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Fruit and Vegetable Intake of US Adults: Comparing Intake by Mode of Survey Administration

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ABSTRACT

Modes for collecting dietary data vary across studies and include in-person/interviewer-administered surveys, mail, and telephone surveys. Few studies use mixed modes to assess dietary intakes. Using data from the 2007 Health Information National Trends Survey, we compared fruit and vegetable intake of adults measured through dual modes (mail and random-digit dial [RDD] telephone), and discussed potential factors that could account for mode differences. The Health Information National Trends Survey data were collected through mailed (n=3,582), and RDD (n=4,092) surveys from December 2007 to May 2008. Data were weighted and analyzed in SUDAAN. Unadjusted mean fruit and vegetable intake was 0.48 servings higher ($P<0.001$) among mail (mean 5.40) vs RDD (mean 4.09) participants. In a multivariate model that controlled for other predictors, the odds of consuming ≥5 servings of fruit and vegetables per day was 83% higher among mail respondents compared to RDD (odds ratio 1.83, 95% confidence interval 1.62 to 2.07). Other predictors of fruit and vegetable intake were sex, education, participation in physical activity, self-rated health, and knowledge of the fruit and vegetable recommendation. Methodologic issues may account for modal differences in fruit and vegetable intake. Different measures (cups, servings) were used to assess fruit and vegetable intake in both modes, details about portion sizes were provided on the mail mode vs RDD, and closed-ended responses were provided on the mail vs open-ended responses for RDD. We cannot recommend one mode over the other nor attribute mode differences to real differences in reported fruit and vegetable intake between participants from both modes. Future research that uses dual modes needs to use identical methods of dietary assessment to minimize these potential sources of error. Further research is needed to validate the use of dual modes to assess dietary intake and inform research practice.

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Diets that include increased intakes of fruits and vegetables are associated with reduced risk of developing chronic diseases (1-5). Current dietary guidelines recommend that adults consume seven to 13 servings of fruits and vegetables daily (4,6). National data show that most Americans are not meeting the previous recommendation to eat five servings of fruits and vegetables daily (7-9), suggesting the need for interventions that promote fruit and vegetable intake among Americans.

Estimating population compliance with expert dietary guidelines, including fruit and vegetable intake, is a priority of the national nutrition monitoring system. However, modes for collecting diet and health data that vary across surveys may influence such estimates. The National Health and Nutrition Examination Survey uses both in-person and telephone interviews to collect dietary data (10). The National Health Interview Survey uses in-person interviews to collect diet and health-related data (11) whereas the Behavioral Risk Factor Surveillance System uses telephone interviews (12,13). Other modes that are often used in observational studies include mailed and Web-based surveys (14-17).

Few studies combine more than one survey mode to assess dietary intakes (10,18,19). Researchers are adopting mixed or dual modes of survey administration for dietary assessment to increase survey response rates (13,20). These approaches are important and could significantly influence population and individual estimates of dietary intakes. It is important to understand the implications of using mixed survey modes on research design, interpretation of research findings, and estimates of

dietary intakes. The objectives of this study were to: compare FVI of adults measured using dual survey modes (ie, mail vs random-digit dial [RDD]) telephone administration, and discuss potential factors that could contribute to mode differences observed.

METHODS

We analyzed data from the National Cancer Institute's (NCI) 2007 Health Information National Trends Survey (HINTS). This cross-sectional survey of US civilian, noninstitutionalized adults, conducted from December 2007 through May 2008 (21), collected data about Americans' sources of information about health and cancer, and included questions on diet, physical activity, and other behaviors. Appropriate institutional review board approval was obtained to administer HINTS 2007.

The HINTS data have been collected biennially since 2003 using RDD mode only. To increase response rates, and include cellular telephone only households in the survey, HINTS 2007 data were collected using dual modes; a pencil-and-paper mailed survey and an RDD telephone survey. For the mail mode, a stratified sample of respondents was selected from a list of addresses that oversampled minorities. RDD participants were selected from a random sample of all working banks in US telephone exchanges.

The HINTS 2007 sample consisted of 7,674 adults; 3,582 responded by mail mode and 4,092 by RDD mode. Response rates for the mail mode were 40% for households that returned at least one complete survey and 77% for adults within each household that returned a survey, for an overall response rate of 31%. For the RDD mode, response rates were 42.4% for the RDD screener and 57.2% for the RDD interview, for an overall response rate of 24.2%.

Fruit and vegetable intake was assessed using two variants of a two-item fruits and vegetables screener that asked participants about the quantity of fruits and vegetables consumed daily. On the mail survey, participants were asked using closed-ended responses: "About how many cups of fruit (including 100% pure fruit juice) do you eat or drink each day?" and "About how many cups of vegetables (including 100% vegetable juice) do you eat or drink each day?" Participants were provided with 1-c equivalents of various fruits and vegetables (eg, 1 c fruit=one small apple, 1 c or 8 oz 100% fruit juice; 1 c vegetables=1 c cooked leafy greens, 1 c cooked beans). For RDD, participants were asked using open-ended questions: "How many servings of fruit do you usually eat or drink each day?" and "How many servings of vegetables do you usually eat or drink each day?" Participants were instructed to think of a serving of fruit as being one medium piece or ½ c fruit, or ¾ c juice, and to think of a serving of vegetable as being about 1 c raw leafy vegetables, ½ c other cooked or raw vegetables, or ¾ c vegetable juice. The two-item cup and serving fruits and vegetables screeners were developed and validity established by the NCI as part of another study, using individual mean intakes. The two-item cup screener (correlation coefficient 0.38) showed better evidence of validity than the two-item serving screener (correlation coefficient 0.27) when compared to three 24-hour dietary recalls (22) (A. L. Yaroch, PhD, personal communication, December 2008). A different fruits and vegetables screener was used for the RDD mode because the 1-c equivalents that were incorporated on the mail survey were not feasible to include and read over the telephone. Responses provided on the mail survey were converted into servings to ensure consistency in units of measurement used during data analysis.

Statistical Analysis

Data were analyzed using SUDAAN (version 9.0.1, 2005, RTI International, Research Triangle Park, NC). Sample weights were applied in all analyses to generalize results to the US population. Differences in participants' characteristics by survey mode were examined using χ^2. We conducted t tests were conducted to calculate unadjusted mean differences in fruit intake, vegetable intake, and total fruit and vegetable intake by survey mode. Logistic regression for binary outcomes (the outcome variables were fruit intake, vegetable intake, and total fruit and vegetable intake) was used to determine whether survey mode was associated with fruit intake, vegetable intake, and fruit and vegetable intake combined, controlling for multiple participant characteristics (ie, sex, age, race/ethnicity, body mass index, participation in physical activity, self-rated health, and knowledge of the recommendation to consume seven to 13 servings of fruits and vegetables daily). The logistic regression analyses generated odds ratios and 95% confidence intervals for both the predictor variable (ie, survey mode), and covariates (ie, participants' characteristics) (results are shown in Table 1). To allow comparison with earlier 5-A-Day surveillance data (8,23) and because preliminary analyses showed that most (92%) participants in our study did not know about the new seven to 13 recommendation, we calculated the percentage of respondents who ate ≥5 servings of fruits and vegetables daily. Two-sided $P<0.05$ was used to determine statistical significance.

RESULTS AND DISCUSSION

Characteristics of participants are described in Table 2. Education, participation in physical activity, self-rated health, and knowledge of the fruits and vegetables recommendation were significantly different by survey mode. Participants in the mail mode were more likely to have higher educational attainment ($P<0.001$), better perceived health ($P<0.001$), but lower participation in physical activities ($P<0.001$), and somewhat poorer understanding of fruits and vegetables dietary guidelines ($P<0.05$) compared to RDD respondents. Sex, age, race/ethnicity, and body mass index were not different between mail and RDD participants.

Unadjusted mean reported intakes of fruit, vegetable, and total fruits and vegetables between participants from both the mail and RDD modes differed significantly. Participants from the mail mode consumed 0.48 more servings of fruit (mean intake 2.53 vs 2.05 servings, $P<0.001$), 0.84 more servings of vegetable (mean intake 2.86 vs 2.02 servings, $P<0.001$), and 1.31 more servings of total fruits and vegetables (mean intake 5.40 vs 4.09 servings, $P<0.001$) than RDD participants. Unadjusted mean reported fruit and vegetable intake among participants in