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The impact of dairy product consumption on nutrient adequacy and weight of Head Start mothers

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Abstract

Objective: To assess the relationship of dairy product consumption on diet quality and weight of low-income women.
Setting: Head Start centres in Texas and Alabama, USA.
Design: Cross-sectional study. Women were divided into dairy consumption groups: ≤1, >1 to ≤2 and >2 servings/d. Nutrient intake/diet quality was determined by calculating the percentage meeting the Estimated Average Requirement, guidelines for fat and added sugar, and Mean Adequacy Ratio (MAR). Mean BMI was compared for the dairy consumption groups.
Subjects: Mothers with children in Head Start; 609 African-Americans (43 %), Hispanic-Americans (32 %) and European-Americans (24 %).
Results: Fifteen per cent of participants consumed >2 servings of dairy products and 57 % consumed ≤1 serving of dairy daily. Intakes of protein, vitamin D, riboflavin, P, Ca, K, Mg and Zn were significantly higher in those consuming >2 servings/d. Total SFA were higher and added sugars were lower in those consuming >2 servings of dairy products daily compared with those consuming ≤2 servings/d. Forty-one per cent of women consuming >2 servings of dairy daily had MAR scores under 85 compared with 94 % consuming ≤1 serving/d. Mean BMI was 30·36 kg/m^2; there was no association between BMI and dairy product consumption.
Conclusions: Consumption of dairy products was low and was not associated with BMI in this low-income population. Higher levels of dairy product consumption were associated with higher MAR scores and improved intakes of Ca, K and Mg, which have been identified as shortfall nutrients in the diets of adults.

Keywords
Dairy foods
Milk
Nutrient adequacy
Nutrient intake
Body mass index
Low-income women

The 2005 Dietary Guidelines for Americans recommend consumption of three servings of milk and milk products daily for most Americans[1]. Coupled with other dietary sources of Ca, such as leafy green vegetables, beans and tofu, three servings of dairy should allow most women 19 to 50 years of age to meet their Ca requirement of 1000 mg/d[2]. Consumption of dairy products has been associated with improved bone mineralization and reduced risk of osteoporosis[3], prevention and treatment of hypertension[4], and reduced risk of type 2 diabetes[5], metabolic syndrome[5] and stroke mortality[6]. Dairy foods may also have favourable effects on body weight and body composition[7,8].

Since milk and other dairy products are considered nutrient-dense beverages/foods, consumption improves overall diet quality[9,10]. Using data from the Continuing Survey of Food Intake for Individuals 1994–1996 (*n* 17 959), it was demonstrated that individuals in the highest quartiles of milk product intake had higher intakes of micronutrients than individuals in the lowest quartiles, except for vitamin C[11]. Specifically, intakes of Ca, K, Mg, Zn, Fe, vitamin A, riboflavin and folate were higher in the highest quartiles of milk product consumption[11]. In an intervention study designed to increase consumption of milk by 3 cups/d compared with usual diet, Barr *et al.*[12] showed that, compared with controls, the intervention group consumed significantly more energy, protein, cholesterol, vitamins A, D and B_{12}, riboflavin, pantothenate, Ca, P, Mg, Zn and K. Ca, K, Mg and vitamin A were identified as shortfall nutrients in the diets of adults[1].

Despite the health and nutrition advantages of consuming dairy products, intake of these foods by adults is low[9,13,14] and as many as 75 % of women fail to meet the recommendations for Ca intake[14]. There are ethnic

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differences in intake of dairy foods, with African-Americans and other ethnic minorities[9,15] in particular having very low intakes compared with European-Americans[9,14,16]. Women in these ethnic groups may consume few dairy products because of real or perceived lactose intolerance[17] or lack of nutrition knowledge and the belief that they are not at risk for osteoporosis[18,19]. Diets of low-income women, especially those in the southern USA[20,21], are very low in dairy products.

Head Start is a national programme designed to promote school readiness by enhancing social and cognitive development of children through educational, health, nutrition, social and other services to children from birth to 5 years of age and families with incomes below the poverty line[22]. Despite the critical role that mothers with children in Head Start have in providing a healthy diet and modelling good dietary behaviours for their children, little is known about their diet[23]. Overall, however, low-income women tend to have diets that compromise their health[20,21]. Females of low socio-economic status (SES) are more likely than middle- or high-SES females to report poor overall health[23], a chronic disease[24] or overweight/obesity[25]. Thus it is critical to understand their diet more fully prior to designing interventions to improve it. The purposes of the present study were to examine the association of different levels of dairy product consumption with nutrient intake, nutrient adequacy and BMI of a group of ethnically diverse low-income mothers with children participating in Head Start.

Design and methods

Design

A non-probability sample of participants was recruited from fifty-seven Head Start centres in Alabama and Texas. Inclusion criteria were: (i) being a non-pregnant mother 20 to 50 years of age; (ii) having a child enrolled in Head Start in his or her first year of participation; (iii) having an income at or below 100 % of the poverty index; and (iv) self-identifying race/ethnicity as African-American (AA), Hispanic-American (HA) or European-American (EA). There were 620 participants out of the original 757 interviewed who completed three days of dietary intakes. Women were excluded if they reported an average daily energy intake of <2512 kJ (<600 kcal; *n* 6) or >16 747 kJ (>4000 kcal; *n* 4)[26]; and one subject was deleted because she reported consuming more than eleven servings of cheese. The final sample had 609 individuals.

Methods

The study was approved by the Institutional Review Boards of Baylor College of Medicine and University of Alabama at Birmingham. All subjects provided written informed consent prior to participating in the study. Three interviews (120, 30 and 60 min in length, respectively) were conducted with each participant at a Head Start centre over a two-week period. Data collectors trained and certified in dietary and anthropometric assessments conducted three sets of dietary recalls following standardized protocols and obtained heights, weights and demographic data, including marital status, level of education and race/ethnicity. For the HA participants, Spanish-speaking interviewers were available if needed.

Using the multiple-pass method, three 24 h dietary recalls, consisting of one weekend day and two non-consecutive weekdays, were collected on each participant[27]. Two-dimensional food models were used to help participants describe portion sizes[28]. Information about dietary supplements, including vitamins and minerals, was also collected, but was not used in the analyses. Two registered dietitians reviewed each recall for clarity, completeness and accuracy.

At the second interview, heights and weights were measured twice on each participant without shoes and dressed in light clothing[29]. Weight was measured to the nearest 0·1 kg on a digital platform scale accurate to 500 kg within ±0·05 kg (Befour model PS-6600). Height was measured to the nearest 0·1 cm using the Shorr Adult Height Measuring Board. BMI (kg/m^2), calculated from the means of the two weight and height measurements, is presented as mean with its standard error. In the present study BMI was adjusted for ethnicity, age and energy intake.

Diet quality analysis

Dietary data were analysed using the Nutrient Data System for Research (NDS-R) software version 5·0_35 (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA). Diet quality was assessed by several methods: (i) nutrient adequacy and achieving less than the Estimated Adequate Intake (EAR) or Adequate Intake (AI) as appropriate; (ii) dietary intakes of fats, added sugars and Na in excess of dietary recommendations; (iii) Mean Adequacy Ratio (MAR) of eight nutrients; and (iv) food group intake.

Nutrient adequacy without supplements from foods and beverages was examined for protein, dietary fibre, *n*-3 fatty acids, vitamins A, D, E, B_6 and C, niacin, riboflavin, thiamin, folate, Ca, Fe, K, Mg and Zn. Nutrient intakes were compared with the Dietary Reference Intakes (DRI) and the percentage meeting the EAR or AI as appropriate and reported by race/ethnicity. Nutrients of concern for excessively high intakes were fat, both total in grams and as a percentage of energy, SFA, MUFA, PUFA and *trans* fat, cholesterol, total and added sugars, and Na. *Trans* fat did not include conjugated linoleic acid.

The MAR of eight key nutrients was calculated as an indicator of overall nutrient adequacy, in addition to individual nutrient adequacy. The nutrient adequacy ratio, or percentage of the Recommended Dietary Allowances (RDA) consumed, was calculated for each

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nutrient and the resulting value truncated at 100 prior to averaging, so those consuming large amounts of food were not unfairly advantaged. Indicator nutrients selected for the MAR score were those that are good markers for fruit, vegetables, milk and whole grains, or are low in the diets of women of childbearing age: dietary fibre, vitamins A and C, folate, Ca, Fe, Zn and K. The MAR equals the sum of nutrient adequacy ratios divided by the number of nutrients considered. Since there is no consensus as to the best cut-off point for an MAR score, a score of 85 was selected as the cut-off point for adequacy because it fell between conservative and liberal scores of 100 to 67 used in previous studies[30,31].

Mean intakes of foods and beverages of interest were reported as the five main food groups of fruit, vegetables, dairy, grains and meats. Legumes were counted in the vegetable group and nuts in the meat group. Dairy products included all fluid milks, cheese and yoghurt. The mean of three 24 h intakes of dairy products was divided into three groups according to dairy servings consumed per day: ≤1 serving, >1 to ≤2 servings, >2 servings. Food group serving sizes were from NDS-R version 5·0_35.

All statistical analyses were run using the Statistical Analysis Software (SAS) version 9·1·3 statistical software package (SAS Institute Inc., Cary, NC, USA). To estimate the degree of under-reporting, the ratio of energy intake (EI) to BMR was calculated using the Harris Benedict equation[32], assuming low levels of physical activity[33]. The percentage of participants with an EI:BMR < 1·30 was reported. Nutrient intakes were compared by the two age groups for which there are separate DRI, 19–30 years and 31–50 years, but no differences were found except for vitamins A, D and E and folate, with lower percentages of women aged 31–50 years meeting the EAR ($P < 0·05$). Because the main objective was to compare intakes by race/ethnicity and not by age, the age groups were combined for ease of data reporting. Differences in the percentage of mothers meeting the EAR by race/ethnicity were compared using the independent samples χ^2 test.

Means with their standard errors as well as frequency distributions of participant characteristics were calculated. ANOVA was conducted for detecting differences in dairy product consumption groups for continuous variables and the χ^2 test was used for categorical outcomes. For multiple comparisons, the least square means (LSMeans) were obtained with the LSMEANS statement of the procedure GLM (general linear model) in SAS, adjusted for age, ethnicity, BMI and energy intake. Data are presented as LSMeans with their standard errors. For linear trends, a P value of <0·05 was used. Since multiple comparisons were made, the Bonferroni correction was used to account for an increase in type 1 error; the initial level of significance was 0·05, which was then divided by the three groups of dairy consumption for a final level of significance of 0·0167.

Results

Population characteristics

Population characteristics and BMI data by dairy product consumption groups are shown in Table 1. The sample distribution by location and race/ethnicity was 32 % HA from urban Texas, 43 % AA from urban Texas and Alabama, and 24 % EA from rural Alabama (mean age: 29·5 years). Adjusted mean BMI was 30·36 kg/m^2 and there was no difference among the dairy consumption groups. The urban AA women in Alabama had the highest prevalence of overweight and obesity, significantly higher than the rural EA women (data not shown).

The mean number of servings of dairy products consumed daily in the consumption groups were ≤1 serving, 0·52 (SE 0·02); >1 to ≤2 servings, 1·42 (SE 0·03); and >2 servings, 2·72 (SE 0·05). Only 15 % of participants consumed >2 servings of dairy products daily and 57 % consumed ≤1 serving/d. Overall, 72 % of participants had EI:BMR<1·3; the percentage was highest (68 %) in the group consuming ≤1 serving of dairy daily and lowest (7 %) in the group consuming >2 servings/d.

Effect of dairy product consumption

The nutrients and diet quality indicators of concern for adequacy and excess by dairy product consumption groups are shown in Tables 2 and 3, respectively. Higher mean adjusted energy intakes were seen with higher intake of consumption of dairy products, and energy intake was highest (9276 kJ) in those consuming >2 servings/d. Mean MAR scores for diet quality, adjusted for energy, age, ethnicity and BMI, were lowest in those consuming ≤1 serving of dairy daily (65·2) as compared with those consuming >1 to ≤2 servings/d (71·9) and >2 servings/d (72·6). Only 41 % of women consuming >2 servings of dairy products daily had MAR scores under 85 compared with 94 % of women consuming ≤1 serving/d.

Compared with women consuming >1 serving of dairy products daily, mean intakes of thiamin and Fe were significantly lower in those consuming ≤1 serving/d (Table 2). Participants consuming >2 servings of dairy products daily had significantly higher intakes of protein, vitamin D, riboflavin, P, Ca, K, Mg and Zn than those consuming ≤2 servings/d. Overall, for most of the vitamins and minerals, participants consuming more dairy products had better nutrient intakes than those consuming less dairy products. In contrast, a higher percentage of women consuming >2 servings of dairy products daily exceeded the DRI for percentage of energy from SFA than those who consumed ≤1 serving/d.

Compared with participants consuming ≤2 servings of dairy products daily, mean intakes of SFA and percentage of energy from SFA were significantly higher in those consuming >2 servings/d (Table 3). Women consuming >2 servings of dairy products daily had significantly lower intakes of total added sugars and percentage of

Table 1 Population characteristics of a multi-ethnic population of mothers with children in Head Start centres in Texas and Alabama, USA

	Total		Servings of dairy products daily					
			≤1		>1 to ≤2		>2	
Characteristic	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Age (years)	29·5	0·24	29·9	0·33	28·6	0·41	29·5	0·58
Number of household members	4·4	0·06	4·5	0·09	4·2	0·11	4·5	0·18
BMI* (kg/m^2)	30·36	1·65	31·53	0·47	30·15	0·62	29·41	0·91
EI:BMR	1·2	0·02	1·0[a]	0·03	1·3[b]	0·04	1·7[c]	0·07
	n	%	*n*	%	*n*	%	*n*	%
Dairy product groups	609	100	346	57	171	28	92	15
EI:BMR < 1·3	428	72	290[a]	68	109[b]	25	29[c]	7
Race/ethnicity								
Texan HA	194	32	61	31	77	40	56	29
AA	261	43	192[a]	73	54[b]	21	15[c]	6
Alabaman EA	147	24	88[a]	60	39[b]	26	20[c]	14
Education completed								
High school or less	156	26	81[a]	51	49[b]	31	28[b]	18
High school	191	31	111[a]	58	50[b]	26	30[b]	16
Some college/technical	207	34	123[a]	59	57[b]	27	27[c]	13
College graduate and higher	53	9	31[a]	58	15[ac]	28	7[c]	13
Marital status								
Married	281	46	152[a]	54	77[b]	27	52[b]	19
Divorced/widowed/separated	115	19	64[a]	56	33[b]	28	18[b]	16
Never married	170	28	108[a]	64	48[b]	28	14[c]	8
Other	43	7	19	44	15	35	9	21

EI, energy intake; HA, Hispanic-Americans; AA, African-Americans; EA, European-Americans.
[a,b,c]Mean values within a row with unlike superscript letters were significantly different ($P < 0·05$).
*Adjusted for ethnicity, age and energy intake.

Table 2 The association of dairy product consumption with nutrient intake and nutrient adequacy in a multi-ethnic population of mothers with children in Head Start centres in Texas and Alabama, USA

	Total		Servings of dairy products daily							% below EAR†		
			≤1		>1 to ≤2		>2					
Nutrient*	LSMean	SE	LSMean	SE	LSMean	SE	LSMean	SE	Total	≤1	>1 to ≤2	>2
Energy‡ (kJ)	7712	106·3	6475[a]	128·0	7403[b]	171·7	9277[c]	240·8	–	–	–	–
MAR§	70·0	0·46	65·2[a]	0·54	71·9[b]	0·72	72·6[b]	1·06	79	94	72	41
Protein (g)	67·1	0·72	64·7[a]	0·86	65·0[a]	1·12	71·3[b]	1·68	14	23	5	0
Dietary fibre (g)	14·1	0·26	13·6	0·32	13·6	0·41	15·1	0·62	89	96	87	64
n-3 Fatty acids (mg)	1·3	0·03	1·4[a]	0·04	1·2[b]	0·05	1·3[ab]	0·08	50	58	47	24
Vitamin A (μg)	780	35·6	678	42·3	780	56·0	883	83·6	48	58	40	24
Vitamin D (μg)	4·1	0·17	3·0[a]	0·20	3·6[a]	0·30	5·6[b]	0·40	80	91	75	45
Vitamin C (mg)	55·4	1·95	71·0	3·00	80·4	3·94	71·8	5·88	51	61	41	34
Vitamin E (AT mg)	5·2	0·11	5·5	0·13	5·0	0·17	5·1	0·26	97	97	97	94
Vitamin B_6 (mg)	1·5	0·03	1·4	0·03	1·6	0·04	1·6	0·06	38	52	24	15
Niacin (mg)	17·9	0·24	18·3	0·29	18·1	0·38	17·1	0·57	13	19	7	0
Riboflavin (mg)	1·7	0·02	1·4[a]	0·03	1·7[b]	0·03	2·0[c]	0·05	17	29	3	0
Thiamin (mg)	1·4	0·01	1·3[a]	0·02	1·4[b]	0·02	1·5[b]	0·03	20	32	8	0
Folate (mg)	380	6·9	351[a]	8·3	391[b]	10·8	395[ab]	16·1	53	71	36	17
P (mg)	1088	10·1	955[a]	12·1	1052[b]	15·9	1252[c]	23·6	15	25	2	0
Ca (mg)	725	7·5	485[a]	9·0	687[b]	11·8	1001[c]	17·7	87	100	89	36
Fe (mg)	12·8	0·2	11·7[a]	0·22	13·0[b]	0·29	13·6[b]	0·43	24	36	13	2
K (mg)	2026	23·8	1852[a]	28·4	2001[b]	37·3	2212[c]	55·9	99	100	99	95
Mg (mg)	210	2·6	198[a]	3·0	204[a]	4·0	227[b]	6·0	79	92	74	45
Zn (mg)	9·0	0·13	8·5[a]	0·15	8·7[a]	0·20	9·7[b]	0·30	36	51	23	2

LSMean, least square mean; EAR, Estimated Adequate Requirement; MAR, Mean Adequacy Ratio; AT, α-tocopherol equivalents.
[a,b,c]Mean values within a row with unlike superscript letters were significantly different ($P < 0·016$ using a Bonferroni correction).
*Adjusted for age, BMI, ethnicity and energy intake.
†EAR or Adequate Intake for those nutrients without an EAR.
‡Adjusted for age, ethnicity and BMI only.
§MAR = percentage of the Recommended Dietary Allowance for each of eight nutrients (dietary fibre, vitamin A, vitamin C, folate, Ca, Fe, Zn and K) but truncated at 100 prior to averaging. The percentages with scores less than 85 are reported as % below EAR.

energy from added sugars compared with those consuming ≤2 servings/d.

Mean consumption of other food groups by dairy product consumption is presented in Table 4. There was a significant decrease in servings of sweetened beverages and meats consumed with higher consumption of dairy products. Consumption of ≤1 serving of dairy products daily was also associated with higher intakes of fried

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Table 3 The association of dairy product consumption with fat, cholesterol, carbohydrate and sodium intake in a multi-ethnic population of mothers with children in Head Start centres in Texas and Alabama, USA

	Total		Servings of dairy products daily: ≤1		>1 to ≤2		>2			% high		
Nutrient*	LSMean	SE	LSMean	SE	LSMean	SE	LSMean	SE	Total	≤1	>1 to ≤2	>2
Total fat† (g)	66·3	0·63	66·8	0·76	64·9	1·00	66·9	1·49	–	–	–	–
SFA (g)	23·4	0·27	20·9[a]	0·33	22·7[b]	0·43	26·3[c]	0·64	–	–	–	–
MUFA (g)	24·6	0·29	25·7	0·34	24·3	0·45	23·6	0·67	–	–	–	–
PUFA (g)	12·5	0·20	14·1[a]	0·27	12·2[b]	0·36	11·1[b]	0·53	–	–	–	–
Trans fat† (g)	4·5	0·10	4·7	0·13	4·6	0·17	4·1	0·26	–	–	–	–
Fat (% of energy)‡,§	34·1	0·31	33·9	0·41	33·7	0·55	36·1	0·77	45	46	39	49
SFA (% of energy)‡,‖	11·4	0·13	10·7[a]	0·16	11·9[b]	0·21	13·5[c]	0·30	69	63	75	84
Cholesterol¶ (mg)	263	6·8	270	8·2	247	10·7	269	15·9	34	28	31	61
Carbohydrate (g)	214	1·8	214	2·1	218	2·8	209	4·2	–	–	–	–
Sugars (g)	95·9	1·60	96·6	1·91	100·0	2·49	90·5	3·72	–	–	–	–
Sugars (% of energy)‡	24·1	0·36	23·6	0·49	24·9	0·65	21·7	0·92	–	–	–	–
Added sugars (g)	65·9	1·64	75·5[a]	1·96	70·8[a]	2·57	50·7[b]	3·83	–	–	–	–
Added sugars (% of energy)‡,**	17·9	0·43	17·9[a]	0·51	17·0[a]	0·68	13·8[b]	1·00	15	19	14	5
Na†† (mg)	2942	35·1	2948	41·8	2866	55·1	2990	82·3	68	55	77	98

LSMean, least square mean.
a,b,c Mean values within a row with unlike superscript letters were significantly different ($P<0·016$ using a Bonferroni correction).
*Adjusted for age, BMI, ethnicity and energy intake.
†Reference value for 'high' is any *trans* fat.
‡Adjusted for age, ethnicity and BMI only.
§Reference value is <35 % energy from fat.
‖Reference value is <10 % energy from SFA.
¶Reference value is <300 mg cholesterol.
**Reference value is <25 % energy from added sugars.
††Reference value is 2300 mg Na.

vegetables (and fried potatoes) and lower intakes of total fruit and ready-to-eat cereal (RTEC) compared with women consuming >2 servings/d.

Discussion

Low-income women tend to have diets that compromise their health[20,21,34], often make poor food choices that lead to dietary inadequacies, and tend to report poor overall health[23]. They are, however, an understudied group and little is known about dairy intake of low-SES mothers, especially those participating in a Head Start programme.

In common with other studies that used self-reported dietary intake[35], under-reporting of energy intake was seen. The under-reporting criterion of EI:BMR used in the present study was similar to others[30,31] and was selected because Goldberg *et al.*[35] calculated that the minimum energy requirement of EI:BMR < 1·35 was not consistent with usual dietary intake. Under-reporting is more common in females[36], the overweight/obese[36] and low-income individuals[37,38]. Our population was homogeneous for these variables, but the group with the lowest dairy intake showed the highest level of under-reporting. Even after energy adjustment, this group of women had the poorest intake of micronutrients. Investigators have shown that controlling for energy intake negates differences in micro- and macronutrient intake[32]; however, after controlling for energy intake, under-reporters can be used in comparative analyses[39]. It is not clear why the group consuming ≤1 serving of dairy daily under-reported energy intake whereas the other groups of dairy consumption, especially the >2 serving/d group, appeared less likely to do so. Energy-dense, nutrient-poor foods tend to be the most likely foods to be under-reported[37], so the data for dairy consumption should be fairly robust; however, it is probable that the women with low dairy intake did have an overall poorer diet.

A high percentage of low-income women in our study did not meet the number of servings of dairy recommended by the current Dietary Guidelines for Americans. Hispanic women had the highest average intake of dairy products, with 29 % consuming more than 2 servings daily; however, mean intake was still below the recommended number of 3 servings of dairy daily. Only 6 % of AA and 14 % of EA consumed at least 2 servings dairy/d. This is consistent with the findings of others[20].

Women in the present study were not asked why they did not consume more servings of dairy products; however, it has been postulated that AA women may consume few dairy products because of real or perceived lactose maldigestion[17], the belief that they are not at risk for osteoporosis, the perception that 'milk is for children' or a preference for soft drinks rather than milk; cultural foodways and preferences learned early in life may also contribute to low dairy intake[16] seen in these groups.

That these women had low income may have also affected dairy intake. In a study of Canadian low-SES households, access to food retailers was a determinant of purchasing dairy foods[40]. To our knowledge, this has

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Table 4 Mean consumption of food groups by dairy consumption groups in a multi-ethnic population of mothers with children in Head Start centres in Texas and Alabama, USA

			Servings of dairy products daily					
	Total		≤1		>1 to ≤2		>2	
Food group*	LSMean	SE	LSMean	SE	LSMean	SE	LSMean	SE
Grain†	5·62	0·08	5·51	0·09	5·69	0·12	5·63	0·18
Whole	1·18	0·07	1·12	0·08	1·20	0·11	1·22	0·16
Bread & pasta	4·52	0·08	4·61	0·09	4·48	0·12	4·46	0·19
Ready-to-eat cereal	0·45	0·03	0·2a	0·03	0·51[b]	0·04	0·62[b]	0·06
Cake/cookie/pie/pastry/bar	0·38	0·03	0·42	0·03	0·41	0·04	0·32	0·07
Salty snack	0·27	0·02	0·28	0·02	0·29	0·03	0·23	0·05
Fruit	0·62	0·04	0·56[a]	0·05	0·49[a]	0·06	0·81[c]	0·09
Fruit & juice	1·28	0·06	1·14	0·08	1·28	0·10	1·43	0·15
Vegetables‡	2·45	0·06	2·49	0·08	2·42	0·10	2·44	0·15
Fried potatoes	0·26	0·02	0·35[a]	0·03	0·24[ac]	0·03	0·18[c]	0·05
Dark: green & yellow	0·26	0·02	0·22	0·03	0·27	0·03	0·29	0·05
Dark green	0·16	0·02	0·13	0·02	0·18	0·03	0·18	0·04
Dark yellow	0·10	0·01	0·09	0·01	0·09	0·01	0·11	0·02
Tomatoes	0·54	0·03	0·49	0·03	0·55	0·04	0·59	0·06
Starchy	0·14	0·01	0·14	0·02	0·15	0·02	0·12	0·03
Fried vegetables	0·29	0·02	0·39[a]	0·03	0·27[b]	0·04	0·21[b]	0·05
Legumes	0·36	0·03	0·37	0·03	0·31	0·04	0·39	0·06
Other	0·86	0·03	0·88	0·04	0·88	0·05	0·83	0·08
Meat	4·57	0·11	5·48[a]	0·13	4·36[b]	0·17	3·86[b]	0·26
Red	1·14	0·06	1·26	0·07	1·20	0·09	0·95	0·14
Pork	0·58	0·05	0·70	0·06	0·53	0·08	0·52	0·12
Luncheon	0·59	0·04	0·73[a]	0·05	0·59[ac]	0·07	0·44[c]	0·10
Poultry	1·21	0·08	1·46	0·09	1·20	0·12	0·97	0·18
Fish	0·48	0·06	0·65	0·08	0·35	0·10	0·45	0·15
Alternatives	0·57	0·05	0·68	0·05	0·50	0·07	0·54	0·11
Dairy (including milk)	1·55	0·02	0·52[a]	0·02	1·42[b]	0·03	2·71[c]	0·05
Cheese	0·67	0·03	0·25[a]	0·03	0·53[b]	0·04	1·21[c]	0·06
Dessert§	0·16	0·01	0·01[a]	0·02	0·20[b]	0·02	0·27[b]	0·03
Beverages	5·52	0·14	5·57	0·17	5·61	0·22	5·38	0·33
Juice	0·66	0·05	0·58	0·06	0·79	0·07	0·62	0·11
Fluid milk	0·73	0·02	0·26[a]	0·03	0·69[b]	0·04	1·23[c]	0·06
Sweetened beverages	1·52	0·06	2·07[a]	0·07	1·55[b]	0·10	0·92[c]	0·15
Non-caloric beverages	0·67	0·07	0·70	0·09	0·59	0·12	0·72	0·18
Water	1·87	0·12	1·86	0·15	1·90	0·19	1·86	0·29

LSMean, least square mean.

[a,b,c]Mean values within a row with unlike superscript letters were significantly different ($P < 0·016$ using a Bonferroni correction).

*Food servings are based on serving sizes recommended in NDS-R (Nutrient Data System for Research software version 5·0_35; Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA) and adjusted for age, BMI, ethnicity and energy intake.

†The individual components of the grain category will not total to the number of servings in the overall grain group since there is duplication within the groups; for example, ready-to-eat cereals (RTEC) that are whole grains would have been counted in whole grains and in the RTEC group.

‡The individual components of the vegetable category will not total to the number of servings in the overall vegetable group since there is duplication within the groups; for example, fried potatoes presented as a group here are also included in the fried vegetable group.

§This group included sugar; syrup; honey; jam; jelly; preserves; sauces, sweet – regular; sauces, sweet – reduced-fat/reduced-calorie/fat-free; frosting or glaze; chocolate candy; non-chocolate candy; and miscellaneous desserts.

not been looked at for consumption of dairy products in the southern USA; however, lack of accessibility and availability to other healthful foods, like fruit and vegetables, is one reason low-income individuals fail to purchase and consume these foods[41]. Women with higher education levels, often used as a surrogate for income, have been shown to consume more dairy products than lower-income women[9]. Lack of nutrition knowledge probably plays a role in the low dairy product consumption by the participants in the present study; women may be unaware of strategies associated with minimizing symptoms of lactose maldigestion. Participation in the Food Stamp Program, which should provide nutrition education about the importance of dairy foods in the diet, has been shown to lead to higher Ca intakes in AA women[41].

The present study showed that women with higher intakes of dairy products had significantly higher intakes of energy and nutrients, including protein, vitamin D, riboflavin, P, Ca, Mg, K and Zn, several of which have been identified as shortfall nutrients by the 2005 Dietary Guidelines Advisory Committee[1]. Although intake of these nutrients improved with higher consumption of dairy products, only in the group with dairy consumption >2 servings/d did mean Ca intake meet the DRI for women in this age group. Overall nutrient adequacy for all dairy consumption groups was poor, although it is noteworthy that in the group consuming >2 servings/d, the percentage below the EAR was zero for protein, niacin, riboflavin, thiamin and P, suggesting that consumption of dairy foods makes a positive contribution to nutrient adequacy.

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All dairy consumption groups exceeded the recommendations for percentage of energy from SFA in the diet[1]. SFA (grams) and percentage of energy from SFA were highest in women consuming >2 servings of dairy products daily, whereas PUFA intake was the lowest. The levels of SFA consumed by the group consuming >2 servings dairy/d are higher than those recently reported[42], and may reflect consumption of full-fat dairy. Since the most likely source of SFA in the diet of these women is full-fat dairy products, this suggests that women may need to be counselled to consume more low-fat or fat-free dairy foods as recommended by the 2005 Dietary Guidelines for Americans[1].

Food group consumption data showed that with higher dairy consumption there was a lower consumption of sweetened beverages and meats. Interestingly, the consumption of >1 serving of dairy products daily was associated with higher consumption of RTEC, suggesting that RTEC may be a way to increase dairy consumption, presumably fluid milk, in these women. Others have shown that RTEC consumed at breakfast is often accompanied by milk and that the overall impact on diet is positive with higher intakes of protein, Ca and vitamins A and D[43]. This may be one reason why women with higher milk consumption have higher nutrient intakes. There are tantalizing hints that women consuming more dairy products have an overall healthier diet. Consumption of >2 servings of dairy products daily was associated with lower intakes of sweetened beverages and fried vegetables (including fried potatoes), and higher intakes of total fruit and RTEC.

Mean consumption of vegetables in all groups was unusually high with the mean exceeding the recommended number of cups. Our previous work has suggested that the high intake of fruits and vegetables by HA in this population contributed to the higher mean intake[31]. Other studies have suggested that HA, even low-income HA, have better diet quality than other groups[44,45]. This finding suggests that some low-income individuals and groups can eat a healthful diet, and nutrition educators should explore their enabling factors.

In common with other studies of low-income women, the mean BMI of study participants[25] was categorized as 'obese'. Why low-income women are overweight/obese is not clear, but episodic eating patterns associated with Food Stamp Program participation[23,45,46], high-energy food choices[45,46], disordered eating[45,46] and stress[46] are potential reasons. Although accumulating evidence from epidemiology and intervention studies suggests that Ca-rich diets, especially those high in dairy foods, are associated with a lower body weight or BMI[6,7,9] or enhance weight loss[9], not all studies have shown this association with weight loss[47,48]. Barr *et al.*'s review of randomized trials also failed to provide convincing evidence that increased dairy products resulted in weight loss[12]. Once our data were controlled for energy intake, age and ethnicity, a relationship between dairy intake and an initial difference in BMI was no longer observed. Failure to show a relationship between dairy food consumption, Ca and weight has been observed in other populations of obese individuals[49] and may result from an 'anti-obesity' effect of Ca/dairy foods being overwhelmed from excessive energy intake[49]. This is a consideration in this obese group, despite the relatively low reported energy intakes.

The present study is not without limitations. First, the cross-sectional study design does not provide the longitudinal data needed to determine if the higher levels of energy intake associated with higher levels of dairy consumption would lead to increased weight over time, or whether higher levels of dairy consumption would result in decreased weight over time. Moreover, no cause-and-effect relationships can be determined. A population from limited geographic areas was used; therefore, results may not be generalizable to a broader US population. Finally, physical activity, which contributes to the weight balance equation, was not measured.

In a multi-ethnic low-SES population, consumption of more than two servings of dairy products daily was associated with improved nutrient intake, including Ca, K and Mg – three shortfall nutrients in adults. Although overall nutrient intake and nutrient adequacy were improved with higher levels of dairy product consumption, nutrient adequacy was poor in this low-SES group. Data suggest that efforts should be made to increase consumption of dairy products in this population so that they approach the current dietary recommendations of three servings per day.

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