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## Food Intake Patterns of Self-identified Vegetarians among the U.S. Population, 2007-2010

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### Abstract

Vegetarians' food intake patterns vary in the extent that they exclude all or some animal products (e.g., meat, poultry, fish/seafood, eggs, and dairy). We examined the differences of consumption of selected USDA Food Patterns food groups, subgroups, and food components, total calorie intake, and the number of food items between self-identified vegetarians and non-vegetarians in the U.S. population aged 1 year and older. Weighted reliable food consumption data from day 1 of the National Health and Nutrition Examination Survey, 2007-2010 and the USDA Food Patterns Equivalents Database, 2007-2010 were analyzed in the U.S. population (n=15,453) using SAS 9.3. Only 3% of the self-identified vegetarians (total 2.1%; n=323) did not consume any animal products. Compared to non-vegetarians, vegetarians consumed significantly fewer calories (1862 kcal vs. 2058 kcal;  $p < 0.05$ ) with the same number of food items (n=16) per day, and they consumed significantly less meat, poultry, solid fats and added sugars, and more soy, legumes, and whole grains than non-vegetarians. Both groups consumed about the same amounts of eggs, dairy, seafood, fruits, and vegetables. After energy adjustment, vegetarians consumed significantly more fruits, vegetables, whole grains, and total grains than non-vegetarians per 1000 kcal. Although a large proportion of self-identified vegetarians report consuming some type of animal products, such as meat, poultry and/or seafood, their dietary patterns contain more plant-based foods and whole grains with less solid fats and added sugars. Caution is needed in interpreting the term "vegetarian" from self-reports. Increasing fruit, vegetable, and whole grain consumption remains a targeted message for all populations.

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## 1. Introduction

Vegetarianism has become a popular and a potentially healthful eating practice for more than a decade in the United States<sup>1</sup>. Generally, vegetarians are identified as individuals who do not consume any foods containing animal flesh product<sup>2</sup>. There are different eating patterns among vegetarians: vegans are those who do not eat any animal products including meat, fish/seafood, poultry, eggs, and dairy, while others may include dairy (lacto-vegetarians), eggs (ovo-vegetarians), or both products (lacto-ovo-vegetarians) in their diets. The percent of individuals who are identified as following a vegetarian diet varies, based on the specific survey and the way in which a vegetarian diet is identified. Most recently, in a 2012 survey, about 4% of U.S. adults aged 18 years and older self-reported that they were vegetarians, including about 1% that were vegans<sup>3</sup>. A similar prevalence in vegetarian and vegan children aged 8-18 years old was reported in a 2014 survey<sup>4</sup>.

Other studies have reported that individuals who considered themselves vegetarians may also consume some animal products (e.g., fish, chicken or red meat) as part of their daily diet<sup>5,6</sup>. These individuals could be considered to be “self-described” vegetarians, or “semi-vegetarians<sup>2</sup>”. For example, in a British Columbia cross-sectional survey, about 14 (16%) and 51 (57%) out of 90 self-identified vegetarian women aged 18 to 50 years reported occasional consumption of chicken or fish, respectively<sup>5</sup>. A 1994-1996 national study found that 2.5% of the U.S. population aged 6 years and older considered themselves vegetarians, but about 36% of these self-reported vegetarians reported consuming meat products on the surveyed consumption day<sup>6</sup>. A 1999-2004 population-based survey of the U.S. adults aged 19 years and older found that 6% of the participants did not report eating any meat, poultry or fish on the day of the survey<sup>7</sup>. Reported prevalence of a vegetarian eating pattern has varied in these studies, perhaps due to when the study was conducted, the specific population group, or the way in which a vegetarian eating pattern was defined and assessed.

Despite the consumption of animal flesh products reported by the self-identified vegetarians, the dietary pattern in general for vegetarians appears to indicate a more “healthful” dietary practice compared to non-vegetarians. In general, self-identified vegetarians consumed more total fruits, total vegetables, especially dark green and deep yellow vegetables, legumes, and less table fats than non-vegetarians; there were no differences in consumption of milk and cheese products compared to non-vegetarians<sup>6</sup>. Self-identified vegetarians also reported consuming plant protein sources at least weekly<sup>5</sup>.

Although the dietary patterns of vegetarians suggest healthful dietary practices, there has been inconsistent evidence on the use of such dietary practices for weight loss or weight management purposes, which focus on the reduction of energy intake<sup>8</sup>. While some studies reported that vegetarians’ dietary patterns had been suggested as an approach for weight reduction or weight management to improve health<sup>7-9</sup>, other studies found that there was no difference in total energy intake between vegetarians and non-vegetarians<sup>10, 11</sup>. Energy reduction could be the result of a reduction of variety in the diet<sup>12</sup> — in other words; it could be associated with the number of food items consumed per day. To our knowledge, no study has examined the differences in the number of food items consumed per day and only limited research has explored the differences in food intake patterns among self-identified vegetarians and non-vegetarians, especially in a nationally representative sample of the U.S. population. Therefore, the main purpose of this study was to compare the types and quantities of food groups and subgroups, as well as the average total energy intake and the number of food items consumed per day, in the dietary patterns of self-identified vegetarian and non-vegetarians in the U.S. population during the years of 2007-2010.

## 2. Subjects and method

For this study, we examined food consumption data from the combined survey years of 2007-2008 and 2009-2010 National Health and Nutrition Examination Survey (NHANES). NHANES uses a stratified, multiple-stage of probability sampling method to collect health- and nutrition-related information from about 5,000 civilian, non-institutionalized United States populations per year. The Diet Behavior and Nutrition component of the NHANES survey includes a question (“Do you consider yourself to be a vegetarian”) asking participants (or their proxies) aged 1 year and older their self-perception of vegetarian dietary practices. Only the definitive answers from the participants as either “yes” (considered as the “self-identified vegetarian”) or “no” (considered as “self-identified non-vegetarian” or “non-vegetarian”) were included in the data analysis for this study. The consumption data of the

NHANES, called “What We Eat in America” (WWEIA) were collected by the United States Department of Agriculture (USDA). Detailed information on two consumption days (day 1 and day 2) of the types and amounts of food consumed in the past 24-hours was collected among participants of all ages. The first day (day 1) of the dietary data were collected during an in-person Mobile Examination Center (MEC) interview and the second day (day 2) of the dietary data were collected 3 to 10 days later during a phone interview<sup>13</sup>.

We included only the reliable day 1 food consumption data from participants aged 1 and older in the study (n=15,453). The amounts of intakes in WWEIA-NHANES were further estimated for the consumption of 37 components of food groups and subgroups, based on the ingredients of the foods. The consumption of food groups and subgroups was estimated based on the Food Patterns Equivalents Database (FPED) 2007-2008 and 2009-2010 developed by the Food Surveys Research Group, Agricultural Research Service of USDA. The FPED is often used to evaluate the dietary patterns of Americans in compliance with the recommendations from the Dietary Guidelines for Americans (DGA)<sup>14,15</sup>. The major food groups in the FPED are: Fruits, Vegetables, and Dairy presented in cup equivalents; and Grains and Protein foods presented in ounce equivalents. Additional food components in the FPED are: number of Alcoholic drinks; teaspoon equivalents of Added Sugars; and gram equivalents of Solid Fats and Oils. The major food groups, are further divided into subgroups (e.g., whole grain subgroup and refined grains subgroup for the Grains food group), which can be used to examine the variety of the dietary patterns and compliance with key recommendations from the DGA.

For this study, we examined the dietary patterns among the self-identified vegetarians based on consumption of any amount of several major animal protein sources, such as meat, poultry, seafood, eggs, and dairy. Additionally, we examined the differences in dietary patterns between the self-defined vegetarians and non-vegetarians based on consumption of selected USDA Food Pattern food groups, subgroups, and FPED components: animal protein foods, such as meat, poultry, seafood, eggs, and dairy; fruits; vegetables; soy products; legumes; total grains and whole grains; added sugars; and solid fats. The differences in consumption between self-identified vegetarians and non-vegetarians were adjusted per 1000 calories for the same food group components to evaluate the diet quality between those two subpopulations at the  $p < 0.05$  level. Weighted analyses were computed using SAS 9.3 (Statistical Analysis System, Cary, NC) taking into account the survey design to produce the U.S. population representative estimates.

### 3. Results

As shown in Table 1, only 2.1% (n=323) of the U.S. population identified themselves as a vegetarian (the “self-identified vegetarians”). Self-identified vegetarians were more likely than non-vegetarians to be females (68%). The self-identified vegetarians consumed significantly fewer average calories per day compared to non-vegetarians (1862 vs. 2058 kcal); however, there was no difference in the average total number of food items (about 16) reported in a day between the two groups.

Table 1. Characteristics of self-identified vegetarians and non-vegetarians

	Self-identified vegetarians (n=323; 2.1%)	Self-identified non-vegetarians (n=15,130; 97.9%)
Age (years)	35.3	37.2
Sex		
Males	32%	48%
Females	68%	52%
Average number of foods consumed /day	16.8	16.4
Average calories (kcal)/day	1862	2058*

\*Significantly different between self-identified vegetarians and non-vegetarians at  $p < 0.05$ .

Very few ( $n=10$ ; 3%) self-identified vegetarians reported consuming no animal protein foods at all on any given consumption day (Figure 1). The majority of self-identified vegetarians reported consumption of dairy (93%), and eggs (65%). In addition, more than one-fourth (27%) reported consumption of some type of red meat. When meat, poultry, and seafood were grouped, almost half (48%) of self-identified vegetarians reported consumption of some food from this combined grouping (Figure 1).

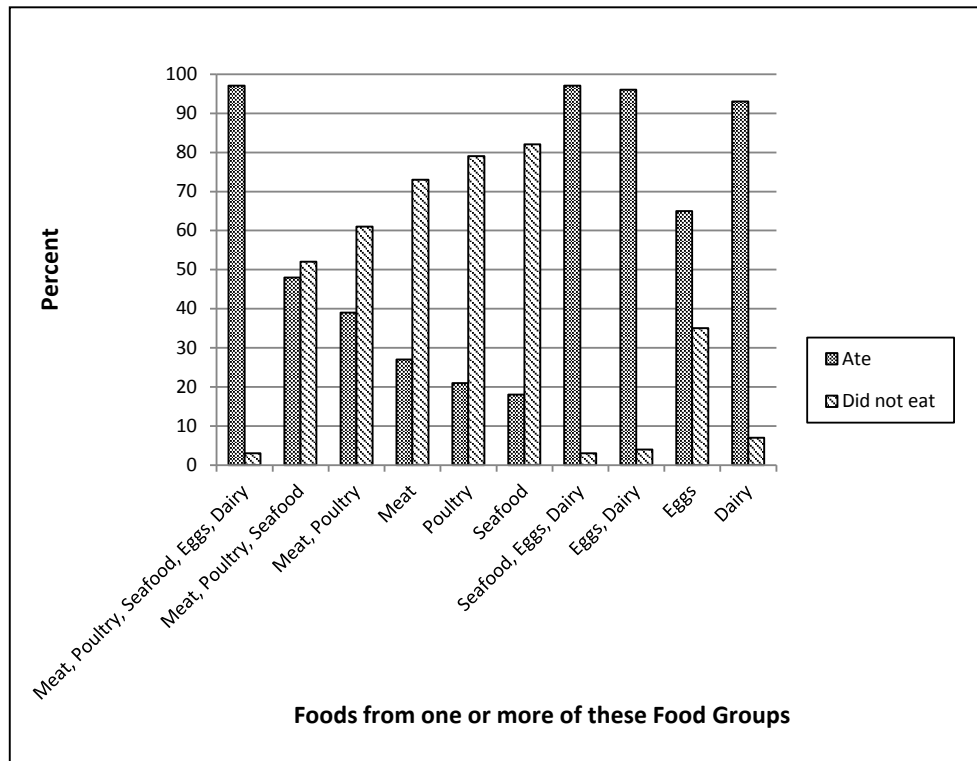


Fig.1. Percent of self-identified vegetarians consumed or did not consume animal protein food groups

Table 2 shows the average amounts of food groups, subgroups, and components consumed by self-identified vegetarians and non-vegetarians. On average, self-identified vegetarians consumed significantly less meat, poultry, solid fats and added sugars, but more legumes, soy, and whole grains per day compared to non-vegetarians. After adjusting the average daily consumption to amounts per 1000 kcal, to examine the diet quality between the self-identified vegetarians and non-vegetarians, we found that compared to non-vegetarians, self-identified vegetarians consumed significantly less meat, poultry, solid fats, and added sugars per 1000 kcal and more fruits, vegetables, legumes, soy, whole grains, and total grains per 1000 kcal than non-vegetarians. The consumption of seafood, eggs, and dairy did not differ between self-identified vegetarians and non-vegetarians whether adjusting for energy intake or not.

#### 4. Discussion

A very small percentage (2.1%) of the U.S. population aged 1 year and older identified themselves as vegetarians; and within this group, only about 3% were true vegans they did not report consuming any animal protein sources on any given day. Almost all of the self-reported vegetarians included some type of animal product in their diet, most commonly dairy products and eggs which are considered acceptable foods for many vegetarians. Sometimes, individuals may become vegetarians by gradually eliminating meat and poultry from their diets, and further reducing dairy products and eggs as suggested by a previous study<sup>5</sup>. However, since this is a cross-

sectional study, it is impossible to know whether individuals who reported consuming animal proteins were trending towards eliminating those protein sources from their diet. The duration of practicing vegetarianism may be an important factor to consider in examining the dietary patterns of individuals.

Table 2. Average consumption for selected food groups, subgroups, and components among self-identified vegetarians and non-vegetarians

Food groups and subgroups (measurement unit)	Self-identified vegetarians		Self-identified non-vegetarians	
	Mean	SE	Mean	SE
Meat (oz equiv.)	0.67*	0.2	2.57	0.05
Poultry (oz equiv.)	0.68*	0.1	1.45	0.04
Seafood (oz equiv.)	0.42	0.1	0.53	0.03
Eggs (oz equiv.)	0.41	0.1	0.47	0.01
Dairy (cup equiv.)	1.65	0.1	1.79	0.04
Fruits (cup equiv.)	1.21	0.1	1.05	0.03
Vegetables (cup equiv.)	1.49	0.1	1.4	0.03
Legumes (cup equiv.)	0.2*	0.04	0.1	0.01
Soy (oz equiv.)	0.32*	0.07	0.1	0.01
Grains (oz equiv.)	7.05	0.4	6.43	0.07
Whole grains (oz equiv.)	1.23*	0.2	0.7	0.03
Solid fats (grams)	28.9*	1.9	38.13	0.5
Added sugars (grams)	63.2*	4.4	76.9	1.6
Food groups and subgroups (measurement unit/1000 kcal)				
Meat (oz equiv./1000 kcal)	0.38*	0.09	0.73	0.03
Poultry (oz equiv./1000 kcal)	0.38*	0.07	0.74	0.03
Seafood (oz equiv./1000 kcal)	0.28	0.09	0.26	0.01
Eggs (oz equiv./1000 kcal)	0.21	0.05	0.23	0.007
Dairy (cup equiv./1000 kcal)	0.88	0.05	0.9	0.02
Fruits (cup equiv./1000 kcal)	0.77*	0.09	0.57	0.02
Vegetables (cup equiv./1000 kcal)	0.87*	0.06	0.72	0.01
Legumes (cup equiv./1000 kcal)	0.09*	0.02	0.05	0.003
Soy (oz equiv./1000 kcal)	0.2*	0.05	0.03	0.004
Grains (oz equiv./1000 kcal)	3.78*	0.2	3.15	0.03
Whole grains (oz equiv./1000 kcal)	0.74*	0.1	0.38	0.01
Solid fats (grams/1000 kcal)	14.7*	0.8	17.9	0.16
Added sugars (grams/1000 kcal)	32.3*	1.97	36.7	0.75

\*Significantly different between self-identified vegetarians and non-vegetarians at  $p < 0.05$ .

Vegetarian dietary patterns have been suggested for weight management or weight reduction purposes. To use a dietary pattern for the weight reduction purpose, it is often suggested to reduce the total daily energy intake by 500 calories per day for adults<sup>16</sup>. In this study, we found that self-identified vegetarians (some of whom included animal

proteins in their diet) consumed significantly less average daily total calories than non-vegetarians (about 200 calories,  $p < 0.05$ ). A similar study that defined vegetarians as respondents who did not include any animal proteins in their diet on the consumption day of the survey<sup>7</sup>, found that vegetarians consumed about 363 fewer calories compared to non-vegetarians. This suggests the potential usefulness of a vegetarian dietary pattern to promote weight loss. Even though the majority of the self-identified vegetarians in our study were women, who typically need and consume fewer calories than men, a 200 calorie deficit could make a meaningful contribution to weight loss over time<sup>16</sup>.

Although self-identified vegetarians consumed significantly lower average calories per day compared to non-vegetarians, this difference was due to the amounts and types of food consumed, rather than the number of foods. While about half of self-identified vegetarians consumed some meat and poultry products, compared to non-vegetarians, they consumed more meat alternative products made of legumes and soy. Some meat alternative products contain fewer calories per 100 grams compared to meat or poultry products (e.g., beef hot dog, 322 kcal/100 g vs. meatless hot dog, 233 kcal/100 g), which could contribute to lower calorie consumption. On a per 1000 calorie basis, they also consumed more fruits, vegetables, and whole grains and less empty calories (calories from solid fats and added sugars) compared to non-vegetarians. Since almost two-thirds of the study sample of self-identified vegetarians were female, it is also possible that the calorie difference is due to the lower calorie needs per day of females. Females also were more likely to consider themselves as vegetarians compared to males in a previous study<sup>11</sup>. However, we could not examine the impact of gender due to the small sample size of the self-identified vegetarians. Future studies examining the gender effect on the vegetarian dietary pattern, numbers of food items consumed, and calorie consumption are warranted.

A vegetarian dietary pattern might affect nutrient density more than energy reduction<sup>7</sup>. When examining the types and amounts of food groups and subgroups consumed between self-identified vegetarians and non-vegetarians, we found that among the self-identified vegetarians, almost all (97%) reported consuming some types of animal protein sources (such as meat, poultry, seafood, eggs, or dairy); and about half of them consumed some meat, poultry, and/or seafood. This finding is similar to previous studies, which reported that self-identified vegetarians included those who reduced the consumption of red meat, or occasionally ate chicken or fish<sup>5, 9, 11</sup>. It appears that self-defined vegetarians may have different dietary practices compared to the dietary patterns that are generally recognized as vegetarianism. Therefore, caution is needed when interpreting vegetarian dietary practices based on self-reports. Additionally, a consistent characterization of vegetarian dietary patterns should be carefully developed and examined in research studies<sup>17</sup>.

Self-identified vegetarians in this study, reported per 1000 kcal consuming more fruits, vegetables, and whole grains and less empty calories (calories from solid fats and added sugars) compared to non-vegetarians. Similar findings were found in a previous study<sup>7</sup>. We did not find any differences in consumption of seafood, eggs, and dairy whether adjusting by energy or not, which was different than a previous study which found that vegetarians had higher intake of dairy but no difference in consumption of eggs compared to non-vegetarians<sup>7</sup>.

Although self-identified vegetarians appear to have a somewhat more healthful intake pattern compared to non-vegetarians, with higher consumption of fruits, vegetables and whole grains, these intake levels remain below the recommendations based on the 2010 DGA as measured by Healthy Eating Index-2010 (HEI-2010) standards<sup>18</sup>. The maximum scoring standards for the components of the HEI-2010 are often used to assess diet quality and conformance to the key recommendations from the 2010 DGA<sup>18</sup>. Fruits, vegetables, and whole grains are some of the components of the HEI-2010. The HEI-2010 standards set the consumption amount of  $\geq 0.8$  cup/1000 kcal for total fruits,  $\geq 1.1$  cup equivalents/1000 kcal for total vegetables, and  $\geq 1.5$  ounce equivalents/1000 kcal of whole grains to receive the maximum component scores<sup>18</sup>. On average, the self-identified vegetarians consumed about 0.8 cup equivalents, 0.9 cup equivalents, and 0.7 ounce equivalents of fruits, vegetables, and whole grains per 1000 kcal, respectively (Table 3). These amounts, except for fruits, are less than the standards set for the HEI-2010. Therefore, the self-identified vegetarians would not receive the maximum score for vegetables and whole grains component.

Additionally, the consumption of solid fats and added sugars per 1000 kcal for self-identified vegetarians was significantly less than non-vegetarians; however, it was still higher than the recommended limit based on the HEI-2010 standard (Table 3). While the total consumption of calories from these two components are not directly comparable to the “empty calories” component of HEI-2010 (which includes the total calories from solid fats,

alcohol, and added sugars), the calories from just these two components exceeds the recommended limit. The mean calorie intake from both solid fats and added sugars among self-identified vegetarians was about 27.5% of energy, which was higher than the standard for the maximum score of the empty calories component of HEI-2010 ( $\leq 19\%$  of energy), but lower than the non-vegetarians (31.6%). Therefore, the self-identified vegetarians would not receive the maximum score for this HEI component amount. In other words, for both food group intakes and limits on empty calories, their consumption did not fully meet recommendations based on the 2010 DGA.

Table 3. Mean intakes and Healthy Eating Index-2010 (HEI-2010) standards for self-identified vegetarians and non-vegetarians

Component	HEI-2010		
	standard for maximum component score	Self-identified vegetarians	Self-identified non-vegetarians
Fruits (cup equiv./1000 kcal)	$\geq 0.8$	0.77	0.57
Vegetables (cup equiv./1000 kcal)	$\geq 1.1$	0.87	0.72
Whole grains (oz equiv./1000 kcal)	$\geq 1.5$	0.74	0.38
Empty calories (% of kcal)	$\leq 19$	27.5*	31.6*

\*Percent of energy intake from solid fats and added sugars.

## 5. Conclusion

Almost all self-identified vegetarians consumed some type of animal protein products. Among these self-identified vegetarians, almost half reported consumption of meat, poultry, or seafood. Dairy and eggs were the most commonly consumed animal protein products, and are considered acceptable in many vegetarian dietary patterns. Therefore, caution is needed in interpreting the dietary pattern based on the term “vegetarian” from self-reports.

Vegetarian dietary patterns as seen in this sample appear to have better diet quality with lower energy intake when compared to the non-vegetarian dietary pattern. When planned carefully, it may be useful for weight reduction or weight management without lessening the quality of the diet.

Vegetarian dietary patterns based on self-report included more fruits, vegetables, and whole grains; and less solid fats and added sugars than non-vegetarians. However, the consumption amounts are still below the recommendations based on the 2010 DGA. Practitioners and future researchers should examine the types and amounts of foods that are consumed by individuals that identify themselves as vegetarians when assessing if nutrients that might be of concern in a vegetarian dietary pattern in general, such as protein, iron, vitamin B12, and zinc, are inadequate.

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