended in the USDA guide to measuring household food security (15). A raw score (number of affirmative responses on the food security scale) of 0–2 classified household food security, indicating no problems regarding food or having some anxiety attaining food but little or no changes in diet (7, 15). A raw score of 3–10 classified household food insecurity, indicating reduction in the diet quality, variety, desirability, and/or disrupted eating patterns due to inadequate resources (7, 15).

Dietary intake information was collected using two 24-h dietary recalls on nonconsecutive days using the ASA24-2014 tool, developed by the NCI, Bethesda, MD (16). Approximately 51% of participants reported recalls on 1 weekday and 1 weekend day, whereas 44% reported both recalls on weekdays and 5% reported both recalls on weekend days. The ASA24-2014 system automatically codes and converts reported foods and beverages to their respective nutrient values using the USDA Food and Nutrient Database for Dietary Studies 2011–2012 (17) and the Food Patterns Equivalents Database 2011–2012 (18, 19). Each food item was self-reported as 1 of 8 eating occasions, including breakfast, brunch, lunch, dinner, supper, snack, just a drink,

and supplements. Breakfast was defined as the self-reported breakfast eating occasion that was consumed between 04:00 and 10:00 and provided ≥230 kcal, similar to previous research (5, 20). Breakfast consumers included participants who consumed breakfast on ≥1 recall day ($n = 264$). Breakfast skippers included participants who did not consume breakfast on both recall days ($n = 208$).

The Healthy Eating Index-2010 (HEI-2010) was used to quantify diet quality since the data were collected during the implementation of the 2010 Dietary Guidelines for Americans. The HEI-2010 total and component scores, developed by the NCI and the USDA, can be calculated as continuous scores with higher scores indicating better diet quality and conformance with dietary recommendations (2, 21, 22). HEI-2010 scores can be calculated at the level of groups or at the level of individuals (21–23). For the analyses conducted here, individual- or person-level scores were needed and thus the SAS macro "ASA24-2014-Per Day-HEI-2010" provided by the NCI (23) was used to derive the HEI-2010 scores from the 2 ASA24-2014 recalls using previously described methods (22). The HEI-2010 total score is composed of 9 adequacy component scores and 3 moderation component scores, which sum to a maximum total score of 100 (21, 22). The adequacy components or dietary components to emphasize include Total Fruit (score range 0–5), Whole Fruit (score range 0–5), Total Vegetable (score range 0–5), Greens and Beans (score range 0–5), Total Protein Foods (score range 0–5), Seafood and Plant Proteins (score range 0–5), Whole Grains (score range 0–10), Dairy (score range 0–10), and Fatty Acids (score range 0–10) (21, 22). The moderation components or dietary components to limit include Refined Grains (score range 0–10), Sodium (score range 0–10), and Empty Calories (score range 0–20) (21, 22). Because the 2010 USDA Food Patterns recommendations are calculated in amounts that vary according to energy level, the HEI-2010 scores use a density approach to set standards that are expressed as either a percentage of energy or per 1000 kcal with the exception of fatty acids, which are expressed as a ratio of unsaturated fatty acids to SFAs (22, 24). Density standards are useful because they are independent of an individual's energy requirement (22, 24). The standards for assigning maximum scores were the least-restrictive (easiest to achieve) recommendations among those that vary by energy level, sex, and/or age (22).

Statistical analyses

Sample size calculation of the parent project "Voices for Food" has been described elsewhere (12). For the secondary analyses in this study, a sample size of 75 was shown sufficient in a previous study to detect significant difference in the HEI-2010 total score between breakfast consumers and skippers (20). Statistical analyses were performed using SAS version 9.4 (SAS Institute).

Participant characteristics were compared across breakfast pattern groups using chi-square tests; Fisher's exact test was used for race and state due to small sample size in subgroups. Primary outcomes included the HEI-2010 total and component scores, and usual intake of total energy and nutrients. Multiple linear regression models were used to compare HEI-2010 total and 12 component scores by breakfast pattern categories. Covariate adjustment included age, sex, and household food security, highest level of education, household size, with breakfast skippers being the reference group. Model assumptions were verified by plotting residuals against predicted means, Q-Q plot, and histograms of residuals. Data were investigated for normality and determined not necessary to transform before analyses. Differences between least-squares means were reported with 95% CI. Results were considered significant when $P \leq 0.05$.

Nutrients identified by the 2015 Dietary Guidelines for Americans as underconsumed nutrients for the entire population and for at-risk subgroups were examined (25), including vitamin A [retinol activity equivalents (RAE) μg/d], vitamin D (μg/d), vitamin E (mg/d), vitamin C (mg/d), calcium (mg/d), magnesium (mg/d), potassium (mg/d), iron (mg/d), and fiber (g/d). In addition, researchers also examined nutrients previously determined to be underconsumed among food pantry clients (10), including vitamin B-6 (mg/d), vitamin B-12 (μg/d), riboflavin (mg/d), thiamin (mg/d), niacin (mg/d), folate (μg/d), and zinc (mg/d). The usual intake for total energy and nutrients were estimated using the NCI Method (26, 27). The NCI Method typically uses a 2-part model accounting for both the probability and the amount of consumption and allows the random effects to correlate (26, 27). However, in our sample, the probability for both total energy and nutrients was 1, or consumed daily, because the percentage of participants reporting zero intake was ≤5% on the first 24-h recall (28). In consequence, modeling for probability was not necessary. For the amount of consumption, the NCI Method transformed data from both 24-h recalls using the Box–Cox transformation; and transformed observations were then modeled using linear mixed effects models with adjustment for covariates via fixed effects (26). The %MIXTRAN SAS macro of the NCI Method (26) compared the effects of breakfast pattern (breakfast consumers compared with skippers) on usual intakes. The %DISTRIB SAS macro (26) produced the mean usual intake for each breakfast pattern category and the proportions of participants consuming below the EAR for 14 nutrients (29). The cut-off approach was used for assessing the prevalence not meeting the EARs for women aged between 31 and 50 y, which were chosen because women aged between 31 and 50 y was the most prevalent sex/age group in the study sample. These EARs included 500 μg RAE/d for vitamin A, 10 μg/d for vitamin D, 12 mg α-tocopherol equivalents (ATE)/d for vitamin E, 60 mg/d for vitamin C, 320 μg/d for folate, 1.1 mg/d for vitamin B-6, 2.0 μg/d for vitamin B-12, 0.9 mg/d for riboflavin, 0.9 mg/d for thiamin, 11 mg/d for niacin, 800 mg/d for calcium, 265 mg/d for magnesium, 8.1 mg/d for iron, and 6.8 mg/d for zinc. Similarly, the proportions of participants below the AI for potassium (4700 mg/d) and fiber (25 g/d) were produced by the %DISTRIB SAS macro and then subtracted from 100% to generate the proportions exceeding AI for the 2 nutrients with no established EAR. One hundred bootstrap samples of all participants (with replacement) of the mean usual intake output by the %DISTRIB macro were generated to obtain the SD of the mean usual intake for each nutrient. The main predictor in the models (separate model for each nutrient) for estimating usual intake was breakfast pattern categories. Covariates adjusted in the models for estimating and comparing usual nutrient intakes included total energy intake, sex, age, household food security, highest level of education, household size, day of the week of dietary recall (weekday/weekend), and sequence of the dietary recall (first/second). Covariates adjusted in the model for estimating and comparing usual energy intake included all covariates above except for total energy intake. Significant group differences were indicated when $P \leq 0.05$. Each nutrient was considered a separate independent outcome, thus multiple comparisons were not adjusted.

Results

Approximately 82% of participants were living in food-insecure households. About 56% ($n = 264$) of participants were breakfast consumers, of which 109 participants consumed breakfast on both recall days. Breakfast consumers and skippers were similar on most demographic characteristics, except for age, household size, highest level of education, and household food security status (**Table 1**). There were more breakfast skippers aged between 18–44 and 45–64 y, living in a household of 2 persons, having received high school or less as the highest level of education, and living in food-insecure households (Table 1).

The HEI-2010 total score was low among both breakfast consumers and skippers (**Table 2**). Breakfast consumers had a significantly higher HEI-2010 total score compared with breakfast skippers (Table 2). Total Fruit, Seafood and Plant Proteins, Whole Grains, and Empty Calories component scores were statistically different across groups (Table 2).

The usual intake of total energy was significantly higher among breakfast consumers compared with skippers (**Table 3**). Breakfast consumers had 10–59% significantly higher usual mean intakes of all nutrients compared with breakfast skippers (Table 3).

TABLE 1 Sociodemographic characteristics by breakfast pattern categories among adult food pantry clients living in rural communities[1]

	Breakfast consumers		Breakfast skippers		
	n	%	*n*	%	*P*
All	264	56	208	44	
Sex					0.12
Men	54	24	51	31	
Women	173	76	115	69	
Race					0.14
White	184	83	131	79	
Black	12	5	18	11	
Others[2]	26	12	17	10	
Age, y					0.03
18–44	70	30	64	38	
45–64	101	44	80	47	
≥65	59	26	25	15	
Household size					0.05
1	86	34	52	26	
2	54	21	61	30	
≥3	116	45	88	44	
Highest level of education					0.00
≤High school	137	60	128	76	
>High school	90	40	40	24	
Household annual income, US$					0.06
≤10,000	121	49	115	59	
10,001–15,000	53	21	39	20	
≥15,001	73	30	40	21	
Household food security in the last 12 mo[3]					0.00
Food secure	58	23	24	12	
Food insecure	195	77	172	88	
Employment					0.27
Working last week	51	21	45	26	
Not working last week	192	79	131	74	
Frequency of food pantry visit in the last 12 mo, times/mo					0.43
≤5	130	49	110	53	
≥6	134	51	98	47	
SNAP participation					0.62
Yes	167	65	134	68	
No	88	35	64	32	
Participation in ≥1 food assistance program[4]					0.65
Yes	197	75	159	76	
No	67	25	49	24	
State of enrollment					0.09
Indiana	63	24	56	27	
Michigan	63	24	32	15	
Missouri	50	19	57	27	
Nebraska	30	11	19	9	
Ohio	27	10	24	12	
South Dakota	31	12	20	10	

[1] Total numbers do not always add up to sample size due to missing values; percentages do not always add up to 100 due to rounding. Chi-square tests were used to determine differences between categorical variables. Fisher's exact test was reported for race and state due to small sample size in subgroups. Statistical significance level was set at $P \leq 0.05$. SNAP, Supplemental Nutrition Assistance Program.

[2] Others included American Indian, Asian, Hawaiian, Hispanic or Latino or Spanish origin, and any combination of races. These responses were collapsed into 1 category because of the small sample size.

[3] Assessed by the 18-item US Household Food Security Survey Module; and unanswered items were imputed using previously described methods recommended in the USDA guide to measuring household food security (15). A raw score (number of affirmative responses on the food security scale) of 0–2 classified household food security, indicating no problems regarding food or having some anxiety attaining food but little or no changes in diet (7, 15). A raw score of 3–10 classified household food insecurity, indicating reduction in the diet quality, variety, desirability, and/or disrupted eating patterns due to inadequate resources (7, 15).

[4] Food assistance program included the Supplemental Nutrition Assistance Program, Special Supplemental Nutrition Program for Women, Infants, and Children, Meals on Wheels, soup kitchens, free or reduced price meal at school, and free or reduced price meal at summer program.

TABLE 2 Associations between breakfast consumption and the Healthy Eating Index-2010 scores among adult food pantry clients living in rural communities

Healthy Eating Index-2010 (range of scores)	Breakfast consumers[1] ($n = 264$)	Breakfast skippers[1] ($n = 208$)	β[2] ± SE	P
Total score[3] (0–100)	45.7 ± 0.9	42.2 ± 1.1	3.5 ± 1.2	0.00
Total Fruit[4] (0–5)	1.9 ± 0.2	1.3 ± 0.2	0.6 ± 0.2	0.01
Whole Fruit[5] (0–5)	1.8 ± 0.2	1.4 ± 0.2	0.3 ± 0.2	0.13
Total Vegetable[6] (0–5)	3.3 ± 0.1	3.3 ± 0.2	0.1 ± 0.2	0.47
Greens and Beans[6] (0–5)	1.1 ± 0.2	1.2 ± 0.2	−0.0 ± 0.2	0.85
Total Protein Foods[7] (0–5)	4.5 ± 0.1	4.3 ± 0.1	0.2 ± 0.1	0.21
Seafood and Plant Proteins[7,8] (0–5)	1.6 ± 0.2	1.0 ± 0.2	0.6 ± 0.2	0.00
Whole Grains (0–10)	2.7 ± 0.3	1.8 ± 0.3	0.9 ± 0.3	0.01
Dairy[9] (0–10)	5.5 ± 0.3	5.2 ± 0.4	0.2 ± 0.4	0.55
Fatty Acids[10] (0–10)	4.0 ± 0.3	4.3 ± 0.3	−0.3 ± 0.4	0.37
Refined Grains (0–10)	6.1 ± 0.3	6.2 ± 0.4	−0.1 ± 0.4	0.70
Sodium (0–10)	2.6 ± 0.3	2.8 ± 0.3	−0.2 ± 0.3	0.54
Empty Calories[11] (0–20)	10.6 ± 0.5	9.3 ± 0.6	1.2 ± 0.6	0.05

[1]Values are adjusted least-squares mean ± SE. Multiple linear regression models were used to determine the difference in the Healthy Eating Index-2010 total score and each component score across breakfast pattern categories. Models were adjusted for age, sex, household food security, highest level of education, household size, with breakfast skippers being the reference group. Age was categorized as 18–44 y, 45–64 y, and ≥65 y. Sex was categorized as men and women. Household food security status was categorized as food security and food insecurity. Highest level of education was categorized as high school or less and above high school. Household size was categorized as 1, 2, and ≥3. Statistical significance level was set at $P \leq 0.05$.
[2]Values are β coefficient ± SE. Positive β indicates a higher Healthy Eating Index-2010 score in breakfast consumers compared with breakfast skippers.
[3]Healthy Eating Index-2010 total score is the sum of the 12 component scores.
[4]Includes 100% fruit juice.
[5]Includes all forms except juice.
[6]Includes any beans and peas not counted as Total Protein Foods.
[7]Beans and peas are included here (and not with vegetables) when the Total Protein Foods standard is otherwise not met.
[8]Includes seafood, nuts, seeds, and soy products (other than beverages), as well as beans and peas counted as Total Protein Foods.
[9]Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.
[10]Ratio of PUFAs and MUFAs to SFAs.
[11]Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is >13 g/1000 kcal.

More than 60% of both breakfast consumers and skippers did not meet the EAR for vitamin A, vitamin D, vitamin E, vitamin C, total folate, calcium, and magnesium (**Figure 1**). Breakfast consumers had 12–21% lower prevalence of at-risk intakes for nutrients examined, except for vitamin D, vitamin E, and magnesium, which almost all in both groups underconsumed (>85%, Figure 1). Only a small proportion of breakfast consumers and skippers exceeded the AI for potassium (2% compared with 1%) and fiber (4% compared with 1%).

Discussion

This study is the first to report the breakfast consumption pattern and its association with diet quality and usual nutrient intakes in food pantry clients living in rural communities. Approximately 82% of participating households were food insecure and accessing food pantries to secure food supplies on a monthly basis. Although unhealthy eating patterns have been observed in severe cases of food insecurity (30), this study adds novelty by characterizing the pattern of breakfast skipping and consumption in this population. About 81% of US adults in the 2007–2010 NHANES self-reported consuming breakfast (3), which contrasts dramatically with the low prevalence of breakfast consumption (56%) among rural food pantry clients in this study. Inadequate food access may be one reason for the low prevalence of breakfast consumption in this sample; adults living in food-insecure households, especially very low food-secure households, may not have enough resources for food or have to conserve food for children and other household members (30). Skipping breakfast may be a strategy that very low food-secure adults use to conserve food resources.

A major finding in the current study was that breakfast consumers had significantly higher usual intake of underconsumed nutrients and nutrients of public health concern, suggesting that breakfast may be an important element in the daily diet to provide key nutrients among food pantry clients living in rural communities. These findings are consistent with past studies that illustrate higher intakes of fiber (20, 31–33), B vitamins (20, 32–35), vitamin D (33, 36), vitamin C (32, 35), vitamin E (35), vitamin A (33), potassium (20, 32, 35, 37, 38), calcium (20, 31–33, 35, 36, 39), magnesium (32, 33, 35), and iron (32, 33, 35) among adolescent and adult breakfast consumers compared with breakfast skippers. Greater nutrient intakes among breakfast consumers may be explained by the nutrient composition of breakfast. Previous studies have shown that ready-to-eat cereal is a common breakfast food and is one of the major items distributed in pantry food bags to clients along with bread, rice, and pasta (40). Many ready-to-eat cereals are fortified and rich in B vitamins, vitamin C, calcium, and iron (41), thus contributing to higher total daily nutrient intakes (42). Eating breakfast cereals may also facilitate greater milk consumption in adults (33, 39) because cereals are most often consumed with milk. This study is also the first to characterize the prevalence of usual nutrient intakes not meeting the EAR in this population; breakfast consumers had lower prevalence of at-risk intakes for all nutrients examined, except for vitamin D, vitamin E, and magnesium, which were underconsumed by almost everyone in both groups (>85%). Results are consistent with previous studies conducted among US adults (43, 44) and children (45, 46), although a limitation in previous studies is the use of mean or median intake instead of applying the NCI Method to predict long-term usual intake.

TABLE 3 Mean usual energy and nutrient intakes by breakfast pattern categories among adult food pantry clients living in rural communities[1]

	Breakfast consumers ($n = 264$)	Breakfast skippers ($n = 208$)	P
Total energy intake, kcal/d	1200 ± 60	1100 ± 60	<0.001
Vitamin A,[2] μg RAE/d	410 ± 30	260 ± 20	<0.001
Vitamin D,[2,3] μg/d	3.0 ± 0.3	2.0 ± 0.2	<0.001
Vitamin E,[2] mg ATE/d	4.2 ± 0.3	2.8 ± 0.2	<0.001
Vitamin C,[2] mg/d	46 ± 5	29 ± 3	0.001
Total folate, μg/d	230 ± 10	160 ± 10	<0.001
Vitamin B-6, mg/d	1.2 ± 0.1	1.0 ± 0.1	<0.001
Vitamin B-12, μg/d	3.4 ± 0.2	2.3 ± 0.2	<0.001
Riboflavin, mg/d	1.4 ± 0.1	1.0 ± 0.1	<0.001
Thiamin, mg/d	1.1 ± 0.1	1.0 ± 0.0	<0.001
Niacin, mg/d	15 ± 0.8	11 ± 0.6	<0.001
Calcium,[2,3] mg/d	590 ± 40	390 ± 30	0.008
Magnesium,[2] mg/d	160 ± 8	120 ± 6	<0.001
Iron,[2] mg/d	10 ± 0.6	7.0 ± 0.4	<0.001
Zinc, mg/d	7.8 ± 0.4	5.5 ± 0.3	<0.001
Potassium,[2,3] g/d	1.6 ± 0.1	1.1 ± 0.1	0.001
Dietary fiber,[2,3] g/d	9.2 ± 0.4	6.4 ± 0.4	<0.001

[1]Values are means ± SDs. Means of usual intake were estimated using the National Cancer Institute Method. The main predictor in the models (separate model for each nutrient) for estimating usual intake was breakfast pattern categories. Covariates in the usual nutrient intake models included total energy intake, sex (men, women), age (18–44 y, 45–64 y, ≥65 y), household food security status (food secure, food insecure), highest level of education (high school or less, above high school), household size (1, 2, ≥3), day of the week of dietary recall (weekday, weekend), and sequence of the dietary recall (first, second). Covariates in the usual intake model for estimating usual energy intake included all covariates above except for total energy intake. Statistical significance level was set at $P \leq 0.05$. ATE, α-tocopherol equivalents; RAE, retinol activity equivalents.
[2]Underconsumed nutrients for US adults ages 2 y and older, relative to the Estimated Average Requirement or Adequate Intake (25).
[3]Nutrients of public health concern for US adults ages 2 y and older as low intakes are associated with health concerns (10).

Besides the link with nutrient intakes, this study adds critical information about the nutritional challenges experienced by adult food pantry clients living in rural communities. The majority of participants had low diet quality that was even lower than US adults (mean = 59) surveyed in the 2011–2012 NHANES (47). Although breakfast consumers had statistically significantly higher diet quality compared with breakfast skippers, the 3.5-point difference in HEI-2010 total score was small and likely not enough to boost their diet quality from grade F (0–59) to a higher grade (D, 60–69; C, 70–79; B, 80–89; A, 90–100) (48). Two previous studies have reported a 10-point significantly higher HEI total score and higher component scores for Total Fruits, Whole Fruits, Whole Grains among breakfast consumers compared with skippers in adult populations with more adequate resources (20, 35). However, neither of these studies was among a low-resource population. Households in the present study were predominantly food insecure, an aspect that may already severely constrict dietary intake and potentially have a conforming effect on the types and variety of foods consumed by both breakfast consumers and skippers, resulting in the lack of variability in the participants' diet.

An additional major difference that may help explain the discrepancy in the HEI total score results between breakfast skippers and consumers of this study compared with previous studies, is the way breakfast pattern was classified. Widaman and colleagues (20) classified groups based on breakfast habits (the number of days per week of food/beverage consumption between 04:00 and 10:00); however, the classification of breakfast skippers may be biased if only based on self-report without any criteria specifying the caloric content of breakfast. In contrast, the present study classified breakfast habits based on 24-h recalls where the times, foods, and amounts of all eating occasions consumed by an individual on the previous day were reported instead of reporting diet histories that were based on the individual's perceptions of intake over a less recent and precisely defined period of time. Additionally, the present study applied the recommended classification criteria for breakfast as the first meal of the day (before 10:00) contributing 20% of the mean usual total energy intake (1). The current study also labeled breakfast skippers as not consuming breakfast on 2 recall days, which is a stronger indicator of overall breakfast skipping compared with labeling breakfast skippers based on a single recall.

Breakfast could potentially represent a key opportunity through which to design and deliver tailored messaging through nutrition educational programs to improve this modifiable dietary behavior and promote the choice of healthier foods within a limited budget (1). In addition, overcoming dietary constraints that are manifested during times of food insecurity may be limited by the food choices available at food pantries. Food pantries may provide low quantities of certain dietary components such as milk products, vitamins A and C, calcium, and healthy breakfast food options (19). Therefore, supporting the provision of healthy breakfast foods and promoting client choice as the food pantry distribution model may help improve the food environment, facilitate behavior change, and reduce nutrient inadequacy in this socioeconomically disadvantaged group.

Dietary assessments in existing literature are limited in several ways: *1*) nutrient intake is usually reported as the mean from 24-h recalls that does not represent long-term intakes; *2*) HEI-2010 scores are often calculated based on a single 24-h recall that only captured a snapshot of dietary intake. By addressing limitations in previous methodology, one strength of the present study is the application of the NCI Method that allows the prediction of long-term usual intake and comparison

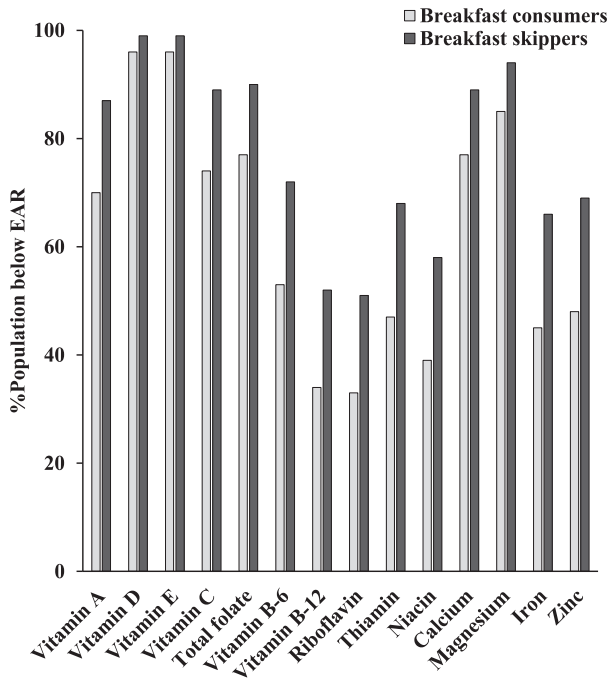

FIGURE 1 Percentage of adult food pantry clients living in rural communities with usual nutrient intakes below the EAR. Means of usual intake were estimated using the National Cancer Institute Method. The main predictor in the models (separate model for each nutrient) for estimating usual intake was breakfast pattern categories. Covariates in the usual nutrient intake models included total energy intake, sex (men, women), age (18–44 y, 45–64 y, ≥65 y), household food security status (food security, food insecurity), highest level of education (high school or less, above high school), household size (1, 2, ≥3), day of the week of dietary recall (weekday, weekend), and sequence of the dietary recall (first, second). The %DISTRIB SAS macro produced the mean usual intake for each breakfast pattern category and the proportions of participants consuming below the EAR for 14 nutrients. The cut-off approach was used for assessing the prevalence not meeting the EARs for women aged between 31 and 50 y, including vitamin A [500 μg retinol activity equivalents (RAE)/d], vitamin D (10 μg/d), vitamin E [12 mg α-tocopherol equivalents (ATE)/d], vitamin C (60 mg/d), folate (320 μg/d), vitamin B-6 (1.1 mg/d), vitamin B-12 (2.0 μg/d), riboflavin (0.9 mg/d), thiamin (0.9 mg/d), niacin (11 mg/d), calcium (800 mg/d), magnesium (265 mg/d), iron (8.1 mg/d), and zinc (6.8 mg/d). For nutrients without established EARs, the prevalence exceeding the Adequate Intake was calculated for potassium (4700 mg/d) and fiber (25 g/d, not shown in Figure 1). EAR, Estimated Average Requirement.

of population subgroup intakes to the Dietary Reference Intake, EAR, with adjustment for measurement error. Another strength of the study is the large sample size derived from a multi-state sample of US adult food pantry clients living in rural communities, a subpopulation that is understudied and facing many diet and health challenges. Causality cannot be inferred due to the observational and cross-sectional nature of the study. Despite adjustment for measurement error, a known limitation of self-reported dietary data is the systematic underreporting of energy that may influence nutrient estimates (49, 50). Yet, for the 82% of our sample experiencing food insecurity, energy intake may truly be lower than in populations where resources are adequate. Investigation of misreporting in food-insecure populations is a current research need. Other factors such as physical activity, body weight status, and disease conditions (e.g., obesity, diabetes, cardiovascular disease), and participants working night shifts were not recorded but may influence dietary intake and breakfast consumption. Generalizability may be a limitation as the study was conducted among food pantry clients living in rural communities. Another limitation is that speaking English was required to participate in this study and thus the sample may not be representative of the non-English speaking food pantry clients.

In conclusion, food pantry clients living in rural communities experienced hardships in meeting dietary recommendations and guidelines. Breakfast consumption was positively associated with usual nutrient intakes in this population and breakfast consumers had lower prevalence of at-risk intakes for nutrients compared with breakfast skippers, despite little meaningful difference in diet quality as measured by the HEI-2010. Incorporating more healthy breakfast foods in food pantries may be an opportunity to help improve the nutrient intakes of food pantry clients living in rural communities.

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