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A Comparison of Fruit and Vegetable Intake Estimates from Three Survey Question Sets to Estimates from 24-Hour Dietary Recall Interviews

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Abstract

Background—Fruit and vegetable (F/V) intake surveillance can provide information critical to the design and evaluation of interventions and the assessment of progress toward national intake objectives. The CDC's Youth Risk Behavior Surveillance System (YRBSS) assesses F/V intake among high school students using six questions about the frequency of intake in times per day. It is not known whether F/V intake frequency in times per day can be used as a proxy for intake in servings per day.

Objective—To compare F/V intake estimates based on responses to three sets of survey questions, including the standard set of six YRBSS questions, with criterion F/V intake in servings per day based on data from 24-hour dietary recall interviews.

Participants/setting—Study participants were 610 high school students who completed an in-class questionnaire and three telephone-administered 24-hour dietary recall interviews. The questionnaire asked students how many times they consumed 100% fruit juice and ate fruit, carrots, potatoes, green salad, and other vegetables during the "past 7 days" (set 1), the number of times they did so "yesterday" (set 2), and the number of cup-equivalents of fruits and vegetables they consumed per day (set 3).

Main outcome measure—Mean estimated F/V intake either as "times/day" or "servings/day" and the percentage of students whose estimated F/V intake was ≥1, ≥2, and ≥3 times/day or servings/day.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

Statistical analyses performed—*t* tests and corrected Pearson correlations were used to compare F/V intake estimates based on survey question responses with estimates based on responses to the 24-hour dietary recall interviews.

Results—Mean F/V intake estimates (in times/day or servings/day) based on responses to all sets of survey questions were significantly more than servings/day estimates based on responses to the 24-hour dietary recall interviews, and the percentages of students meeting each intake cutpoint were also more. Of the three sets of survey questions, the standard YRBSS questions produced estimates and percentages that were most consistently closest to 24-hour dietary recall interview estimates.

Conclusions—For brief self-administered questionnaires of high school students, the current YRBSS questions are recommended for monitoring F/V intake even though mean intake estimates in times/day will likely be higher than, and are not a proxy for, mean intake estimates in servings/day.

Keywords

Fruit; Vegetable; Dietary assessment; Validity; Adolescents

ALTHOUGH DIETS RICH IN FRUITS AND VEGETABLES reduce the risk for some types of cancer,[1–3] cardiovascular disease,[4] stroke,[5] and obesity,[6–8] fruit and vegetable (F/V) intake is insufficient for many Americans.[9] Surveillance of F/V intake is critical both in designing and evaluating public health interventions to promote healthy eating and in monitoring progress toward meeting national F/V intake objectives.[9]

Many dietary intake assessment methods are available, but the methods least susceptible to measurement error (eg, laboratory methods, multiple 24-hour dietary recall interviews) are expensive to administer and time-consuming for respondents, making them impractical for most population-level surveillance systems.[10] These systems tend to rely instead on short self-administered questionnaires. Previous studies[11–13] of the validity of such questionnaires used to assess F/V intake generally found moderate agreement between estimates based on questionnaire responses and criterion estimates derived from 3-day food records or 24-hour dietary recall interviews, with one questionnaire producing a mean F/V intake estimate lower than its criterion[11] and two producing an estimate higher than its criterion.[12,13] The accuracy of self-administered dietary questionnaires can be influenced by the length of the recall period and the number of questions used, and such questionnaires are more useful as screening tools or for epidemiological surveillance than for estimating mean dietary intake.[14–16]

The Youth Risk Behavior Surveillance System (YRBSS) monitors priority health-risk behaviors, including dietary behaviors, among US high school students and representative samples of students in selected states and large urban school districts.[17] Since 1999, the YRBSS has assessed students' F/V intake frequency with six questions that ask the number of times during the previous 7 days that each of the following were consumed: 100% fruit juice, fruit, green salad, potatoes (excluding French fries, fried potatoes, and potato chips), carrots, and other vegetables. Responses to each question are combined to produce an

estimate of overall daily F/V intake frequency in times/day.[18] The YRBSS historically has used questions that assess F/V intake in times/day rather than servings/day because the accuracy of self-report is thought to be higher when recalling and calculating times/day compared with servings/day, particularly among high school–age youth. However, the extent to which F/V intake estimates in "times/day" calculated from the standard YRBSS questions, or F/V intake estimates based on two proposed alternative sets of questions, compare to F/V intake estimates in servings/day based on 24-hour dietary recall interview responses is unknown.

The purpose of this study was to compare daily F/V intake estimates based on students' responses to three sets of questions (the standard set of YRBSS questions and two proposed alternative sets of questions) with estimates of F/V intake based on their responses to three 24-hour dietary recall interviews. We hypothesized that estimates of F/V intake based on data from the three sets of survey questions would be higher than, but correlated with, estimates of F/V intake based on their 24-hour dietary recall interview responses. Results from this study will inform decisions on which question set is best for assessing F/V intake on future surveys of high school students and, when interpreting survey results, whether intake in times/day can be used as a proxy for servings/day.

METHODS

Data were analyzed from two components of the National Youth Physical Activity and Nutrition Study (NYPANS) conducted by the Centers for Disease Control and Prevention (CDC) in 2010: (a) a survey assessing physical activity and dietary behaviors and behavioral determinants in a nationally representative sample of high school students, and (b) multiple 24-hour dietary recall interviews conducted among a subsample of survey participants. Recommended procedures were followed to approximate "usual intake" using 24-hour dietary recall interviews, including combining data from more than two 24-hour dietary recall interviews, administering multiple 24-hour dietary recall interviews at least 3 to 4 days apart, and using statistical methods to adjust for within-person variation.[19] The Institutional Review Board of ICF Macro, the contractor that CDC hired to conduct this study, approved the study protocol.

Sample and Design

Survey—NYPANS used a three-stage cluster-sample design to obtain a nationally representative sample of public- and private-school students in grades 9 through 12. Students selected to participate were asked to complete a 120-item self-administered questionnaire in their classrooms during a regular class period in the spring of 2010. Response rates were: 82% (school), 89% (student), and 73% (overall). Usable questionnaires were returned by 11,429 students.

24-Hour Dietary Recall Interviews—Of the 138 schools that participated in NYPANS, 56 agreed to also participate in the 24-hour dietary recall interviews. In each of these schools, only one of the classes selected for the survey was chosen to participate in the dietary recall interviews. Classes were selected so as to provide an approximately equal

distribution of 9th- through 12th-grade students. All students in each selected classroom were eligible to participate.

During survey administration, each student in the classes selected to participate in the 24-hour dietary recall interview received a questionnaire booklet and a student contact form that were linked by a unique 5-digit number. Prior to responding to the questionnaire, students completed the student contact form so they could be reached by telephone for the 24-hour dietary recall interview. Student contact forms were returned by 1,240 of 1,416 eligible students. Of these, 11 did not contain sufficient contact information, leaving 1,229 students in the 24-hour dietary recall interview sample.

In the dietary recall interviews, dietary intake data were collected via telephone by trained interviewers and analyzed with the Nutrition Data System for Research (NDSR), version 2009, developed by the Nutrition Coordinating Center at the University of Minnesota. Students used pictures in a booklet provided during survey administration to help them estimate portion sizes. Because dietary practices have been found to vary by day of the week, interviews were, whenever possible, conducted on 2 nonconsecutive weekdays and 1 nonconsecutive weekend day over a 3- to 4-week period; however, data from interviews conducted over a longer period were not excluded. On average, the first interview lasted 27 minutes and the second and third interviews lasted approximately 22 minutes. A $20 incentive was mailed to students immediately after the completion of each interview. Of the 1,229 students who originally agreed to participate in the 24-hour dietary recall interviews, 615 (50%) completed three or more interviews (613 completed three, and two completed five); 294 (24%) completed one or two interviews; and 320 (26%) did not complete any.

F/V Intake Measures

Survey—The NYPANS questionnaire included three sets of questions assessing F/V intake (Table 1): the six previously described questions used by the YRBSS to assess frequency of F/V intake during the previous 7 days (set 1); six questions about the frequency of the same F/V categories except over a 1-day period (“yesterday”) (set 2); and a set of two questions from the National Cancer Institute’s Food Attitudes and Behaviors Survey[20] that asked respondents to estimate the number of cup-equivalents of fruit and the number of cup-equivalents of vegetables they consumed each day (set 3). On the NYPANS questionnaire, these two questions were preceded by examples of 1-cup equivalents of commonly consumed fruits and vegetables based on serving size definitions in the 2005 Dietary Guidelines for Americans (DGA).[21]

Data from the first two sets of questions were used to estimate the mean number of times/day that respondents consumed each of the six categories of fruits and vegetables. Responses for the “past 7-day” questions that included a range of values were assigned the midpoint of the range and then divided by 7 to determine daily intake (Table 1). Responses to the questions about 100% fruit juice and fruit intake were summed to estimate respondents’ total daily fruit intake frequency, and responses to the other four questions were summed to estimate their total vegetable intake frequency. For the third set of questions, the midpoint in the range of cup-equivalents per day for both vegetable and fruit consumption was multiplied by 2 to estimate the number of “servings per day” that

respondents consumed. This conversion was based on the 2005 DGA[21] serving size definition that 1 cup-equivalent of fruit or vegetable equals 2 servings (Table 1).

24-Hour Dietary Recall Interviews—The NDSR, which was used to analyze 24-hour dietary recall interview data, is based on serving definitions established by the Food Group Serving Count System. This system assigns serving sizes to selected foods or beverages based on recommendations in the 2005 DGA[21] or (for foods and beverages whose recommended serving sizes are not included in the DGA) on serving size definitions of the Food and Drug Administration. For this study, respondents' total vegetable intake both excluding and including fried potatoes was estimated. Additional details about the Food Group Serving Count System are available elsewhere (Harala P, ed. *NDSR Nutrition Data System for Research*. Minneapolis, MN: University of Minnesota; 2009).

Data Analysis

For each student who completed three or more 24-hour dietary recall interviews, the mean number of servings of fruit juice, fruit, total fruit, and total vegetables consumed was calculated. This mean was used as the criterion against which to compare F/V intake estimates derived from students' responses to each of the three sets of survey questions. Because the "past 7-day" and "yesterday" questions about potato intake specifically excluded fried potatoes, estimates of total vegetable intake derived from these questions were compared with 24-hour dietary recall interview estimates of total vegetable intake excluding fried potatoes. Because the "cup-equivalent" question about vegetable intake does not specifically exclude fried potatoes, vegetable intake estimates derived from this question were compared with 24-hour dietary recall interview estimates of total vegetable intake including fried potatoes.

Mean differences in intake estimates were calculated by subtracting the estimates based on 24-hour dietary recall interview responses (in servings/day) from estimates based on responses to each set of self-administered survey questions (in times/day for the first two sets of questions and in servings/day for the third) and used paired *t* tests to determine whether differences were statistically significant. If "times/day" is a perfect proxy for "servings/day" then mean differences would equal zero. Corrected Pearson's correlations were calculated on root-transformed intake values accounting for within-person variation in the multiple 24-hour dietary recall interviews using Willett's deattenuation methods.[22,23] Variation by sex, race/ethnicity, and grade was examined for mean differences using paired *t* tests and for correlations using Willett's equation for comparing two corrected correlation coefficients.[22]

For public health surveillance, it is useful to monitor the proportion of the population reporting F/V intake at various cutpoints, such as one or more times per day. The percentage of students who reported consuming fruits and vegetables ≥1, ≥2, and ≥3 times per day in response to the first two sets of survey questions were compared with the percentage of students who reported consuming a mean of ≥1, ≥2, and ≥3 F/V servings/day in the 24-hour dietary recall interviews, both overall and by sex, race/ethnicity, and grade. Proportions were not calculated for the third set of questions ("cup-equivalent") because the intake

ranges included in the response options could not be coded into the categories of ≥1 and ≥2 servings/day (see Table 1). For the 24-hour dietary recall interviews, proportions of students who reported total fruit and total vegetable intakes of ≥1, ≥2, and ≥3 servings/day were calculated using a measurement error model for episodically consumed foods that was developed to estimate population distributions of usual intake.[24]

All statistical analyses were done using SAS version 9.2 (2008) and SUDAAN version 10.0.1 (2009). Significance levels were defined as $P<0.05$ for analyses of data from respondents overall and as $P<0.01$ for subgroup analyses by sex, race/ethnicity, and grade.

Of the 615 students who completed three or more 24-hour dietary recall interviews, four were excluded because they reported a total energy intake of less than 500 kcal/day or more than 5,000 kcal/day in at least one interview and one was excluded because of no corresponding survey data, leaving 610 students in the analytic sample. The distribution of students did not differ significantly by sex, race/ethnicity, or grade between those in the analytic sample and those previously excluded because they completed fewer than three 24-hour dietary recall interviews (n=614).

RESULTS

The demographic distribution of students was 50.7% female; 36.7% was white, 25.7% black or African American, 28.5% Hispanic, and 9.2% of other race/ethnicity. Most students were 14 to 18 years old, with 29.6% in 9th grade, 20.7% in 10th grade, 21.2% in 11th grade, and 28.5% in 12th grade.

The mean number of F/V servings/day based on 24-hour dietary recall interview responses were 1.12 for total fruit, 1.19 for total vegetables (excluding fried potatoes), and 1.46 for total vegetables (including fried potatoes). Intake estimates derived from all three sets of survey questions were substantially higher. For total fruit intake, the mean difference in intake based on responses to the survey questions compared to the 24-hour dietary recall interview was smallest for the “past 7-day” (difference=0.98) and “yesterday” (difference=0.99) questions. For total vegetable intake, the mean difference was smallest for the “cup-equivalent” questions (difference=0.33).

Some variation in mean differences by demographic characteristics was observed (data not shown). For the “past 7-day” questions, the mean difference for total vegetable intake was greater for female (difference=0.75) than male (difference=0.31) students. For the “cup-equivalent” questions, the mean difference for total vegetable intake was greater for female (difference=0.63) than male (difference=−0.01) students and greater for white (difference=0.58) than Hispanic (difference=0.15) students, and the mean difference for total fruit intake was greater for 10th-grade (difference=1.92) than 12th-grade (difference=0.89) students. The mean difference for total vegetable intake decreased as grade increased for the “past 7-day” questions (difference: 9th-grade students=0.83; 12th-grade students=0.24) and the “yesterday” questions (difference: 9th-grade students=1.27; 12th-grade students=0.53).

F/V intake estimates derived from responses to each of the three sets of survey questions were positively correlated with those derived from 24-hour dietary recall interview

responses except for the "yesterday" total vegetable intake estimates, for which the corrected correlation was not significantly different from zero (r=0.05) (Table 2). Corrected correlations between survey questions and 24-hour dietary recall interview intake estimates were consistently higher for total fruit intake (r values: 0.23 to 0.26) than for total vegetable intake (r values: 0.05 to 0.14). Corrected correlations did not vary significantly by sex, race/ethnicity, or grade (data not shown).

The percentages of students who consumed fruits and vegetables ≥1, ≥2, and ≥3 times/day based on responses to the first two sets of questions ("past 7 days" and "yesterday" questions) were compared with the proportion of students with total F/V vegetable intake of ≥1, ≥2, and ≥3 servings/day from the 24-hour dietary recall interviews (Figures 1 and 2; see Table 3 for numerical values). In general, the percentage of students was higher when based on responses to the "past 7 days" and "yesterday" survey questions compared with responses from the 24-hour dietary recall interviews. The percentages of students with intake of ≥1, ≥2, and ≥3 times/day calculated from the "past 7-day" questions most closely approximated the percentages of students with intake of ≥1, ≥2, and ≥3 servings/day based on the 24-hour dietary recall interviews, respectively.

DISCUSSION

This study found that estimates of F/V intake based on responses to all three sets of survey questions were higher than those based on responses to the 24-hour dietary recall interviews. This finding was consistent with results from a study of middle-school students that tested the validity of a set of two questions used to estimate the number of F/V servings consumed in a "typical day"[12] and with results of a study of high school seniors and recent graduates that tested the validity of a set of 24 questions used to assess the number of F/V servings consumed during the previous week.[13] In this study, for all three survey question sets, the corrected correlations between intake estimates based on survey responses and those based on responses to 24-hour dietary recall interviews were <0.30, although the level of agreement in estimates of fruit intake differed from the level of agreement in estimates of vegetable intake. Although the reason that correlations differed for F/Vs cannot be determined from this study, it is possible that F/Vs are consumed with varying regularity by high school students and, therefore, would be differentially affected by the different reference periods in the three survey question formats. For example, if day-to-day fruit consumption is more consistent than vegetable consumption, the "cup-equivalent" question (which asks about intake in general, without a specific reference period) might perform better for estimating usual intake of vegetables than the "past 7-day" or "yesterday" questions, whereas a similar difference for fruit consumption may not be observed.

Although this study found statistically significant correlations between F/V intake estimates based on responses to each set of survey responses with those based on 24-hour dietary recall interview responses, the magnitude of the correlations was not high (all correlations <0.30). This relatively low correlation in intake estimates may have resulted from differences in reference periods (eg, intake over the previous 7 days vs intake during the previous 24 hours) or from different units of measurement (times/day vs servings/day), or it could be a sign of substantial day-to-day variation in F/V intake. The magnitude of

correlations observed in this study is similar to what has previously been reported among adolescents.[11,12]

The percentages of students who met or exceeded the three "times/day" cutpoints (based on responses to the first two sets of questions) were all higher than the percentages who met or exceeded the three corresponding "servings/day" cutpoints based on responses to the 24-hour dietary recall interviews. However, the percentages of students who met these "times/day" cutpoints according to results from the "past 7-day" set of questions were closer to the percentages who met corresponding "servings/day" cutpoints according to 24-hour dietary recall interview results.

The reason that F/V intake in times/day based on the survey questions was higher than intake in servings/day based on the 24-hour dietary recall interviews cannot be determined from this study, but a few explanations are possible. First, servings/day calculated from 24-hour dietary recall interview data are based on the frequency and quantity of foods consumed. Alternately, the "past 7-day" and "yesterday" question formats asked students to report the number of times each food item was consumed without information on quantity to determine serving size. Although both methods attempt to estimate typical or usual F/V intake for surveillance purposes, the resulting times/day does not seem to be a good proxy for servings/day. Based on the results from this study, it is likely that students are consuming less than a serving of F/V each time it is consumed. Therefore, for surveys of adolescents that assess the number of times/day F/Vs are consumed, the results should not be reported as servings/day. The YRBSS historically has reported F/V intake based on responses to the "past 7-day" questions as times/day, and this should continue. A conversion factor could be calculated to convert times/day to servings/day based on the average F/V portion sizes typically consumed by adolescents; future studies that assess F/V portion size per eating occasion among adolescents are needed to develop such a conversion factor. Although intake in cup-equivalents per day based on responses to the third set of questions can be directly converted into servings/day (using the formula of 1 cup equivalent=2 servings), students may have had difficulty estimating their F/V intake in cup-equivalents. The questionnaire included instructions with several examples of the amount of F/V that should be considered as 1 cup, though some of these examples may have been confusing. For example, the questionnaire instructions stated that ½ cup of dried fruit should be considered 1 cup of fruit and that 2 cups of lettuce should be considered 1 cup of vegetables. These 1 cup-equivalent descriptions were based on serving size definitions in the 2005 DGA.[21] Future research should examine whether asking respondents to report the number of F/V servings rather than the number of cup-equivalents consumed would provide estimates of F/V intake that more closely approximate those obtained from 24-hour dietary recall interviews.

Although estimates of F/V intake based on responses to 24-hour dietary recall interviews are generally more accurate than estimates based on responses to self-administered surveys, 24-hour dietary recall interviews are also more expensive and time-consuming. Therefore, self-administered surveys that incorporate a short set of dietary intake questions that can be completed quickly and fairly inexpensively are important for public health surveillance of F/V intake. Results from this study among high school students indicate that of the three sets

of survey questions assessed, the questions currently used by the YRBSS (in which students are asked to indicate the number of times per day fruits or vegetables are consumed during the preceding week) produced F/V intake estimates that most closely compare to those derived from 24-hour dietary recall interview responses.

This study is subject to at least two limitations. First, because the three sets of questions estimated respondents' daily F/V intake over different periods, the extent to which estimates derived from each method approximated students' true "usual intake" likely also varied. Second, because all three sets of questions were placed on one questionnaire and were responded to sequentially during a single survey administration, correlations between F/V intake estimates derived from each may be artificially inflated.

CONCLUSIONS

Results from this study showed that estimates of daily F/V intake in times/day and servings/day based on responses to three sets of self-administered survey questions were all higher than estimates of daily F/V intake in servings/day based on responses to 24-hour dietary recall interviews. However, of the three sets of survey questions examined, the standard YRBSS questions that asked respondents about their F/V intake in times/day during the past 7 days produced daily F/V intake estimates closest to the daily servings/day estimates derived from 24-hour dietary recall interviews. Continued use of these questions in YRBSS surveys as well as in similar surveys administered for the purpose of population-level surveillance of usual F/V intake among high school students is recommended. Estimates of F/V intake should be reported as the number of times per day that fruits or vegetables are consumed (as the YRBSS currently does) rather than as the number of F/V servings per day that are consumed. Researchers should understand that daily F/V intake frequency estimates derived from self-administered survey questions should not be used as a proxy for "servings/day" estimates because, as results from this study showed, estimates of the number of times per day that students consume fruits and vegetables are likely to be higher than estimates of the number of servings of fruits and vegetables that they consume per day. Nevertheless, the standard set of F/V questions used by the YRBSS are useful for population-level surveillance of F/V intake among high school students and in monitoring progress toward meeting national F/V intake objectives such as those in the 2010 DGA.[9]

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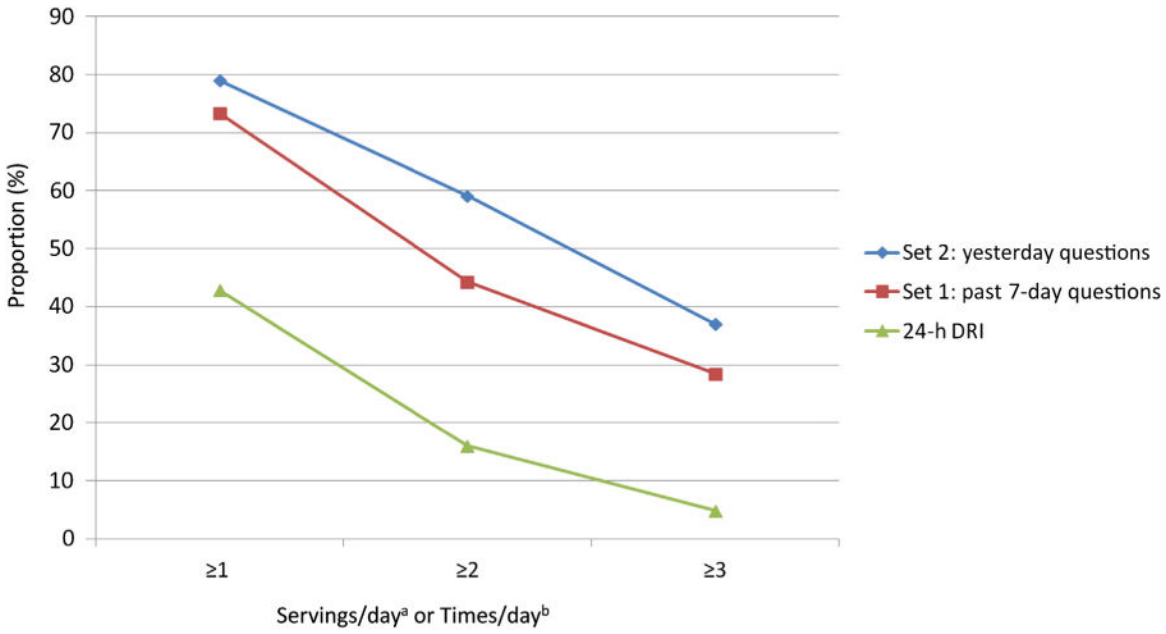

Figure 1.

Proportion of high school students reporting total fruit intake of ≥1, ≥2, and ≥3 servings/times per day: comparison of 24-hour dietary recall interviews (24-h DRI) and two sets of survey questions (n=610). [a]Intake from 24-hour dietary recall interviews reported in servings/day. [b]Intake from past 7-day and yesterday survey questions reported in times/day.

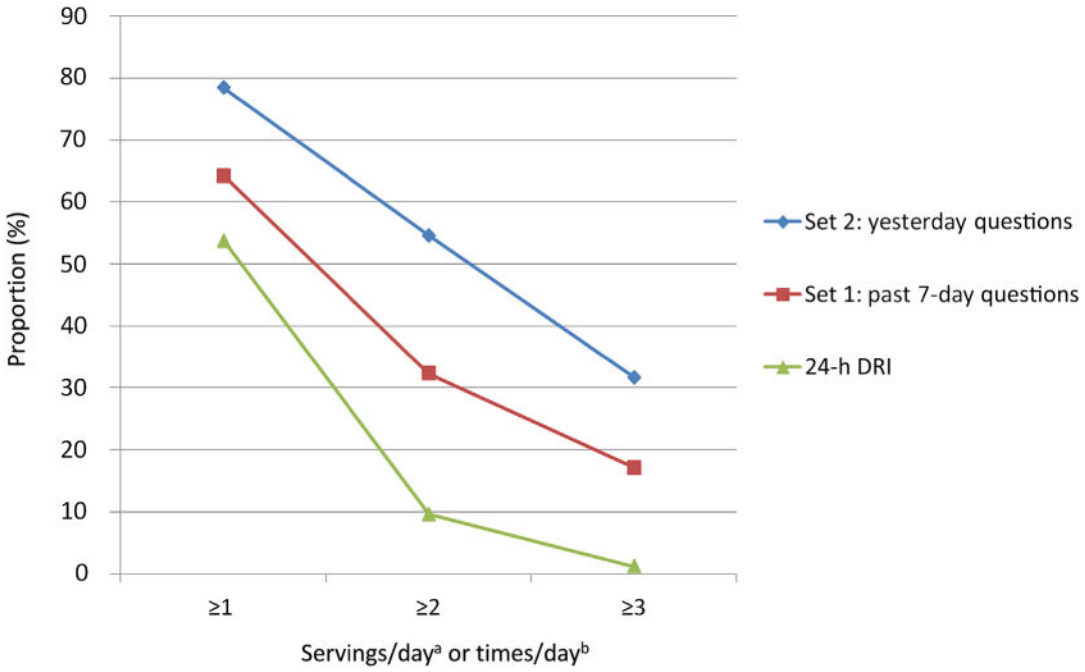

Figure 2.

Proportion of high school students reporting total vegetable intake (excluding fried potatoes) of ≥1, ≥2, and ≥3 servings/times per day: comparison of 24-hour dietary recall interviews (24-h DRI) and two sets of survey questions (n=610). [a]Intake from 24-hour dietary recall interviews reported in servings/day. [b]Intake from past 7-day and yesterday survey question formats reported in times/day.

Table 1

Three sets of survey questions for assessing fruit and vegetable intake: Question and response option wording, coding, and intake values—National Youth Physical Activity and Nutrition Study, 2010

Survey Question		Response Options: Wording (for each question)	Coding	Intake value
Set 1: Past 7 days				
1	During the past 7 days, how many times did you drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid[a], sports drinks, or other fruit-flavored drinks.)	A. I did not (__) during the past 7 days	A=0	0 times/day
2	During the past 7 days, how many times did you eat fruit? (Do not count fruit juice.)	B. 1 to 3 times during the past 7 days	B=2/7	0.29 times/day
3	During the past 7 days, how many times did you eat green salad?			
4	During the past 7 days, how many times did you eat potatoes? (Do not count French fries, fried potatoes, or potato chips.)	C. 4 to 6 times during the past 7 days	C=5/7	0.71 times/day
5	During the past 7 days, how many times did you eat carrots?			
6	During the past 7 days, how many times did you eat other vegetables? (Do not count green salad, potatoes, or carrots.)	D. 1 time per day	D=1	1 time/day
		E. 2 times per day	E=2	2 times/day
		F. 3 times per day	F 3 G= 4	3 times/day
		G. 4 or more times per day	=	4 times/day
Set 2: Yesterday				
1	Yesterday, how many times did you drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)	A. 0 times	A=0	0 times/day
		B. 1 time	B=1	1 time/day
2	Yesterday, how many times did you eat fruit? (Do not count fruit juice.)	C. 2 times	C=2	2 times/day
3	Yesterday, how many times did you eat green salad?	D. 3 times	D=3	3 times/day
4	Yesterday, how many times did you eat potatoes? (Do not count French fries, fried potatoes, or potato chips.)	E. 4 times	E=4	4 times/day
		F. 5 or more times	F=5	5 times/day
5	Yesterday, how many times did you eat carrots?			
6	Yesterday, how many times did you eat other vegetables? (Do not count green salad, potatoes, or carrots.)			
Set 3: Cup-equivalents				
1	About how many cups of fruit (including frozen, canned, and dried fruit and 100% fruit juice) do you eat or drink each day?[b]	A. None	A=0	0 servings/day[c]
2	About how many cups of vegetables (including frozen and canned vegetables and 100% vegetable juice) do you eat or drink each day?[d]	B. ½ cup or less	B=0.25	0.5 servings/day
		C. ½ to 1 cup	C=0.75	1.5 servings/day
		D. 1 to 2 cups	D=1.5	3.0 servings/day
		E. 2 to 3 cups	E=2.5	5.0 servings/day
		F. 3 to 4 cups	F=3.5	7.0 servings/day
		G. 4 or more cups	G=4	8.0 servings/day

[a] Kraft Foods, Inc.

[b] Examples: 1 cup of fruit=1 small apple, 1 large banana, 8 large strawberries, 2 large plums, 32 seedless grapes, 1 cup of 100% juice, ½ cup dried fruit.

[c] Unit conversion of cups per day to servings per day based on 2005 Dietary Guidelines for Americans serving size definitions: ½ cup=1 serving, or 1 cup=2 servings.

[d] Examples: 1 cup of vegetables=3 broccoli spears, 5-in long; 1 cup of cooked leafy greens; 2 cups of lettuce or raw greens; 12 baby carrots; 1 large potato or sweet potato; 2 large celery stalks; 1 cup of cooked beans.

Table 2

Comparison of fruit and vegetable intake estimates based on responses to three sets of survey questions and responses to 24-hour dietary recall interviews: means, mean differences, and correlations (n=610)—National Youth Physical Activity and Nutrition Study, 2010

				Total Vegetables	
	100% Fruit juice	**Fruit**	**Total fruit**	**Excluding fried potatoes**	**Including fried potatoes**
24-h dietary recall interviews (criterion)					
Mean servings/d (95% CI)	0.70 (0.61–0.79)	0.41 (0.34–0.49)	1.12 (1.00–1.23)	1.19 (1.08–1.30)	1.46 (1.34–1.57)
Set 1: Past 7-days[a]					
Mean times/d (95% CI)	0.96 (0.84–1.08)	1.13 (1.02–1.25)	2.09 (1.91–2.28)	1.73 (1.59–1.87)	—
Mean difference[b]	0.27*	0.72*	0.98*	0.54*	—
r[c]	0.29*	0.25*	0.26*	0.14*	—
Set 2: Yesterday[d]					
Mean times/d (95% CI)	1.05 (0.94–1.16)	1.06 (0.95–1.16)	2.10 (1.94–2.26)	2.08 (1.91–2.25)	—
Mean difference[b]	0.36*	0.64*	0.99*	0.88*	–
r[b]	0.28*	0.27*	0.26*	0.05	–
Set 3: Cup-equivalents[e]					
Mean servings/d[f] (95% CI)	—	—	2.40 (2.16–2.64)	—	1.79 (1.62–1.96)
Mean difference[b]	—	—	1.28*	—	0.33*
r[b]	—	—	0.23*	—	0.10*

[a] Fruit intake assessed with two questions about the number of times during the past 7 days that the student drank 100% fruit juice and ate fruit. Vegetable intake assessed with four questions about the number of times during the past 7 days that the student ate green salad, carrots, potatoes (not counting French fries, fried potatoes, or potato chips), and other vegetables.

[b] Calculation: survey intake meane24-hour dietary recall interviews intake mean. A positive value indicates overestimation of intake in servings/d on survey compared with 24-hour dietary recall interviews.

[c] Pearson correlation based on root transformed mean values and corrected for within-person variation using Willett's deattentuation methods.[22,23]

[d] Fruit intake assessed with two questions about the number of times yesterday that the student drank 100% fruit juice and ate fruit. Vegetable intake assessed with four questions about the number of times yesterday that the student ate green salad, carrots, potatoes (not counting French fries, fried potatoes, or potato chips), and other vegetables.

[e] Fruit intake assessed with one question that asked students to estimate the number of cup equivalents of fruits consumed each day. Vegetable intake assessed with one question that asked students to estimate the number of cup equivalents of vegetables consumed each day.

[f] Calculated as 1 cup-equivalent=2 servings.

* $P<0.05$.

Table 3

Proportion of high school students reporting fruit and vegetable intake of ≥1, ≥2, and ≥3 servings/day calculated from 24-hour dietary recall interviews and times/day calculated from two sets of survey questions (n=610)

	Total Fruit Intake (%)			Total Vegetable Intake (%)		
	≥1	≥2	≥3	≥1	≥2	≥3
24-h dietary recall interviews[a]						
Overall	42.8	16.0	4.8	53.7	9.6	1.2
Female	41.3	14.2	3.8	47.5	6.7	0.7
Male	44.0	17.6	5.8	60.2	12.8	1.9
White	34.0	10.3	2.5	60.3	12.3	1.8
Black	43.2	17.3	5.9	37.7	3.8	0.3
Hispanic	54.5	22.7	7.4	61.3	12.5	1.6
9th	40.4	14.1	4.0	38.8	4.4	0.4
10th	47.0	17.9	5.4	61.4	13.6	2.0
11th	38.6	13.1	3.2	55.5	10.1	1.3
12th	46.6	19.2	6.3	61.6	12.6	1.7
Set 1: Past 7-day[b]						
Overall	73.3	44.3	28.4	64.2	32.3	17.1
Female	73.4	42.8	26.3	65.6	33.8	17.5
Male	72.9	45.4	30.5	62.3	30.5	16.8
White	70.8	42.0	22.8	73.5	37.0	18.3
Black	77.5	43.7	32.5	56.8	29.7	17.6
Hispanic	75.4	49.1	34.7	54.5	28.9	17.5
9th	70.1	44.1	30.5	66.9	34.3	18.3
10th	77.2	46.3	26.8	62.6	30.9	17.1
11th	75.4	45.2	29.4	62.1	32.3	21.8
12th	71.3	41.5	35.1	62.9	30.6	12.4
Set 2: Yesterday[c]						
Overall	79.0	59.1	37.0	78.4	54.6	31.7
Female	76.3	56.0	37.3	77.7	54.7	31.7
Male	81.4	62.4	37.2	79.2	54.3	31.1

	Total Fruit Intake (%)			Total Vegetable Intake (%)		
	≥1	≥2	≥3	≥1	≥2	≥3
White	76.6	55.0	27.1	83.0	55.5	31.7
Black	79.1	62.2	43.2	71.2	49.3	28.8
Hispanic	49.8	62.0	46.0	76.2	52.4	29.3
9th	76.7	57.6	38.4	84.3	54.4	33.7
10th	85.0	67.5	42.5	78.3	56.7	34.2
11th	77.0	59.5	38.1	75.2	53.6	30.4
12th	77.6	54.1	31.8	74.7	51.2	27.1

[a] Adjusted for within-person variation, using methods described by Tooze et al.[24]

[b] Fruit intake was assessed with two questions that asked the number of times during the past 7 days that the student drank 100% fruit juice and ate fruit. Vegetable intake assessed with four questions that asked the number of times during the past 7 days that the student ate green salad, carrots, potatoes (not counting French fries, fried potatoes, or potato chips), and other vegetables.

[c] Fruit intake assessed with two questions that asked the number of times yesterday that the student drank 100% fruit juice and ate fruit. Vegetable intake assessed with four questions that asked the number of times yesterday that the student ate green salad, carrots, potatoes (not counting French fries, fried potatoes, or potato chips), and other vegetables.