

Appendix E-3.2

Realigning Vegetable Subgroups: Food Pattern Modeling Analysis

RESEARCH QUESTION

What revisions to the vegetable subgroups (such as including tomatoes with orange vegetables and leafy lettuce with dark green vegetables) may help to highlight vegetables of importance and allow recommendations for intake levels that are achievable, without compromising the nutrient adequacy of the patterns?

BACKGROUND AND RATIONALE

Recommendations over time:

Over time, vegetables have been separated into varied subgroups, alone or with fruits, in food guidance systems (see Chart, Appendix A). In the 1980s, 3 subgroupings were identified for the food patterns that later became the basis for the Food Guide Pyramid. These were: dark green/deep yellow, starchy/legumes, and other. (Welsh, 1996) Later in the development of the original Pyramid, the dark green and deep yellow subgroup and the starchy and legumes subgroup were split to form the five vegetable subgroups currently used in the USDA food intake patterns: Dry Beans and Peas (legumes), Starchy Vegetables, Dark Green Vegetables, Orange Vegetables, and Other Vegetables. (Welsh et al, 1993)

The original intake recommendation for these 5 subgroups was to “Include all types regularly; use dark-green leafy vegetables and dry beans and peas several times a week.” (Shaw et al, 1996) This general recommendation was operationalized into specific amounts for analysis of the patterns: 0.43 daily half-cup servings (3 per week) of dark green, 0.57 daily half-cup servings (4 per week) of orange (deep-yellow), 0.43 daily half-cup servings (3 per week) of dry beans and peas, 0.57 daily half-cup servings (4 per week) of starchy, and 1 daily half-cup serving of other vegetables in the pattern with a total of 3 daily servings of vegetables (Cronin et al, 1987). These amounts were modified with the major revision of the food intake patterns undertaken in 2003 to meet the Dietary Reference Intakes (Federal Register notice, 2003), and the revised amounts, as weekly recommendations, were included in the 2005 Dietary Guidelines (p. 24):

“In the USDA Food Guide at the reference 2,000 calorie level, the following weekly amounts are recommended:

Dark green vegetables	3 cups/week
Orange vegetables	2 cups/week
Legume (dry beans)	3 cups/week
Starchy vegetables	3 cups/week
Other vegetables	6 ½ cups/week”

These weekly amounts translate into 2 ½ cups of total vegetables per day, the recommended amount for the 2000 calorie pattern.

Consumption:

In 2003-2004, the largest contributor, by far, to total vegetable consumption was Other Vegetables (55.3%), followed by Starchy Vegetables (29.0%). Relatively small proportions of total vegetable consumption were from Dry Beans and Peas (5.9%), Dark Green Vegetables (5.9%), and Orange Vegetables (4.0%). Recommended intake levels of the 3 subgroups with low consumption levels have been targeted for marked increases in consumption. For example, amounts of orange vegetables recommended for teenagers in the 2005 Dietary Guidelines are more than 9 times (girls) to 14 times (boys) their usual median intake of these vegetables (NCI, 2001-2004 NHANES intakes).

The orange vegetable subgroup, with 4% of total vegetable consumption, is comprised of four vegetables: carrots, sweet potatoes, winter squash, and pumpkin. While carrots make up only 3.3% of total vegetable consumption, they make up 83.5% of the consumption in this subgroup. In contrast, tomatoes comprise almost one-quarter (21.6%) of total vegetable consumption. They have been categorized in the other vegetables subgroup along with over 35 different vegetables of varying nutrient profiles and characteristics. Tomatoes are 39% of the total consumption of this subgroup. (Iceberg lettuce, the next most popular, is 15.3% of the subgroup.) Despite their popularity and nutritive value, tomatoes are not positioned to stand out in the USDA food patterns. They are effectively hidden because they are grouped with so many other vegetables in a subgroup that represents over half of all vegetable consumption, because of the dissimilarity of the vegetables within the group, and because the name of the subgroup does not bring to mind an image of tomatoes. Tomatoes are identified in the 2005 Dietary Guidelines as a source of vitamins A and C and potassium. In addition, tomatoes are recognized as an important source of lycopene. In some past food grouping systems (Appendix A), tomatoes have been more prominently identified.

Table 1 compares usual intakes of vegetable subgroups to amounts recommended in the 2005 USDA food patterns at selected calorie levels. Medians and 95th percentiles of usual intake are shown. Recommended intakes are notably high compared to usual intakes of Dry Beans and Peas, Dark Green Vegetables, and Orange Vegetables. For the Dry Beans and Peas, Dark Green, and Orange subgroups, the recommendations are 4 to 8 times usual median intakes, and above 95th percentile of intakes for most patterns.

Table 1. Usual intakes of vegetable subgroups compared to recommendations in the 2005 USDA food patterns at selected calorie levels, in cup equivalents per day

	Usual median intake*	95 th %ile of usual intake*	1600 kcal pattern	2000 kcal pattern	2400 kcal pattern
Dark Green	0.05	0.32	0.29	0.43	0.43
Orange	0.05	0.18	0.21	0.29	0.29
Dry Beans and Peas	0.05	0.37	0.36	0.43	0.43
Starchy	0.43	0.85	0.36	0.43	0.86
Other	0.82	1.65	0.79	0.93	1.00
Total Vegetables			2.00	2.50	3.00

* Usual median and 95th percentile of intake for dark green, orange, and dry beans and peas are by persons 1+ years; those for starchy and other vegetables are by persons 2+years, NHANES 2001-2004.

Source: NCI usual intake tables at <http://riskfactor.cancer.gov/diet/usualintakes/pop/#results> .

Encouraging consumption increases of this magnitude has been difficult. If more vegetables could be included in the smaller subgroups and these subgroups therefore represented a larger share of current consumption, it would be feasible to make the recommendations for subgroup consumption more evenly spread among the subgroups and closer to current intake amounts and proportions. In addition, intake recommendations that are at or below the 95th percentile of intakes may be more achievable goals since at least 5 percent of the population has demonstrated that these amounts can be consumed.

Therefore, the rationale for examining potential changes in the subgroup structure is fourfold:

- 1) To facilitate development of food intake patterns that meet nutritional recommendations within calorie needs and are realistic in that they are, where possible, within the range of “best” current consumption (95th percentile of current intakes) and similar to proportions selected by consumers.
- 2) To encourage increased vegetable consumption and selection of a variety of vegetables to meet nutrient needs by providing guidance that may be better understood and considered more achievable by consumers.
- 3) To decrease the wide discrepancy between the largest subgroup (Other Vegetables) and the smallest (Orange Vegetables) in the number of vegetables included and the amounts consumed.
- 4) To provide more focus on tomatoes, now part of the Other Vegetables subgroup, as a vegetable choice in recognition of its nutrient contributions.

METHODS

1. Select item clusters within the vegetable food group that could potentially be shifted from one subgroup to another to help balance the relative consumption amounts among the subgroups and to offer more flexibility to consumers in following food pattern recommendations, while meeting nutrient needs.
2. Shift selected item clusters to create revised subgroups and compare the consumption amounts and nutrient profiles of the revised subgroups to the original subgroups.
3. Calculate potential new recommended intake amounts for each vegetable subgroup, based on proportional and 95th percentile consumption amounts and overall vegetable intake recommendations.
4. Replace the original subgroup nutrient profiles and intake levels with the revised profile and intake levels in the automated food pattern spreadsheet. This spreadsheet is used to assess nutrient adequacy of intake patterns with varying food group intake amounts and nutrient profiles for the food groups. Identify changes in nutrient content of the food patterns at each calorie level.
5. Identify the magnitude of the change in amounts from current consumption to recommended consumption levels for the original and revised subgroups.

RESULTS

1. Item clusters identified to be moved in proposed revisions to vegetable subgroups:

Vegetables in the Other vegetable subgroup were reviewed to identify any that might be logically placed into the Orange or Dark Green subgroups.

The following vegetables were identified for potential movement:

Tomatoes and red peppers—consider moving to the orange vegetables subgroup, creating a new red/orange vegetable subgroup. For tomatoes, this would give them more prominence and help balance the subgroups. For red peppers, this would reduce consumer confusion if the proposed subgroup is to be called red-orange. (Note that while it was not included in this analysis, it would be feasible to move beets into this new subgroup as well, without any impact on the subgroup’s nutrient profile, since consumption of beets is very low.)

Butterhead lettuce and bok choy—consider moving to the Dark Green subgroup. These are both leafy greens, and other similar leafy greens (romaine lettuce) are in the dark green group. Since the foods in this group have traditionally been “leafy greens”, also consider putting that term back into the subgroup name to clarify its content. We did not identify any other vegetables that seemed appropriate to shift to the Dark Green subgroup. Note that since these shifts were very minor, the remainder of the report will focus mainly on potential changes in the orange vegetable subgroup.

Green peppers were not considered for movement to the proposed Red/Orange or the Dark Green group for several reasons. Green peppers, sweet or hot, are substantially different in nutrient content from sweet or hot red peppers (see Table 2 for sample data on sweet peppers). Red peppers are much higher in vitamin A, potassium, and folate, and somewhat higher in fiber, iron, magnesium, and vitamin C than green peppers. In addition, the green peppers do not share the red color that is planned to identify this subgroup of vegetables to consumers. We do not currently have consumption data or nutrient data for orange peppers. In all likelihood, consumers will assume that orange peppers would be in the Red/Orange subgroup. We will classify them when data are available.

Table 2. Comparison of selected nutrients in one cup equivalent (149 grams) of raw green and red sweet peppers

	Raw green peppers	Raw red peppers
Calories	30 kcal	46 kcal
Dietary Fiber	2.5 g	3.1 g
Calcium	15 mg	10 mg
Iron	0.51 mg	0.64 mg
Magnesium	15 mg	18 mg
Potassium	261 mg	314 mg
Vitamin A	27 mcg RAE	234 mcg RAE
Vitamin C	120 mg	190 mg
Folate	15 mcg DFE	69 mcg DFE

Source: USDA National Nutrient Database for Standard Reference, Release 22 (2009).

2. Proposed subgroups--Consumption and Nutrient Profiles

Consumption

Moving tomatoes into the Orange Vegetables subgroup will create a new subgroup with substantial consumption. (The consumption from the Dark Green subgroup does not substantially change with the minor addition of the butterhead lettuce and bok choy.)

Table 3 compares the proportion of vegetable consumption from the current subgroups and proposed realigned subgroups. About 30% each of total vegetable consumption would be from the Red/Orange, Starchy, and Other subgroups. The remaining 10% would be split between the Dry Beans and Peas, and Dark Green Leaves and Broccoli. Tomatoes replace carrots as the predominant vegetable in the Red/Orange subgroup. The composition of this new subgroup is 82.4% tomatoes, 12.7% carrots, 2.4% red peppers, 1.9% sweet potatoes, 0.4% winter squash, and 0.2% pumpkin.

Table 3. Proportion of total vegetable consumption (cup equivalents) from vegetable subgroups used to develop USDA Food Patterns: Current and proposed subgroups compared, NHANES 2003-2004, all individuals

	Dry Beans and Peas	Starchy Vegetables	Dark Green	Orange (Red/Orange)*	Other
Current Subgroups	5.9%	29.0%	5.9%	4.0%	55.3%
Proposed Subgroups	5.9%	29.0%	6.0%	26.2%	32.9%

* Proposed new name for subgroup.

Nutritional Content of Proposed Subgroups Compared to Original Subgroups

The vegetable group is a major contributor to intakes of vitamin A, vitamin B6, potassium, copper, and fiber in the 2005 food patterns, and a substantial contributor (>10% of total) to a number of others, including calcium, iron, magnesium, vitamin C, and folate (2005 DGAC report). Table 4 identifies the range of nutrient content in the original Orange Vegetables subgroup, in comparison to the amount of these nutrients in cooked and raw tomatoes. For the selected nutrients, tomatoes are within the current range for all except vitamin A.

Table 4. Nutrient content of cooked and raw tomatoes (nutrient amount per cup equivalent for selected nutrients) in comparison to the range of nutrient content in current "orange" vegetables.

Nutrient	Current Range	Cooked Tomatoes	Raw Tomatoes
Fiber (g)	1.9 - 7.1	2.4	2.2
Iron (mg)	0.4 - 3.4	2.2	0.5
Magnesium (mg)	14.6 - 56.4	28.8	19.8
Potassium (mg)	343 - 950	549	426
Vitamin A (mcg RAE)	535 - 2255	33*	76*
Vitamin C (mg)	5.3 - 39.2	13.3	22.8
Folate (mcg DFE)	9.4 - 41.0	13.8	27.0

*Outside of current range.

Table 5 summarizes the effect of the proposed changes in vegetable subgroup composition on the nutrient content of the Orange (proposed Red/Orange) Vegetable subgroup and the Other Vegetables subgroup for calories and the shortfall nutrients contributed by vegetables. There are substantial changes in nutrient content of the subgroups when expressed on a per cup equivalent basis, as in Table 4. However, this may not influence the overall nutrient intakes in the patterns, since different amounts may be recommended from the proposed subgroups.

Table 5. Effect on Nutrient Profiles (nutrient content per cup equivalent) of Moving Tomatoes and Red Peppers from Other Vegetables to Orange Vegetables.

	Original Orange Subgroup	Proposed Red/Orange Subgroup	Original Other Vegetable Subgroup	Proposed Other Vegetable Subgroup*
Calories	69 kcal	48 kcal	46 kcal	48 kcal
Dietary Fiber	4.4 g	2.6 g	2.5 g	2.7 g
Calcium	48 mg	25 mg	30 mg	35 mg
Iron	0.61 mg	1.57 mg	1.12 mg	0.70 mg
Magnesium	21 mg	26 mg	21 mg	18 mg
Potassium	450mg	505 mg	366 mg	263 mg
Vitamin A	1257 mcg RAE	229 mcg RAE	31 mcg RAE	19 mcg RAE
Vitamin C	10.8 mg	20.6 mg	19.4 mg	17.3 mg
Folate	21 mcg DFE	19 mcg DFE	30 mcg DFE	38 mcg DFE

*Also reflects the minor effects of moving butterhead lettuce and bok choy from other vegetables to the Dark Green Vegetables subgroup.

Also, while the pro-vitamin A content of tomatoes and red peppers is lower than that in carrots and other orange vegetables, these vegetables are similar in that all are sources of one or more carotenoids. In addition to the alpha and beta carotene in carrots and other orange vegetables, tomatoes are rich in lycopene, red peppers in cryptoxanthin, and winter squash in lutein and zeaxanthin. These are not evaluated in the food patterns because there are no Dietary Reference Intake (DRI) values for carotenoids. However, the IOM noted that “although no DRIs are proposed for beta carotene or other carotenoids...existing recommendations for increased consumption of carotenoid-rich fruits and vegetables are supported.” (IOM, 2000)

3. Development of new recommended intake levels

Current USDA food patterns include a recommended amount of vegetables to eat each day at 12 food energy levels, ranging from 1000 to 3200 calories. Using these amounts as the intake levels for the vegetable group as a whole, we revised the recommended intakes for the proposed vegetable subgroups. Recommended intakes for vegetable subgroups are expressed on a weekly basis because there is not an expectation that all subgroups would be consumed daily. For analysis, we translate the weekly recommendations into average daily intakes by dividing by 7.

In order to make recommended amounts from each subgroup more realistic, we used proportional consumption amounts among the proposed subgroups as the basis for developing recommended intakes. Note that the proportional intake amounts are not actual intakes, but amounts that would be consumed if overall recommendations for vegetable intakes were met using the same mix of vegetables now consumed. Current vegetable consumption is substantially below recommendations for most age/gender groups.

Weekly recommendations for total vegetable intake were proportionately distributed among the subgroups based on consumption levels from each subgroup as reported in NHANES 2003-2004 (shown in Table 3). The weekly subgroup amounts were rounded to the nearest 0.5 cup equivalent.

For analysis and comparison to usual consumption amounts, the rounded weekly amounts were converted to a daily amount by dividing by 7. The resulting amounts were compared to existing recommendations and tested for nutrient adequacy in the patterns. Amounts of Dark Green and Dry Beans and Peas subgroups were increased at some calorie levels to improve nutrient adequacy, with compensating decreases in amounts of Other Vegetables. Only minor compensation was considered necessary in the proposed Red/Orange subgroup, since the addition of tomatoes raised the proportional intake levels.

The increased intake recommendations for Dark Green and Dry Beans and Peas are still less than existing recommendations. For example, in the 2000 calorie intake pattern, the existing recommendation for dry beans and peas is .43 cup equivalents per day (3 cups per week). Proportional consumption amounts would be .15 cup equivalents per day (1 cup per week), adjusted recommendation would be .21 cup equivalents per day (1.5 cups per week). Table 6 provides a comparison of existing, proportional, and adjusted recommendations for the 2000 calorie pattern. Appendix Table B1 provides the same information for additional selected intake patterns.

Table 6. Development of proposed new Vegetable Subgroup recommendations, in cup equivalents per day, and comparison to recommendations (sample pattern at 2000 kcal)

	Existing	Proportional ¹	Adjusted new
Dark green	0.43	0.15	0.21
Orange (Red-Orange)	0.29 ²	0.66 ³	0.79 ³
Dry Beans and Peas	0.43	0.15	0.21
Starchy	0.43	0.72	0.71
Other	0.93 ³	0.82 ²	0.57 ²

¹ Recommendation for total vegetable consumption times percentage of total vegetable consumption from that subgroup.

² Excludes tomatoes.

³ Includes tomatoes.

4. Comparison of old and new recommended intake levels to usual intake

Tables 7 and 8 show how the 2005 USDA food patterns and the proposed new recommended intake levels compare to the 50th and 95th percentiles of usual intake for representative sex-age categories and food energy levels. Appendix tables B2 and B3 show the actual 50th and 95th percentile intakes and recommended intakes in addition to percentages shown in tables 7 and 8.

The new recommendations are much more likely than the old to be within the 95th percentile of usual intake. Further, in the few instances where the new recommendations exceed the 95th percentile, such as the Dark Green and Red/Orange Vegetable recommendations for some sex-age categories, they do so by much smaller percentages than do the old recommendations. For example, for a young adult woman consuming a 2000-calorie diet, the old recommendation for Orange Vegetables is more than double the 95th percentile of usual intake, while the recommendation for the new Red/Orange subgroup is just barely above the 95th percentile of usual intake for her sex-age category. The new recommendation represents an achievable level of intake, one that about 5% of young women currently reach. Overall, the new recommendations represent more achievable goals than the old.

Table 7. Comparison of vegetable intake recommendations in 2005 food pattern (OLD) and proposed food patterns (NEW) to 95th percentile of usual intake. Recommendation is shown as a percent of the 95th percentile of intake for the age-sex group.

Vegetable Subgroup	OLD	NEW	OLD	NEW	OLD	NEW	OLD	NEW
	1800 kcal, F 14-18	1800 kcal, F14-18	2000 kcal, F 19-30	2000 kcal, F 19-30	2200 kcal, M 14-18	2200 kcal, M 14-18	2400 kcal, M 19-30	2400 kcal, M 19-30
Dark Green	286%	140%	165%	81%	357%	242%	186%	126%
Orange or Red-Orange ¹	260%	123%	220%	105%	260%	97%	168%	83%
Dry Beans and Peas	195%	97%	119%	60%	134%	89%	87%	58%
Starchy	61%	102%	56%	94%	96%	96%	93%	93%
Other ²	77%	84%	62%	62%	64%	92%	54%	70%

¹Orange subgroup is in the OLD food patterns; Red-orange subgroup is in the NEW food patterns.

²Tomatoes are in the Other vegetable subgroup in the OLD patterns, and in the Red-Orange subgroup in the NEW patterns.

The new recommendations for Dark Green Vegetables, Orange Vegetables, and Dry Beans and Peas are closer to usual median intakes than the old recommendations by large magnitudes. The magnitude of the differences between recommendations and intakes has been reduced by half or more. For example, recommendations for the old Orange subgroup are up to 14 times usual median intakes while recommendations for the new Red/Orange subgroup are 1-1/2 to 2-1/2 times usual median intakes. For young adult women, the old recommendation of 2 cups of Orange Vegetables per week is a 7-fold increase above their median intake of about 1/4 cup per week. Their new Red/Orange Vegetable recommendation is 5-1/2 cups per week, just twice their median intake of 2-3/4 cups. While still a large increase above the median, the change required may be more achievable than the change required for meeting current targets.

Table 8. Comparison of vegetable intake recommendations in 2005 food pattern (OLD) and proposed food patterns (NEW) to usual median intake. Recommendation is shown as a percent of the median intake for the age-sex group

Vegetable Subgroup	OLD 1800 kcal, F 14-18	NEW 1800 kcal, F14-18	OLD 2000 kcal, F 19-30	NEW 2000 kcal, F 19-30	OLD 2200 kcal, M 14-18	NEW 2200 kcal, M 14-18	OLD 2400 kcal, M 19-30	NEW 2400 kcal, M 19-30
Dark Green	1429%	700%	857%	420%	4286%	2900%	1429%	967%
Orange or Red-Orange ¹	952%	246%	714%	201%	1429%	204%	714%	168%
Dry Beans and Peas	1429%	714%	714%	357%	1071%	714%	612%	408%
Starchy	119%	198%	107%	179%	171%	171%	168%	168%
Other ²	150%	190%	115%	133%	125%	197%	99%	137%

¹Orange subgroup is in the OLD food patterns; Red-orange subgroup is in the NEW food patterns.

²Tomatoes are in the Other vegetable subgroup in the OLD patterns, and in the Red-Orange subgroup in the NEW patterns.

5. Comparison of nutrient adequacy of old and new intake patterns

Table 9 shows how the 2005 food patterns and the proposed new food patterns compare to RDAs for shortfall nutrients and nutrients for which vegetables are a major contributor to intakes. The overall nutrient adequacy of the new patterns is essentially the same as the old patterns. Both sets of patterns meet or exceed RDAs or AIs for all of these nutrients except potassium. The patterns shown in Table 9 provide 70% to 87% of AIs for potassium. (Patterns at 3000 and 3200 calories provide more than 100% of the AI for potassium.)

Table 9. Nutrient adequacy of the USDA Food Patterns with OLD and NEW vegetable subgroups, selected age-sex groups and food energy levels. Amounts shown as percent of the recommendation

Nutrient	OLD 1800 kcal, F 14-18	NEW 1800 kcal, F14-18	OLD 2000 kcal, F 19-30	NEW 2000 kcal, F 19-30	OLD 2200 kcal, M 14-18	NEW 2200 kcal, M 14-18	OLD 2400 kcal, M 19-30	NEW 2400 kcal, M 19-30
Dietary Fiber	107%	112%	100%	106%	102%	112%	98%	109%
Calcium	97%	94%	127%	124%	101%	99%	134%	132%
Iron	113%	110%	97%	94%	177%	177%	270%	266%
Magnesium	98%	93%	118%	113%	180%	96%	108%	104%
Potassium	69%	70%	74%	74%	82%	82%	85%	84%
Vitamin A	156%	117%	160%	122%	128%	103%	133%	108%
Vitamin C	173%	166%	174%	168%	184%	183%	154%	153%
Folate	174%	154%	177%	157%	197%	184%	214%	201%

¹Orange subgroup is in the OLD food patterns; Red-orange subgroup is in the NEW food patterns.

²Tomatoes are in the Other vegetable subgroup in the OLD patterns, and in the Red-Orange subgroup in the NEW patterns.

Levels for all nutrients are similar in the old and new patterns. The largest differences between the old and new patterns are for vitamin A, with the new patterns having less than the old, but still more than the RDAs.

Since tomatoes would be a large proportion of a red-orange vegetable subgroup and are a popular vegetable among consumers, we analyzed the patterns in one more way— if only tomatoes were selected among all Red/Orange Vegetables, what would the impact on nutrient adequacy of the patterns be?

A nutrient profile for only cooked tomatoes (the most common form eaten) was used to replace the Red/Orange Vegetable subgroup nutrient profile. The nutrient adequacy of the patterns if only tomatoes were eaten (no carrots or other orange vegetables) is very close to the same as if tomatoes and orange vegetables are both consumed. Table 10 compares percentages of the RDA or AI provided by the two patterns for selected age/gender groups and nutrients. The values for vitamin A for some age/gender groups are marginal if no orange vegetables are included. However, it is important to note that this is not the recommended pattern. Choosing a variety of foods within each food group and subgroup is always encouraged.

Table 10. Nutrient adequacy of the USDA Food Patterns with tomatoes only in comparison to NEW vegetable subgroups, selected age-sex groups and food energy levels. Amounts shown as percent of the recommendation

Nutrient	Tomato 1800 kcal, F 14-18	NEW 1800 kcal, F14-18	Tomato 2000 kcal, F 19-30	NEW 2000 kcal, F 19-30	Tomato 2200 kcal, M 14-18	NEW 2200 kcal, M 14-18	Tomato 2400 kcal, M 19-30	NEW 2400 kcal, M 19-30
Dietary Fiber	108%	112%	103%	106%	108%	112%	106%	109%
Calcium	93%	94%	123%	124%	98%	99%	131%	132%
Iron	108%	110%	93%	94%	175%	177%	264%	266%
Magnesium	91%	93%	111%	113%	94%	96%	103%	104%
Potassium	67%	70%	71%	74%	78%	82%	81%	84%
Vitamin A	94%	117%	98%	122%	83%	103%	88%	108%
Vitamin C	150%	166%	155%	168%	168%	183%	141%	153%
Folate	151%	154%	155%	157%	182%	184%	198%	201%

Source: For “Tomato” and “Red/Orange” patterns, NHANES 2003-2004, 2-day and National Nutrient Database for Standard Reference, Release 22 (SR22).

Conclusion:

The proposed revision of the vegetable subgroups resulted in moving tomatoes and red peppers from Other Vegetables to a new Red/Orange Vegetable subgroup, and making only minor shifts of butterhead lettuce and bok choy from Other Vegetables to the Dark Green subgroup. This shift represents vegetables in a way that more accurately reflects their actual consumption as part of U.S. diets, without compromising the nutrient adequacy of the patterns.

In addition, the realignment helps to more evenly distribute actual consumption across the vegetable subgroups. Conceptually, this means that in developing USDA food patterns it will not be necessary to rely so heavily on increasing consumption of a subgroup made up predominantly of one vegetable

(e.g., carrots) for which consumption is very low. Existing patterns recommend amounts of Dark Green and Orange Vegetables and Dry Beans and Peas that far exceed the “best practices” of the population—i.e., the 95th percentile of intake for these vegetables. In most cases, the recommended intakes for the new subgroupings are at or below this “best practices” intake, with at least 5 percent of the population consuming at this level. It would seem, then, that these amounts would be reasonable to recommend to the population as a whole.

The intent of the USDA food intake patterns is to identify amounts of foods to consume for nutrient adequacy while staying within an individual’s calorie needs. These proposed new intake amounts for vegetable subgroups are increases above current consumption of vegetables, but may be more achievable than the existing recommendations.

References

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Appendix A

Chart 1. Major U.S. food guides: food groups and numbers of servings (daily unless noted otherwise)

FOOD GUIDE	NUMBER OF FOOD GROUPS	PROTEIN-RICH FOOD			BREADS	VEGETABLES				FRUIT		OTHER	
		MILK	MILK-CHEESE GROUP	MEAT, POULTRY, FISH AND BEANS GROUP		MEATS AND OTHER PROTEIN-RICH FOOD (10% cal. milk, 10% cal. other)	LEAFY GREEN YELLOW	POTATOES SWEET POTATOES	POTATOES & OTHER VEGETABLES & FRUIT	TOMATOES & CITRUS	FATTY FOODS (30% CAL.)	SUGARS (10% cal)	BUTTER
1916 Caroline Elant 9, 79 buying guides	6			MEAT, POULTRY, FISH, EGGS, DRIED BEANS, PEAS, NUTS 1/wk	CEREALS AND OTHER STARCHY FOODS (30% cal) (based on 1 oz or 3/4 C dry cereal avg)	VEGETABLES AND FRUIT (30% cal) (based on average 8oz avg)							
1933 Siebeling 15, 14 buying guides	12	MILK 2 C	LEAN MEAT, POULTRY FISH 9-10/wk	EGGS 1/wk	FLOURS, CEREALS As desired	LEAFY GREEN YELLOW 11-13/wk	POTATOES SWEET POTATOES 1	OTHER VEGETABLES & FRUIT 3	TOMATOES & CITRUS 1	BUTTER -	OTHER FATS -	SUGARS -	
1943 Basic Seven 74, 78 foundation diet	7	MILK AND MILK PRODUCTS 2 C or more	MEAT, POULTRY, FISH, EGGS, DRIED BEANS, PEAS, NUTS 2 C or more	MEAT, POULTRY, FISH, EGGS, DRIED BEANS, PEAS, NUTS 1-3	BREAD, FLOUR, AND CEREALS every day	LEAFY GREEN YELLOW 1 or more	POTATOES & OTHER VEGETABLES 2 or more	POTATOES & OTHER VEGETABLES FREQUENTLY AND CITRUS DAILY (1/2 C or average size piece)	CITRUS, TOMATO, CABBAGE SALAD GREENS 1 or more	BUTTER-FORTIFIED MARGARINE some daily			
1956 Basic Four 10, 78 foundation diet	4	MILK GROUP 2 C or more	MEAT GROUP 2 or more (2-3 oz avg)	MEAT, POULTRY, FISH AND BEANS GROUP 2 (2-3 oz avg)	BREAD, CEREAL 4 or more (1 oz dry, 1 slice, 1/2-3/4 C cooked)	VEGETABLE-FRUIT GROUP 4 or more							
1979 Basic-Five 77 foundation diet	6	MILK-CHEESE GROUP 2 (1 C, 1-1/2 oz cheese)	MEAT, POULTRY, FISH AND BEANS GROUP 2 (2-3 oz avg)	MEAT, POULTRY, FISH, EGGS, DRY BEANS, NUTS 2-3	BREAD-CEREAL GROUP 4 (1 oz dry, 1 slice; 1/2-3/4 C cooked)	VEGETABLE-FRUIT GROUP 4 or more (incl. dark green/yellow vegetables frequently and citrus daily)							
1985 Food Guide Pyramid 17, 78 total diet	6	MILK, YOGURT, CHEESE 2-3 (1 C, 1-1/2 oz cheese)	MEAT, POULTRY, FISH, EGGS, DRY BEANS, NUTS 2-3 (6-7 oz total/day)	MEAT, POULTRY, FISH, EGGS, DRY BEANS, NUTS 2-3 (6-11 whole grain enriched (1 slice, 1/2 C cooked)	BREADS, CEREALS, RICE, PASTA 6-11 whole grain enriched (1 slice, 1/2 C cooked)	VEGETABLE 3-5 dark green/deep yellow starchy/legumes other (1 C raw, 1/3 C cooked)	FRUIT 2-4 citrus other (1/2 C or average)			FATS, SWEETS, ALCOHOL GROUP use dependent on calorie needs			FATS, OILS, SWEETS total fat not to exceed 30% cal., sweets vary according to calorie need

From: Welsh, S. Nutrient Standards, Dietary Guidelines, and Food Guides. In Ziegler EE and Filer LJ Jr., *Present Knowledge in Nutrition, Seventh Edition*. ILSI Press, Washington DC, 1996.

Appendix B

Table B1. Development of Proposed New Vegetable Subgroup Recommendations and Comparison to 2005 Dietary Guidelines Recommendations at selected calorie levels

Amounts in cup equivalents per day.

Food Energy Level of Food Pattern	1200	1600	2000	2400	2800	3200
EXISTING RECOMMENDATIONS –From 2005 Dietary Guidelines						
Dark green	0.21	0.29	0.43	0.43	0.43	0.43
Orange	0.14	0.21	0.29	0.29	0.36	0.36
Dry Beans & Peas	0.14	0.36	0.43	0.43	0.50	0.50
Starchy	0.36	0.36	0.43	0.86	1.00	1.29
Other	0.64	0.79	0.93	1.00	1.21	1.43
Total Vegetable	1.5	2	2.5	3	3.5	4
INITIAL NEW RECOMMENDATIONS BASED ON PROPORTIONAL CONSUMPTION¹						
Dark green	0.09	0.12	0.15	0.18	0.21	0.24
Red Orange ²	0.39	0.52	0.66	0.79	0.92	1.05
Dry Beans & Peas	0.09	0.12	0.15	0.18	0.21	0.24
Starchy	0.43	0.58	0.72	0.87	1.01	1.16
Other (red removed) ³	0.49	0.66	0.82	0.99	1.15	1.32
Total Vegetable	1.5	2	2.5	3	3.5	4
FINAL NEW RECOMMENDATIONS AFTER ADJUSTMENT TO MEET NUTRIENT GOALS						
Dark green	0.14	0.21	0.21	0.29	0.36	0.36
Red Orange ²	0.43	0.57	0.79	0.86	1.00	1.07
Dry Beans & Peas	0.07	0.14	0.21	0.29	0.36	0.43
Starchy	0.50	0.57	0.71	0.86	1.00	1.14
Other (red removed) ³	0.36	0.50	0.57	0.71	0.79	1.00
Total Vegetable	1.5	2	2.5	3	3.5	4
FINAL NEW RECOMMENDATIONS AS PERCENT OF PROPORTIONAL CONSUMPTION						
Dark green	155%	175%	140%	161%	171%	150%
Red Orange ²	109%	109%	120%	109%	109%	102%
Dry Beans & Peas	81%	121%	146%	162%	174%	182%
Starchy	115%	99%	99%	99%	99%	99%
Other (red removed) ³	73%	76%	69%	72%	69%	76%

¹Proportion of total vegetable consumption (cup equivalents) from vegetable subgroups.

²Includes all vegetables in the orange subgroup from existing groupings plus tomatoes and red peppers from the existing other vegetables subgroup.

³Tomatoes and red peppers moved to red orange subgroup from existing Other vegetables subgroup.

Table B2. 2005 (OLD) USDA food pattern vegetable recommendations compared to usual intake

Selected food energy levels and age-sex group intakes shown. Amounts in cup equivalents per day or percents of usual intake

Food Energy Level and Age-sex group	1600 kcal F 51-70	1800 kcal F 14 to 18	2000 kcal F 19-30	2200 kcal M 14-18	2400 kcal M 19-30
DARK GREEN Subgroup					
Usual intake - 50th percentile	0.10	0.03	0.05	0.01	0.03
Usual intake - 95th percentile	0.40	0.15	0.26	0.12	0.23
Recommended Intake (OLD)	0.29	0.43	0.43	0.43	0.43
Recommended as Percent of Usual Intake					
Percent of 50th percentile	286%	1429%	857%	4286%	1429%
Percent of 95th percentile	71%	286%	165%	357%	186%
ORANGE Subgroup					
Usual intake - 50th percentile	0.07	0.03	0.04	0.02	0.04
Usual intake - 95th percentile	0.18	0.11	0.13	0.11	0.17
Recommended Intake (OLD)	0.21	0.29	0.29	0.29	0.29
Recommended as Percent of Usual Intake					
Percent of 50th percentile	306%	952%	714%	1429%	714%
Percent of 95th percentile	119%	260%	220%	260%	168%
DRY BEANS AND PEAS Subgroup					
Usual intake - 50th percentile	0.05	0.03	0.06	0.04	0.07
Usual intake - 95th percentile	0.29	0.22	0.36	0.32	0.49
Recommended Intake (OLD)	0.36	0.43	0.43	0.43	0.43
Recommended as Percent of Usual Intake					
Percent of 50th percentile	714%	1429%	714%	1071%	612%
Percent of 95th percentile	123%	195%	119%	134%	87%
STARCHY Subgroup					
Usual intake - 50th percentile	0.37	0.36	0.40	0.50	0.51
Usual intake - 95th percentile	0.72	0.70	0.76	0.89	0.92
Recommended Intake (OLD)	0.36	0.43	0.43	0.86	0.86
Recommended as Percent of Usual Intake					
Percent of 50th percentile	97%	119%	107%	171%	168%
Percent of 95th percentile	50%	61%	56%	96%	93%
OTHER subgroup					
Usual intake - 50th percentile	0.89	0.62	0.81	0.80	1.01
Usual intake - 95th percentile	1.59	1.20	1.49	1.56	1.85
Recommended Intake (OLD)	0.79	0.93	0.93	1.00	1.00
Recommended as Percent of Usual Intake					
Percent of 50th percentile	88%	150%	115%	125%	99%
Percent of 95th percentile	49%	77%	62%	64%	54%

Table B3. Proposed (NEW) USDA food pattern vegetable recommendations compared to usual intake.

Selected food energy levels and age-sex group intakes shown. Amounts in cup equivalents per day or percents of usual intake.

Food Energy Level and Age-sex group	1600 kcal F51-70	1800 kcal F 14 to 18	2000 kcal F 19-30	2200 kcal M 14-18	2400 kcal M 19-30
DARK GREEN Subgroup					
Usual intake - 50th percentile	0.10	0.03	0.05	0.01	0.03
Usual intake - 95th percentile	0.40	0.15	0.26	0.12	0.23
Recommended Intake (NEW)	0.21	0.21	0.21	0.29	0.29
Recommended as Percent of Usual Intake					
Percent of 50th percentile	210%	700%	420%	2900%	967%
Percent of 95th percentile	53%	140%	81%	242%	126%
RED-ORANGE Subgroup					
Usual intake - 50th percentile	0.38	0.32	0.39	0.42	0.51
Usual intake - 95th percentile	0.73	0.64	0.75	0.88	1.03
Recommended Intake (NEW)	0.57	0.79	0.79	0.86	0.86
Recommended as Percent of Usual Intake					
Percent of 50th percentile	150%	246%	201%	204%	168%
Percent of 95th percentile	78%	123%	105%	97%	83%
DRY BEANS AND PEAS Subgroup					
Usual intake - 50th percentile	0.05	0.03	0.06	0.04	0.07
Usual intake - 95th percentile	0.29	0.22	0.36	0.32	0.49
Recommended Intake (OLD)	0.14	0.21	0.21	0.29	0.29
Recommended as Percent of Usual Intake					
Percent of 50th percentile	286%	714%	357%	714%	408%
Percent of 95th percentile	49%	97%	60%	89%	58%
STARCHY Subgroup					
Usual intake - 50th percentile	0.37	0.36	0.40	0.50	0.51
Usual intake - 95th percentile	0.72	0.70	0.76	0.89	0.92
Recommended Intake (OLD)	0.57	0.71	0.71	0.86	0.86
Recommended as Percent of Usual Intake					
Percent of 50th percentile	154%	198%	179%	171%	168%
Percent of 95th percentile	79%	102%	94%	96%	93%
OTHER subgroup (without tomatoes)					
Usual intake - 50th percentile	0.56	0.30	0.43	0.36	0.52
Usual intake - 95th percentile	1.15	0.68	0.92	0.77	1.02
Recommended Intake (OLD)	0.50	0.57	0.57	0.71	0.71
Recommended as Percent of Usual Intake					
Percent of 50th percentile	89%	190%	133%	197%	137%
Percent of 95th percentile	43%	84%	62%	92%	70%