Noodle consumption patterns of American consumers: NHANES 2001-2002

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Abstract

Although noodles occupy an important place in the dietary lives of Americans, up until the present time research and in-depth data on the noodle consumption patterns of the US population have been very limited. Therefore, this study aimed to analyze the food consumption and diet patterns of noodle consumers and non-consumers according to age, gender, income, and ethnicity. The 2001-2002 NHANES databases were used. The NHANES 2001-2002 data showed that noodle consumers reporting noodle consumption in their 24-h recall were 2,035 individuals (23.3% of total subjects). According to the results, the mean noodle consumption was 304.1 g/day/person, with 334.3 g for males and 268.0 g for females. By age, the intake of those in the age range of 9-18 years old ranked highest at 353.0 g, followed by the order of 19-50 year-olds with 333.5 g, 51-70 year-olds with by 280.4 g, older than 71years old with 252.3 g, and 1-8 year-olds with 221.5 g. By gender, males consumed more noodles than females. Also, according to income, the intake amount for the middle-income level (PIR 1~1.85) of consumers was highest at 312.5 g. Noodle intake also showed different patterns by ethnicity in which the "other" ethnic group consumed the most noodles with 366.1 g, followed by, in order, Hispanics with 318.7 g, Whites with 298.6 g, and Blacks with 289.5 g. After comparing food consumption by dividing the subjects into noodle consumers and non-consumers, the former was more likely to consume milk, fish, citrus fruits, tomatoes, and alcoholic beverages while the latter preferred meat, poultry, bread, and non-alcohol beverages.

Key Words: Noodles, food and diet consumption patterns, NHANES 2001-2002, Americans

Introduction

Although they originated in Asia, noodles have become one of the most popular foods in the United States. Growth in the domestic food use of wheat has accelerated during the last two decades and wheat flour is used to produce noodles. The U.S. market for pasta and noodles increased at a compound annual growth rate of 6.7% between 2003 and 2008, and the dried pasta/noodles category led the pasta and noodles market, accounting for 76.9% [1].

Japanese style (e.g., udon) and Chinese-type noodles (e.g., ramen) as well as spaghetti are frequently consumed in restaurants and at home. However, the effects of noodle consumption on the diet patterns and eating habits of Americans have not been studied in detail.

Examining patterns of food group consumption has emerged as an important focal point for understanding the role of diet in disease risk [2-4]. Instead of determining single nutrients, stratifying the food groups is more likely to reflect habitual food intake, and embody characteristics of the total dietary intake [2,4,5], and embody characteristics of the total diet, including all nutrient interactions.

However, in the case of noodles, little is known about noodle consumption patterns and the contribution that noodle provide in the American diet. Dietary patterns and food groups reflect different ethnic eating traditions [5]. Mediterranean and Asian diets are widely known to incorporate higher intakes of legumes, fish, vegetables, and fruits, contrasted with the American dietary pattern consisting of higher intakes of deep-fried fast foods, refined grains, processed meats, commercially baked products, and sweets. Understanding these ethnic differences in food group consumption becomes increasingly significant in the United States as the US Census Bureau has reported that, from 1990 to 2000, the foreign-born population increased by 57% to represent 13% of the total US population [6].

Bui and Small [7] analyzed the thiamin contents of white salted, yellow alkaline, and instant noodles that were manufactured differently. Fu [8] categorized noodle types by manufacturing methods and Miskelly [9] studied the historical aspects of noodles.

Noodle studies have focused on manufacturing methods or composition analysis, or have been confined to food and cultural

studies, but there is little data on the effects of noodle consumption on diet and health status [10-28].

This article provides information on current noodle consumption patterns in the United States and the dietary intake of noodles by consumers in general. It also offers analyses of noodle consumers by income, race, and ethnicity. The primary objective of the research was to gain a better understanding of noodle consumption in the United States and whether consuming noodles has a beneficial effect on total diet, in which they may play a role in healthful eating. The contribution of economic, social, and demographic factors related to noodle consumption were examined. The differences in noodle consumption by income level and ethnic background provide insights into the factors that affect food selection among these groups. The results provide useful information for designing food programs and planning national food supply strategies.

Subjects and Methods

Data and procedures

We used data collected in the National Health and Nutrition Examination Survey (NHANES) 2001-2002 [29], conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention. Each survey was a stratified, multistage, national probability sample of the civilian non-institutionalized population of the United States. The subjects surveyed in NHANES 2001-2002 were of all ages. All surveys collected dietary information with the use of a 24-h recall administered by trained dietary interviewers, and the dietary recalls collected for the NHANES 2001-2002 survey years used a computer-assisted dietary interview that included a 4-step multiple pass approach. In NHANES 2002, the dietary data were collected using a 5-step multiple pass approach with dietary recall methods that are part of the integrated US Department of Agriculture and NHANES protocol "What We Eat in America" [30].

Identification and classification of noodle consumers

The noodle consumers were identified and classified based on the intake of noodles consumed in food items. Information from the NHANES code book was used to identify foods that contained noodles. Foods containing noodles, spaghetti, macaroni, and pasta were included. Noodles from other sources (chicken noodle soup, etc.) were not counted in the selection. The classification of "noodle consumer" was assigned to individuals who reported eating noodles during one day, and other individuals were classified as non-consumers.

The food groups were classified according to USDA food group classifications and were regrouped as 38 food groups, including noodles (noodles, macaroni, pasta, spaghetti) (Table 1).

Table 1. Food groupings used in noodle consumption patterns

	Food Group Description
1	Milks
2	Milk drinks
3	Yogurt
4	Creams and cream substitutes
5	Milk desserts, puddings, sauces
6	Cheeses
7	Beef
8	Pork
9	Lamb, veal, game, other carcass meat
10	Poultry
11	Organ meats, sausages and lunchmeat
12	Fish
13	Mixed meat with nonmeat items
14	Noodles, macaroni, Pastas, spaghetti
15	Sandwiches with meat, poultry, fish
16	Eggs, egg substitutes, eggs baby food
17	Legumes
18	Nuts, seeds, nut mixtures
19	Breads, rolls, pancakes, waffles
20	Cakes, cookies, pies, pastries
21	Crackers and salty snacks
22	Cereals, cooked or not cooked
23	RTEC
24	Grain mixtures, frozen plate meals, soups
25	Fruit juice, nectar, juices baby food
26	Citrus fruits
27	Dried fruits
28	Other fruits
29	White potatoes and starchy vegetables
30	Dark-green, Deep-yellow vegetables
31	Tomatoes and tomato mixtures
32	Other vegetables, vegetable mixtures
33	Fat and Oils
34	Salad dressings
35	Sugars and sweets
36	Nonalcoholic beverages
37	Alcoholic beverages
38	Water as an ingredient

Statistical analysis

We examined the associations between noodle consumption variables and socioeconomic characteristics such as gender, age, income, and ethnicity. All statistical analyses were adjusted for the sample weights and the complex sample design of NHANES by using SAS (release 9.13, SAS Institute Inc., Cary, NC) and SUDAAN (release 10.1, Research Triangle Institute, Research Triangle Park, NC) [31]. All data sets were weighted to be nationally representative and standard errors were calculated by Taylor linearization variance estimation. Comparison of noodle consumption by gender was tested using t-tests, and Bonferroni multiple t-tests were used to analyze the differences in noodle intake by several ethnicity and income groups. The other ethnic

groups such as "White", "Black", "others" were statistically compared with Hispanics. The Chi-square test was used to compare noodle consumption with age, gender, income, and ethnicity (The result of Chi-square test were not showed in table).

Results

The analysis and results based on the NHANES 2001-2002 data include basic information on noodle consumption as well as comparisons across other food groups showing the comparative importance of noodles in the diets of Americans.

Consumption of noodles and comparisons across demographic groups

To determine the positioning of noodles in the dietary patterns of Americans, we investigated the vast quantity of consumed food groups using NHANES data. The NHANES 2001-2002 data showed that noodle consumers (NC, 23.3%), those who had eaten noodles on one day of observed data, included 2,035 persons with 975 (47.9%) males and 1,060 females (52.1%). All others were classified as non-consumers (noodle non-consumers: NNC, 76.7%).

First, we researched the ranking of noodles for noodle consumers among the vast quantity intake foodstuffs. When the average amounts of consumption for the entire age ranges were considered, the ranking of noodles among the vast quantity intake foodstuffs was 5th, which included noodles, macaroni, pasta, and spaghetti. The consumption amount of non-alcoholic beverages was highest, followed by milk, alcoholic beverages, and fruit

juices, in order (Table 2).

The results of NHANES 2001-2002 showed a total number of 2,035 individuals consumed noodles during the survey period. Among them there were 975 males and 1,060 females, indicating that the noodle consumption frequency of females was higher than that of males. The average amount of noodles consumed was 304.1 g a day. The average amount of noodles consumed by the males was 344.3 g, which is significantly higher than that of the females at 268.0 g ($P < 0.01$). As a result of chi-square tests; however, the relationships between gender and noodle consumption patterns were not significant.

Across age groups, the highest noodle consumption was in 9-18 year-olds, with 353.0 g, followed by 19-50 year-olds with 333.5 g, 51-70 year-olds with 280.4 g, 71 years old and above with 252.3 g, and 1-8 year-olds with 221.5 g. In the case of males, the highest ratio of noodle consumers was for those between 19-50 years old. For both males and females, 9-18 year-olds consumed the highest amounts of noodles. Except for the 1-8 year-old consumers, males had higher noodle consumption than females across all age levels, where those who were 9-18 years old ($P < 0.05$), 19-50 years old ($P < 0.01$), and 70 years old and above ($P < 0.05$) had significantly higher intakes compared to the females (Table 3).

Table 3 shows the ranking of quantitatively consumed food groups by age. Noodles, including macaroni, pasta, and spaghetti, ranked in 5th place for individuals under age 8, 14-18, and 19-50 years old. Noodles ranked 4th for 9-13 year-olds and 9th for individuals over age 51. Population aged over 50 showed lower noodle consumption than the other age groups.

According to gender, noodle intake ranked 5th among the vast quantity food items for both males and females, and no difference

Table 2. Ranking of vast quantity intake food items of US subjects by age, NHANES 2001-2002

	All	< 1 yr	1~8 yr	9~13 yr	14~18 yr	19~50 yr	51~70 yr	≥ 71 yr
1	Non-alcoholic beverages	Milk drinks	Milks	Non-alcoholic beverages	Non-alcoholic beverages	Non-alcoholic beverages	Non-alcoholic beverages	Non-alcoholic beverages
2	Milks	Milks	Non-alcoholic beverages	Milks	Milks	Alcoholic beverages	Milks	Milks
3	Alcoholic beverages	Other fruits	Fruit juice, nectar	Fruit juice, nectar	Fruit juice, nectar	Milks	Alcoholic beverages	Other fruits
4	Fruit juice, nectar, juices baby food	Fruit juice, nectar, juices baby food	Milk drinks	Noodles, macaroni, pastas, spaghetti	Grain mixtures	Fruit juice, nectar	Other vegetables	Other vegetables
5	Noodles, macaroni, pastas, spaghetti	Non-alcoholic beverages	Noodles, macaroni, pastas, spaghetti	Grain mixtures	Noodles, macaroni, pastas, spaghetti	Noodles, macaroni, pastas, spaghetti	Other fruits	Fruit juice, nectar
6	Breads, rolls, pancakes, waffles	Noodles, macaroni, pastas, spaghetti	Other fruits	Milk drinks	Breads, rolls, pancakes, waffles	Breads, rolls, pancakes, waffles	Fruit juice, nectar	Breads, rolls, pancakes, waffles
7	Other fruits	Cereals, cooked or not cooked	Breads, rolls, pancakes, waffles	Breads, rolls, pancakes, waffles	Other fruits	Mixed meats	Breads, rolls, pancakes, waffles	Mixed meats
8	Other vegetables, vegetable mixture	Water as an ingredient	Grain mixtures	Other fruits	Mixed meats	Grain mixtures	Mixed meats	Alcoholic beverages
9	Mixed meats	Dark-green, Deep-yellow vegetables	Mixed meats	Mixed meats	White potatoes, starchy vegetables	Other vegetables	Noodles, macaroni, pastas, spaghetti	Noodles, macaroni, pastas, spaghetti
10	Grain mixtures	Other vegetables	White potatoes, starchy vegetables	White potatoes, starchy vegetables	Alcoholic beverages	Other fruits	White potatoes, starchy vegetables	White potatoes, starchy vegetables

Table 3. Noodle intakes of US subjects by gender, 1-85 years, NHANES 2001-2002[1)]

Age	Total		Male		Female	
	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE
Total	2,035	304.1 ± 8.7	975	344.3 ± 12.9	1,060	268.0 ± 8.7**
1~8 yr	565	221.5 ± 6.6	256	211.6 ± 10.9	309	229.1 ± 9.4
9~18 yr	556	353.0 ± 18.4	264	398.9 ± 30.8	292	308.7 ± 20.7*
19~50 yr	518	333.5 ± 14.9	266	383.6 ± 23.3	252	282.8 ± 12.0**
51~70 yr	246	280.4 ± 15.9	118	313.5 ± 27.3	128	254.6 ± 18.2
≥71 yr	150	252.3 ± 12.2	71	291.8 ± 20.4	79	225.1 ± 17.8*

[1)] Noodle consumers were analyzed.
* Means are significantly different at $\alpha = 0.05$ by t-test.
** Means are significantly different at $\alpha = 0.01$ by t-test.

in ranking appeared. In terms of quantity, non-alcoholic beverages were the most highly consumed food group for both men and woman. This was followed in the order of alcoholic beverages, milk, and fruit juice for the men, and milk, fruit juice, and fruit for the women.

After comparing the intakes of two age groups of consumers, those under 18 years old and 19 years old and above, significant relationships between age and noodle consumption ($P < 0.0001$) were found. Comparisons across males and females separately also resulted in significant relationships between age and noodle consumption. In addition, when comparing intake levels among 7 age groups: under 1 year old, 1~8 years old, 9~13 years old, 14~18 years old, 19~50 years old, 51~70 years old, and 71 years old and above, significant relationships between age and noodle consumption ($P < 0.0001$) were found. Furthermore, comparisons across age levels by dividing the subjects by gender revealed significant relationships between age and noodle consumption, except for those who were under 1 year old.

Income, ethnicity, and noodle intake

In order to examine the association between noodle consumption and the social/economic status, the PIR (Poverty Income Ratio) was used. The PIR refers to the poverty level ratio (or poverty threshold), which determines income or poverty. If PIR is 1.0, for instance, it implies living at the poverty level, and if PIR is 0.5, it indicates a living status at half under the poverty level.

Table 4. Ranking of vast quantity intake food items of US subjects by income, NHANES 2001-2002

	PIR < 1.0	1.0 ≤ PIR < 1.85	1.85 ≤ PIR < 3.5	PIR ≥ 3.5
1	Non-alcoholic beverages	Non-alcoholic beverages	Non-alcoholic beverages	Non-alcoholic beverages
2	Milks	Milks	Milks	Milks
3	Alcoholic beverages	Alcoholic beverages	Alcoholic beverages	Alcoholic beverages
4	Fruit juice, nectar juices baby food	Fruit juice, nectar	Fruit juice, nectar	Fruit juice, nectar
5	Noodles, macaroni, pastas, spaghetti	Noodles, macaroni, pastas, spaghetti	Noodles, macaroni, pastas, spaghetti	Other fruits
6	Breads, rolls, pancakes, waffles	Breads, rolls, pancakes, waffles	Breads, rolls, pancakes, waffles	Other vegetables
7	Mixed meats	Grain mixtures	Other fruits	Breads, rolls, pancakes, waffles
8	Other fruits	Mixed meats	Mixed meats	Noodles, macaroni, pastas, spaghetti
9	Milk drinks	Other fruits	Other vegetables	Grain mixtures
10	Grain mixtures	Milk drinks	Grain mixtures	Mixed meats

According to the U.S Census Bureau, a PIR of 0.5 means "severely poor", and a PIR 1.25 means "near poor". In accordance with the U.S PIR standards, we distinguished the groups into 4 categories: "below 1.0", "1.0-1.84", "1.85-3.5", and "above 3.5" to explore the rankings of food consumption by income level. For PIRs below 3.5, noodle intake ranked 5th without notable differences among the three PIR categories. On the other hand, in the higher income group with a PIR above 3.5, noodle intake ranked 8th and showed differences from other the three PIR groups. In the group with PIRs above 3.5, the 5th and 6th ranked food groups were fruits and vegetables, respectively, and the 8th was breads, rolls, pancakes, and waffles (Table 4).

The results of noodle intake by income showed that the ratio of noodle consumers was highest in the group with PIRs below 1.0, but it was concluded that noodle consumption was not significantly related to income. The relationships between noodle intake amounts and income levels did not show consistent

Table 5. Noodle intakes of US subjects by PIR, 1-85 years, NHANES 2001-2002[1)]

Age	Total		PIR < 1.0		1.0 ≤ PIR < 1.85			1.85 ≤ PIR < 3.5			PIR ≥ 3.5		
	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	D[2)]	N	Mean ± SE	D[3)]	N	Mean ± SE	D[4)]
Total	2,035	304.12 ± 8.71	597	307.86 ± 11.93	436	312.45 ± 17.32	-4.59	482	292.33 ± 13.25	15.53	520	305.81 ± 11.58	2.05
1~8 yr	565	221.46 ± 6.59	209	236.25 ± 8.28	126	206.65 ± 20.56	29.61	120	218.69 ± 18.82	17.56	110	221.51 ± 9.67	14.75
9~18 yr	556	353.01 ± 18.39	183	355.48 ± 20.73	130	394.71 ± 47.12	-39.22	129	320.49 ± 33.78	35.00	114	357.33 ± 36.11	-1.85
19~50 yr	518	333.48 ± 14.89	127	339.75 ± 24.99	104	343.38 ± 23.50	-3.63	119	329.90 ± 20.75	9.85	168	327.85 ± 20.58	11.90
51~70 yr	246	280.36 ± 15.85	54	276.84 ± 30.34	31	316.91 ± 81.25	-40.07	62	248.48 ± 28.55	28.36	99	290.32 ± 18.79	-13.48
≥71 yr	150	252.27 ± 12.15	24	231.58 ± 27.38	45	263.17 ± 32.13	-31.59	52	262.49 ± 22.57	-30.91	29	235.75 ± 29.81	-4.17

[1)] Noodle consumers were analyzed.
[2)] Difference = intake (PIR < 1.0 group - 1.0 ≤ PIR < 1.85 group)
[3)] Difference = intake (PIR < 1.0 group - 1.85 ≤ PIR < 3.5 group)
[4)] Difference = intake (PIR < 1.0 group - PIR ≥ 3.5 group)

Table 6. Ranking of vast quantity intake food items of US subjects by ethnicity, NHANES 2001-2002

	Hispanic	White	Black	Other
1	Non-alcoholic beverages	Non-alcoholic beverages	Non-alcoholic beverages	Non-alcoholic beverages
2	Milks	Milks	Alcoholic beverages	Milks
3	Fruit juice, nectar, juices baby food	Alcoholic beverages	Fruit juice, nectar	Cereals, cooked or not cooked
4	Alcoholic beverages	Fruit juice, nectar	Milks	Fruit juice, nectar
5	Grain mixtures	Other fruits	Noodles, macaroni, pastas, spaghetti	Noodles, macaroni, pastas, spaghetti
6	Breads, rolls, pancakes, waffles	Noodles, macaroni, pastas, spaghetti	Breads, rolls, pancakes, waffles	Other vegetables
7	Mixed meats	Other vegetables	Mixed meats	Breads, rolls, pancakes, waffles
8	Noodles, macaroni, pastas, spaghetti	Breads, rolls, pancakes, waffles	Cereals, cooked or not cooked	Grain mixtures
9	Milk drinks	Mixed meats	Grain mixtures	Alcoholic beverages
10	Other fruits	Grain mixtures	Other vegetables	Other fruits

Table 8. The type of food groups consumed with noodles by US subjects, NHANES 2001-2002

Description	Frequency	Percentage(%)
Non-combination food	1,764	63.9
Other mixture	574	29.6
Soup	101	3.0
Salad	54	2.5
Frozen meals	11	0.6
Cereal w/ adds	3	0.1
Sandwiches	2	0.1
Dried beans and vegetable w/ adds	2	0.1
Bread/baked products w/ adds	1	0.0
Tortilla Products	1	0.0

non-Hispanic Blacks with 289.5 g. The average noodle intake amount of White age 1-8 years old was 196.2 g, which was significantly lower than 254.9 g for Hispanics' of the same age ($P < 0.01$). According to the chi-square test results, the relationships between ethnicity and noodle intake were not significant.

Comparison of food consumption patterns between noodle consumers and non-consumers

After dividing the subjects by noodle consumers and non-consumers, we compared food consumption amounts for the 37 food groups for studying food group consumption pattern.

Based on re-categorized foods, we analyzed additional food items that noodles were consumed with, which showed a variety of ranges (Table 8). Those who ate only noodles without other foods accounted for 64%, while the remaining 36% consumed noodles with other foods. Those who dipped noodles in soup or mixed them with salad represented 3% and 2.5%, respectively. The results also indicate that frozen meals, ready-to-eat cereals, sandwiches, dried beans and vegetables, bread/baked products, and tortilla products were added when consuming noodle.

In all age groups, the noodle consumers showed significantly higher intakes of beef ($P < 0.05$), poultry ($P < 0.05$), sandwiches ($P < 0.05$), legumes ($P < 0.01$), breads ($P < 0.01$), ready-to-eat cereals ($P < 0.05$), grain mixtures ($P < 0.01$), white potatoes ($P < 0.01$), vegetable mixtures ($P < 0.05$), and nonalcoholic beverages compared to the non-consumers. On the other hand,

outcomes (Table 5).

Differences in food consumption patterns are not only influenced by culture but also by ethnicity. In order to examine noodle consumption patterns by ethnicity, we categorized the groups into Hispanic, non-Hispanic White, non-Hispanic Black, and others. After analyzing the food groups most consumed according to ethnicity, noodles ranked at remarkably different positions (Table 6). Noodle intake ranked 8th for Hispanics, 6th for non-Hispanic Whites and 5th for non-Hispanic Blacks and others. Therefore, non-Hispanic Blacks and others consumed the most noodles while Hispanics consumed the least. Different from the other ethnic groups, ready-to-eat cereals ranked within the top 10 most consumed foods in those classified as "others", whereas the consumption of alcoholic beverages was less than those of the other ethnic groups.

The ratios of noodle consumers and intake amounts by ethnicity are shown in Table 7. The "other" ethnic group showed the highest noodle intake amount with 366.1 g, followed by Hispanics with 318.7 g, non-Hispanic whites with 298.6 g, and

Table 7. Noodle intakes of US subjects by ethnicity, 1-85 years, NHANES 2001-2002[1]

Age	Total		Hispanic		White		Black		Others	
	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE
Total	2,035	304.1 ± 8.71	551	318.7 ± 10.43	896	298.6 ± 11.24	494	289.5 ± 9.7	94	366.1 ± 35.85
1~8 yr	565	221.5 ± 6.59	189	254.9 ± 7.34	191	196.2 ± 7.64**	153	242 ± 12.99	32	279 ± 43.68
9~18 yr	556	353 ± 18.39	180	365.3 ± 32.57	167	348.1 ± 27.74	181	348.7 ± 19.82	28	371.6 ± 59.8
19~50 yr	518	333.5 ± 14.89	130	335.5 ± 19.61	252	329.2 ± 20.41	111	303.1 ± 15.88	25	437 ± 74.96
51~70 yr	246	280.4 ± 15.85	40	355.3 ± 69.71	160	281 ± 17.69	39	217 ± 24.95	7	254.5 ± 67.28
≥71 yr	150	252.3 ± 12.15	12	169.5 ± 42.55	126	258.7 ± 12.49	10	185.6 ± 30.62	2	116.8 ± 7.59

[1] Noodle consumers were analyzed.
** Means are significantly different at $\alpha = 0.01$ compared to Hispanic by Bonferroni multiple t-test.

Table 9. Intakes of food groups for noodle consumers vs non-consumers, US subjects 1-85 years, NHANES 2001-2002

	Food groups	Total		Noodle Consumer		Noodle Non-Consumer		D[1]
		N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	
1	Milks	4,733	380.68 ± 7.82	1,195	396.47 ± 13.52	3,538	375.38 ± 9.76	21.089
2	Milk drinks	1,103	327.64 ± 16.84	282	317.93 ± 31.37	821	330.47 ± 14.88	-12.53
3	Yogurt	431	179.84 ± 6.51	112	174.47 ± 12.66	319	181.59 ± 6.65	-7.124
4	Creams and cream substitutes	1,262	31.23 ± 1.66	269	25.48 ± 2.38	993	33.05 ± 2.34	-7.565
5	Milk desserts/ puddings/ sauces	1,648	134.56 ± 2.28	426	138.57 ± 5.01	1,222	133.29 ± 2.92	5.281
6	Cheeses	3,191	46.1 ± 1.62	729	40.45 ± 4.16	2,462	47.77 ± 1.62	-7.315
7	Beef	1,810	117.47 ± 4.32	335	95.98 ± 8.12	1,475	122.3 ± 4.95	-26.33*
8	Pork	1,190	67.84 ± 3.38	234	64.97 ± 5.78	956	68.55 ± 4.21	-3.589
9	Lamb/ veal/ game/ other carcass meat	80	106.54 ± 20.51	20	95.09 ± 25.24	60	109.85 ± 20.53	-14.76
10	Poultry	2,393	111.75 ± 2.19	536	102.13 ± 5.05	1,857	114.61 ± 2.29	-12.49*
11	Organ meats/ sausages and lunchmeat	2,567	78.88 ± 2.32	559	71.91 ± 2.36	2,008	80.79 ± 3.09	-8.885
12	Fish	738	134.72 ± 7.61	152	139 ± 18.96	586	133.57 ± 7.04	5.426
13	Mixed meat with nonmeat items	2,294	238.45 ± 10.53	569	227.88 ± 22.48	1,725	242.28 ± 10.88	-14.41
14	Sandwiches with meat/ poultry/ fish	977	207.97 ± 5.61	154	185.53 ± 6.72	823	212.07 ± 6.67	-26.54*
15	Eggs/ egg substitutes/ eggs baby food	1,832	112.59 ± 3.3	385	101.72 ± 4.9	1,447	115.48 ± 4.07	-13.77
16	Legumes	1,412	144.67 ± 6.7	282	123.22 ± 9.4	1,130	150.77 ± 6.93	-27.55**
17	Nuts/ seeds/ nut mixtures	1,099	38.44 ± 1.96	263	38.03 ± 3.33	836	38.57 ± 2.24	-0.537
18	Breads/ rolls/ pancakes/ waffles	6,630	95.28 ± 1.77	1,492	83.09 ± 2.13	5,138	98.88 ± 2.22	-15.79**
19	Cakes/ cookies/ pies/ pastries	3,662	84.03 ± 2.08	912	78.69 ± 4.36	2,750	85.83 ± 2.92	-7.135
20	Crackers and salty snacks	3,313	44.95 ± 1.04	821	44.95 ± 1.34	2,492	44.95 ± 1.19	0.003
21	Cereals/ cooked or not cooked	1,465	220.95 ± 4.78	301	199.91 ± 9.75	1,164	226.1 ± 5.91	-26.19
22	Ready-to-eat cereals	2,661	55.74 ± 1.8	682	51.23 ± 2.74	1,979	57.3 ± 1.65	-6.065*
23	Grain mixtures/ frozen plate meals/ soups	2,667	236.59 ± 7.13	477	197.36 ± 12.48	2,190	245.02 ± 7.83	-47.66**
24	Fruit juice/ nectar/ juices baby food	2,821	345.59 ± 10.38	736	339.46 ± 11.65	2,085	347.51 ± 11.26	-8.047
25	Citrus fruits	732	115.21 ± 5.64	155	124.55 ± 11.26	577	112.75 ± 6.57	11.805
26	Dried fruits	165	46.52 ± 3.01	40	43.36 ± 7.62	125	47.35 ± 4.58	-3.99
27	Other fruits	3,254	187.87 ± 4.91	783	174.36 ± 6.46	2,471	191.93 ± 6.47	-17.57
28	White potatoes and starchy vegetables	3,841	113.05 ± 2.32	753	100.38 ± 4.57	3,088	115.87 ± 2.46	-15.49**
29	Dark-green/ Deep-yellow vegetables	1,459	91.48 ± 4.51	334	80.73 ± 9.01	1,125	94.7 ± 4.46	-13.97
30	Tomatoes and tomato mixtures	3,631	70.37 ± 2.98	727	88.29 ± 9.12	2,904	65.76 ± 2.33	22.537*
31	Other vegetables/ vegetable mixtures	4,449	121.91 ± 5.48	973	110.29 ± 5.98	3,476	125.13 ± 5.85	-14.84*
32	Fat and Oils	1,965	12.27 ± 0.43	480	11.96 ± 0.4	1,485	12.36 ± 0.53	-0.408
33	Salad dressings	2,305	27.78 ± 1.33	456	28.13 ± 1.62	1,849	27.69 ± 1.42	0.44
34	Sugars and sweets	5,067	44.9 ± 1.06	1,189	43.93 ± 1.97	3,878	45.21 ± 1.1	-1.281
35	Nonalcoholic beverages	7,525	1,080.3 ± 18.57	1,667	1,009.5 ± 33.41	5,858	1,100.9 ± 17.35	-91.38**
36	Alcoholic beverages	1,064	910.21 ± 44.18	195	967.05 ± 151.45	869	895.45 ± 38.89	71.601
37	Water as an ingredient	138	415.32 ± 66.18	41	323.34 ± 77.58	97	445.75 ± 83.23	-122.4

[1] Difference = intake (Noodle Consumer - Noodle Non-Consumer)
* Means are significantly different at $\alpha = 0.05$ by t-test.
** Means are significantly different at $\alpha = 0.01$ by t-test.

the noodle consumer group tended to consume more milk, milk desserts, fish, tropical fruit, tomatoes, and alcoholic beverages, but there were no significant differences except for tomatoes ($P < 0.05$) (Table 9). In the noodle non-consumer group, those under 18 years old consumed more food from all food groups. The noodle non-consumers had significantly higher intakes of cream ($P < 0.01$), cheeses ($P < 0.01$), beef ($P < 0.05$), mixed meat with non-meat items ($P < 0.01$), ready-to-eat cereals ($P < 0.05$), grain mixtures ($P < 0.05$), fruit juice ($P < 0.05$), and beverages ($P < 0.01$). The noodle consumers seemed to consume more milk, meats, such as lamb, veal, game, and other meats, as well as tomatoes than the non-consumers (Table 10). In adults older than 19 years of age, the noodle non-consumers ate significantly more sandwiches ($P < 0.05$), legumes ($P < 0.01$), breads ($P < 0.01$), grain mixtures ($P < 0.05$), other fruits ($P < 0.05$), other vegetables ($P < 0.05$), and white potatoes ($P < 0.05$). The adult noodle consumers had a tendency to consume more milk, yogurt, fish, citrus fruit, and tomatoes (Table 11). From the results, the noodle consumers consumed more milk, fish, and fruits, and the non-consumers consumed more meat, legumes, breads, and beverages.

Table 10. Intakes of food groups for noodle consumers vs non-consumers, US subjects 1-18 years, NHANES 2001-2002

	Food groups	Total		Noodle Consumer		Noodle Non-Consumer		D[1]
		N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	
1	Milks	2,621	430.4 ± 9.7	741	453.6 ± 21.1	1,880	421.0 ± 8.6	32.6
2	Milk drinks	797	343.2 ± 20.3	232	340.0 ± 20.5	565	344.4 ± 22.0	-4.4
3	Yogurt	211	163.9 ± 6.8	66	146.8 ± 12.9	145	171.9 ± 7.3	-25.1
4	Creams and cream substitutes	196	30.9 ± 3.2	44	20.5 ± 3.5	152	34.7 ± 3.2	-14.2**
5	Milk desserts/ puddings/ sauces	820	124.0 ± 3.5	244	120.6 ± 9.0	576	125.5 ± 5.6	-4.9
6	Cheeses	1,514	38.6 ± 1.2	378	31.0 ± 2.0	1,136	41.1 ± 1.3	-10.0**
7	Beef	860	95.3 ± 2.6	173	81.6 ± 7.1	687	98.5 ± 2.3	-17.0*
8	Pork	389	65.2 ± 5.0	104	58.1 ± 8.8	285	68.0 ± 6.2	-9.9
9	Lamb/ veal/ game/ other carcass meat	17	97.9 ± 22.4	8	111.3 ± 39.5	9	85.7 ± 24.9	25.6
10	Poultry	1,181	95.0 ± 3.9	293	90.1 ± 4.5	888	96.4 ± 4.8	-6.3
11	Organ meats/ sausages and lunchmeat	1,263	67.0 ± 1.9	312	64.6 ± 3.6	951	67.8 ± 2.0	-3.2
12	Fish	253	95.9 ± 5.5	72	84.5 ± 9.6	181	100.4 ± 8.2	-15.9
13	Mixed meat with nonmeat items	953	200.9 ± 9.1	287	164.5 ± 13.4	666	218.9 ± 10.2	-54.3**
14	Sandwiches with meat/ poultry/ fish	532	170.4 ± 7.2	86	149.2 ± 10.9	446	174.3 ± 7.9	-25.1
15	Eggs/ egg substitutes/ eggs baby food	724	106.1 ± 3.8	190	93.6 ± 8.1	534	110.8 ± 4.5	-17.2
16	Legumes	529	118.6 ± 9.4	114	93.0 ± 12.2	415	126.0 ± 11.9	-33.0
17	Nuts/ seeds/ nut mixtures	447	29.2 ± 2.2	128	27.1 ± 4.0	319	30.0 ± 2.1	-2.9
18	Breads/ rolls/ pancakes/ waffles	3,024	81.2 ± 1.5	788	74.7 ± 4.0	2,236	83.5 ± 1.7	-8.8
19	Cakes/ cookies/ pies/ pastries	1,816	74.1 ± 3.1	507	70.2 ± 5.2	1,309	75.7 ± 4.5	-5.5
20	Crackers and salty snacks	1,873	44.5 ± 0.9	531	41.2 ± 2.6	1,342	45.7 ± 1.0	-4.5
21	Cereals / cooked or not cooked	632	210.0 ± 14.9	158	185.6 ± 20.6	474	218.8 ± 15.8	-33.3
22	Ready-to-eat cereals	1,713	49.3 ± 1.5	471	44.2 ± 2.2	1,242	51.2 ± 1.9	-7.0*
23	Grain mixtures/ frozen plate meals/ soups	1,570	189.0 ± 3.9	309	167.1 ± 10.2	1,261	194.2 ± 4.4	-27.1*
24	Fruit juice/ nectar/ juices baby food	1,588	347.0 ± 8.7	499	329.4 ± 12.3	1,089	354.9 ± 8.8	-25.5*
25	Citrus fruits	328	105.6 ± 7.8	92	96.7 ± 8.7	236	109.1 ± 9.9	-12.4
26	Dried fruits	37	37.7 ± 5.1	13	28.8 ± 4.5	24	40.4 ± 6.0	-11.6
27	Other fruits	1,447	171.8 ± 5.6	435	167.2 ± 18.3	1,012	173.9 ± 4.6	-6.7
28	White potatoes and starchy vegetables	1,956	86.9 ± 2.3	440	83.3 ± 4.3	1,516	88.0 ± 2.8	-4.7
29	Dark-green/ Deep-yellow vegetables	510	71.7 ± 6.4	141	73.2 ± 10.0	369	71.2 ± 5.9	2.0
30	Tomatoes and tomato mixtures	1,639	51.4 3.0	361	69.8 ± 12.1	1,278	46.5 ± 3.8	23.3
31	Other vegetables/ vegetable mixtures	1,741	83.7 ± 4.3	446	77.3 ± 6.6	1,295	86.0 ± 5.5	-8.7
32	Fat and Oils	690	8.8 ± 0.5	198	8.3 ± 0.6	492	9.0 ± 0.6	-0.7
33	Salad dressings	912	21. ± 1.6	206	21.7 ± 3.4	706	21.6 ± 1.6	0.1
34	Sugars and sweets	2,359	61.0 ± 2.1	635	59.4 ± 1.8	1,724	61.6 ± 2.9	-2.2
35	Nonalcoholic beverages	3,355	675.0 ± 21.0	836	602.1 ± 26.4	2,519	700.1 ± 22.7	-98.1**
36	Alcoholic beverages	60	1,138.5 ± 217.3	7	365.8 ± 113.4	53	1,195.4 ± 210.9	-829.6**
37	Water as an ingredient	57	166.1 ± 29.7	23	167.6 ± 44.1	34	164.9 ± 30.5	2.7

[1] Difference = intake (Noodle Consumer - Noodle Non-Consumer)
* Means are significantly different at $\alpha = 0.05$ by t-test.
** Means are significantly different at $\alpha = 0.01$ by t-test.

Discussion

This study provides information on noodle consumption in the United States and shows similarities and differences in the dietary sources of those who consume noodles compared to those who do not. The research focused on examining noodle consumers, understanding any differences in noodle consumption according to demographic factors, and analyzing how the food intake of noodle consumers differed from that of non-noodle consumers.

Even though noodles and ramen are not consumed frequently by all consumers in the United States, noodles are a main dietary source, especially for some ethnic groups. Moreover, the noodle consumers differed from the non-noodle consumers in their food intake. When the two groups were compared, the noodle consumers showed food choices that contained more tomatoes and less beef, poultry, sandwiches, legumes, breads, ready-to-eat cereals, grain mixtures, white potatoes, and vegetable mixtures. While a causal relationship was not found, noodle consumption was associated with the choice of other food groups that were consumed with noodles.

Age exerted a significant influence on noodle consumption, indicating that noodle intake may differ by demographic factors.

Table 11. Intakes of food groups for noodle consumers vs non-consumers, US subjects 19+ years, NHANES 2001-2002

	Food groups	Total		Noodle Consumer		Noodle Non-Consumer		D[1]
		N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	
1	Milks	2,112	354.5 ± 9.6	454	359.3 ± 16.3	1,658	353.1 ± 14.0	6.2
2	Milk drinks	306	311.4 ± 24.8	50	285.1 ± 69.4	256	317.3 ± 23.2	-32.2
3	Yogurt	220	185.7 ± 8.3	46	189.3 ± 14.2	174	184.7 ± 8.6	4.6
4	Creams and cream substitutes	1,066	31.3 ± 1.8	225	25.9 ± 2.6	841	32.9 ± 2.5	-7.1
5	Milk desserts/ puddings/ sauces	828	139.0 ± 3.7	182	149.0 ± 9.8	646	136.2 ± 4.1	12.8
6	Cheeses	1,677	48.7 ± 2.2	351	44.1 ± 5.6	1,326	50.0 ± 2.3	-5.9
7	Beef	950	125.3 ± 5.6	162	101.4 ± 11.1	788	130.5 ± 6.8	-29.2
8	Pork	801	68.4 ± 3.3	130	67.3 ± 7.4	671	68.7 ± 4.4	-1.4
9	Lamb/ veal/ game/ other carcass meat	63	107.9 ± 23.3	12	88.6 ± 30.9	51	112.2 ± 22.1	-23.6
10	Poultry	1,212	117.7 ± 3.4	243	106.3 ± 7.0	969	121.1 ± 3.6	-14.8
11	Organ meats/ sausages and lunchmeat	1,304	83.2 ± 3.0	247	75.1 ± 3.3	1,057	85.2 ± 3.9	-10.1
12	Fish	485	142.5 ± 8.6	80	154.6 ± 22.7	405	139.6 ± 7.7	15.0
13	Mixed meat with nonmeat items	1,341	249.2 ± 13.9	282	252.0 ± 31.3	1,059	248.3 ± 13.0	3.7
14	Sandwiches with meat/ poultry/ fish	445	223.3 ± 6.8	68	200.2 ± 8.2	377	227.6 ± 8.4	-27.4*
15	Eggs/ egg substitutes/ eggs baby food	1,108	114.3 ± 3.6	195	104.7 ± 5.5	913	116.6 ± 4.2	-11.9
16	Legumes	883	150.2 ± 7.4	168	129.7 ± 10.5	715	156.0 ± 7.4	-26.2**
17	Nuts/ seeds/ nut mixtures	652	41.3 ± 2.4	135	42.3 ± 4.7	517	41.0 ± 2.7	1.3
18	Breads/ rolls/ pancakes/ waffles	3,606	100.1 ± 2.1	704	86.7 ± 2.4	2,902	103.8 ± 2.7	-17.1**
19	Cakes/ cookies/ pies/ pastries	1,846	87.9 ± 2.6	405	82.8 ± 4.6	1,441	89.5 ± 3.3	-6.8
20	Crackers and salty snacks	1,440	45.2 ± 1.4	290	47.4 ± 1.9	1,150	44.6 ± 1.4	2.8
21	Cereals/ cooked or not cooked	833	224.4 ± 5.6	143	206.7 ± 14.6	690	228.1 ± 6.6	-21.5
22	RTEC	948	60.5 ± 2.1	211	57.1 ± 3.6	737	61.6 ± 2.1	-4.5
23	Grain mixtures/ frozen plate meals/ soups	1,097	260.5 ± 9.5	168	214.8 ± 18.3	929	269.8 ± 9.6	-54.9*
24	Fruit juice/ nectar/ juices baby food	1,233	344.9 ± 12.8	237	347.0 ± 14.8	996	344.4 ± 14.2	2.7
25	Citrus fruits	404	118.1 ± 6.7	63	137.1 ± 15.4	341	113.7 ± 7.5	23.4
26	Dried fruits	128	47.6 ± 3.5	27	45.3 ± 8.8	101	48.2 ± 5.4	-2.8
27	Other fruits	1,807	193.3 ± 7.7	348	178.0 ± 6.7	1,459	197.3 ± 9.0	-19.3*
28	White potatoes and starchy vegetables	1,885	123.2 ± 3.0	313	109.3 ± 6.0	1,572	126.0 ± 3.3	-16.7*
29	Dark-green/ Deep-yellow vegetables	949	96.0 ± 4.9	193	82.9 ± 9.4	756	99.7 ± 5.3	-16.8
30	Tomatoes and tomato mixtures	1,992	76.1 ± 3.4	366	94.1 ± 13.3	1,626	71.6 ± 2.9	22.5
31	Other vegetables/ vegetable mixtures	2,708	130.9 ± 6.0	527	120.3 ± 6.5	2,181	133.6 ± 6.3	-13.3*
32	Fat and Oils	1,275	13.2 ± 0.5	282	13.1 ± 0.5	993	13.2 ± 0.6	-0.1
33	Salad dressings	1,393	29.2 ± 1.5	250	29.7 ± 1.8	1,143	29.1 ± 1.6	0.7
34	Sugars and sweets	2,708	39.3 ± 1.0	554	37.3 ± 2.2	2,154	39.9 ± 1.0	-2.6
35	Nonalcoholic beverages	4,170	1,206.6 ± 27.6	831	1,160.4 ± 49.3	3,339	1,219.3 ± 24.7	-58.9
36	Alcoholic beverages	1,004	905.2 ± 42.4	188	971.4 ± 150.9	816	887.7 ± 39.8	83.6
37	Water as an ingredient	81	475.1 ± 80.9	18	398.1 ± 105.2	63	495.3 ± 90.5	-97.2

[1] Difference = intake (Noodle Consumer - Noodle Non-Consumer)
* Means are significantly different at $\alpha = 0.05$ by t-test.
** Means are significantly different at $\alpha = 0.01$ by t-test.

Noodle intake also differed by ethnicity, showing cultural background to be an important factor for differences in food group intake and can affect the nutritional status of different ethnic groups. There were significant differences between ethnic groups in their rankings of the vast quantity intake foodstuffs as compared to other demographic factors such as gender, age, and PIR. Differences in noodle consumption among age and racial groups explain changes in both food preferences among the age groups and the different populations. In the case of the "other" ethnic group, including Asians, noodles and ready-to-eat-cereals held especially high rankings in the vast quantity

intake foodstuffs. These results are due to Asian culture where noodles are a staple food. There are, however, a number of problems that remain to be explored. In this study, the source of data lacked accurate demographic information. NHANES data make no distinction between "other" ethnic groups. Therefore, it is difficult to research the actual conditions of noodle intake in various racial and ethnic groups belonging to the "other" category. Another limitation of our analysis is there was no consideration for eating location (at home or away from home).

The current study indicated that individuals consuming more noodles showed higher consumption of tomatoes. It is probable

that the major sources of noodles are pasta and spaghetti. On the other hand, the noodle consumers had a tendency of consuming less amounts of vegetables, beans and domestic fowl as compared to those of non-noodle consumers. The inclusion of noodles in planning menus for school lunch programs or food assistance programs may further encourage the consumption of a varied diet that contains more vegetables, legumes, poultry, and beef. In addition, noodle consumers may benefit from new recipes in which noodles, particularly nutrient fortified noodles, are used in combination with vegetables and legumes. Finally, further research is necessary to examine shifts in noodle consumption by passage of time and demographic factors.

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