# Validation of a Questionnaire to Measure Fruits and Vegetables Selected and Consumed at School Lunch among Second- and Third-Grade Students

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ABSTRACT

**Background** Interventions designed to encourage fruit and vegetable (F/V) consumption within schools are increasingly common. Thus, there is a need for valid, practical dietary assessment instruments to evaluate their effectiveness.

**Objective** The aim of this study was to examine the validity of a group-administered, paper-and-pencil questionnaire to assess F/V selection and consumption at school lunch relative to digital photography.

**Design** This was a five-phase, method-comparison study in which the questionnaire was iteratively modified between each phase.

**Participants/setting** The study examined sets of questionnaires and photographs of lunch trays (n=1,213) collected on 44 days between May 2015 and June 2016 among second-grade students from three New York City schools (phases 1 to 4) and second- and third-grade students from 20 schools across eight states (phase 5).

**Main outcome measures** Outcomes assessed were selection, amount eaten, preference, and intention to consume F/V.

**Statistical analyses performed** Validity was assessed by percent agreement (categorized as "match, omission, or intrusion" for items on or off tray and "match, overestimation, or underestimation" for amount eaten), Spearman correlation coefficients, and intraclass correlation coefficients (ICC).

**Results** The total match rate for items on tray was substantial (phases 1 to 5: 83%, 84%, 92%, 93%, and 89%), with items more frequently intruded than omitted. For amounts eaten, the total match rates were moderate, but generally improved throughout the study (phases 1 to 5: 65%, 64%, 83%, 83%, and 76%), with overestimations more frequent than underestimations. There was good correspondence between methods in the estimates of amount eaten in a quantitative, cup equivalent amount (fruit ICC=0.61; vegetables ICC=0.64). Significant differences ($\alpha$=.05) were not observed between second- and third-grade students, respectively, in the match rate for fruits (86% and 89%) or vegetable (89% and 86%) items on tray or fruit (69% and 73%) and vegetables (74% and 76%) amount eaten. Excellent correlations were observed between amount eaten and preference for fruit (r=0.91) and vegetables (r=0.93).

**Conclusions** The questionnaire offers a feasible, valid instrument for assessing F/V selection and consumption among elementary students in schools participating in the National School Lunch Program. Additional research is recommended to test the instrument's sensitivity and to reproduce these findings using an alternative reference method, such as direct observations.
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I N THE UNITED STATES, FEW CHILDREN AGED 4 TO 8 years meet federal recommendations for daily fruit and vegetable (F/V) consumption, putting them at increased risk for obesity and several noncommunicable diseases.[1] There is a growing interest in designing interventions to increase preference for and consumption of F/V among children of this age, a period when habits are formed that may track into adulthood.[2] Given that children consume up to half of

their daily calories within schools,[3] child nutrition programs, such as the National School Lunch Program (NSLP),[4] may offer an opportunity to increase F/V consumption among many children.

However, to understand if policies and programs such as the NSLP are effective in increasing F/V consumption, there is a need for valid and practical dietary assessment instruments.[5-7] Assessing F/V consumption during the school

# RESEARCH

lunch meal remains a challenge owing to several logistical, financial, and methodological constraints associated with this context. Although the 2010 Healthy, Hunger Free Kids Act[4] brought greater consistency to the nutritional content of school meals served via the NSLP, students are still offered considerable choice in selecting among F/V items and deciding how much, if any, of those items to consume. For example, schools must offer at least $3/4$ cup vegetables and $1/2$ cup of fruit at lunch; children must choose at least one of these to comply with reimbursable meal requirements.[4] There are also differences in cafeteria environments and variation in how lunch is served across school contexts,[8] for example, in the provision of F/V via self-serve salad bars, wherein children can select F/V in variable portions.[9] These variations across school lunch contexts make it challenging to design an instrument that captures the dimensions of F/V selection and consumption within the NSLP regulations.

Objective methods, such as weighed-plate waste, direct observations, and digital photography, are commonly used within school lunch settings.[5] However, these methods require highly trained research staff and are therefore costly, with estimates of $0.95, $0.62, and $0.62 per observation, respectively.[10] Questionnaire methods, despite a reliance on children's memory and possibility of social desirability bias,[5,11] may reduce costs and participant burden as compared to other self-report methods like 24-hour recalls.[12] Modification of self-report methods has also been observed to improve accuracy; a recent review of self-report methods used among children 6 to 12 years old summarized evidence showing improved accuracy with the use of a shorter retention interval between consumption and reporting, meal-specific prompts, and items assessing hedonic preferences.[13] Compared with administering a self-report instrument through a one-on-one interview that can be costly and time-intensive, a group-administered instrument allows for a greater number of observations to be collected simultaneously, requiring fewer trained staff and a lower cost.

Few validated group-administered, paper-and-pencil questionnaire instruments exist to measure F/V consumption at school lunch among elementary students.[5,14] One existing instrument, the School Lunch Recall Questionnaire,[15] includes characteristics that are associated with improved accuracy, such as timing the administration immediately following lunch to minimize the retention interval and including items assessing hedonic preferences. A validation of the instrument among third- to fifth-grade students in a summer school setting found high accuracy in quantifying the consumption of all lunch meal components (including entrée, milk, and F/V) as compared with direct observations.[15] However, because individual meal components were not disaggregated, little can be concluded about the accuracy of the instrument specifically for assessing the consumption of F/V. Moreover, the instrument has not been validated for use among students younger than third grade.

The objective of this study was to examine the validity of the Fruit and Vegetable Recall Questionnaire (FVRQ), a group-administered, paper-and-pencil questionnaire modified from the School Lunch Recall Questionnaire[15] to assess F/V selection and consumption during lunch, relative to a digital photography method among second- and third-grade students within schools participating in the NSLP.

## RESEARCH SNAPSHOT

**Research Question:** What is the validity of a questionnaire to measure fruit and vegetable (F/V) selection and consumption at school lunch among second- and third-grade students?

**Key Findings:** This five-phase study of elementary students across 23 schools found a high percent agreement between questionnaire and digital photography methods, with match rates for the final phase 89% for F/V items on or off tray and 76% for amounts eaten. There was no difference in accuracy between second- and third-grade students. The questionnaire offers a valid, practical instrument for measuring F/V consumption and selection and should be further examined prior to use in an intervention.

## METHODS

This method-comparison study was conducted in five phases over which the questionnaire was iteratively modified to improve accuracy. Data were collected across 44 school days between May 2015 and June 2016. The Institutional Review Boards of Teachers College Columbia University, the New York City Department of Education, the District of Columbia Department of Education, and Newark Public Schools approved this research.

### Participants

Across phases 1 to 5, all students present on the day of data collection were eligible to participate. Students participated if they provided written assent and if their parents did not return an opt-out consent form prior to the day of data collection. In phases 1 through 4, participants were second-grade students within a convenience sample of three New York City public elementary schools across 4 days. Research staff worked with administrators to select classrooms to participate in the study based on logistical considerations. In phase 5, participants were second- and third-grade students within 20 schools participating in FoodCorps, a national program that focuses on improving the healthfulness of school environments by focusing on hands-on learning, school meals, and a schoolwide culture of health, from eight different states. Schools were selected to display a range of scores on the Healthy Schools Progress Report, an instrument designed to assess the healthfulness of the school environment (development of the instrument and recruitment of schools has been described elsewhere[16]). Briefly, a stratified sampling technique was used to select schools from a population of 293 elementary schools using the Healthy School Progress Report score and several publically available sociodemographic characteristics (including race or ethnicity, sex and eligibility for free or reduced price lunch). In this phase, data were collected over the course of 2 days at each school (40 days total); research staff randomly selected up to 6 classrooms to participate on each day. As further described later, the final sample for the study included 1,213 matched sets of questionnaires and photographs collected from students across 44 lunch-day observations in phases 1 to 5.

No individual sociodemographic information was collected; school-level sociodemographic information was collected to describe the student body at each school from