

Several Morning Food Patterns in Children are Linked to Greater Intakes of 2015-2020 Dietary Guidelines Shortfall Nutrients and Whole Grain Consumption Compared to No Morning Foods

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ABSTRACT

Objectives: The objective of this study was to identify the most commonly consumed morning food (MF) dietary patterns in children (2-18 years-old; N=5,876) and compare intakes of 2015-2020 Dietary Guidelines (2015-2020 DGA) shortfall nutrients, relative to children with no MF consumption. Participation in the supplemental nutrition program Women, Infants and Children (WIC) was also examined.

Methods: Cluster analysis identified MF patterns using the National Health and Nutrition Examination Survey 2011-2014. The USDA food coding system defined MF consumed and clusters were developed using the percentage of calories consumed from foods. Eight food patterns were identified: 1) protein foods/breads/whole fruit/juices; 2) no MF; 3) milk/higher-sugar (HS) ready-to-eat cereals (RTEC); 4) milk/pancakes/sauces; 5) eggs/protein foods/juice; 6) milk/HS and lower-sugar (LS) RTEC; 7) milk/sweet pastries; and 8) milk/LS RTEC.

Results: Children consuming milk/LS-RTEC had greater calcium, folate and iron intake, in addition to having higher milk and total dairy intake vs. no MF (p<0.0001). Dietary fiber was higher in all clusters except eggs/protein foods/juice relative to no MF, ranging from 2.2 to 5.7 g/day more fiber. Vitamin D intake was higher in all MF patterns except sweet pastries vs. no MF (p<0.001). Potassium intake was greater in all MF patterns, with all milk/RTEC patterns representing the largest increases vs. no MF (p<0.0001). All MF patterns were associated with greater whole-grain intake, except eggs/protein foods/juice and milk/sweet pastries. Added sugar intake was greater in milk/sweet pastries vs. no MF (23±1.5 vs. 18±0.7 tsp eq; p=0.0002) and lower with LS-RTEC/milk vs. no MF (13±1 vs. 18±0.7 tsp eq; p=0.0002). The highest WIC participation (28.2%) was seen in the milk/LS-RTEC, while the lowest WIC participation (11.5%) was in the milk/pancakes/sauces MF pattern.

Conclusions: Consumption of several MF patterns in children are associated with greater consumption of 2015-2020 DGA shortfall nutrients and whole-grains. Children consuming a milk/LS-RTEC MF pattern also had lower added sugar intakes relative to no MF.

BACKGROUND

• While the 2015-2020 Dietary Guidelines for Americans 2015 encourages several healthy dietary food patterns (1), at present, there are no data that evaluate the association of different morning food patterns on nutrient intakes and diet quality in children and adults

• Recent studies show that certain grain food patterns were associated with greater 2015-2020 Dietary Guidelines' shortfall nutrients, better diet quality and lower body weights in both adults and children/adolescents (2,3). Additionally, certain grain food patterns were associated with lower intake of nutrients to limit, including saturated fat (2,3) and added sugars (2).

• Previous data show there are dietary intake and weight advantages of consuming breakfast, especially breakfasts that include grains, cereals, lower fat milk, and fruit/ fruit juices, in contrast to the potential adverse effects of skipping breakfast (4).

PURPOSE

To identify the most commonly consumed morning food (MF) dietary patterns in US children/adolescents (2-18 years-old) and compare intakes of 2015-2020 Dietary Guidelines' nutrients of concern (dietary fiber, calcium, vitamin D, potassium), compared with children/adolescents who did not consume any morning foods. The analysis also examined participation in the supplemental nutrition program—Women, Infants and Children (WIC).

METHODS

Subjects

- Data were obtained from What We Eat In America 2011-2014, the dietary intake component of the National Health and Nutrition Examination Survey (NHANES).
- Participants included were children and adolescents 2-18 years of age (n = 5,876) with reliable day 1 24-hour recall dietary interviews.

Description of Dataset

- NHANES is a continuous survey conducted by the National Center for Health Statistics.
- The present analysis combined 2 NHANES datasets (NHANES 2011-2012; NHANES 2013-2014).

Analysis

- Cluster analysis was used to develop patterns of morning food consumption—cluster analysis is a statistical procedure that analyses large data sets to develop various patterns while trying to maximize differences among the patterns.
- USDA food coding system was used to define main categories of morning foods, namely a) yeast bread and rolls; b) quick breads; c) sweet pastries; d) milk; e) pancakes, waffles, French toast and other related grain products; f) eggs; g) fruits; h) juices; i) cereals not cooked and not specified as cooked. Clusters were developed based on the percentage of calories consumed from the grain products as the centroid for each cluster—listed foods contributed approx. 10% or more morning energy intake.
- Data were adjusted for age, ethnicity, socioeconomic status, exercise and smoking in those 19+
- SAS 9.0 and SUDAAN 11.0 were used to analyze the data, and all analyses were adjusted for the complex sampling design of NHANES using appropriate sample weights.
- Diet quality was assessed using USDA's 2015 Healthy Eating Index
- Data are presented as means ± standard errors and a p-value of <0.05 was deemed significant.

RESULTS

Morning Food Patterns/Clusters In Children 2-18 Yrs. Old and WIC Participation

Cluster No: Cluster Description	Weighted N	Population N	% of Population	SOCIOECONOMIC MEASURES			
				WIC (%)	PIR<1.35 (%)	1.35-PIR1.85 (%)	PIR>1.85 (%)
All	5,876	69,208,497	100	16.7	38.4	10.7	51.0
1: Milk*, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	2,000	23,401,270	34	17.0	35.8	9.6	54.6
2: No Morning Foods	1,014	11,464,507	17	14.4	44.5	13.0	42.5
3: Milk*, HS-RTEC	652	11,388,038	16	17.5	39.4	10.4	50.2
4: Milk*, Pancakes/Waffles, Sugars/Fats/Sauces	504	6,184,761	9	11.5	28.0	8.5	63.5
5: Milk*, Eggs/Protein Foods	485	4,657,461	7	18.1	48.7	9.2	42.2
6: Milk**, HS-RTEC/LS-RTEC*	451	4,493,535	6	19.8	45.0	13.1	41.9
7: Milk*, Sweet Pastries	316	4,187,995	6	13.0	32.3	13.7	54.0
8: Milk**, LS-RTEC	254	3,432,291	5	28.2	35.5	10.1	54.3

* 275% Non-Whole Milk
** 100% Whole Milk
*** 100% Non-Whole Milk
* approximately 80% of RTEC is from HS-RTEC

HS=Higher Sugar; LS=Lower Sugar; RTEC=Ready-to-Eat Cereals
Higher Sugar RTEC defined as >31.2g/100g
Lower Sugar RTEC defined as <23.2g/100g

PIR=Poverty Income Ratio; lower values represent a lower income status, while higher values represent the subject was

Energy and Nutrient Intake by Morning Food Pattern

Energy intake, kcal (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	1928.01	30.86	239.25	53.89	0.0001
2: No Morning Foods	1688.76	44.66			
3: Milk, HS-RTEC	1813.43	39.15	124.67	55.94	0.0337
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	2045.90	36.59	357.15	65.74	<0.0001
5: Milk, Eggs/Protein Foods	2027.24	59.16	338.49	80.28	0.0002
6: Milk, HS-RTEC/LS-RTEC	1969.89	59.39	281.13	69.22	0.0003
7: Milk, Sweet Pastries	2209.23	62.09	520.47	80.32	<0.0001
8: Milk, LS-RTEC	1829.11	50.13	140.36	64.65	0.0383

Protein intake, g (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	71.29	1.73	13.23	2.37	<0.0001
2: No Morning Foods	58.96	2.12			
3: Milk, HS-RTEC	65.16	1.30	7.10	2.36	0.0054
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	68.42	1.35	10.36	2.55	0.0003
5: Milk, Eggs/Protein Foods	82.29	5.36	24.24	6.09	0.0004
6: Milk, HS-RTEC/LS-RTEC	71.42	3.42	13.37	3.98	0.0022
7: Milk, Sweet Pastries	70.27	4.11	12.21	5.49	0.0340
8: Milk, LS-RTEC	74.61	3.25	16.55	3.97	0.0003

Total fat intake, g (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	71.66	1.56	8.35	2.37	0.0015
2: No Morning Foods	63.31	1.79			
3: Milk, HS-RTEC	63.80	1.92	0.48	2.72	0.8602
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	73.47	2.32	10.16	3.38	0.0054
5: Milk, Eggs/Protein Foods	83.77	2.74	20.46	3.24	<0.0001
6: Milk, HS-RTEC/LS-RTEC	75.07	2.96	11.76	3.44	0.0019
7: Milk, Sweet Pastries	85.56	3.14	22.25	3.39	<0.0001
8: Milk, LS-RTEC	63.25	3.29	-0.07	3.63	0.9854

Saturated fat intake, g (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	24.74	0.55	3.13	0.83	0.0007
2: No Morning Foods	21.90	0.61			
3: Milk, HS-RTEC	22.74	0.79	1.13	1.00	0.2670
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	24.86	0.78	3.26	1.19	0.0072
5: Milk, Eggs/Protein Foods	29.03	0.85	7.42	1.03	<0.0001
6: Milk, HS-RTEC/LS-RTEC	28.26	1.39	6.66	1.54	0.0002
7: Milk, Sweet Pastries	30.77	1.37	9.16	1.35	<0.0001
8: Milk, LS-RTEC	22.32	1.06	0.72	1.13	0.5329

Added sugar intake, tsp eq (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	16.96	0.48	-0.85	0.88	0.3418
2: No Morning Foods	17.81	0.65			
3: Milk, HS-RTEC	17.09	0.68	-0.72	0.89	0.4265
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	19.90	1.07	2.09	1.27	0.1119
5: Milk, Eggs/Protein Foods	16.41	0.68	-1.40	0.87	0.1166
6: Milk, HS-RTEC/LS-RTEC	18.57	0.62	0.76	0.76	0.3222
7: Milk, Sweet Pastries	23.16	1.47	5.35	1.81	0.0061
8: Milk, LS-RTEC	13.47	0.93	-4.33	1.02	0.0002

Total sugar intake, g (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	120.40	2.45	10.29	4.41	0.0267
2: No Morning Foods	110.11	4.16			
3: Milk, HS-RTEC	121.04	2.82	10.93	3.96	0.0099
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	131.49	5.15	21.39	6.53	0.0027
5: Milk, Eggs/Protein Foods	113.43	3.91	3.33	6.18	0.5947
6: Milk, HS-RTEC/LS-RTEC	128.48	3.34	18.37	3.88	0.0001
7: Milk, Sweet Pastries	140.79	7.66	30.68	9.85	0.0041
8: Milk, LS-RTEC	110.58	3.79	0.48	5.38	0.9302

Sodium intake, mg (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	3057.52	58.96	374.99	125.94	0.0058
2: No Morning Foods	2682.63	107.13			
3: Milk, HS-RTEC	2859.58	70.93	177.05	114.70	0.1335
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	3230.75	79.56	548.22	137.05	0.0004
5: Milk, Eggs/Protein Foods	3431.24	127.59	748.71	165.51	0.0001
6: Milk, HS-RTEC/LS-RTEC	3084.42	151.20	401.89	132.70	0.0051
7: Milk, Sweet Pastries	3306.89	127.24	624.36	191.01	0.0028
8: Milk, LS-RTEC	2960.24	109.06	277.71	163.93	0.1010

Morning Food Patterns and Diet Quality, as measured by the 2015 Healthy Eating Index (HEI)

Diet Quality (HEI-2015 Score; 2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	50.38	0.40	5.05	0.74	<0.0001
2: No Morning Foods	45.33	0.64			
3: Milk, HS-RTEC	50.90	0.58	5.57	0.78	<0.0001
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	47.38	0.94	2.05	1.10	0.0729
5: Milk, Eggs/Protein Foods	46.06	0.80	0.74	0.81	0.3711
6: Milk, HS-RTEC/LS-RTEC	47.25	1.03	1.93	1.23	0.1293
7: Milk, Sweet Pastries	41.70	0.73	-3.63	0.88	<0.0001
8: Milk, LS-RTEC	54.53	1.40	9.20	1.47	<0.0001

Nutrients of Concern Intake by Morning Food Pattern

Potassium intake, mg (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	2289.08	41.65	459.84	66.20	<0.0001
2: No Morning Foods	1829.24	59.34			
3: Milk, HS-RTEC	2196.96	48.33	367.72	77.08	<0.0001
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	2222.78	52.10	393.53	80.00	<0.0001
5: Milk, Eggs/Protein Foods	2277.83	81.55	448.59	104.11	0.0002
6: Milk, HS-RTEC/LS-RTEC	2326.19	77.69	496.95	88.69	<0.0001
7: Milk, Sweet Pastries	2132.38	94.68	303.13	126.35	0.0231
8: Milk, LS-RTEC	2521.28	118.20	692.04	132.73	<0.0001

Dietary fiber intake, mg (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	14.75	0.29	3.33	0.53	<0.0001
2: No Morning Foods	11.42	0.41			
3: Milk, HS-RTEC	14.49	0.41	3.07	0.56	<0.0001
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	14.92	0.31	3.50	0.58	<0.0001
5: Milk, Eggs/Protein Foods	12.53	0.58	1.11	0.61	0.0778
6: Milk, HS-RTEC/LS-RTEC	13.59	0.43	2.17	0.63	0.0016
7: Milk, Sweet Pastries	13.58	0.58	2.16	0.65	0.0023
8: Milk, LS-RTEC	17.15	1.13	5.74	1.19	<0.0001

Vitamin D intake, mcg (2-18 yr olds; N=5,876; NHANES 2011-2014)

Morning Food Pattern	Mean	SE	Beta	SE	P value
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	5.30	0.21	1.65	0.24	<0.0001
2: No Morning Foods	3.66	0.19			
3: Milk, HS-RTEC	7.22	0.19	3.56	0.26	<0.0001
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	5.28	0.25	1.62	0.32	<0.0001
5: Milk, Eggs/Protein Foods	6.31	0.28	2.65	0.34	<0.0001
6: Milk, HS-RTEC/LS-RTEC	7.92	0.32	4.26	0.38	<0.0001
7: Milk, Sweet Pastries	4.94	0.40	1.28	0.41	0.0041
8: Milk, LS-RTEC	7.53	0.49	3.87	0.53	<0.000