

Appendix E-3.12

Potassium: Food Pattern Modeling Analysis

INTRODUCTION

The main purpose of this study was to conduct a sensitivity analysis to determine how the potassium levels of the base USDA food patterns would change if an assumed amount of coffee and tea, based on current intake levels, were to be added. Potassium intakes by the U.S. population and the levels of potassium in the base USDA food patterns and in the diets used in the DASH-Sodium trial are described using three metrics: (1) absolute levels (mg); (2) adjusted for energy (mg per kcal); and (3) because the interaction of sodium and potassium is of interest, as the ratio of sodium to potassium (mg/mg and mmol/mmol) (see, for example, He, 2009). The tabulations addressed the following specific questions:

1. What are the current mean potassium intakes of the U.S. population, and what are the sodium/potassium ratios?
2. What are the potassium levels in the base USDA food patterns, and what are the sodium/potassium ratios?
3. What are the potassium levels in the DASH intermediate-sodium level diets, and what are the sodium/potassium ratios?
4. What would the potassium content of the USDA food patterns at the 1600 calorie to 3200 calorie levels be if coffee and tea were to be included in amounts typically consumed by Americans ages 19 and older?

The USDA food patterns represent ideal diets designed to meet adequacy and moderation goals. The goals include 4700 mg of potassium for people ages 14 and older and lower levels for younger children (Britten et al., 2006). These targets are the Adequate Intake levels set by the Institute of Medicine (IOM, 2004).

The food patterns were developed by identifying amounts of representative foods that would meet all nutritional goals within energy limits, using nutrient-dense forms of each food in all food groups. This means that the food items selected are in forms without added sugars and excess solid fats. Most foods selected are in low salt or no-added-salt form. Nutrient profiles for each food group are calculated using the representative foods. (For a description of the representative foods, how nutrient profiles for each food group were calculated, and how the overall patterns were developed, see Appendix E-3.1 *Adequacy of USDA Food Patterns*, and Britten, 2006.)

Each pattern identified the number of additional calories that fit within the calorie goal after nutrient needs are met from nutrient-dense food choices. These additional calories are termed “discretionary calories” since they are not needed to meet nutrient needs. Added sugars, solid fats, and alcoholic beverages are always sources of discretionary calories, and current levels of intake of these dietary components are far above the discretionary calorie allowances (Krebs-Smith et al., 2009). Inclusion of a small number of discretionary calories in the patterns allows for some flexibility in food choices while still meeting nutrient needs within calorie limits. For example, using the discretionary calorie allowance, a person could choose to consume whole milk, or 80% lean ground beef, or regular cheese, rather than a nutrient-dense form of these foods. For almost all individuals, the discretionary calorie allowance is not large enough to allow many such choices. When modeling

various scenarios for the patterns, the discretionary calorie allowance is split equally between solid fats and added sugars (by caloric value).

The USDA food patterns do not include coffee or tea. The potassium content of 8 fl. oz. of these beverages is as follows (USDA/ARS/NDL, 2009):

Regular, black coffee	116 mg
Decaffeinated, black coffee	128 mg
Regular, black tea	88 mg
Decaffeinated, black tea	88 mg
Herbal tea	21 mg

METHODS

- The 2005-2006 mean potassium and energy intakes of the U.S. population were obtained from published tables (USDA/ARS/FSRG, 2009).
- The potassium levels of the base USDA food patterns were obtained from Center for Nutrition Policy and Promotion (CNPP) data files, which had been created using the USDA/ARS National Nutrient Database for Standard Reference, Release 21. (Note that the base USDA food patterns referred to in this report are draft patterns developed in 2009 that have since been updated.)
- The target potassium levels in the DASH intermediate-sodium-level and lower-sodium-level diets were obtained from the principle investigator, Dr. Lawrence J. Appel (personal communication, July 17, 2009).
- The mean coffee and tea intakes by men and women ages 19 and older for 2005-2006 and the nutrient contributions of these beverages, including all methods of preparation and additions to them, were estimated by the USDA/ARS Food Surveys Research Group (2010). They also estimated the percentages of men and women who consume coffee and/or tea on a given day and at least once a year.
- All ratios and correlations were calculated in Excel 2007.

RESULTS

Estimated mean potassium intakes in the United States

The mean potassium intakes by the U.S. population range from 1486 mg/day for 2- to 5-year-old girls to 4715 mg/day for 30- to 39-year-old men, as shown in Table 1 below; and the mean potassium intake by the U.S. population ages 2 and over is 3436 mg/day or 1.2 mg/kcal (USDA/ARS/FSRG, 2008). The correlation between potassium and energy intakes is 0.82 (USDA/ARS/FSRG, 2010).

Table 1. Estimated potassium intakes, 2005-2006

Gender and age (years)	Energy (kcal)	K (mg)	K (mmol)	K/energy (mg/kcal)	Na/K (mg/mg)	Na/K (mmol/mmol)
Males:						
2-5	1641	2083	53	1.27	1.15	1.95
6-11	2092	2258	58	1.08	1.42	2.40
12-19	2707	2730	70	1.01	1.56	2.64
20-29	2821	2951	76	1.05	1.52	2.58
30-39	2978	3377	87	1.13	1.40	2.37
40-49	2753	3311	85	1.20	1.31	2.23
50-59	2597	3283	84	1.26	1.20	2.25
60-69	2202	3077	79	1.40	1.21	2.07
70 and over	1984	2863	73	1.44	1.10	1.87
Females:						
2-5	1486	1977	51	1.33	1.09	1.83
6-11	1879	2016	52	1.07	1.47	2.50
12-19	1906	1976	51	1.04	1.49	2.53
20-29	1959	2205	57	1.13	1.41	2.39
30-39	1923	2453	63	1.28	1.30	2.21
40-49	1873	2443	63	1.30	1.25	2.12
50-59	1718	2458	63	1.43	1.22	2.06
60-69	1598	2606	67	1.63	1.00	1.69
70 and over	1495	2223	57	1.49	1.08	1.82
All, age 2+	2157	2617	67	1.21	1.31	2.22

Potassium levels in the USDA food patterns and the DASH diets

The target level for all the USDA base food patterns was 4700 mg of potassium; however, the potassium levels do not meet the target at most calorie levels, as shown in Table 2 below. They range from 1711 mg/day to 4867 mg/day in the 2009 draft patterns. The potassium/energy ratios range from 1.5 to 1.9, and correlation of potassium and energy in the patterns is 0.98.

Table 2. Potassium levels in base USDA food patterns

Calorie level	K ¹ (mg)	K ¹ (mmol)	K/energy ¹ (mg/kcal)	Na/K ¹ (mg/mg)	Na/K ¹ (mmol/mmol)
1000	1711	44	1.71	0.58	0.98
1200	2107	54	1.76	0.57	0.96
1400	2432	62	1.74	0.57	0.98
1600	3045	78	1.90	0.53	0.90
1800	3510	90	1.95	0.51	0.87
2000	3558	91	1.78	0.56	0.95
2200	3917	100	1.78	0.56	0.95
2400	4029	103	1.68	0.59	1.01
2600	4357	112	1.68	0.59	1.00
2800	4634	119	1.66	0.60	1.02
3000	4867	125	1.62	0.61	1.04
3200	4867	125	1.52	0.65	1.11

¹Amounts in draft patterns.

Unlike the USDA food patterns, the potassium targets for the DASH diets were designed to be proportional to energy intake and provided 4258 mg potassium/2000 kcal (Pao-Ha et al., 2003). The menus used in the DASH trials intentionally included fruits and vegetables that were especially high in potassium to meet the potassium targets. The USDA food patterns, on the other hand, use composite potassium values of fruits and of each vegetable subgroup that reflect the weighted population average intakes of all fruits and all vegetables in each subgroup, as well as the other food groups and subgroups

The absolute potassium levels of the intermediate DASH diets ranged from 3941 mg to 5851 mg, as shown in Table 3 below. The potassium/energy ratios ranged from 1.9 to 2.5 mg/kcal, somewhat higher than the draft USDA pattern ratios, which range from 1.5 to 1.9, and much higher than current average potassium/energy intake ratio, which is 1.2.

Table 3. Potassium levels in DASH intermediate- and lower-sodium-level diets

Calorie level	K (mg)	K (mmol)	K/energy (mg/kcal)	Intermediate Na/K (mg/mg)	Intermediate Na/K (mmol/mmol)	Lower Na/K (mg/mg)	Lower Na/K (mmol/mmol)
1600	3941	101	2.46	0.23	0.79	0.47	0.40
2100	4589	118	2.19	0.25	0.85	0.50	0.42
2600	5181	133	1.99	0.27	0.90	0.53	0.45
3100	5851	150	1.89	0.28	0.93	0.55	0.47

The potassium/energy levels reported in Tables 1-3 are summarized in the figure below.

Figure. Potassium and energy levels in U.S. diets, USDA food patterns and the DASH diet

Figure shows sodium and energy intakes in all three scenarios are highly correlated; sodium and energy intakes in the diets of Americans are highly correlated; and sodium and energy levels in the DASH-Sodium diets are perfectly correlated.

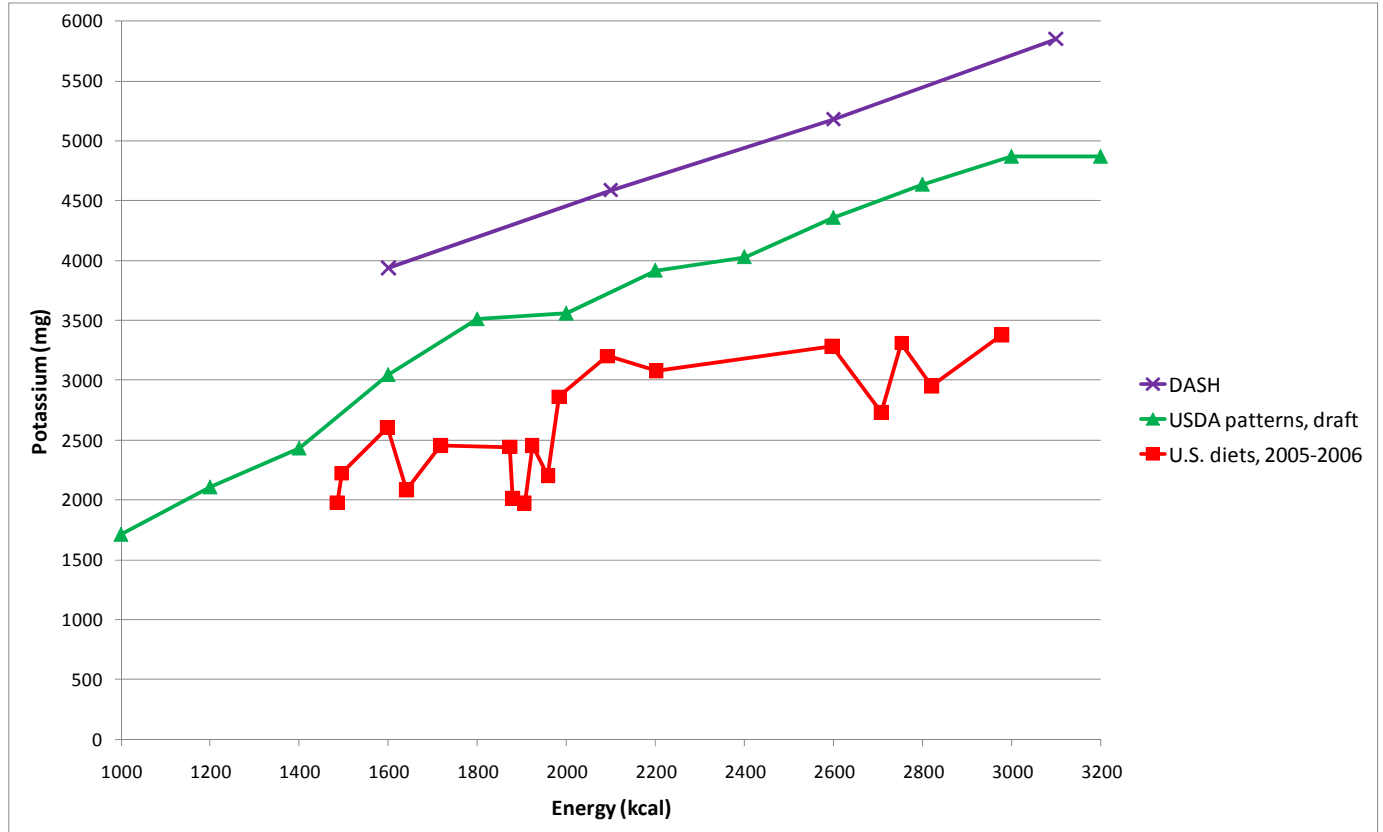


Figure. Data points. DASH.

Energy level (kilocalories)	1600	2100	2600	3100
Potassium level (milligrams)	3941	4589	5181	5851

Figure. Data points. USDA patterns, draft.

Energy level (kilocalories)	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Potassium level (milligrams)	1711	2107	2432	3045	3510	3558	3917	4029	4357	4634	4867	4867

Figure. Data points. U.S. diets, 2005-2006.

Energy level (kilocalories)	1486	1495	1598	1641	1718	1873	1879	1906	1923	1959	1984	2092	2202	2597	2707	2753	2821	2978
Potassium level (milligrams)	1977	2223	2606	2083	2458	2443	2016	1976	2453	2205	2863	3202	3077	3283	2730	3311	2951	3377

In 2005-2006, adults ages 19 and older drank an average of 556 grams (about 18 fl. oz.) of coffee or tea per day, and these beverages provided an average of 247 mg of potassium per day (USDA/ARS/FSRG, 2010). On a given day, 66% of adults drink coffee and/or tea, and 90% drink these beverages at least once in a year. If the average amount of coffee/tea were to be assumed to be consumed by adults and, therefore, included in the patterns which are designed primarily to meet the recommendations for adults (i.e., 1600 calories and higher), the amount of potassium in the patterns would be increased by 5 to 8 percent, as shown in Table 4:

Table 4. Projected potassium levels in USDA patterns plus coffee and tea

Calorie level	Current K ¹ (mg)	Projected K ² (mg)	Percent increase
1600	3045	3293	8.1
1800	3510	3758	7.0
2000	3558	3806	6.9
2200	3917	4165	6.3
2400	4029	4277	6.1
2600	4357	4605	5.7
2800	4634	4882	5.3
3000	4867	5115	5.1
3200	4867	5115	5.1

¹Amounts in draft USDA patterns.

²Projected potassium value if 247 mg, the mean amount of potassium provided by coffee and tea in the diets of adults ages 19 and over, were to be added to the patterns.

DISCUSSION

The correlation of potassium and energy makes interpretation of cohort studies difficult. The potassium in the USDA food patterns is effectively, if not intentionally, energy adjusted. Work on the USDA base food patterns continued after this study was completed. The patterns found in Appendix E-3.1 *Adequacy of USDA Food Patterns* are slightly lower in potassium than what was reported here. If the 247 mg potassium from coffee and tea were to be added to those patterns (1600 to 3200 calorie levels), the increase in the potassium levels remains at 5 to 8 percent.

SUMMARY

The sensitivity analysis revealed that the potassium levels in the draft USDA food patterns would be increased by 5 to 8 percent if the mean amount of coffee and tea consumed by adults were to be included in the patterns designed for adults. The amounts of potassium in the DASH intermediate-sodium-level diets are somewhat higher than the amounts in the current USDA food patterns, and both are much higher than current potassium intake levels in the United States.

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