

Table 3.1. Validation of dietary assessment methods in infant (0-12 mo.) children

Reference	Study Population	Test Method (TM)	Reference Measurement (RM)	Design Features	Correlation Between TM and RM	Mean Intake Difference Between TM and RM
TEST WEIGHING – FORMULA FEEDING (FF)						
Borschel et al., 1986 (80)	1 mo. = 7M, 4F 2 mo. = 7M, 5F 4 mo. = 7M, 7F 6 mo. = 10M, 8F Purdue University community	Test weighing of infant by mother (mechanical scale)	Direct measurement of formula by mother	Test weighing by mother for a 24h period using a mechanical scale. Direct measurement of formula for same 24h period by mother.	Pearson correlation 1 mo. = 0.66 2 mo. = 0.78 4 mo. = 0.86 6 mo. = 0.85	Test weighing vs. Direct measure 1 mo. = -10% (174 vs. 194 ml/kg/d) 2 mo. = -14% (136 vs. 159 ml/kg/d) 4 mo. = -9% (120 vs. 132 ml/kg/d) 6 mo. = -7% (103 vs. 111 ml/kg/d)
Hendrickson et al., 1985 (79)	Newborns = 188 Billings, MT.	Test weighing of infant by nurse (scale not specified)	Direct measurement of formula by a second nurse	Single feed test weighing and formula measurement by nurse.	Linear correlation 0.82	Test weighing vs. Direct measure - 1% (41.7 vs. 42.3 ml/feeding)
Montandon et al., 1986 (75)	1 mo. = 5 4 mo. = 4 USA	Test weighing of infant by mother (electronic scale)	Direct measurement of formula by the laboratory. Direct measurement of formula by mother.	Test weighing by mother for 5 consecutive 24h periods. Formula intake measured pre- and post-feed by laboratory and by mother for 5 consecutive 24h periods.	Not specified	Test weighing vs. Direct measure <u>Laboratory FF measurement</u> 1 mo. = 7% (908 vs. 850g/d) 4 mo. = 13% (1014 vs. 1168g/d) <u>Mother FF measurement</u> 1 mo. = 7% (908 vs. 852g/d) 4 mo. = 11% (1014 vs. 1135g/d)
TEST WEIGHING – BREASTFEEDING (BF)						
Arthur et al., 1987 (127)	1-7 d = 21 2-18 mo. = 20 Australia	Test weighing of infant by investigator	Test weighing of mother (seated on electronic scale) by investigator	Single breastfeeding measured by both the maternal and infant test weighing methods. In newborns, the evaporated water loss measured by weighing the mother at three consecutive 10 min intervals immediately after feeding.	1-7 d = 0.94 p < 0.001 2-18 mo. = 0.99 p < 0.001	Test weighing infant vs. mother 1-7 days = -1.0g ± 8.7g after correction for evaporated water loss (EWL) 2-18 mo. = 0.7g ± 3.1 g after correction for EWL

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TEST WEIGHING – BREAST FEEDING, CONTINUED						
Matheny and Picciano, 1985 (31)	4 wks. = 11 8 wks. = 11 12 wks. = 20 Illinois (Champaign/ Urbana area)	Abbreviated methods to estimate 24h BM intake: a) doubling test weights for 12h periods-- 6am to 6pm, 7am to 7pm, 2pm to 2pm; b) 1-feed method (1st feed); and c) 2-feed method (mid 24hr feeds).	Test weighing by mother for 24h period	Test weighing by mother for 3 consecutive 24h periods at 4, 8, and 12wks were completed. Three abbreviated methods to estimate 24h breast milk (BM) intake were compared with 24h measurements.	<u>Selected Results</u> <u>4 weeks</u> 7am to 7pm = 0.87 (d2) to 0.78 (d3) 2pm to 2am = 0.82 (d1) to 0.89 (d2) 1st nursing x no./24h = 0.61 (d1) to 0.84 (d3) <u>12 weeks</u> 7am to 7pm = 0.80 (d2) to 0.86 (d1) 2am to 2pm = 0.61(d2) to 0.81 (d1) 1st nursing x no./24h = 0.63 (d2) to 0.80 (d1) <u>2-mid 24h feeds x no./24h</u> 4wks = 0.75 (d1) to 0.92 (d2) 8wks = 0.83 (d2) to 0.97 (d3) 12wks =0.70 (d2) to 0.86 (d1)	Abbreviated methods vs. Test weighing <u>4 weeks</u> 7am to 7pm = 20% to 40% overestimation 2am to 2pm = 0.4% underestimation to 3% overestimation 1st nursing x no./24h= 14% to 26% overestimation <u>12 weeks</u> 7am to 7pm = 25% to 52% overestimation 2am to 2pm = 5% underestimation on all days 1st nursing x no./24h = 27% to 54% overestimation <u>2-mid 24h feeds x no./24h</u> 4wks = 6% underestimation to 0.6% overestimation. 8wks = 0.7% to 3.7% underestimation 12wks = 3% to 6% underestimation

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TEST WEIGHING – BREAST FEEDING, CONTINUED						
Houston et al., 1983 (81)	1-9 days = 18 (10M, 8F) Scotland	1-feed method (1st feed after 9am) 2-feed method (2 feeds after 9am) 1-feed method (mid 24h feed) 2-feed method (mid 24h feed)	Sum of test weights by mother for all feeds from midnight to midnight	Mothers weighed infants pre- and post-feeds for 24h periods for up to 9d (63 completed 24h periods). <u>Post 9am 1 or 2-feed methods:</u> Product of test weights of infant for the first 1 or 2 consecutive feeds after 9am and the number of feeds during the 24h period. <u>Mid-24h 1 or 2 feed method:</u> Product of test weights of infant for one or two feeds in the middle of the 24h period.	1 feed after 9am = 0.90 2 feeds after 9am = 0.97 1 feed mid 24h = 0.89 2 feeds mid 24h = 0.94	Not reported
Neville and Kellar, 1984 (82)	3-9 days and 21-56 days = 6 Colorado	1-feed method (mid 24h feed) 2-feed method (mid 24h feed)	Test weighing by mother for 24h period	Test weighing for consecutive 24h periods 3-9d (representing 275 feedings) and 24h periods at weekly intervals from 21d to 56d (representing 29d and 234 feedings). Product of 1 or 2 consecutive mid-24h feeds and the total number of feeds in the 24h period compared with test weighing for 24h.	<u>Days 3-9</u> 1-feed method =0.63 2-feed method =0.74 <u>Days 21 to 56</u> 1-feed method = 0.13 2-feed method = 0.09	1 or 2 Feed Method vs. Test weighing <u>Days 3-9</u> 1-feed method = 0.2% overestimation (515 vs. 514 ml/d) 2 feed method = 3 % underestimation (498 vs. 514 ml/d) <u>Days 21 to 56</u> 1-feed method = 0.4% overestimation (672 vs. 699 ml/d) 2-feed method = 0.7% underestimation (664 vs. 669 ml/d)

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DOUBLY LABELED WATER (DLW) METHOD – FORMULA FEEDING						
Butte et al., 1991 (83)	1 mo. = 9 4 mo. = 9 Houston, Texas	DLW method	5d of test weighing of formula and complementary food intake	Mother-infant pair in CRC unit for 24h for dosing. Spot urine collected for 14d. Weight measured d1 and d14. Test weighing of ready-to-feed formula intake for 5d by mother in home. Pre-weighed jars of complementary food and pre-weighed towels for formula loss (spit up, spills) provided.	Not specified	DLW vs. Test weighing 70g/d (SD 155) or 8% overestimation of intake. When corrected for environmental water influx and insensible water loss, 14g/d (SD 154) or 2 % overestimation of intake.
Lucas et al., 1987 (84)	5-11 wks. = 8 UK	DLW method (14 studies on 8 infants)	7d of test weighing	Dosing d1. Spot urine collected for 7d. Formula intake measured by test weighing for 7d.	0.93	DLW vs. Test weighing -8g/d (827 vs. 837g/d) or 1% (SD 5%) underestimation of intake. Corrected for environmental water influx and insensible water loss
Vio et al., 1986 (85)	Mean age 147.3 d = 10 Recovering from protein-energy malnutrition Chile	DLW method	15d of test weighing	Dosing d1. Spot urine collected for 15d. Direct measurement of formula intake and complementary food intake for 15d in hospital	0.97	DLW vs. Test weighing -14ml/d (519-963 vs. 519-1002ml/d) or 2% underestimation of intake.

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DOUBLY LABELED WATER (DLW) METHOD – FORMULA FEEDING, CONTINUED						
Wong et al., 1990 (86)	1 mo. = 10 4 mo. = 10 (14 M, 6 F) Houston, Texas	DLW method	5d of test weighing	Mother-infant pair in CRC unit for 24h for dosing. Spot urine collected for 14d. Weight measured d1 and d14. Test weighing of ready-to-feed formula intake for 5d by mother in home. Pre-weighed jars of complementary food and pre-weighed towels for formula loss (spit up, spills) provided.	Not specified	DLW vs. Test weighing -1.2 ± 15.5kcal/kg/d to - 0.3 ± 16.0kcal/kg/d, or 1-2 % underestimation of intake. Used Roberts or modified Jones mode of calculation and estimated or measured values for insensible water loss.

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DOUBLY LABELED WATER (DLW) METHOD – BREASTFEEDING						
Butte et al., 1991 (83)	1 mo. = 10 4 mo. = 10 (12M, 8F) Houston, Texas	DLW method	5 consecutive days of infant test weighing before and after each feed	Mother-infant pair in CRC unit for 24h for dosing. Spot urine collected for 14d. Weight measured d1 and d14. Test weighing of BM intake for 5d. by mother in home. Pre-weighed jars of complementary food and pre-weighed towels for BM loss (spit up) provided.	Not specified	DLW vs. Test weighing 55g/d (SD 50) or 5 % overestimation of intake. (P < 0.001) Corrected for environmental water influx and insensible water loss.
Butte et al., 1988 (88)	Mean age 101 days \pm 42 days = 9 Houston, Texas	DLW method	5 consecutive days of infant test weighing before and after each feed	Mother-infant pair in CRC unit for 24h for dosing. Spot urine collected for 14d. Weight measured d1 and d14. Test weighing of BM intake for 5d by mother in home. Pre-weighed jars of complementary food and pre-weighed towels for BM loss (spit up) provided.	Not specified	DLW vs. Test weighing 12g/d (648 \pm 6 g/d vs. 636 \pm 84g/d) or 2% overestimation of intake. Corrected for environmental water influx and insensible water loss
Butte et al., 1983 (87)	Experiment 1: Mean age 3.2 mo. \pm 0.4 mo. = 14 (5 M, 9 F) Experiment 2: Mean age 2.5 mo. \pm 1 mo. = 8 (4M; 4F) Houston, Texas	DLW method	48h of infant test weighing before and after each feed. 24h infant test weighing before and after each feed by mother in home	Experiment 1: Spot urine samples collected at 48h after dosing. Test weighing before and after each feed for 48 h. Experiment 2: Spot urine collected over 5d at 48, 72, and 120h. Test weighing of infant before and after each feed for 24h.	<u>Experiment 1:</u> Interclass correlation of 0.60. <u>Experiment 2:</u> Interclass correlation of 0.28.	DLW vs. Test weighing <u>Experiment 1:</u> 167ml/d (1616 \pm 353 vs. 1449 \pm 234ml/d) or 12% overestimation of intake. (P < 0.001). <u>Experiment 2:</u> 187ml/d (878 \pm 188 vs. 691 \pm 141ml/d) or 27% overestimation of intake. (P < 0.001).

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FOOD RECORDS (FR) or DIET HISTORY (DH)						
Lanigan, et al., 2001 (90)	6-12 mo. = 38 (45% M) 12-24 mo. = 34 (53% M) UK	5d Estimated FR	5d Weighed FR DLW method (subset of 21 infants 6-12 mo.)	Cross-over design of 5d weighed FR and 5-d estimated FR; collection periods separated by approximately 2wks. DLW spot urine collected for 7d. Random assignment to one method in week 1 crossing over to alternative method in week 2. Parents attended 3 training sessions. <u>BM intake:</u> BM intake (6% of total group energy intake) estimated from recording of duration of each feed. Milk consumption based on Medical Research Council data of 135g for infants 6-7mo. and 100g for 8-12mo., where a feed of 10 or more minutes was equivalent to a full feed; consumption adjusted proportionally to feedings of less time. <u>Child Care Input:</u> Not specified	Not specified	Estimated vs. Weighed FR 3.6% mean difference (937 ± 2 vs. 904 ± 206 kcal/d) [non-significant] Estimated/Weighed FR vs. DLW Both overestimated DLW measurement of energy expenditure by 7%: Estimated intake vs. DLW $= 238 \pm 1623$ kJ/d. Weighed intake vs. DLW $= 243 \pm 1690$ kJ/d.
Harbottle et al., 1994 and 1992 (91;92)	4-40 mo. = 117 Indo-Asian children from low literacy HHs. Sheffield, UK	4d Weighed FR (infants) or 5-d 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 occasionally 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. <u>BM Intake:</u> Not Specified <u>Child Care Input:</u> Not Specified	Not specified	DH vs. Weighed FR DH higher than weighed FR for mean intakes as follows: 7% energy, 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.

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FOOD RECORDS (FR) or DIET HISTORY (DH), CONTINUED						
Wharf et al., 1997 (93)	8 mo. = 20 18 mo. = 20 From healthy full-term pregnancies Norwich, UK.	DH (Standardized question sheet reprinted in article)	3d weighed FR (at least one weekend day and 2 weekdays)	DH obtained by interview using a standardized question sheet. One week later mothers kept a 3-d weighed FR. <u>BM Intake:</u> Not Specified <u>Child Care Input:</u> Not Specified	<u>8 mo.</u> Iron intake = 0.93 <u>18 mo.</u> Iron intake = 0.66	DH vs. FR <u>8 mo.</u> overestimated kcal by 5% and iron intake by 8%. <u>18 mo.</u> overestimated kcal by 5% and iron intake by 2%. Differences not significant at 8 or 18 mo.
24-HOUR RECALL (24HR)						
Horst, et al., 1988 (96)	6 mo. = 41 Non-breastfed Netherlands	24HR	Duplicate diet (collected by parent day before 24HR)	In 1984, parents were instructed in the home to collect a duplicate portion of all foods the infant consumed in 24h. The morning after the duplicate portion was collected, the 24HR interview was conducted in the home and the duplicate portions were collected. <u>BM Intake:</u> Not Applicable <u>Child Care Input:</u> Not Specified	Spearman rank correlation coefficients = 0.77 to 0.90 for energy and micro nutrients and 0.69 to 0.96 for minerals (all highly significant).	24HR vs. Duplicate plate 24HR 9% higher in energy and macronutrients; 10% and 13% higher in calcium and phosphorus; and 2% higher in iron than duplicate diet. All differences significant except iron.
Bogle et al., 2001 (97)	0-2 yrs. = 32 3-5 yrs. = 28 Lower Mississippi Delta Region: 17 from telephone HHs and 43 from non-telephone HHs.	Telephone 24HR	In-person 24HR Multiple pass methodology from 1994-96 CSFII	Dual sampling frame from telephone and non-telephone HHs. In telephone HHs caretaker completed 24HR either in-person or by telephone. In non-telephone HHs 24HR completed in-person or by cell phone provided by the interviewer. <u>BM Intake:</u> Time of feeds collected. Low BF rates; BF infants excluded from analysis. <u>Child Care Input:</u> Caretaker provided information or interviewer contacted child care center.	Not specified	Telephone 24HR vs. In-person 24HR Results reported for total sample and not by age group. Mean non significant difference between telephone and in-person interviews for telephone HHs was -171kcal, and for non-telephone HHs -143kcal (P=0.1).

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FOOD FREQUENCY QUESTIONNAIRE (FFQ)						
Marshall, et al 2003 (98)	6 wks. = 240 (50% M) Followed longitudinally through 5 yrs. 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 5 yrs. Parents completed FFQ for the week preceding the 3-d FR and returned by mail. Analysis reported at 6 and 1 mo. and 3 and 5 yrs. <u>BM Intake</u> : estimated at 6 mo. by calculating total energy requirements based on mean intake for body weight minus energy from other beverages divided by the energy concentration of human milk. At 12 mo. infants were assigned an intake of 2 oz. of human milk. <u>Child Care Input</u> : Parent obtained information from childcare provider or provider completed FR.	Spearman correlations <u>6 mo.</u> BM = 0.95 IFS = 0.84 cow's milk = 0.86 juice/drinks = 0.66 water = 0.54-0.66 <u>12 mo.</u> BM = 0.95 IFS = 0.84 cow's milk = 0.86 juice/drinks = 0.69 water = 0.60 soft drinks = 0.26-0.35 (liquid or powdered)	Beverage FFQ vs. FR <u>6 mo.</u> BM FFQ estimate = 0.1 feedings higher than FR IFS FFQ estimate = 0.2oz higher than FR <u>12 mo.</u> BM FFQ estimate = 1.6 feedings lower than FR IFS FFQ = 1.4oz higher than FR cow's milk FFQ intake = 0.7oz higher than FR
OTHER QUESTIONNAIRES						
Persson and Carlgren, 1984 (128)	6 mo. and 12 mo. = 93 Child Health Center, Sweden	Interview with short questions on prevalence, and duration of breastfeeding, and timing of introduction of solid foods	Notes in medical record on breastfeeding prevalence	Mothers of infants were interviewed at 6 and 12 mo. after birth. Infant's medical record was reviewed for reporting of breastfeeding practices at well baby visits.	Not specified.	Medical record vs. Interview <u>6 mo.</u> : 94% of the mother's reporting of breastfeeding prevalence agreed with the notes in the medical record. <u>12 mo.</u> : about 25% of the mothers who stopped breastfeeding before 6mo. added one or two months to their answer.