

# Select Morning Food Patterns are Linked to Higher Intakes of 2015-2020 Dietary Guidelines' Nutrients of Concern and Whole Grains and Lower Added Sugar Intake in US children

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## ABSTRACT

**Objectives:** The purpose of this study was 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 MF.

**Methods:** The analyses used data from the National Health and Nutrition Examination Survey 2011-2014. Cluster analysis was used to develop MF patterns of consumption in children/adolescents. The USDA food coding system was used to define MF consumed all morning and before lunch. Clusters were developed using the percentage of calories consumed from various foods. Eight food patterns were identified in children and adolescents. The patterns included 1) protein foods/breads/whole fruit/juices; 2) milk/higher-sugar (HS) ready-to-eat cereals (RTEC); 3) milk/pancakes/sauces; 4) eggs/protein foods/juice; 5) milk/HS and lower-sugar (LS) RTEC; 6) milk/sweet pastries; 7) milk/LS RTEC and 8) no MF.

**Results:** All MF patterns had greater calcium intake compared to the no MF pattern (p<0.001). Children consuming milk/lower-sugar RTEC had higher calcium intake vs. no MF (1227±45 vs. 810±21 mg/day, p<0.0001). Dietary fiber was higher in all clusters except eggs/protein foods/juice relative to those consuming no MF, ranging from 2.2 to 5.7 g/day more fiber when MF was consumed. Vitamin D (D2+D3) intake was higher in all MF patterns vs. no MF (p<0.005). Potassium intake was significantly greater in all MF patterns vs. no MF. All MF patterns were associated with greater whole grain intake, except eggs/protein foods/juice and milk/sweet pastries. Children consuming a MF pattern of LS RTEC/milk had greater whole grain intake vs. no MF (1.4±0.1 vs. 0.5±0.1 oz eq; p<0.0001). 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).

**Conclusions:** Consumption of MF patterns in US children/adolescents is associated with greater consumption of 2015-2020 Dietary Guidelines' nutrients of concern and greater whole grain intakes. Additionally, lower added sugar intakes were seen in children consuming LS RTEC/milk. Avoiding MF may lead to nutrient and public health consequences.

## 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.

## 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

Cluster No: Cluster Description	Weighted N	Population N	% of Population	% of MF Pattern
ALL	5,876	69,208,497	100	
1: Milk, Protein Foods/Eggs, Breads, Whole Fruit/FV Juices	2,000	23,401,270	34	these foods represented 55% of the MF pattern
2: No Morning Foods	1,014	11,464,507	17	
3: Milk, HS-RTEC	852	11,388,678	16	these foods represented 92% of the MF pattern
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	504	6,184,761	9	these foods represented 82% of the MF pattern
5: Milk, Eggs/Protein Foods	485	4,657,461	7	these foods represented 74% of the MF pattern
6: Milk, HS-RTEC/LS-RTEC	451	4,493,535	6	these foods represented 83% of the MF pattern
7: Milk, Sweet Pastries	316	4,187,995	6	these foods represented 85% of the MF pattern
8: Milk, LS-RTEC	254	3,432,291	5	these foods represented 89% of the MF pattern

\* ≥75% Non-Whole Milk  
 \*\* 100% Whole Milk  
 \*\*\* 100% Non-Whole Milk  
 † approximately 80% of RTEC is from HS-RTEC

Higher Sugar, LS=Lower Sugar, RTEC=Ready-to-Eat Cereals  
 Higher Sugar RTEC defined as >21.2g/100g  
 Lower Sugar RTEC defined as ≤21.2g/100g

### 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	59.06	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	0.76	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	41.66	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	<0.0001

**Calcium 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	1064.32	26.22	253.82	26.71	<0.0001
2: No Morning Foods	810.51	21.14			
3: Milk, HS-RTEC	1100.04	21.40	289.53	31.93	<0.0001
4: Milk, Pancakes/Waffles, Sugars/Fats/Sauces	1096.85	29.35	286.34	33.19	<0.0001
5: Milk, Eggs/Protein Foods	1042.88	31.28	232.37	31.71	<0.0001
6: Milk, HS-RTEC/LS-RTEC	1150.52	48.01	340.01	56.48	<0.0001
7: Milk, Sweet Pastries	1058.26	53.98	247.76	54.68	0.0001
8: Milk, LS-RTEC	1226.88	45.46	416.38	49.07	<0.0001

### Whole Grain Intake by Morning Food Pattern