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Data from a Validation Study of Reporting Accuracy over Multiple Recalls, and School Foodservice Production Records Provide Insight into the Origins of Intrusions (Reports of Uneaten Food Items) in Children's Dietary Recalls

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Abstract

Background—Intrusions in dietary recalls may originate in confusion of episodic memories manifested as temporal dating errors.

Objective—Data from a validation study (concerning reporting accuracy over multiple recalls) and school foodservice production records were used to investigate origins of intrusions in school meals in children's 24-hour recalls.

Design/subjects/setting—During the 1999–2000 school year, 104 fourth-grade children were observed eating school meals on one to three non-consecutive days separated by ≥ 25 days, and interviewed about the previous day's intake in the morning on the day after each observation day.

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Statistical analyses performed—For breakfast and lunch separately, logistic regression was used to investigate the effect of time (i.e., days) before the interview day on the probability that intrusions referred to items available in the school foodservice environment. Exploratory analyses were conducted for breakfast options observed and/or reported eaten.

Results—For interviews in which reported meals met criteria to be considered school meals and that contained intrusions, of 634 and 699 items reported eaten at breakfast and lunch, respectively, 394 and 331 were intrusions. Availability in the school foodservice environment of items referred to by intrusions in reports of lunch, but not breakfast, decreased as days increased before the interview day (P values=0.031 and 0.285, respectively). Concerning breakfast, children observed eating a cold option (i.e., ready-to-eat [RTE] cereal, milk, juice, crackers [graham; animal]) almost always reported a cold option, whereas children observed eating a hot option (i.e., non-RTE-cereal entrée [e.g., sausage biscuit], milk, fruit or juice) reported a cold option in approximately 50% of interviews.

Conclusions—In children's 24-hour recalls, confusion of episodic memories contributes to intrusions in school lunch, and generic dietary information (e.g., cold option items available daily) or confusion of episodic memories may contribute to intrusions in school breakfast. Understanding the origins of intrusions may help in developing interview methods to decrease the occurrence of intrusions.

Keywords

Children; dietary recalls; intrusions

INTRODUCTION

A 24-hour dietary recall (24hDR) is essentially a memory test in which an individual is to retrieve and report specific information about eating episodes that occurred during a particular 24-hour target period (1). Errors in dietary recalls include *intrusions* (reported items that were not eaten) and *omissions* (eaten items that were not reported) (1,2). Intrusions and omissions, along with *matches* (reported items that were eaten) can be identified in *validation studies* in which reported information (e.g., 24hDR) is compared to reference information (e.g., meal observations) obtained from a method that is independent of the subject's memory (3,4). (In "relative validation" studies, both reported information and reference information are provided by subjects.) Most studies that utilize 24hDRs cannot determine whether reported items are matches or intrusions because reference information is lacking; thus, for non-validation studies, intrusions are indistinguishable from matches, and both are analyzed for results concerning dietary intake (5–7).

Parents have difficulty accurately reporting their children's intake (8–12), possibly because children eat meals in locations where parents are not present (e.g., school). Therefore, children must report this information themselves. Children have provided multiple 24hDRs for a variety of studies, including relative validation studies of food frequency questionnaires (13–15), evaluations of nutrition education interventions (16–19), and national nutrition surveys (20).

School-meal observations provide excellent opportunities to validate reports of school meals in children's 24hDRs (21,22). Observations of children eating meals in private homes are obvious to children (22) and may influence eating and/or reports of intake (23). Such reactivity is less likely when observations are conducted at school (22) because children are accustomed to being watched while eating in groups (22,24) and groups may be observed in a manner that prevents individual children from knowing specifically who is being observed (25). In most validation studies in which children have provided dietary recalls orally and without help from parents or other adults, reference information has been obtained by observing school lunch or

both school breakfast and school lunch (24–39); results from these studies indicate both omissions and intrusions.

Errors in 24hDRs indicate difficulty in reporting information about specific eating episodes. Smith et al. (2) referred to an individual's memory for particular meals and snacks as specific memories and to an individual's knowledge of his/her dietary intake in general as generic information [see also Tulving (40)]. Suppose a child usually consumes turkey sandwich, apple, and white milk for lunch, but one day consumes cheeseburger, carrot sticks, and chocolate milk. In a 24hDR obtained the next morning about the previous day's intake, the child might correctly report yesterday's unusual lunch items, or, alternatively, incorrectly report the usual lunch items. The former, correct response would be based on specific memories for yesterday's lunch while the latter response would erroneously rely on generic information (2). Furthermore, Smith et al. (2) suggested that intrusions would be expected if dietary reporting involves compromises between specific memories and generic information.

The origins (or sources) of intrusions in 24hDRs are unclear. From the perspective of source monitoring (41,42), self-reporting one's intake requires discrimination between various sources of information. Eating is a recurring autobiographical event; it is difficult to recall specific episodes of recurring autobiographical events (43,44). Children are more prone than adults to confuse memories from highly similar sources such as recurring events (45). Additionally, school meals generally follow a cycle menu that includes a somewhat limited variety of foods (33), which could contribute to children's use of generic dietary information when reporting school meals in 24hDRs. Validation studies that use school-meal observations, along with production records completed by school foodservice managers (to comply with federal school meal regulations) to document availability of items at each school meal, provide an opportunity to systematically investigate the origins of intrusions in school meals in children's 24hDRs. A better understanding of the origins of intrusions may guide the development of methods to decrease the occurrence of intrusions and thereby improve the accuracy of children's 24hDRs.

Intrusions in school meals in children's 24hDRs may be due to confusion of episodic memories that are manifested as temporal dating errors: Children may report school meals for another day. When children report incorrect school meals, they should be more likely to report items available at that school meal (breakfast or lunch) on school days *closer* to and before the interview day than *farther* back in time that week (46,47). For example, in a child's 24hDR obtained on Thursday about Wednesday's intake, intrusions in the report about Wednesday's school breakfast should be more likely to have been available at school breakfast on Wednesday than on Tuesday, and on Tuesday than on Monday.

For this article, data from a validation study concerning the consistency of children's reporting accuracy in multiple recalls over time (31), and school foodservice production records, were used to investigate the origins of intrusions in school meals in children's 24hDRs. The hypothesis was that for intrusions, availability of those items at the respective school meal in the school foodservice environment that week should decrease as time (i.e., days) before the interview day increases.

METHODS

This section summarizes the sample and methods; additional details are provided in the original publication of the validation study (31). Approval was obtained from the institutional review boards for research involving human subjects at the Medical College of Georgia and University of South Carolina.

Sample

In the fall of the 1999–2000 school year, all 523 fourth-grade children from six public schools in one district were invited to participate in the study. From the 382 children who provided both written child assent and parental consent, 104 children were selected randomly with the constraints that there be approximately equal numbers in each of four race/sex groups and that children ate both school breakfast and school lunch on days when one or more observers were present. Although the sample was stratified by race and sex, the study was not powered to detect race or sex differences (primarily due to budgetary constraints). Only children who obtained breakfast and lunch at school were observed and interviewed because it is difficult to unobtrusively identify contents of meals brought from home (48). Each of the 104 children selected (24 African-American boys, 27 African-American girls, 25 white boys, 28 white girls; age [mean $\pm$ standard deviation]=10.17 $\pm$ 0.51 years) was observed and interviewed once. Ninety-two children (21 African-American boys, 23 African-American girls, 23 white boys, 25 white girls; 10.31 $\pm$ 0.51 years) of the 104 were each observed and interviewed a second time. Seventy-nine children (19 African-American boys, 20 African-American girls, 20 white boys, 20 white girls; 10.43 $\pm$ 0.48 years) of the 92 were each observed and interviewed a third time. Thus, there were 275 interviews overall. There were 25 to 99 days between any two consecutive interviews for an individual child.

Observations

In the schools where data were collected, most foods were served to children because *offer-versus-serve* (49), which allows children to refuse some items, had not been implemented by the district. Children had to take milk, but could select the flavor/fat content. For breakfast, children chose either a cold option (i.e., ready-to-eat [RTE] cereal, milk, juice, and crackers [graham; animal]) or a hot option (i.e., non-RTE-cereal entrée [e.g., sausage biscuit], milk, and fruit or juice). Children could select limited quantities of condiments when available in single-serving packets.

Each of 104 children was observed on one to three non-consecutive days, with breakfast and lunch observed each day. Observations were conducted on Mondays through Thursdays. For each observation, one of three dietitians trained for this task observed one to three children simultaneously and recorded food items and amounts eaten in servings on observation forms (31). Observers were present for entire meal periods so that food trades could be noted (50). Children did not know who would be interviewed. Inter-observer reliability, assessed twice monthly throughout data collection on a total of 17 children, indicated 92% mean agreement across three observers for food items in which amounts observed eaten were within one-quarter serving (31,51).

Interviews

Each of 104 children was interviewed about the previous day's intake on one to three days in a private location at school. Each interview was conducted after breakfast but before lunch on a Tuesday through Friday morning following the observation day. Each interview was conducted by one of the three dietitians who had conducted observations, but not by the same dietitian who had observed that child's meals on the previous day. Interviews were conducted on different days and by different dietitians whenever possible for any child interviewed multiple times (31). The interview protocol (fully described in reference 31) was multiple-pass and modeled on the computerized interview of the Nutrition Data System for Research (NDSR; 4.03, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, 2000); however, during interviews, interviewers wrote information that children reported onto paper forms instead of using NDSR software. Each interview was audio recorded and transcribed. Random selection and review of 5% of each interviewer's transcripts and audiotapes, and monthly assessment of inter-interviewer reliability throughout data collection, indicated that

interviews were conducted according to protocol (31). Each child was mailed a \$10 check per interview.

Classification of Reported Food Items

Analyses were restricted to reported information for school meals because reference information from observation was available only for school meals. Reported items were considered eaten at school meals only if children identified “school” as the meal’s location, referred to breakfast as “school breakfast” or “breakfast”, referred to lunch as “school lunch” or “lunch”, reported mealtimes to within one hour of observed mealtimes, and reported consuming nonzero quantities of the items (31).

Each item that a child reported as eaten at a school meal was classified as a *match* if the child had been observed eating that item at that school meal; otherwise, the reported item was classified as an *intrusion*. Reported items were classified as matches unless it was clear that the child’s reports did not describe items observed eaten (31). Footnote a of Table 1 provides examples.

Availability of Food Items in School Foodservice Environments

For interviews with one or more intrusions, an item availability file was constructed for all days of interest; these days included the observation day and all school days before the interview day during the week of the interview. Each food item in this file was available in a particular school’s foodservice environment for a particular meal on a particular day of interest. The core set of 3,091 items (breakfast-1,263; lunch-1,828) was from production records for breakfast and lunch on each day of interest. In this core set, all kinds/flavors of RTE cereal, milk, and juice were considered available daily for breakfast, and all kinds/flavors of milk were considered available daily for lunch. (Production records usually listed these items in general terms, but never listed specific kinds/flavors.) Next, 407 items (breakfast-145; lunch-262) were added that were observed available during particular school meals but were not listed on production records. Finally, 393 items (breakfast-153; lunch-240) were added that were assumed available in particular school foodservice environments for particular meals on particular days of interest even though these items were neither listed in production records from those schools for those meals nor observed at those schools for those meals. (For example, if French fries were on a particular school’s production record for a particular lunch, but ketchup was not, then ketchup was assumed available and added to the item availability file for that school for that lunch.) Various kinds of ice cream were assumed available at every lunch. (Ice cream was never listed on production records, but observers noted that various kinds of ice cream were sold à la carte during lunch at most schools on most school days.)

For each intrusion, the item availability file was checked to assess the availability for that item in the foodservice environment of the child’s school for the respective school meal for each day of interest. (Footnotes c and d of Table 1 explain this process.)

Analyses

Separate analyses were conducted for breakfast and lunch because many breakfast and lunch items differ, and how children sat in the cafeteria differed for breakfast and lunch, which may help differentiate episodic memories for school meals. (Children typically sat as they arrived at school to eat breakfast, but with their classes to eat lunch.) Thus, intrusions should refer to items that are meal-specific instead of cross-meal: Intrusions in reports of breakfast should refer to items available at breakfast, and intrusions in reports of lunch should refer to items available at lunch. Analyses used Stata (9.2, Stata, Inc., College Station, TX) and SAS (9.0, SAS Institute, Inc., Cary, NC). Intrusion was the unit of analysis.

For each school meal, a logistic regression model was fit to investigate the effect of time before the interview day (1=observation day, 2=pre-observation day, 3=two-days-pre-observation, 4=three-days-pre-observation), sex, race, sequence (first, second, or third interview for the child), and all two-way interactions involving sex, race, and sequence on the probability that intrusions refer to items available in the school foodservice environment at the respective school meal. (Table 1 shows information about interviews and intrusions by interview day, and terms used to label days.) For each analysis, a full model was fit; next, a backward stepwise model was estimated with non-significant variables and non-significant two-way interactions ($P>0.40$) removed, and a final model was constructed from these results. Because each child could have one, two, or three interviews, and because each interview could have multiple intrusions, each model was interpreted using empirical standard errors from the modified sandwich variance estimator, so P values are conservative (52). A significance criterion of 0.05 was used.

RESULTS

Of the 275 interviews conducted, 248 and 268 interviews contained a reported meal that met criteria to be considered school breakfast and school lunch, respectively. Of the 248 interviews in which a reported meal met criteria to be considered school breakfast, there were 53 intrusion-free interviews in which 149 items were reported eaten; in the remaining 195 interviews, 394 of 634 items reported eaten at breakfast were intrusions. These 195 interviews were included in the availability analyses for breakfast. Of the 268 interviews in which a reported meal met criteria to be considered school lunch, there were 95 intrusion-free interviews in which 297 items were reported eaten; in the remaining 173 interviews, 331 of 699 items reported eaten at lunch were intrusions. These 173 interviews were included in the availability analyses for lunch.

Table 2 shows intrusions by school meal and meal component. For breakfast, the largest percentages of intrusions were beverages (49%) and breads/grains (38%); for lunch, they were vegetables (21%) and combination entrées (20%).

Table 3 shows the distribution of number of intrusions per interview by school meal and interview sequence; the breakfast and lunch distributions over all interview sequences differed statistically when they included intrusion-free interviews ($P=0.001$, chi square), but just missed being statistically different when they excluded intrusion-free interviews ($P=0.059$, chi square). The proportion of intrusion-free interviews was greater for lunch ($95/268=0.35$) than breakfast ($53/248=0.21$) ($P<0.001$, two-sample test of proportion) but did not vary by interview sequence for breakfast ($P>0.206$, chi square) or lunch ($P>0.122$, chi square).

Availability

Table 4 shows, for each school meal, how many items referred to by intrusions were available in the school foodservice environment on days before the interview day. For breakfast, logistic regression showed neither a significant effect of time (odds ratio=1.10, $P=0.285$) nor any other significant effects or interactions. For lunch, logistic regression showed a significant effect of time (odds ratio=1.22, $P=0.031$) but no other significant effects or interactions.

Exploratory Analyses for Breakfast

The lack of a significant effect of time for breakfast was not especially surprising considering the repetitive availability, at least insofar as could be determined from production records, of breakfast items in school foodservice environments: For the item availability file, all kinds/flavors of RTE cereal, milk, and juice were treated as available daily at breakfast due to the lack of specificity for these items in the production records. Thus, exploratory analyses were

conducted to examine origins of intrusions in breakfast by focusing on the breakfast options (cold; hot) observed and/or reported eaten, as well as linking of intrusions.

Table 5 shows the number of breakfast options observed eaten by reported eaten; the footnotes provide information concerning the categorization of breakfast options. The first four sections of Table 5 show that across all 275 interviews, and for each interview sequence, when the option observed eaten was cold, a hot option was almost never reported eaten; however, when the option observed eaten was hot, a cold option was reported almost half of the time.

Of the 92 children interviewed multiple times, observations indicated that 13 children consistently ate a cold option and 25 children consistently ate a hot option. The last two sections of Table 5 show that the tendency of children to report a cold option when a hot option was observed eaten did not depend on whether children interviewed multiple times were consistent or inconsistent in which breakfast option was observed eaten. Even children who, when observed, consistently ate a hot option reported a cold option about half of the time.

For breakfast in Table 2, the 151 bread/grain intrusions included 88 RTE cereals and 49 crackers, and the 193 beverage intrusions included 114 juices and 77 milks. For the 88 RTE cereal intrusions, the breakfast option observed eaten was hot for 63 interviews (by 48 children), cold for 15 interviews (by 14 children), mixed for 2 interviews (by 2 children), beverage only for 6 interviews (by 6 children), and nothing for 2 interviews (by 2 children). Concerning the 15 cold options observed eaten for breakfast, although a cold option was reported in all 15 of these interviews, there were intrusions because an incorrect RTE cereal was reported (e.g., flake-shaped RTE cereal observed, donut-shaped RTE cereal reported).

Linking of intrusions was evident when a hot option was observed eaten for breakfast but items from a cold option were reported eaten: Specifically, 10 interviews (by 9 children) each had 4 intrusions (RTE cereal, crackers, milk, juice). Twenty-five interviews each had 3 intrusions, with RTE cereal, milk, and juice in 14 interviews; RTE cereal, crackers, and juice in 6 interviews; and RTE cereal, crackers, and milk in 5 interviews. Eighteen interviews each had 2 intrusions with RTE cereal and juice in 4 interviews (by 4 children); RTE cereal and milk in 8 interviews (by 7 children); and RTE cereal and crackers in 6 interviews.

DISCUSSION

Intrusions from a previously conducted validation study were examined along with school foodservice production records to better understand the origins of intrusions in school meals in children's 24hDRs. More interviews were intrusion-free for school lunch than school breakfast. For school lunch, but not for school breakfast, a significant trend was found for time before the interview day on availability of items referred to by intrusions. Specifically, intrusions that occurred in school lunch in 24hDRs referred to items that, for each day closer in time before the interview day, were 1.22 times more likely to have been available in the child's foodservice environment at school lunch that week. These results are consistent with the idea that confusion of episodic memories contributes to intrusions in school lunch in children's 24hDRs.

Results from exploratory analyses provided evidence that intrusions in school breakfast in children's 24hDRs are reports of items from an incorrect breakfast option. Notably, there was a profound asymmetry in misreports of school breakfast: Children observed eating a cold option almost always reported a cold option, whereas children observed eating a hot option reported a cold option in approximately 50% of interviews. Also, in misreports of school breakfast, there was a tendency for intrusions to be linked; children frequently misreported multiple items of the incorrect option. There are nutritional implications, for example, for estimated consumption of energy, fat, and fiber, when a hot option was consumed but a cold option was

reported. Breakfast consumption plays an important role in children's health and has been associated with nutritional adequacy, body weight, and academic and cognitive performance (53,54). Results from a previous investigation indicated that children were less accurate in reporting school breakfast than school lunch during 24hDRs (55); the current investigation provides insight concerning why.

Perhaps children who had difficulty remembering a specific hot option eaten for the school breakfast episode on the previous morning reverted to a more generic cold option, which included RTE cereal, crackers, milk, and juice each school day. This would suggest that intrusions in school breakfast in children's 24hDRs may originate in generic dietary information. Alternatively, misreports of a cold option could be reports of a cold option that was eaten for school breakfast on another day.

The *intervening school breakfast* that occurred (on the interview day) between the to-be-reported school breakfast and the interview might have compromised children's ability to report items from a correct option for school breakfast. However, this could not be examined due to a lack of specificity in the daily school foodservice production records for RTE cereal, milk, and juice at school breakfast, and because children were not observed eating school breakfast on their interview day.

These results suggest that how children report school breakfast and school lunch during 24hDRs may differ. Specifically, children's reports about school lunch may involve episodic recollective effort that is not entirely successful due to temporal dating errors. Children's reports about school breakfast may tend to involve, or be supplemented by, generic dietary information, as well as temporal dating errors.

The primary limitation of these analyses is that because conducting dietary validation studies is time- and labor-intensive, data previously collected from schools in one district were utilized, along with school foodservice production records, to investigate origins of intrusions. Specific information concerning an individual child's consumption during the week of an interview was limited to two school meals on the day before the interview.

A primary strength is that these analyses investigated origins of intrusions in school meals in children's 24hDRs – an issue about which there is published speculation (10,26,32), but that apparently has not been studied systematically. School-meal observations were used to validate these meals in children's 24hDRs and thus identify intrusions without relying on children to provide reference information (e.g., food diaries) to compare to their own recalls. Observations were conducted in a setting and manner that minimized reactivity. School meals are an important part of children's 24-hour dietary intake, and millions of children in the United States eat school meals each school day (56). Quality control for both observations and interviews was assessed regularly throughout data collection.

CONCLUSIONS

Confusion of episodic memories contributes to intrusions that occur in school lunch in children's 24hDRs. Generic dietary information (e.g., cold option items available daily) and confusion of episodic memories may contribute to intrusions that occur in school breakfast in children's 24hDRs. These results have several applications for the practice of food and nutrition science.

- Interview techniques need to be modified or developed, and utilized, to decrease the occurrence of intrusions in 24hDRs by helping children report the correct, specific meal episodes and reducing reliance on generic dietary information. Results from small validation studies with children (28,57) indicate that the occurrence of intrusions may be decreased when

24hDRs concern the prior 24 hours (i.e., from 24 hours before the interview to when the interview starts) instead of the previous day (i.e., from midnight to midnight of the day before the interview). The prior-24-hour target period reduces memory burden by eliminating both the time interval and intervening meals between the end of the target period and the interview.

- To further investigate origins of intrusions in children's 24hDRs, dietary-reporting validation studies with consecutive days of observation per child are needed to supplement information about availability with information about actual consumption by specific children on multiple and consecutive days.
- Expanding the meals and setting to the evening meal in private homes would be valuable. However, numerous practice observations per home would be needed to minimize reactivity, and generalizability of results to non-validation studies could be compromised because the intrusiveness of home observations could limit participation in such validation studies.

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Table 1
Information about Interviews and Intrusions by Interview Day, and Terms Used to Label Days ^a

Interview day	Number of interviews conducted	Number of interviews for which no reported meals met criteria to be considered the school meal ^b		Number of interviews with meals reported that met criteria to be considered the school meal, and with one or more intrusions		Number of intrusions		Terms used to label days ^c					
		Breakfast	Lunch	Breakfast	Lunch	Breakfast	Lunch	Monday	Tuesday	Wednesday	Thursday	Friday	
Tuesday	63	6	2	47	37	87	68	observation day	interview day				
Wednesday	64	6	1	45	40	100	78	pre-observation day	observation day	interview day			
Thursday	75	8	3	51	47	99	103	two-days-pre-observation	pre-observation day	observation day	interview day		
Friday ^d	73	7	1	52	49	108	82	three-days-pre-observation	two-days-pre-observation	pre-observation day	observation day	interview day	

^a 104 fourth-grade children were each observed eating two school meals (breakfast, lunch) and then interviewed the next morning about the previous day’s intake. 92 of the 104 children were observed and interviewed a second time (25 to 99 days later). 79 of the 92 children were observed and interviewed a third time (25 to 99 days later). Thus, there were 275 interviews (104 + 92 + 79). Examples of items reported eaten that were similar to items observed eaten and were classified as matches included all kinds of white milk (e.g., whole, 1%, skim) and all types of pizza (e.g., cheese, hamburger). Examples of items reported eaten that differed from items observed eaten and were classified as intrusions included vegetables (e.g., broccoli observed, green beans reported), ready-to-eat (RTE) cereals (e.g., flake-shaped RTE cereal observed, donut-shaped RTE cereal reported), milk flavors (e.g., chocolate milk observed, strawberry milk reported), and fruit juices (e.g., apple juice observed, orange juice reported).

^b Criteria to be considered a school meal: A reported item was considered as eaten at a school meal only if the child identified “school” as the meal’s location, referred to breakfast as “school breakfast” or “breakfast”, referred to lunch as “school lunch” or “lunch”, reported the mealtime to within one hour of the observed mealtime, and reported consuming a nonzero quantity of the item.

^c Observations of school breakfast and school lunch were conducted on Mondays through Thursdays. Interviews were conducted on Tuesdays through Friday mornings, on the day after observations of school breakfast and school lunch. Suppose that during an interview on Thursday morning about Wednesday’s intake, a child reported having eaten a bagel for school breakfast but had not been observed eating a bagel at that meal, so bagel was an intrusion. The item availability file might show that bagels were available for school breakfast in the foodservice environment of that child’s school on Tuesday (pre-observation day), but not on Wednesday (observation day) or Monday (two-days-pre-observation). For another example, suppose that during an interview on Friday morning about Thursday’s intake, a child reported having consumed strawberry milk for school lunch but had not been observed drinking strawberry milk at that meal, so strawberry milk was an intrusion. According to the item availability file, strawberry milk was available for school lunch in the foodservice environment of that child’s school on Thursday (observation day), Wednesday (pre-observation day), Tuesday (two-days-pre-observation), and Monday (three-days-pre-observation).

^d Three consecutive school holidays occurred at the beginning of one week of data collection; thus, for intrusions in six interviews conducted on Friday during that week, availability of the items referred to by intrusions could be assessed only on one school day (observation day) before the interview day that same week. For intrusions in the other 67 interviews on Fridays, availability of those items could be assessed on all four school days before the interview day that same week.

Table 2Intrusions by School Meal and Meal Component ^a

Meal component	School breakfast		School lunch	
	n	%	n	%
Beverage	193	49.0%	53	16.0%
Bread/grain	151	38.3%	24	7.3%
Combination entrée	13	3.3%	67	20.2%
Condiment	14	3.6%	41	12.4%
Dessert (lunch only)	--	--	23	6.9%
Entrée (lunch only)	--	--	16	4.8%
Fruit	13	3.3%	34	10.3%
Meat (breakfast only)	7	1.8%	--	--
Miscellaneous	1	0.3%	4	1.2%
Vegetable	2	0.5%	69	20.8%
Total	394	100%	331	100%

^a See footnote a of Table 1 for information (about the sample of children, study design, and examples of items classified as intrusions) that is pertinent to Table 2.

Table 3
Distribution of Number of Intrusions per Interview by School Meal and Interview Sequence ^a

	School breakfast					School lunch				
	Interview sequence (and number of interviews for which meals reported met criteria to be considered the school meal)					Interview sequence (and number of interviews for which meals reported met criteria to be considered the school meal)				
	1 st (n=91)	2 nd (n=83)	3 rd (n=74)	Total (n=248)	Number of interviews (% of interviews)	1 st (n=102)	2 nd (n=89)	3 rd (n=77)	Total (n=268)	
Intrusions per interview										
0	16 (18%)	16 (19%)	21 (28%)	53 (21%)	30 (29%)	30 (29%)	31 (35%)	34 (44%)	95 (35%)	
1	26 (29%)	29 (35%)	24 (33%)	79 (32%)	36 (35%)	36 (35%)	27 (30%)	24 (31%)	87 (33%)	
2	24 (26%)	16 (19%)	12 (16%)	52 (21%)	20 (20%)	20 (20%)	11 (12%)	7 (9%)	38 (14%)	
3	15 (16%)	17 (21%)	14 (19%)	46 (19%)	11 (11%)	11 (11%)	10 (11%)	9 (12%)	30 (11%)	
4	10 (11%)	5 (6%)	2 (3%)	17 (7%)	3 (3%)	3 (3%)	7 (8%)	2 (3%)	12 (5%)	
5	0 (0%)	0 (0%)	1 (1%)	1 (<1%)	2 (2%)	2 (2%)	3 (4%)	1 (1%)	6 (2%)	
Interviews with intrusions	75 (82%)	67 (81%)	53 (72%)	195 (79%)	72 (71%)	72 (71%)	58 (65%)	43 (56%)	173 (65%)	

^a See footnote a of Table 1 for information (about the sample of children, study design, and examples of items classified as intrusions) that is pertinent to Table 3. See footnote b of Table 1 for information (about criteria to be considered a school meal) that is pertinent to Table 3. The breakfast and lunch distributions over all interview sequences differed statistically when they included intrusion-free interviews ($P=0.001$, chi square), but just missed being statistically different when they excluded intrusion-free interviews ($P=0.059$, chi square). The proportion of intrusion-free interviews was greater for lunch (95/268=0.35) than breakfast (53/248=0.21) ($P<0.001$, two-sample test of proportion) but did not vary by interview sequence for breakfast ($P>0.206$, chi square) or lunch ($P>0.122$, chi square).

Table 4
Information, for Each School Meal, on Availability in the School Foodservice Environment of Food Items Referred to by Intrusions by Time (in Days) before the Interview Day ^a

		Time (in days) before the interview day				Logistic regression test of time – Odds Ratio (P value)
		Observation Day	Pre-Observation Day	Two-Days-Pre- Observation	Three-Days-Pre-Observation	
School breakfast	Number of items referred to by intrusions that were available in the school foodservice environment ^b	334	250		79	1.10 (0.285)
	Total number of intrusions ^c	394	298	198	99	
	Proportion	0.85	0.84	0.83	0.80	
School lunch	Number of items referred to by intrusions that were available in the school foodservice environment ^b	116	114	40	20	1.22 (0.031)
	Total number of intrusions ^c	331	257	179	76	
	Proportion	0.35	0.44	0.22	0.26	

^a See footnote a of Table 1 for information (about the sample of children, study design, and examples of items classified as intrusions) that is pertinent to Table 4. See Table 1 for an illustration of terms used to label days.

^b Availability farther back in time could only be assessed for intrusions in interviews that occurred later in the week because availability could not be assessed for school meals on weekend days or school holidays. Thus, for example, only for intrusions in Friday interviews could availability be assessed for the observation day and all preceding school days that week. Therefore, the numbers in this row decrease as the number of preceding days increases. (Table 1 illustrates terms used to label days, and footnotes c and d of Table 1 explain this process.)

^c The numbers in this row decrease as one goes back in time from the observation day to the pre-observation day to two-days-pre-observation to three-days-pre-observation because only intrusions from interviews for which that day was a school day were included. (Table 1 illustrates terms used to label days, and footnotes c and d of Table 1 explain this process.)

Table 5
School Breakfast Option Observed Eaten by Reported Eaten across all 275 Interviews, by Interview Sequence (First, Second, Third),
and by Consistency ^{a, b}

All interviews	Option Reported eaten ^c					
	Cold	Hot	Mixed	Beverage only	No meal reported met criteria to be considered school breakfast	Total
Option Observed eaten ^d						
Cold	97	5	0	2	9	113
Hot	62	60	3	8	18	151
Mixed	2	1	0	0	0	3
Beverage only	6	0	0	0	0	6
Nothing	2	0	0	0	0	2
Total	169	66	3	10	27	275
First interview	Option Reported eaten ^c					
	Cold	Hot	Mixed	Beverage only	No meal reported met criteria to be considered school breakfast	Total
Option Observed eaten ^d						
Cold	35	5	0	0	5	45
Hot	24	18	2	1	8	53
Mixed	0	1	0	0	0	1
Beverage only	4	0	0	0	0	4
Nothing	1	0	0	0	0	1
Total	64	24	2	1	13	104
Second interview	Option Reported eaten ^c					
	Cold	Hot	Mixed	Beverage only	No meal reported met criteria to be considered school breakfast	Total
Option Observed eaten ^d						
Cold	35	0	0	0	3	38
Hot	23	20	1	2	6	52
Mixed	1	0	0	0	0	1
Beverage only	0	0	0	0	0	0
Nothing	1	0	0	0	0	1
Total	60	20	1	2	9	92
Third interview	Option Reported eaten ^c					
	Cold	Hot	Mixed	Beverage only	No meal reported met criteria to be considered school breakfast	Total
Option Observed eaten ^d						
Cold	27	0	0	2	1	30
Hot	15	22	0	5	4	46
Mixed	1	0	0	0	0	1
Beverage only	2	0	0	0	0	2
Nothing	0	0	0	0	0	0
Total	45	22	0	7	5	79
Consistent ^e	Option Reported eaten ^c					
	Cold	Hot	Mixed	Beverage only	No meal reported met criteria to be considered school breakfast	Total
Option Observed eaten ^d						
Cold	34	0	0	0	2	36
Hot	27	28	3	5	8	71
Mixed	0	0	0	0	0	0
Beverage only	0	0	0	0	0	0
Nothing	0	0	0	0	0	0
Total	61	28	3	5	10	107
Inconsistent ^f	Option Reported eaten ^c					
	Cold	Hot	Mixed	Beverage only	No meal reported met criteria to be considered school breakfast	Total

All interviews		Option Reported eaten ^c					Total
		Cold	Hot	Mixed	Beverage only	No meal reported met criteria to be considered school breakfast	
	Option Observed eaten ^d						
	Cold	59	3	0	2	6	70
	Hot	33	31	0	2	9	75
	Mixed	2	1	0	0	0	3
	Beverage only	6	0	0	0	0	6
	Nothing	2	0	0	0	0	2
	Total	102	35	0	4	15	156

^a See footnote a of Table 1 for information (about the sample of children and study design) that is pertinent to Table 5.

^b For school breakfast each day, one of two options could be *selected* – *cold* (i.e., ready-to-eat [RTE] cereal, milk, juice, and crackers [graham or animal]) or *hot* (i.e., non-RTE-cereal entrée [e.g., sausage biscuit], milk, and fruit or juice). Across the 275 observed breakfasts, a cold option and a hot option were selected 117 and 158 times, respectively. For 11 of the 275, the breakfast observed eaten was *mixed*, *beverage only*, or *nothing* (all defined in footnote d below), which differed from the option selected.

^c For a single interview, the breakfast option *reported* eaten was categorized as *cold* (if RTE cereal and/or crackers was/were reported eaten), *hot* (if a non-RTE-cereal entrée and/or fruit was/were reported eaten), *mixed* (if RTE cereal and/or crackers was/were reported eaten as well as a non-RTE-cereal entrée and/or fruit), *beverage only* (if only milk, juice, and/or some other beverage was/were reported eaten), or *no meal reported met criteria to be considered school breakfast* (explained in footnote b of Table 1).

^d For an individual child on a school morning, the breakfast option *observed eaten* was categorized as *cold* (if RTE cereal and/or crackers was/were observed eaten), *hot* (if a non-RTE-cereal entrée and/or fruit was/were observed eaten), *mixed* (if RTE cereal and/or crackers was/were observed eaten as well as a non-RTE-cereal entrée and/or fruit, with one of more items from the non-selected option obtained in a trade from another child), *beverage only* (if only milk and/or juice was/were observed eaten), or *nothing* (if none of the breakfast was observed eaten).

^e The school breakfast option observed eaten was *consistent* for 38 (41%) of 92 children interviewed multiple times.

^f The school breakfast option observed eaten was *inconsistent* for 54 (59%) of 92 children interviewed multiple times.