Table 5.1. Validation of dietary assessment methods in school age children (6-12 years)

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
FOOD RECORDS (FR) or DIET HISTORY (DH)						
Livingston et al., 2003 (199)	7 yrs = 11 (7 M; 5 F) 9 yrs = 9 (5 M; 4 F) 12 yrs = 10 (5 M; 5 F) 15 yrs = 6 (3 M; 3 F) Total = 36 UK	7d Weighed FR DH	DLW Method for TEE (EE_{DLW}) Heart Rate Monitoring for EE (EE_{HR}) BMR by indirect calorimetry	Retrospective analysis of 1990 dataset (138) to identify underreporters (UR). Students recruited from schools with mixed SES. Parents of children 7-9 yrs completed 7d weighed FR; older children were assisted by parents. Subjects visited at home least 4 times during the weighing period. DH conducted with the child and/or parent either 2-4 wks. before or after 7d FR. TEE was measured over 10 days with daily spot urine collection after dosing. HR monitoring for 4 days. BMR measured in early morning in fasting state. School Intake: For weighed FR, pocket notebook carried for recording food and beverages consumed away from home. For DH, school menu obtained and child asked about which foods and amounts eaten.		**Weighed FR vs. TEE** Acceptable reporters (AR) = 83.3% Overreporters (OR) = 5.6% Underreporters (UR) = 11.1% **Diet History vs. TEE** AR = 80.6% OR = 16.7% UR = 2.8% The sensitivity of energy intake measured by heart rate monitoring was 0.50 and specificity was 1.00. Only 25% of children who underreported energy intake on weighed FR were identified by cut offs based on a blanket PAL of 1.55; none of the underreporting by DH was identified.

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
FOOD RECORDS (FR) or DIET HISTORY (DH), CONTINUED						
McGloin et al., 2002 (197)	6-8 yrs = 114 58% male; 44% high risk for obesity; 44% low risk for obesity; and 2% obese; mixed SES status; predominantly white. Northern Ireland, UK	7d Weighed FR	DLW Method for TEE	Cross-sectional study of energy and fat intake in children using 7d weighed FRs validated by DLW (DLW dosing and 10d spot urine collection). 7d weighed FRs collected during spot urine collection period. Subjects visited daily in home. Reported energy intake was compared with estimated TEE in lean children at high risk (HR) and low risk (LR) of obesity and with obese children. Obese children had BMI over 95th percentile. HR children had one parent with BMI>29.5; LR children had two lean biological parents (BMI<25). School Intake: Child reported		**7d FR Energy Intake (EI) vs. DLW TEE** 2, 5, and 14% underestimation in low risk, high risk and obese children. EI/TEE x 100 Mean(SD) Low Risk = 98.4% (16.7) High Risk = 95.3% (19.2) Obese = 86.3% (16.3) No significant difference in energy intake between groups, but obese children consumed significantly more fat than did lean children.
Zive et al., 2002 (220) Study of Children's Activity and Nutrition (SCAN)	4-12 yrs = 22 Demographics of validation study subjects not specified; in main study 49.6% males; 45% non-Hispanic whites; 55% Mexican – Americans; 31% of mothers < HS education California	1d Estimated FR (modified 24HR) (Intake observed at lunch and dinner at school or home; parent interviewed for breakfast meal and unobserved snacks)	12 Hour Direct Observation	This study validated method used for longitudinal study of 350 children. Intake was directly observed for 12 hours and compared with FR-modified 24HR method. School Intake: Direct observation	**FR vs. DO** Saturated fat r = 0.20 Cholesterol r = 0.86 Average for 9 nutrients r = 0.58	**Not Specified**

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
FOOD RECORDS (FR) or DIET HISTORY (DH), CONTINUED						
O'Connor et al., 2001 (198)	6-9 yrs = 47 47% male; mixed SES Sydney, Australia	3d Estimated FR	DLW Method for TEE	Anthropometric measurements included standing height, and body weight to calculate BMI. Fat-free body mass derived from the ^{18}O dilution space. TEE was measured over a 10d period with post-DLW dose urine samples collected daily. Parents recorded child's food and drink intake for 3 consecutive days. Goldberg's cut offs of EI:REE of 1.06 applied to child intakes to identify misreporting. School Intake: Parent's asked caretakers to document food intake when child away form home.	**3d FR EI vs. TEE** r = 0.10, p = 0.51 Most significant predictor of misreporting was dietary fat intake (r(2) = 0.45, p<0.0001)	**3d FR EI vs. TEE** 118kJ/d or 1.6% overestimation Limits of agreement (bias ± 2 SD) = -3226 KJ and 3462 kJ Misreporting = EI-TEE (kJ/d) x 100 33% of children within 10% of TEE Mean % misreporting = 4% ± 23%. 55% of children had EI > TEE. Range from an underestimation of 33% to an overestimation of 56%. Misreporting not associated with sex or body composition

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
24-HOUR RECALL (24HR)						
Warren et al., 2003 (202)	5-7 yrs = 203 public school grades 1 and 2; 51% male; 50% high SES households; race not specified Oxford, UK	Recall of lunch meal Interview included free recall and then non-directed prompts.	Direct Observation	From December 1999 to September 2000, children observed eating lunch in school cafeteria. Within 2 hours of finishing lunch, child interviewed. Foods recalled were classified as matches (recalled food agreed with observation) omissions (failed to report food observed) or phantoms (reported but not observed). Before lunch and secretly, foods in packed lunches were listed (65% of children ate packed lunches from home).	**Pearson's Correlation** Packed lunch: r = 0.22 between number of foods offered and number of foods recalled School lunch: r = 0.16 between number of foods offered and number of foods recalled No child offered 6 or 7 foods recalled all; children offered 8 foods recalled 4	**Lunch Recall vs. DO Accurate Recall (# Foods Recalled/# Foods Observed x 100)** Packed lunch: mean percentage of accurate recall = 70% (± 29%) School lunch: mean percentage of accurate recall = 58% (± 28%) Non-directed prompts increased recall by 66 to 80 percent ($p<0.001$). Year 2 children had significantly higher recall ($p<0.05$)
Baranowski et al., 2002 (203)	9 yrs = 58 10 yrs = 73 11 yrs = 7 public school 4th graders; 45% male; 33.7% white; 30.4% black; 14.5% Hispanic Texas	Food Intake Recording Software System (FIRSSt) 24HR	Multiple pass 24HR by dietitian using laptop computer with NDS software Direct observation of food eaten during lunch at school (packed lunch or school lunch program meal) Prompts included school lunch menu	FIRSSt is an interactive, multimedia, and multiple pass 24HR for students to self report intake. Students randomly assigned to 6 study groups systematically varying the sequence of self report (FIRSSt vs. standard 24HR), observation of school lunch, and hair sample collection as a bogus pipeline manipulation (to make students think hair sample could validate report of food intake). Recalls were conducted the morning after observation. Accuracy measured in terms of matches, intrusions, and omissions.	**Pearson's Correlation** For portion size estimates: FIRSSt & 24HR = 0.75 FIRSSt & DO = 0.73 24HR & DO = 0.76	**FIRSSt vs. DO** % matches = 46% % intrusions = 24% % omission = 30% **24HR vs. DO** % matches = 59% % intrusions = 17% % omission = 24% **FIRSSt vs 24HR** % matches = 60% % intrusions = 15% % omission = 24% match = item reported eaten and observed eaten intrusion = item reported eaten, but not observed omission = item not reported but observed eaten

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
24-HOUR RECALL (24HR) CONTINUED						
Baxter et al., 2003 (204)	4th grade students = 69 49% male; 54% black Georgia	24HR Telephone 24HR (n = 36) In-person 24HR (n = 33) 4-pass method based on NDS protocol with written (vs. computerized) recording.	Direct observation of school breakfast and lunch (Only children eating meals provided by school participated.)	In 2001-2002, 451 children were recruited from 4th grade classes at 10 public schools. A random sample of 69 stratified by ethnicity and gender was selected. In a 2-arm parallel design, each child was observed eating school breakfast and school lunch once and was interviewed that evening about the day's intake. Half were interviewed in person and half by telephone. In-person interviews conducted in research van outside of child's home. **Omission rate** = [sum of omissions/(sum of omissions + sum of matches)] x 100 Intrusion rate = [sum of intrusions/(sum of intrusions + sum of matches)] x 100 **Inaccuracy** = (absolute difference between amounts reported and observed for each match x statistical weight) + (each omitted amount x statistical weight) + (each intruded amount x statistical weight) summed over all items. A score of 0 servings indicated a perfect recall compared to observation.		**Telephone 24HR vs. In-Person 24HR** ANOVAs on omission rates and total inaccuracy found no difference between interview type. Chi-square test found no difference between proportion passing or failing intrusion rates by interview type. **Telephone 24HR vs. DO** Mean omission rate = 32% Mean intrusion rate = 16% Mean total inaccuracy = 4.3 servings **Telephone 24HR vs. DO** Mean omission rate = 34% Mean intrusion rate = 19% Mean total inaccuracy = 4.6 servings

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
24-HOUR RECALL (24HR), CONTINUED						
Baxter et al., 2002 (205)	4th grade students = 104 47% male; 49% black Georgia	24HR 3x 1 24HR = 104 2 24HR = 92 3 24HR = 79 Total = 275 4-pass method based on NDS protocol with written (vs. computerized) recording.	Direct observation of school breakfast and lunch (Only children eating meals provided by school participated.)	523 children were recruited from 22 4th grade classes at 6 public schools. A sample of 104 stratified by ethnicity and gender was randomly selected. Multiple pass 24HR was administered the morning after school breakfast and lunch was observed. There was a minimum of 4 wks. between each recall.	Interclass Correlation Coefficient 1st to 3rd 24HR = 0.29 for total inaccuracy and 0.15 for omission rate.	**24HR vs. DO** % matches = 35% % omissions = 41% % intrusions = 24% Mean omission rate = 51% Mean intrusion rate = 39% <u>Omission rate</u> = [sum of omissions/(sum of omissions + sum of matches)] x 100 <u>Intrusion rate</u> = [sum of intrusions/(sum of intrusions + sum of matches)] x 100
Baxter et al., 2000 (206)	1st grade students = 48 (7.2 yrs mean age) 4th grade students = 48 (10.1 yrs mean age) Lower to middle socioeconomic status students; 50% black Georgia	Lunch recall 1st pass–free recall or non suggestive prompt recall 2nd pass: specific prompted recall assigned to study group a) Preference prompting; b) Food category prompting; or c) Visual prompting.	Direct observation of lunch meal (Only children eating meals provided by school participated.)	12 children assigned in each of 8 cells as follows: grade (1st or 4th); gender; ethnicity (white or black); and by prompting method (preference, food category, or visual). Children were interviewed the morning after observed eating school lunch using free recall, non suggestive prompted recall, and specific prompted method. **Inaccuracy score**: calculated from the absolute difference between amounts reported and observed eaten multiplied by each items assigned weighted value and then summed across all items for each child.	<u>Authors conclusion</u>: Among 1st graders, prompting may hurt rather than help recall; among 4th graders, food category prompting yields small gains in recall accuracy with minimum losses**.**	**Lunch Recall vs. DO** Median Inaccuracy Score <u>Before Prompting</u> 1st graders = 2.7 serving 4th graders = 1.7 servings <u>After Prompting (All)</u> 1st graders = 2.6 serving 4th graders = 1.8 servings <u>After Preference Prompting</u> 1st graders = 2.3 serving 4th graders = 1.8 servings <u>After Food Category Prompting</u> 1st graders = 3.2 serving 4th graders = 1.3 servings <u>After Visual Prompting</u> 1st graders = 2.8 serving 4th graders = 2.0 servings

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
24-HOUR RECALL (24HR), CONTINUED						
Brady et al., 2000 (200) Longitudinal Study of Childhood Obesity, University of Alabama	7-14 yrs = 110 9.9 yrs mean age; 20.1 kg/m^2 mean BMI; 43% male; 52% white; 48% black Birmingham, AL	24HR 3x Three pass method; 2 in-person and 1 by telephone; 2 dimensional food models	DLW Method	Children admitted to the metabolic unit overnight for DLW dosing and 24HR 1. Two weeks later, children returned to nutrition center for 24HR 2. Third recall by telephone. Energy-adjusted 24HR intake compared to recommended servings from food guide pyramid. Parents consulted during 24HR interview. School or Childcare Intake: Method of collection not specified.	**24HR Energy Intake vs. DLW TEE** 0.32 (P=0.08) Wide individual variability but nearly identical group mean energy intake measured by 24HR and DLW method.	**24HR Energy Intake vs. DLW TEE** Energy = 0.04MJ/d difference (Not Specified)
Fisher et al., 2000 (201)	4-11 yrs = 146 52% male; 34% black; 66% white; all Tanner Index stage 1 Alabama and Vermont	24HR 2 or 3 in-person 24HR during 14d post DLW dose Multiple pass 24HR with child with parental assistance	DLW Method for TEE under free living conditions	Subjects recruited by newspaper advertisements in proximity to study sites. 14-d post DLW dosing urine collections. Tanner Index assessed and height and weight measured. Body composition measured by DEXA (fat free mass included soft lean tissue and bone mass). Children classified as having had an underreported, accurately reported, or overreported dietary intake relative to TEE. School or Childcare Intake: Method of collection not specified. Parents of younger children more involved in interview than parents of older children.	**24HR vs. DLW kcal 0.27 (p<0.01)**	**24HR vs. DLW TEE** 110% $\pm$ 31% kcal overestimation 1,881 $\pm$ 470 kcal/d vs. 1,704 $\pm$ 318 kcal/d (p<0.01) **Accurate reporters** (24HR with 10% TEE) = 34% **Underreporters** (24HR below 90% TEE) = 20% **Overreporters** (24HR above 110% TEE) = 46% Underreporters had higher relative weight and higher adiposity than overreporters (p<0.0001).

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
FOOD FREQUENCY QUESTIONNAIRE (FFQ)						
Lietz et al., 2002 (209)	11-13 yrs = 50 Mean age 12.3 yrs; 36% male; 10% overweight; 2% obese Scotland	EPIC FFQ Interviewer-administered	7d Weighed FR 24h urine collection for urea, sodium, potassium and creatinine	Between November 2000 and February 2001, subjects were recruited from secondary school. The EPIC FFQ was completed by interview one day before the 7d weighed FR. Subjects kept 24h urine collection on the Sunday during the 7d FR.	**Spearman Energy-Adjusted Correlation Coefficients** Range of 0.19 for sodium to 0.67 for total fat; mean correlation for all nutrients of 0.48. Correlations for potassium, calcium, fibre, sugar, total CHO, and total fat were significant. 7d Weighed FR and 24h urine: Nitrogen = 0.45 ($p<0.05$) K = 0.78 ($p<0.001$)	**FFQ vs. 7d FR** 30% overestimation of energy intake **Bland-Altman plots FFQ vs 7d FR** Energy = 2/4 MJ Protein = 31g Total fat = 22g Sugar = 53g Calcium = 203 mg. <u>95% Confidence Intervals</u> Energy = 1.3-3.6 MJ Protein = 22-41g Total fat = 10-33g Sugar = 29-77g Calcium = 791 - -384 mg. **Limits of Agreement** Energy = 13.4 MJ Protein = 120g Total fat = 120g Sugar = 270g Calcium = 1,170 mg Median % classified into same and opposite third of intake was 45.9% and 10.8%. <u>Conclusion:</u> Agreement between EPIC FFQ and 7dFR was poor on both a group and individual bases, and demonstrates that the EPIC FFQ is not an appropriate method for estimating absolute intakes in adolescents.

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
FOOD FREQUENCY QUESTIONNAIRE (FFQ), CONTINUED						
Speck et al., 2001 (207)	6^{th} – 8^{th} grade = 24 in validation study; 446 in survey 12.7 yrs mean age; 50% male; 50% black North Carolina	Eating Habits Questionnaire (EHQ) Section 1 = 83-item FFQ on foods eaten for past week. Section 2 = 14 questions on general food habits, food preparation, and eating out. Section 3 = specific foods eaten one day in past week.	24HR = 3x on week before EHQ	EHQ was adapted from the Health Habits Questionnaire used in the Bogalusa Heart study. EHQ administered to groups of 30-40 students by trained research assistants during health classes. A subset of 24 students were randomly selected to completed 3 24HR administered by a dietitian on week before EHQ. A subset of 31 students repeated EHQ in 48 hours and again 2 weeks later.		**EHQ vs. 24HR** **Mean % (SD) Food Categories in Perfect Agreement** 56.0% (20.3%) Factor analysis found 10 factors explained 81.3% of the variance in eating habits (sweet snacks, meats, vegetables, breads/starch, snack foods, fruits, salad dressing, dairy, butter, and miscellaneous).
Perks et al., 2000 (208)	8.6-16.2 yrs = 50 Mean age 12.6 yrs; 46% male Charlottesville, Virginia	Youth-Adolescent Food Frequency Questionnaire (YAQ) 131 item; Semi-quantitative; Self-administered	DLW Method for TEE	Subjects completed YAQ within 1 year of TEE measurement by DLW. Subjects also had the following measurements: BMI, BMR, and body composition by 4-compartment model of Lohman.	**YAQ EI vs. DLW TEE** **r = 0.22 (p = 0.13)** The discrepancy in energy intake (YAQ – TEE) was related to body weight (r = -0.25, P: = 0.077) and percentage body fat (r = -0.24, P: = 0.09) but not to age (r = -0.07, P: = 0.63) or the time between measures.	**YAQ EI vs. DLW TEE** 2% overestimation 10.03 $\pm$ 3.12 vs. 9.84 $\pm$ 1.79 (p = 0.91) Limits of agreement = -6.30 MJ and 6.67 MJ 26% of subjects YAQ EI within 10% of TEE 50% of subjects misreported intake

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
FOOD FREQUENCY QUESTIONNAIRE (FFQ), CONTINUED						
Koehler et al., 2000 (187) Pathways to Health	11-13 yrs (5^{th} -7^{th} grade) = 120 American Indian; non Hispanic white, Hispanic Southwest United States	33 items; Yesterday's Food Choices (YFC) Self-administered; past day intake; non-quantitative Categories: yes, not sure, no	24HR	Compared child's reported intake of particular foods against child's 24HR, both completed on same day	**Spearman correlations FFQ vs. 24HR** Low fat foods = 0.71 High fiber foods = 0.35 Fruits & veg. = 0.29 High fat foods = 0.40	**FFQ vs. 24HR** Percentage agreement for all food items = 60%
OTHER QUESTIONNAIRES						
Frobisher et al., 2003 (211)	6-16 yrs = 37 17-82 yrs = 42 (Mean age 12 yrs for children and 42 yrs for adults; university academic and administrative personnel or their children; 25 of adults and 8 of children overweight) UK	Portion size estimation	Weighed portion sizes	Subjects served themselves usual portion of food. Food was immediately removed and weighed. Subjects described the portions size (S,M,L) and choose a photograph. Three to four days later the subjects described the portion size again (S,M,L) and choose a photograph. 9 foods studied: baked beans, cheese, chips, cornflakes, margarine on a slice of bread, mashed potato, rice, spaghetti, and sausage roll.		Using descriptions (S,M,L) the percentage of children within $\pm$ 10% and $\pm$ 50% of the actual weights ranged from 3 to 31% and 19 to 84% respectively, compared with 9 to 64% and 60 to 91% for adults. For both children and adults, the food photographs produced higher estimated weights than did the descriptions.

Table 5.1. Validation of dietary assessment methods in school age children (6-12 years), continued

Reference	Study Population	Test Method TM	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
OTHER QUESTIONNAIRES, CONTINUED						
Edmunds and Ziebland , 2002 (221)	7-9 yrs = 255 Middle and lower SES; two city schools; one village school; and one suburban/village school UK	Day in the Life Questionnaire (DILQ) (Classroom exercise to measure fruit and vegetable consumption.)	Direct Observation	Children in four English schools were observed eating lunch. The next morning the children completed the DILQ in the classroom. Rates of packed lunches at four schools = 43, 69, 75, and 88%. Observations and DILQ were made on the same students twice, 2 weeks apart. DILQ reprinted in article.	To complete the DILQ in the classroom, children needed considerable help with writing, spelling, and if they choose to draw their food, with annotation of drawing,	**DILQ vs. DO** Mean servings F/V (SD) Visit 1: 0.77 (0.87) vs. 0.76 (0.81) Visit 2: 0.71 (0.87) vs. 0.67(0.81) DILQ (%) and DO matched Visit 1 = 68.5 Visit 2 = 74.0
Matheson et al., 2002 (210)	8-12 yrs = 54 9.8 yrs mean age; 100% female and African American San Francisco, California	Food recall with two types of portion-measurement aides (2-dimensional food models and manipulative props).	Weighed food portions	Girls were served a standard meal and actual intake was assessed by weighing food portions before and after the meal. On completion of the meal, dietitians administered food recalls and portion estimates. Two-dimensional food models and manipulative props (modeling clay) were used in a randomized order. Foods served represented all physical states of foods: solid, liquid and amorphous (spaghetti with sauce, salad with dressing, bread, milk, juice or water).	Actual vs. Estimated Spearman Correlations r = 0.56 to 0.79; p<.001, with the exception of bread (r = 0.16) Correlations with actual intakes did not differ significantly between the 2 models.	**Actual vs. Estimated Absolute Value % Differences** Manipulative Props = 58% (SD, 102.7%) 2-dimensional Models = 32.8% (SD, 72.8%)