Validation of the School Lunch Recall Questionnaire to Capture School Lunch Intake of Third- to Fifth-Grade Students

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ABSTRACT
Children's dietary intake is a key variable in evaluations of school-based interventions. Current methods for assessing children's intake, such as 24-hour recalls and meal observations, are time- and resource-intensive. As part of a study to evaluate the impact of farm-to-school programs, the school lunch recall was developed from a need for a valid and efficient tool to assess school lunch intake among large samples of children. A self-administered paper-and-pencil questionnaire, the school lunch recall prompts for school lunch items by asking children whether they chose a menu item, how much of it they ate, how much they liked it, and whether they would choose it again. The school lunch recall was validated during summer school in 2008 with 18 third- to fifth-grade students (8 to 11 years old) in a North Carolina elementary school. For 4 consecutive days, trained observers recorded foods and amounts students ate during school lunch. Students completed the school lunch recall immediately after lunch. Thirty-seven total observation school lunch recall sets were analyzed. Comparison of school lunch recalls against observations indicated high accuracy, with means of 6% for omission rate (items observed but unreported), 10% for intrusion rate (items unobserved but reported), and 0.63 servings for total inaccuracy (a measure that combines errors for reporting items and amounts). For amounts, accuracy was high for matches (0.06 and 0.01 servings for absolute and arithmetic differences, respectively) but lower for omissions (0.47 servings) and intrusions (0.54 servings). In this pilot study, the school lunch recall was a valid, efficient tool for assessing school lunch intake for a small sample of third- to fifth-grade students.

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ith rising rates of childhood obesity (1,2) and increasing evidence of the long-term impact of childhood dietary habits (3-12), the school environment is a popular and promising target for environmental interventions to improve children’s intake (13-16). To evaluate the impact that dietary interventions have on children's intake at school, there is a need for efficient, relatively inexpensive, dietary assessment tools. These tools must rely on children's self-reports because parents lack first-hand knowledge of children's intake at school. The 24-hour dietary recall is frequently used with children who are systematically interviewed about what they ate during a 24-hour period (17,18). However, studies have shown that primary school–aged children have difficulty accurately recalling their intake (17,19-26), questioning the ability of dietary recalls to accurately capture intake among this age group. Although research has shown that children's dietary recall accuracy can be improved by study design and methodological decisions made by investigators (19), dietary recalls are expensive and time-consuming.

Meal observations are an alternative to dietary recalls and are often regarded as a gold standard for validating dietary assessment tools (19-28). Trained staff observes and records foods and amounts eaten during a specific time period. Although research has shown that observations of school meals do not affect children's dietary recalls (29,30), observations are expensive and time-consuming.

Food frequencies, food diaries, and combinations of food frequencies and 24-hour recalls have been used to assess children’s intake at school (31-34). However, validation studies of these tools show that multiple days of recording are necessary and overestimated consumption is a concern (17,31). Also, food frequencies and diaries appear to place a significant response burden on children and require a high level of motivation for completion. Thus, there is need for valid and efficient tools to capture children's intake at school.
The school lunch recall was developed to address these concerns and to evaluate the dietary impact of farm-to-school programs on fruit and vegetable consumption during school lunch in elementary schools. The school lunch recall incorporates elements proven to be helpful to children in reporting intake. For example, studies have shown that a shorter time interval between consumption and recall improves children’s accuracy (19,21,26,35). Consequently, the school lunch recall is completed immediately after lunch. Also, research has shown that accuracy for recalling school lunch intake is better when children are asked to recall only school lunch vs all meals during a 24-hour period (22), and that children may be aided to recall additional items when prompted by food categories (36). The school lunch recall captures intake for a single meal and inquires about menu items offered by the National School Lunch Program (NSLP) on the day the school lunch recall is completed.

The purpose of this pilot study was to test the validity of the school lunch recall against school lunch observations. Because study design aspects were not manipulated, there was no study hypothesis.

METHODS

The Institutional Review Board at the University of North Carolina at Chapel Hill approved the study. Students from all third- to fifth-grade (8 to 11 years old) summer school classes in 2008 at one school in the Triangle Area of North Carolina were asked to participate in the study. Written child assent and parental permission were required for participation. Data were collected by school lunch observation and school lunch recalls on 4 consecutive days (Tuesday through Friday). No incentives were provided to students for participating.

School Lunch Recall

The school lunch recall, a self-administered paper-and-pencil tool, was designed with input from researchers and four elementary school teachers (two of whom distributed school lunch recalls during data collection). The school lunch recall asks about each food item on the NSLP menu for the day on which the school lunch recall is completed. The school lunch recall consists of four questions for each item, with response options shown in quotation marks:

1. Did you choose the [insert menu item]? “yes,” “no”;
2. How much of the [insert menu item] did you eat? “I didn’t eat any of it,” “I tasted it,” “I ate a little bit,” “I ate half of it,” “I ate most of it,” “I ate all of it” (19-21,23,25,26,36);
3. How much did you like [insert menu item]? “I loved it,” “I liked it,” “I didn’t like it” (37,38);

Because students did not have choices for lunch during summer school, the first question was eliminated for this study. Second helpings were not available. Because enjoyment of food can facilitate its recall (39-41), and information about food preferences can be useful to school foodservice, the school lunch recall was designed to ascertain the degree to which students liked each item.

Methods for observing, reporting, and recording amounts of food consumed were based on standardized school meal portions for each item, as in previous studies (19,21,23,25,26,36). Serving sizes for menu items were obtained from school foodservice. Items that students brought from home to eat during lunch were recorded in observations. Fruits and vegetables brought from home were captured by the school lunch recall through four additional questions:

1. Did you bring any vegetables from home?
2. How much of those vegetables did you eat?
3. Did you bring any fruit from home?
4. How much of the fruit did you eat?

Response options were either “yes,” “no,” or the same amount response options listed previously.

Immediately after students finished eating, cleaned their lunch area, and moved to another table, school lunch recalls were distributed to all participating students. Teachers on duty during lunch distributed and collected school lunch recalls and clarified questions but were instructed not to assist students. Students were asked to complete school lunch recalls without help from other students. All school lunch recalls were completed within 10 minutes after distribution.

School Lunch Observations

Four research staff members were trained in the office to estimate the amount of a serving of food items left on a plate and spent 2 training days in the school cafeteria. Using interobserver reliability procedures as described by Baglio and colleagues (42), before beginning data collection, six students were selected for observation by the four observers (two observers per student, three students per observer). Foods and amounts observed eaten were recorded and coded relative to standardized school meal portions and to correspond with student response options on the school lunch recall as none=0, taste=10%, little bit=25%, half=50%, most=75%, and all = 1. Observations for the same student were compared across the pair of observers using a strategy (42) that calculates interobserver reliability as the percentage of agreement between two observers. Interobserver reliability had to exceed 85%, which it did, for data collection to proceed.

Menu items during summer school were similar to menu items during the school year. Students obtained lunches from a central table. Teachers distributed white or chocolate milk. Students in the study wore name tags with their first name and first initial of their last name. Before lunch, observers checked for menu changes. One menu item changed on each of 2 days, and those school lunch recalls were revised before distribution.

Observations covered the entire lunch period to account for food trading (43) and saving food in personal containers to take home. On each of the 4 data-collection days, each of three or four trained observers simultaneously observed and recorded lunch intake for one to three randomly selected students. If a randomly selected student was absent, a replacement was randomly selected. Students were aware of being observed but did not know who was being observed on which day. The 2 days of
observations conducted to assess interobserver reliability helped to reduce reactivity during data collection.

**Analyses**

Students' identifying information and dates of observations and school lunch recalls were used to create "sets," defined as school lunch recall and observation pairs. Following Baxter and colleagues' procedures (19,20,25,36), subjective weights were assigned to meal components (entrée multiplied by 2, sides and drinks multiplied by 1) so errors in reporting entrées counted more than errors in reporting sides and drinks. Condiments were not assessed by the school lunch recall or observations.

According to Baxter and colleagues' methodology (19-23,25,26,35,44), three categories were used to compare items reported eaten by students on the school lunch recall with items observed eaten. When students reported eating an item on the school lunch recall and the student was observed eating the same item, the agreement was called "match." If the student did not report eating an item on the school lunch recall, but was observed eating the item by an observer, the discrepancy was labeled "omission." If the student reported eating an item on the school lunch recall, but was not observed eating the item by an observer, the discrepancy was categorized as "intrusion." Rates per student for each lunch were calculated for each of the three categories using the formulas shown in the Table footnote.

The number of liking responses on school lunch recalls was tallied for each category of items (matches, omissions, intrusions).

Statistical calculations were conducted using Statistical Analysis Software (version 9.1, 2006, SAS Institute Inc, Cary, NC). All analyses accounted for clustering because some students were observed and completed school lunch recalls on multiple days. SAS survey procedures were used to conduct analyses with the school lunch recall observation sets per student treated as cluster.

**RESULTS AND DISCUSSION**

Eighteen of 34 students (53% of third- to fifth-grade students attending summer school) returned signed assent and parental consent forms indicating agreement to participate; of these, 10 were female, a representative proportion of the eligible population. The Figure shows information about students in the sample and creation of sets for analyses. During the 4 data-collection days, 18 students were observed on multiple days; however, because of the inconsistent ability to randomly select replacements for absent students, 12 students were not always observed on each of the 4 data collection days. Review of data showed no pattern of improvement in matches or intrusions over multiple days, and mean omission and intrusion rates for students' first sets were lower than for overall means. In addition, each of only two students brought a fruit or vegetable from home on one occasion; thus, analyses excluded the SLR's four additional questions.

The Table shows results for omission rates, intrusion rates, and total inaccuracy. Mean omission and intrusions rates were both low, indicating that most items were correctly reported eaten; there were fewer omissions than intrusions. Total inaccuracy was also low. The low omission and intrusion rates are similar to those found by Baxter and colleagues (21) for fourth-grade children's lunch-only recalls obtained within 90 minutes of eating. In a 1981 publication, Comstock and colleagues (45) reported a correlation of 0.74 between weighed plate waste and primary school-aged children's written consumption ratings obtained immediately after lunch (omission and intrusion rates were not reported).

The Table also shows results for amounts for matches, omissions, and intrusions. For matches, accuracy of amounts reported eaten compared to amounts observed eaten was high for both absolute differences and arithmetic differences (0.06 and 0.01 servings, respectively). However, when students failed to report items observed eaten (ie, omissions) or reported items as eaten that were not observed eaten (ie, intrusions), amounts had relatively high degrees of inaccuracy (0.47 and 0.54 servings, respectively). These results concerning amounts for matches, omissions, and intrusions are similar to results from other studies with children (19,20,23,25). The numbers of omissions and intrusions were similar across entrées, fruits, vegetables, and milk.

Concerning enjoyment (or liking) ratings, for matches, students responded "I loved it" for 40% of matches, "I liked it" for 17%, and "I didn't like it" for 43%. For omissions, the respective percentages were 11%, 22%, and 67%. For intrusions, the respective percentages were 21%, 43%, and 36%. In summary, liking ratings were better for matches than for omissions or intrusions; these results are similar to results from other studies with children (40,42).

Capturing children's school lunch intake requires a dietary assessment tool that overcomes the challenges associated with collecting such data in the school environment, yet accurately reflects children's intake. The school lunch recall promises to address many of these challenges by incorporating prompts for specific foods, requiring few resources to collect, assessing single-meal intake, and obtaining self-reported intake immediately after consumption of the meal. The school lunch recall is different than most dietary assessment tools for children because it reflects a particular yet changeable menu and caters to the recall abilities of primary school-aged children. The school lunch recall has recently been used with larger groups of students during the school year to evaluate school lunch intake of fruits and vegetables.

Although students who bring lunch from home cannot use the school lunch recall, it has the potential to be used widely among the many children who participate in the NSLP (46). The only items brought from home that the current school lunch recall format captures are fruits and vegetables; however, the four additional questions could
18 students were observed eating school lunch on multiple days and completed school lunch recalls (SLRs) to create a total of 44 sets.

3 students were observed on multiple days and completed SLRs to create a total of 7 sets that were excluded from analyses.

15 students were observed on multiple days and completed SLRs to create a total of 37 sets that were included in analyses.

4 sets excluded due to incomplete SLRs
3 sets excluded due to incomplete observations

4 sets for each of 5 students (20 sets total)
3 sets for each of 2 students (6 sets total)
2 sets for each of 3 students (6 sets total)
1 set for each of 5 students (5 sets total)

* A set = a school lunch observation paired with the respective school lunch recall (SLR)

Figure. Structure of the sample for the pilot study comparing third- to fifth-grade students’ school lunch recalls to lunchroom observations.

Table. Results for outcome variables comparing school lunch recalls to lunchroom observations (n=37 sets) for a small sample of third- to fifth-grade students (8 to 11 years old)

<table>
<thead>
<tr>
<th>Outcome variables</th>
<th>n</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omission rates (in %)</td>
<td>37</td>
<td>6</td>
<td>3</td>
<td>-0.88 to 12.77</td>
</tr>
<tr>
<td>Intrusion rates (in %)</td>
<td>37</td>
<td>10</td>
<td>2</td>
<td>5.23 to 14.22</td>
</tr>
<tr>
<td>Total inaccuracy (in servings)</td>
<td>37</td>
<td>0.63</td>
<td>0.05</td>
<td>0.52 to 0.74</td>
</tr>
<tr>
<td>Absolute differences for matches (in servings)</td>
<td>37</td>
<td>0.06</td>
<td>0.01</td>
<td>0.03 to 0.08</td>
</tr>
<tr>
<td>Arithmetic differences for matches (in servings)</td>
<td>37</td>
<td>0.01</td>
<td>0.01</td>
<td>-0.01 to 0.04</td>
</tr>
<tr>
<td>Amounts for omissions (in servings)</td>
<td>5</td>
<td>0.47</td>
<td>0.22</td>
<td>-0.23 to 1.17</td>
</tr>
<tr>
<td>Amounts for intrusions (in servings)</td>
<td>13</td>
<td>0.54</td>
<td>0.11</td>
<td>0.28 to 0.81</td>
</tr>
</tbody>
</table>

*Set—a school lunch observation paired with the respective school lunch recall.
*Definitions adapted from Baxter and colleagues (25).
*Subjective statistical weights were assigned to meal components with entrées multiplied by 2 and sides and drinks multiplied by 1.
*Omission rates = \[\sum (\text{weighted omission}) / (\sum (\text{weighted matches} + \text{weighted omissions}))\] \times 100. Omission rates can range from 0% to 100%, with 0% considered perfect.
*Intrusion rates = \[\sum (\text{weighted intrusion}) / (\sum (\text{weighted intrusions} + \text{weighted matches}))\] \times 100. Intrusion rates can range from 0% to 100%, with 0% considered perfect.
*Total inaccuracy = \[\sum (\text{absolute difference}) / (\sum (\text{weighted matches} + \text{weighted omissions} + \text{weighted intrusions}))\] \times 100. Intrusion rates can range from 0% to 100%, with 0% considered perfect.
*Absolute differences for matches = \[\sum (\text{absolute differences} + \text{excluded amount}) / (\sum (\text{weighted matches}))\] \times 100. Intrusion rates can range from 0% to 100%, with 0% considered perfect.
*Arithmetic differences for matches = \[\sum (\text{amount reported eaten} - \text{amount observed eaten}) / (\sum (\text{weighted matches}))\] \times 100. Intrusion rates can range from 0% to 100%, with 0% considered perfect.
*Amounts for omissions = \[\sum (\text{amount observed eaten but not reported}) / (\sum (\text{weighted omissions}))\] \times 100. Intrusion rates can range from 0% to 100%, with 0% considered perfect.
*Amounts for intrusions = \[\sum (\text{amount not observed eaten but reported}) / (\sum (\text{weighted intrusions}))\] \times 100. Intrusion rates can range from 0% to 100%, with 0% considered perfect.
be revised to capture other foods brought from home. Information obtained on the school lunch recall may provide helpful feedback to school foodservice personnel. A school breakfast recall could also be created, tested, and used for assessing school breakfast intake; however, as time constraints are usually more pronounced at school during breakfast than lunch, collection could be more involved than for the school lunch recall.

This study had several limitations. Although school lunch recall collection required few resources and little time, it was collected on only 4 days during summer school when the cafeteria was not at full capacity and more time was allotted for lunch than during the school year. Teachers on duty during lunch facilitated the use of resources already present to distribute and collect school lunch recalls. The menu was limited and did not offer choices, which ensured shorter school lunch recalls. The participation rate was moderate and sample size was small. For these reasons, collecting school lunch recalls during the school year could be more involved and resource-intensive. The sample size was small (n=18), primarily because of the limited number of students enrolled in summer school. Age and sex were not considered in analyses, nor was school lunch recall sequence (first, second, third, or fourth), although analyses accounted for multiple datasets per student. School faculty indicated that their summer school population may have had academic difficulties in the previous school year and had a high percentage of students eligible for free or reduced meals (for whom school lunch might be the main source of daily nutrition). Success in using the tool with this population suggests its usefulness with similar populations and with populations without academic difficulties; however, the tool must be validated for use in each specific population.

CONCLUSIONS

The school lunch recall, a self-administered, paper-and-pencil questionnaire, obtains information from children about intake and liking ratings for school lunch menu items. In this pilot study, among a small sample of third-to fifth-grade summer school students, the school lunch recall proved to be a valid tool compared to meal observations for assessing school lunch intake. The school lunch recall has potential for efficiently and effectively capturing various elements of school lunch intake for future school-based studies and for providing information about children’s food preferences.

STATEMENT OF POTENTIAL CONFLICT OF INTEREST: A. Paxton’s current and previous research has been externally funded by a competitive grant from the Kellogg Foundation through the Occidental College National Farm to School Network. S.D. Baxter’s current and previous research has been funded externally by competitive grants from the National Institutes of Health as well as the US Department of Agriculture. S.D. Baxter has served as a grant reviewer for the National Institutes of Health and the Centers for Disease Control and Prevention. S.D. Baxter is on the Board of Editors for the Journal of the American Dietetic Association. P. Fleming’s current and previous research has been funded externally by competitive grants from the Centers for Disease Control and Prevention, the Kellogg Foundation through the Occidental College National Farm to School Network, and the North Carolina Health and Wellness Trust Fund. A. Ammerman’s current and previous research has been funded externally by competitive grants from the National Institutes of Health as well as the Centers for Disease Control and Prevention, Robert Wood Johnson Foundation, and the Kellogg Foundation through the Occidental College National Farm to School Network. She has served as a grant reviewer for the National Institutes of Health and the US Department of Agriculture.

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References


