Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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)						
Davies et al., 1994 (129) National Diet and Nutrition Survey	1.5-4.5 yrs. = 81 52%M; 29% 1.5-2.49 yrs.; 38% 2.5-3.49 yrs.; 27% 3.5-4.49 yrs. UK	4d Weighed FR	DLW method to estimated TEE	In fall of 1989, DLW dose followed by 10 daily spot urine collections. During 10d period, mothers kept 4d Weighed FR including 1 weekend day. 64% response rate for all parts of study. Child Care Input: Mothers recorded food consumed away from home in notebook. Supplement Intake: Not specified	**4d Weighed FR EI vs. DLW TEE** 0.41 kJ/d $p < 0.01$ 0.36 kJ/kg $p < 0.01$	**4d weighed FR vs. DLW** 3% underestimation energy 1141 vs. 1178 kcal/d Mean energy difference was greatest for ages 1.5-2.5 yrs. (6% underestimation), and smallest for ages 3.5-4.5 yrs. (1% overestimation)
Harbottle et al., 1993 and 1994 (91;92)	4-40 mo = 117 Indo-Asian children from low literacy HHs. Sheffield, UK.	4d Weighed FR (infants) or 5d weighed FR (children) with a Portable Electronic Tape Recording Automated (PETRA) scale	Diet History (DH) and collection of food samples	The Weighed FR completed by mother in home or by older female sibling or other relative. Field worker provided participant training in home and did monitoring visit after first 24h of weighed FR. DH collected in home to validate FR. Child Care Input: Not specified Supplement Intake: Not specified	Not specified	**Weighed FR vs. DH** 7% underestimation energy 778 vs.838 kcal Weighed FR lower than DH for mean intakes as follows: 9% protein, 3%, fat; 9% iron and 6% vitamin C. Analyzed by age group, differences were significant for energy at 12 to < 18mo.; for iron at 6 to < 12mo and 12 to < 18mo.; and for vitamin C at < 6mo.
Livingston et al., 1992 (138)	3-5 yrs. = 20 3 yrs. = 8 5 yrs. = 12 Belfast, Northern Ireland	Diet History (DH) 1-2 hour in home interview	DLW method to estimated TEE	Energy intake from diet histories was compared with concurrent TEE by the DLW method. Child Care Input: Not specified Supplement Intake: Not specified	Not specified	**DH vs. DLW** 9% overestimation 6.29 $\pm$ 0.71 MJ/d vs. 5.76 + 1.12 MJ/d 3 yrs. = 12% overestimation 5 yrs. = 8% overestimation

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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)						
Reilly et al., 2001 (145)	3-4 yrs. = 41 56% M; representative sample Glasgow, Scotland	24HR 3x in 7d Telephone administered; 3 pass method; photographs of food portion sizes.	TEE by DLW method	Representative sample of population of Glasgow, Scotland recruited from nurseries. Multiple pass (quick list, detailed description, and review) 24HR conducted by telephone with primary care giver. Post DLW dose spot urine collected on d1 and d7. Child Care Input: Not specified Supplement Intake: Not specified	Mean difference (bias) and limits of agreement tended to increase with increasing EI but did not reach significance (r = 0.26, p>.05)	**24HR vs. DLW** 11% overestimation (p<.0.01) 6.5 + 1.1 MJ/d vs. 5.8 + 1.2 MJ/d (p<.0.01) No significant differences between results of boys vs. girls.
Johnson et al., 1996 (144)	4-7 yrs. = 24 50% M; mean age 5.5 for M and 6.4 for F; mean BMI slightly higher than norm for age group; recruited from newspaper ad Vermont	24HR 3x in 14d 2 in person and 1 by telephone USDA 3-pass method	DLW method	First in-person 24HR conducted at research center before DLW dosing; 2nd by telephone during 14d dosing period; and 3rd in-person at research center at 14d visit. Interviews conducted with mother with child present. 8 DLW spot urines collected: after dosing (4), morning after dosing (2) and on day 14 (2). Child Care Input: Only mother and child interviewed. Supplement Intake: Not specified	Pearson Correlation Unadjusted 24HR vs. TEE kcal = 0.24, p=.24 (For individuals, poor prediction of intake from TEE)	**24HR vs. DLW** 3% underestimation 1,553 vs. 1,607 kcal, not significant The limits of agreement ranged from –1,102 to 897 kcal/day, indicating poor agreement on an individual basis. No differences in misreporting by BMI/obesity status of child or parent; no significant difference between boys and girls in misreporting.

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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						
Iannotti et al., 1994 (142)	2-4 yrs = 17 53% M; 50% in daycare Washington, DC	24HR HFFQ for previous 7d	3d Weighed FR	24HR of parents/caregiver. All food and beverages weighed or measured for 3d. HFFQ given at the end of the 3rd day for intake in previous 7d. Examined energy, sodium, cholesterol, PFAT and PSAT Child Care Input: Child care providers measured intake during day care and participated in recall of day care intake. Supplement Intake: Not specified	Pearson Correlation Unadjusted 3d weighed FR vs. 24HR kcal = 0.45 3d FR vs. HFFQ kcal = 0.37 Adjusted (kcal/kg) 3d weighed FR vs. 24HR kcal = 0.61 ($p<.01$) 3d FR vs HFFQ kcal = 0.0.49 ($p<.05$)	**24HR vs. 3d Weighed FR** No significant mean differences for 5 of 5 nutrients and energy.
Baranowski et al., 1991 (139) Texas SCAN (Studies of Child Activities and Nutrition)	3-5 yrs = 56 52% M 48% white 41% black 11% Hispanic 10 mothers <HS 14 mothers HS 32 mothers >HS Texas	24HR NCC protocol	12h direct observation (DO)	Observations of food intake conducted by following each child wherever he or she went (home, school, day care). Observation teams of two alternated every 2 hrs to increase personal safety, permit inter observer reliability checks, and reduce fatigue and error. 24HR conducted by nutritionist using NCC protocol (Nutrition Coding Center, University of Minnesota.) Child Care Input: Mother's recall Supplement Intake: Not reported	Not specified **Other results:** SES status was not consistently related to reporting errors. Caucasian and Hispanic mothers tended to underreport and blacks tended to overreport. Mothers not-at-home were less likely to be able to report on their child's diet for a notable part of the day or for the full day.	**24HR vs. DO** 7% kcal underestimation (1,053 vs. 1,138 kcal/d) 24HR underestimated CHO and calcium and overestimated 9 nutrients. For food items: 65% mean agreement; 18% underreport by 24HR; 10% overreport by 24HR; 7% partial agreement

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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						
Basch et al., 1990 (140)	4 to 7 yrs = 46 61% M, 1st generation Latino from Dominican Republic; low income; healthy New York, NY	24HR 3-dimensional food models; protocol for recall not specified	Direct observation of evening meal	Bilingual observers visited home from 4 to 8 pm to observe and record food intake of child. Parents believed observation of child activity was the purpose of home visit. The day following observation a different investigator administered 24HR to parents. Child Care Input: Not applicable Supplement Intake: Not specified	Pearson Correlation Energy-Adjusted: Kcal = 0.71 Protein = 0.50 Fat = 0.52 14 other nutrients = (-1.0 to 0.72)	**24HR vs. DO** 9% overestimation 507 vs. 465 kcal for evening meal Other results: 51% of reported portion sized equaled observed portion sizes, 15% smaller and 33.5% larger. For 9 out of 10 most frequently eaten food groups, observed and recalled frequencies were identical. Mothers tended to omit food more often than add them.
Eck et al., 1989 (141)	4-9.5 yrs = 34 47% M, mean age 5.8 yrs; Caucasian; 71% middle to upper income HH Memphis, TN	Recall of lunch meal Bogalusa 24HR protocol	Direct observation and weighing of plate waste at lunch meal.	Unobtrusive observation made of child eating with family in cafeteria. Plate waste measured after family left cafeteria. On following day, recall of lunch meal next day in home by interviewer who did not observe intake. Mother and father interviewed separately and then consensus interview with mother, father, and child. Child Care Input: Not applicable Supplement Intake: Not specified	Pearson Correlation Unadjusted Fathers: Kcal = 0.83 Protein 0.79 Fat = 0.72 Other nutrients: 0.61-0.88 Mothers: Kcal = 0.64 Protein 0.56 Fat = 0.65 Other nut: 0.57-0.74 Consensus: Kcal = 0.87 Protein 0.91 Fat = 0.7285 Other nut: 0.75-0.90	**Lunch Recall vs. DO** No significant differences between mean kcal and 9 other nutrients between DO and recall my father, mother, and consensus. Group accuracy in correctly reporting different types of foods varied from the fathers' underreporting of breads (-27%) and overreporting of fruit intake (+50%). The largest percentages of over- and underreporting were in fruits and condiments.

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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						
Klesges et al., 1987(143)	2-4 yrs = 30 57% M; white; middle SES; 63% mothers full time homemakers	24HR Modified Bogalusa 24HR protocol	1d Weighed FR by research staff	Researcher in home observed and weighed all food intake for 24h. 1st 24HR recalled food intake day prior to observation. 2nd 24HR day in evening after weighed FR. Child Care Input: Not applicable Supplement Intake: Not specified	Pearson Correlation Unadjusted same day 24HR vs. 24h Weighed FR Kcal = 0.48 Protein = 0.63 7 nutrients = 0.48-0.75	**24HR vs. 24h Weighed FR** No significant differences for 7 of 7 nutrients. 4% underreporting (not identifying foods eaten)
Persson and Calgren, 1984 (128)	4-8 yrs = 46 Age and sex breakdown not specified Sweden	24HR	7d Estimated FR	7d estimated FR in household measures and recorded on form. Children age 8 yr told parents what they ate at school. Time and method of 24HR not specified. Child Care Input: For 4 yr old children in day care centers, day care staff recorded food intake. Supplement Intake: Not specified	Not specified	**24HR vs. 7d FR** 2% underestimation 1784 ± 384 vs. 1780 ± 568 kcal Other results: 24HR overestimated 1 and underestimated 2 of 8 nutrients. 24HR did not successfully classify the individual to the same category as RM.

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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)						
Parrish et al., 2003 (102) Diabetes Autoimmunity Study in the Young (DAISY)	1-3 yrs = 68 49%M; 79% white; 57% of mothers with 4 yrs. college; 79% HH income > $30,000 Colorado	Harvard 111-item FFQ	24HR 4x, 3 mo apart NCC protocol Blood sample on random sub sample of 38 for plasma lipids, alpha tocopherol, and ascorbic acid	In 1997-98, primary caregiver of participants completed 24HR interview quarterly. At end of year, primary caregiver completed self-administered HFFQ. Child Care Input. Alternative care givers (child care, fathers non living in home, grandparents, etc.) contacted for 24HR information. Responses of parent and alternative caregiver combined into one 24HR. If data not available from alternative care givers or parent recall excluded from analysis. Supplement Intake. Not specified	Pearson Correlation HFFQ vs. 24HR 0.08 for kcal (-0.16 to 0.31) Energy-adjusted nutrient correlations ranged from 0.33 for protein to 0.41 for CHO. HFFQ and plasma correlations: vitamin C (0.51); alpha tocopherol (0.48), beta crptoxanthin (0.41) and alpha carotene (0.39)	**HFFQ vs. 24HR** 70% kcal overestimation 2070 ± 709 kcal vs. 1220 ± 347 kcal
Blum et al., 1999 (103)	1-5 yrs = 233 M and F; 56% Native American; 55% 1-2 yrs 45% 3-4 yrs. 44% white; WIC Program participants North Dakota, US	Modified 84-item HFFQ 2x with 1 mo interval Modified for 1 mo period; self-administered	24HR 3x in 1mo (@ 10d intervals) NDS computer assisted	1st HFFQ administered at routine WIC visit. 3 24HRs administered by telephone or in-person 10d apart. HFFQ administered again after final 24HR. Mean of 3 24HR and 2 HFFQs compared. Child Care Input. Not specified Supplement Intake. Not specified	Pearson Correlation Protein = 0.43 CHO = 0.52 Fat = 0.59 14 other nutrients ranged from 0.26 – 0.63 Correlations not different for younger vs. older children or for Native Americans vs. Caucasians.	**HFFQ vs. 24HR** 0.2% kcal overestimation 1688 ± 482 kcal vs 1684 ± 467 kcal HHHQ overestimated 10 of 20 nutrients; HFFQ intakes for each nutrient within 10% of 24HR.

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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						
FNS, USDA, 1994 (25)	1-4 yrs = 150 WIC participants distributed evenly between black, white, and Hispanic	HFFQ NCI-Block HHHQ	24HR 3x by telephone 2-dimensional food models	Data collection from July 1993 through January 1994. In each category, half the sample received WFFQ followed by 3 non-consecutive phone 24HRs and a second administration of the WFFQ. The other half of the sample received the HHHQ followed by 3 non-consecutive 24HR and a second administration of the HHHQ.	**FFQ vs. 24HR** HFFQ/HHHQ Kcal 0.13/0.14 Pro. 0.19/0.15 Vit. A 0.28/0.03 Vit. C 0.10/0.19 Iron 0.01/0.15 Calcium 0.27/0.04	Not specified
Iannotti et al., 1994 (142)	2-4 yrs = 17 53% M; 50% in daycare Washington, DC	HFFQ for previous 7d 24HR (see 24HR section of table)	3d Weighed FR	All food and beverages weighed or measured for 3d. 24HR of parents/caregiver. HFFQ given at the end of the 3rd day for intake in previous 7d. Examined energy, sodium, cholesterol, PFAT and PSAT Child Care Input: Child care providers measured intake during day care and participated in recall of day care intake. Supplement Intake: Not specified	Pearson Correlation Unadjusted HFFQ vs. 3d FR = 0.37 Adjusted (kcal/kg) HFFQ vs. 3d FR kcal = 0.49 ($p<.05$)	Not specified
Kaskoun MC et al., 1994(146)	4.2-6.9 yrs. = 45 49% M; 80% Caucasian; 20 % Mohawk Native Americans Vermont, US	Harvard FFQ	DLW method to measure TEE	Volunteer parent-child pairs recruited by newspaper ads. DLW dosing on d1, 2 spot urines on morning of d2, 2 spot urines on d14. Child's mother completed FFQ and returned on d2 or d14, reflecting intake for past year. Body composition and anthropometrics on child and parents.	Paternal % body fat was significantly correlated with misreporting of energy intake ($r = 0.32$, $p = .03$). Body composition measurements of children not correlated with misreporting of energy intake.	**HFFQ vs. DLW** 59% overestimation 9.12 ± 2.28 vs. 5.74 ± 1.13 MJ/d (+808 kcal) No significant difference between total energy intake and TEE by sex, ethnicity, sex by ethnicity so data pooled for further analysis.

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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						
Stein et al., 1992 (136) Columbia Study of Childhood Activity and Nutrition	3.6-5 yrs = 224 60% M; 91% Hispanic; 8% black; 1% white New York, NY	Modified HFFQ Interviewer-administered 3x @ 6 mo intervals Modified for 6 mo period; portion sizes changed for 24 foods; 10 common Hispanic foods added	24HR 4x in 1 yr., 3 mo apart 3-dimensional food models, containers, plates, cups, spoons, and other utensils for portion size estimation.	In 1986-87, 24HRs and FFQs administered in the same 1 yr period by trained bilingual interviewers. First FFQ eliminated from analysis as obtained on same day as 1st 24HR. Memory probes tied to child activities and checklist of key foods included in interview. Child Care Input: Times when food was consumed outside of parent's supervision were excluded from recall data. Supplement Intake: Not specified	Pearson correlation Energy and within person adjusted Boys--0.34 kcal; 0.29 protein; 0.28 fat; range of nutrients 0.05 PUFA to 0.71 potassium Girls--0.59 kcal; 0.59 protein; 0.39 fat; range of nutrients 0.14 sodium to 0.78 potassium	**HFFQ vs. 24HR** Boys: 66% overestimation (1063 kcal) 2667.3 ± 637.9 vs. 1604.3 ± 388.2 kcal Girls: 73% overestimation (1093 kcal $p < 0.01$) 2586.1 ± 745.2 vs. 1492.3 ± 330.3 kcal Other results: FFQ significantly overestimated 10 of 10 nutrients both sexes. FFQ overestimated frequency of consumption of dairy products, meat, and FV.
Shea et al., 1991 (148) Columbia Study of Childhood Activity and Nutrition	4-5 yrs = 108 53% M; Hispanic; low income; good health New York, NY	Modified HFFQ Interviewer-administered 3x @ 6 mo intervals Modified for 6 mo period; portion sizes changed for 24 foods; 10 common Hispanic foods added	Serum lipid concentrations 24HR 4x in 1 yr, 3 mo apart 3-dimensional food models, containers, plates, cups, spoons, and other utensils for portion size estimation.	In 1986-87, 24HRs and FFQs administered in the same 1 yr. period by trained bilingual interviewers. First FFQ eliminated from analysis as obtained on same day as 1st 24HR. Memory probes tied to child activities and checklist of key foods included in interview. Fasting venous blood sample collected and height and weight measured to determine BMI. Child Care Input: Times when food was consumed outside of parent's supervision were excluded from recall data. Supplement Intake: Not specified	Not specified	**HFFQ vs. 24HR** 33.2 % vs. 33.0% kcal from fat 165.6 vs. 165.6 mg chol/1,000kcal 137.7 vs. 79.3 g/d total fat for children in highest tertiles. FFQ overestimated intake of total fat, saturated fat, and cholesterol. Total serum cholesterol and LDL cholesterol increased significantly across tertiles of total fat, saturated fat, calorie-adjusted saturated fat intake and calorie-adjusted total fat (LDL cholesterol only); after adjusting for age, sex, and BMI, associations remained significant.

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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						
Treiber et al., 1990 (147) Studies of Children's Activities and Nutrition (SCAN)	3-5 yrs = 33 to 51 Mixed gender; 83% middle SES; 2-parent HH; mean parental education = 14 yrs Georgia	Modified HFFQ 2x 1 wk apart (51 children) Interviewer-administered using food models Modified for a 3 mo period	24HRs 2x 1 wk apart (33 children) Bogalusa method	Interviewer visited home to administer the 24HR (25 min) followed by the FFQ (50 min) two times 1 wk apart. Child Care Input: Recall administered only to parents who directly observed intake. Supplement Intake: Standard questions on HFFQ	Pearson correlation Unadjusted mean of 24HRs 1 and 2 and FFQ 2 Protein = .41 Calcium= 0.50 Potassium = 0.40 Cholesterol = 0.62	**FFQ 1 vs. 24HR1** Unadjusted 42% kcal overestimation 2350 + 749 vs. 1660 + 447 kcal/d Kcal/kg 40% overestimation 126.7 + 47.5 vs. 90.7 + 26.9
OTHER QUESTIONNAIRES						
Marshall, et al 2003 (98) Iowa Fluoride Study (IFS)	6 wks = 240 followed longitudinally through 5 yrs 50% M; from well educated, economically secure HHs in longitudinal Iowa Fluoride Study (IFS) USA	Beverage FFQ	3d Estimated FR (2 weekdays and 1 weekend)	From 1992-2000, instruments mailed to parents when children were 6wks, 3, 6, 9, and 12 mo and every 4 mo through 3 yrs of age and then every 6 mo until 5yrs. Parents completed FFQ for the week preceding the 3d FR and returned by mail. Analysis reported at 6 and 12 mo and 3 and 5yrs. Child Care Input: Parent obtained information from childcare provider or provider completed FR. Supplement Intake: Questionnaire	Spearman correlations 3 yr. milk = 0.76 juice/drinks = 0.64 water = 0.70 soft drinks = 0.59-0.74 (liquid or powdered) 5 yr cow's milk = 0.63 juice/drinks = 0.54 water = 0.70 soft drinks = 0.56-0.63 (liquid or powdered)	**Beverage FFQ vs. FR:** 3 yr FFQ milk estimate 1.3oz./d lower than FR 5 yr FFQ milk estimate = 0.2oz./d lower than FR

Table 4.1. Validation of dietary assessment methods in preschool children (2-5 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						
Dennison et al., 2000 (149)	2-5 yrs = 91 46% M; rural; Head Start population Upstate NY	17-item Child Dietary Fat Questionnaire (CDFQ)	24HR 3d Estimated FR Kids Food Portion Booklet and measuring cups and spoons	24HR administered in the home followed by parent/caretaker completing 3d Estimated FR. CDFQ administered twice separated by 2 wks.	Pearson Correlation CDFQ vs 24HR + 3d FR Total fat = 0.54 ($p<0.0001$) SFA = 0.36 ($p<0.01$) Dietary cholesterol = 0.55 ($p<0.001$)	Not specified
Taylor et al., 1998 (150)	3-6 yrs = 63 65%M New Zealand	35-item calcium intake FFQ	4d Estimated FR	Participants recruited by advertisement and completed FFQ and 4d estimated FR. FFQ queries frequency of intake of 35 food and beverage items for past year.	0.52 (type of correlation not specified)	**Calcium FFQ vs. 4d FR** 942 $\pm$ 419mg vs. 798 $\pm$ 271 mg
Frank et al., 1991 (158)	4 yrs = 341 42% M; 58% Mexican-American; low to middle income San Diego, CA	7-point fat avoidance scale	1d Estimated FR	24-hour food intake record compiled from direct observation by parents at evening meal and recordings by day-care center staff of breakfast and noon meal.	Fat Scale vs. FR Total fat: -0.22 ($p=.006$) 86% agreement for milk type and 78% agreement for cooking fat	Not specified