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Fourth-grade children's dietary reporting accuracy by meal component: Results from a validation study that manipulated retention interval and prompts

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ABSTRACT

We examined reporting accuracy by meal component (beverage, bread, breakfast meat, combination entrée, condiment, dessert, entrée, fruit, vegetable) with validation-study data on 455 fourth-grade children (mean age = 9.92 ± 0.41 years) observed eating school meals and randomized to one of eight dietary recall conditions (two retention intervals [short, long] crossed with four prompts [forward, meal-name, open, reverse]). Accuracy category (match [observed and reported], omission [observed but unreported], intrusion [unobserved but reported]) was a polytomous nominal item response variable. We fit a multilevel cumulative logit model with item variables meal component and serving period (breakfast, lunch) and child variables retention interval, prompt and sex. Significant accuracy category predictors were meal component ($p < 0.0003$), retention interval ($p < 0.0003$), meal-component × serving-period ($p < 0.0003$) and meal-component × retention-interval ($p = 0.001$). The relationship of meal component and accuracy category was much stronger for lunch than breakfast. For *lunch*, *beverages* were matches more often, omissions much less often and intrusions more often than expected under independence; *fruits* and *desserts* were omissions more often. For the meal-component × retention-interval interaction, for the *short retention interval*, *beverages* were intrusions much more often but *combination entrées* and *condiments* were intrusions less often; for the *long retention interval*, *beverages* were matches more often and omissions less often but *fruits* were matches less often. Accuracy for each meal component appeared better with the short than long retention interval. For *lunch* and for the *short retention interval*, children's reporting was most accurate for *entrée* and *combination entrée* meal components, whereas it was least accurate for *vegetable* and *fruit* meal components. Results have implications for conclusions of studies and interventions assessed with dietary recalls obtained from children.

1. Introduction

The relationship between diet and disease is a critical one in public health, but dietary assessment is challenging, especially in children. Parents often report the dietary intake of their elementary school children, but studies (Burrows et al., 2013; Byers et al., 1993; Emmons & Hayes, 1973; Hunsberger et al., 2013) raise concerns about accuracy. For many national surveys, parents assist their elementary school children with 24-hour dietary recalls (24hDR) of children's intake. For example, since 2002, for children aged 6–11

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years, the National Health and Nutrition Examination Survey (NHANES) has used joint recalls, with the child's age determining who the primary respondent is and who assists (National Health and Nutrition Examination Survey, 2002a, 2002b, 2004; National Health and Nutrition Examination Survey (NHANES), 2005, 2006, 2008a, 2008b, 2010a, 2010b, 2012a, 2012b, 2012c, 2013, 2014): Specifically, for children aged 6–8 years, the parent is the primary respondent and the child assists; for children aged 9–11 years, the child is the primary respondent and the parent assists; for children aged less than 6, proxy interviews (usually of a parent) are used; children aged 12 and older are interviewed alone (National Health and Nutrition Examination Survey, 2002a, 2002b, 2004; National Health and Nutrition Examination Survey (NHANES), 2005, 2006, 2008a, 2008b, 2010a, 2010b, 2012a, 2012b, 2012c, 2013, 2014). However, because parents lack first-hand knowledge of their children's intake at school, elementary school children must often self-report this information. For many years, elementary school children have provided dietary recalls for studies (Burghardt, Ensor, Hutchinson, Weiss, & Spencer, 1993; Fenton et al., 2015; Field et al., 1999; Moore et al., 2008; Ollberding et al., 2015; Ritchie et al., 2016; US Department of Agriculture, 2007; Wolfe & Campbell, 1993; Yuan et al., 2013) and interventions (Baranowski et al., 2003; Bartlett et al., 2013; Kitzman-Ulrich et al., 2011; Lindholm, Touliatos, & Wenberg, 1984; Luepker et al., 1996; McDonald, Brun, & Esserman, 1981; Receveur, Morou, Gray-Donald, & Macaulay, 2008; Reynolds et al., 2000; Wilson et al., 2015).

Conformance to nutritional guidelines is an indicator of diet quality; an example of a measure of diet quality is the Healthy Eating Index (HEI). The HEI is a measure of how well dietary intake conforms to the Dietary Guidelines for Americans. The HEI-2010 (Guenther et al., 2013), the latest version of the HEI, has 12 components, including nine adequacy and three moderation components. For purposes of the current article, some of the nine adequacy components (e.g., total fruit, total vegetables, dairy, total protein foods) of the HEI-2010 are similar to food groups or meal components. Most studies of diet quality use intake data that is self-reported, and/or jointly or proxy reported if for children. Banfield and colleagues (Banfield, Lui, Davis, Chang, & Frazier-Wood, 2016) used the HEI-2010 and 24hDR data from NHANES 2005–2006, 2007–2008, and 2009–2010 to describe diet quality among youth. Krebs-Smith and colleagues (Krebs-Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010) used MyPyramid food groups and 24hDR data from NHANES 2001–2004 to determine what proportion of the USA population does not meet federal dietary recommendations. Lorson and colleagues (Lorson, Melgar-Quinonez, & Taylor, 2009) used MyPyramids food groups and 24hDR data from NHANES 1999–2002 to assess fruit and vegetable intake among youth. Thus, the accuracy of children's (and/or adults') 24hDRs by food group or meal component could have major implications for conclusions concerning children's diet quality or adherence to dietary recommendations.

Some nutrition interventions are designed to change children's intake of specific food groups or meal components. For example, nutrition interventions have been conducted to increase children's consumption of milk and/or fruits and vegetables (Baranowski et al., 2003; Cohen, Richardson, Parker, Catalano, & Rimm, 2014; Cohen et al., 2012; Cullen, Lui, & Thompson, 2016; Day, Strange, McKay, & Naylor, 2008; Eriksen, Haraldsdottir, Pederson, & Flyger, 2003; Hanks, Just, & Wansink, 2014; Perry et al., 1998, 2004; Reynolds et al., 2000; Upton, Upton, & Taylor, 2013; Wengreen, Madden, Aguilar, Smits, & Jones, 2013). For some of these interventions, children provided 24hDRs via face-to-face interview (Perry et al., 1998; Reynolds et al., 2000), telephone interview (Cullen et al., 2016), computer (Baranowski et al., 2003), or questionnaire (Day et al., 2008; Eriksen et al., 2003) before and after the intervention to assess change in their intake of the specific food groups or meal components. Thus, the accuracy of children's 24hDRs by food group or meal component could have major implications for conclusions concerning the effectiveness of such nutrition interventions.

To our knowledge, research specifically concerning children's reporting accuracy by meal component is sparse. In a retrospective analysis, examination was conducted of fourth-grade children's reporting accuracy by meal component of recalls for school lunch only (Study 1; 148 children) and for the school lunch portion of 24hDRs (Study 2; 104 children); all recalls by children were obtained in the morning on the day after school lunch had been observed (Baxter & Thompson, 2002). For the two studies, food-item omission rate for a specific meal component was calculated as the number of omissions for that meal component divided by the number of omissions plus the number of matches for that meal component. Also, food-item intrusion rate for a specific meal component was calculated as the number of intrusions for that meal component divided by the number of intrusions plus the number of matches for that meal component. For Study 1, food-item omission rates were greatest (i.e., least accurate) for condiment at 64%, followed by vegetable, bread, and dessert at 45–49%, then fruit at 31% and entrée at 22%, and smallest (i.e., most accurate) for beverage at 8%; food-item intrusion rates were greatest (i.e., least accurate) for bread, vegetable, entrée, condiment, dessert, and fruit at 15–18%, and smallest (i.e., most accurate) for beverage at 8%. For Study 2, food-item omission rates were greatest for fruit, condiment, vegetable, and dessert at 67–72%, followed by bread at 56%, then entrée at 46%, and smallest for beverage at 16%; food-item intrusion rates were greatest for dessert, condiment, entrée, fruit, and vegetable at 37–47%, and smallest for bread at 24% and beverage at 20% (Baxter & Thompson, 2002). Thus, for each of Studies 1 and 2, beverage was the meal component for which children's reporting was most accurate, and condiment and vegetable were the meal components for which children's reporting was least accurate.

The aim of the current article was to investigate children's reporting accuracy by meal component for school-meal intake obtained during 24hDRs using data from a cross-sectional validation study (Baxter, Smith, Hitchcock, et al., 2015). That validation study was designed to investigate the combined influence of retention interval (time between the to-be-reported meals and the recall) and prompts (questions used to obtain reports of intake during the first pass of a multiple-pass recall procedure) on fourth-grade children's dietary reporting accuracy; intake was validated with direct meal observations of school-provided breakfast and lunch. We investigated three hypotheses which were not examined previously.

Hypothesis 1 states that the accuracy with which children report food intake at school meals during 24hDRs will vary over meal component (i.e., beverage, bread, breakfast meat, combination entrée, condiment, dessert, entrée, fruit, vegetable). Specifically, omissions (items observed eaten but not reported eaten) and intrusions (items not observed eaten but reported eaten) will vary over meal component. This hypothesis was based on results from the retrospective analysis (Baxter & Thompson, 2002) summarized earlier.

Hypothesis 2 states that the effect on children's reporting accuracy by meal component will differ by school-meal serving period (breakfast, lunch). Specifically, there will be more variation over meal components in reporting accuracy for lunch than for breakfast. This hypothesis was based on results from past studies on fourth-grade children, with one study on the same sample as the current article's investigation and the other study on two different samples, which found that children's food-item accuracy for