Table 2.2. Validation of dietary assessment methods in pregnant women

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<td>Goldberg et al., 1993 (14)</td>
<td>Pregnant women 12</td>
<td>TEE by DLW Method</td>
<td>7d weighed FR (4d weighed FR, off for 7d, then 3d weighed FR)</td>
<td>Purpose of study was to examine energy requirements during pregnancy. Subjects received whole body calorimetry, indirect calorimetry and DLW dosing. Women visited in home after first day of weighed FR to review understanding of procedures. When snacks and meals eaten away from home not weighed, researchers purchased similar foods and weighed portions. DLW spot urine specimens collected daily for 14d after dosing.</td>
<td>Not specified</td>
<td>DLW Method vs. FR TEE measured by DLW greater than FR energy intake at non-pregnancy, and at 6, 12, 18, 24, 30, and 37 wks gestation. 6 wks. = 6% 12 wks. = 15% 18 wks. = 12% 24 wks = 18.8% 30 wks. = 24% 37 wks. = 23% Four subjects FR implausible based on 1.14 times BMR; 2 more were questionable.</td>
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<td>Forsom et al., 1992 (15)</td>
<td>Pregnant women 22</td>
<td>TEE by DLW Method before pregnancy and at 16-18 wks.</td>
<td>4d weighed FR before pregnancy</td>
<td>DLW spot urine specimens collected 6 and 13d after dosing. FR kept 3 weekdays and 1 weekend day after dosing.</td>
<td>Not specified</td>
<td>DLW Method vs. FR 27% overestimation 10.7 ± 1.9 vs. 8.4 ± 1.8 MJ/d.</td>
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<td><strong>DIET HISTORY (DH)</strong></td>
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<td>Tapsell et al., 2002 (16)</td>
<td>Pregnant women 14 @ beginning of 3rd trimester with gestational diabetes mellitus (GDM) and 19 @ beginning of 3rd trimester without GDM, mean age 30.7 yrs., New South Wales</td>
<td>Research DH (included a meal-based FFQ with space to record food specifications and a core food group checklist)</td>
<td>7d weighed FR</td>
<td>Research DH obtained on all women at beginning of 3rd trimester. Women without GDM kept 7d weighed FR and a 2nd DH two weeks later. Instruments administered before intervention counseling. Criterion validity (number reporting intake below cut off value of 1.14 of energy intake:BMR ratio) calculated in women with GDM.</td>
<td>Correlation and Confidence Interval r (CI) Energy = 0.27 (0.2, 0.64) Pro. % kcal = 0.56 (0.15, 0.80) p&lt;0.05 Fat % kcal = 0.47 (0.03, 0.73) CHO % kcal = 0.42 (0.03, 0.73)</td>
<td>DH vs 7d weighed FR 4% kcal overestimation (p = 0.41) 10,238 ± 1576 vs. 9804 ±1443 KJ/d Non significant differences for % kcal from protein, carbohydrate and fat, and for % fat from SFA, PUFA, and MUFA</td>
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<td><strong>24-HOUR RECALL (24HR)</strong></td>
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<td>Klebanoff et al., 1998 (17)</td>
<td>Pregnant women 239 &lt;26 wks. Multiparous, with risk factors for reduced fetal growth, and with normal pregnancy outcomes for current pregnancy, Birmingham, AL</td>
<td>Serum caffeine and paraxanthine</td>
<td>24HR</td>
<td>On the day of the first 24HR during first prenatal visit, serum drawn for storage. Women divided into quartiles based on reported caffeine use from 24HR.</td>
<td><strong>Pearson Correlation</strong> 24H caffeine intake vs. serum paraxanthine = 0.50 for smokers and 0.53 for nonsmoker. 24H caffeine intake vs. serum caffeine = 0.37 for smokers and 0.52 for nonsmokers. Values comparable to correlation between reported smoking and serum cotinine in pregnancy.</td>
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<td>Parra et al., 2002 (18)</td>
<td>Pregnant women 35 in 3rd trimester</td>
<td>104-item FFQ</td>
<td>Erythrocyte cell membrane content of fatty acids in 35 women</td>
<td>The goal of the study was to evaluate the validity of the FFQ for assessment of the dietary intakes of PUFAs (n-3 and n-6) against a biochemical marker of fat intake. FFQ administered to 146 women during last trimester. First 35 had erythrocytes analyzed for fatty acid status.</td>
<td>Linear regression coefficients Erythrocyte PUFA vs. log transformed dietary PUFA 18:3n-3 = 0.52 (95% CI 0.020-1.10; p=0.61) 22:6n-3 = 0.30 (95% CI 0.007-0.60; p=0.045) 20:4n-6 = 0.49 (95% CI 0.010-0.98; p=0.044)</td>
<td>Not Applicable</td>
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<td>19-41 yrs.; healthy; Mexican; without habitual drug or alcohol use or on prescription medications</td>
<td>Semi-quantitative Interviewer administered Past year intake</td>
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<td>De Vriese et al., 2001 (19)</td>
<td>Pregnant women 26 Followed longitudinally 1st and 3rd trimester</td>
<td>180-item FFQ</td>
<td>7d Estimated FR</td>
<td>The main objective of the FFQ was to estimate the dietary intake of fat and fatty acids in the preceding month. Dietitian administered FFQ in home and reviewed 7d FR every two days in the home in first and third trimester.</td>
<td>Pearson correlations Total fat = 0.64 SFA = 0.63 MUFA = 0.62 PUFA = 0.68 18:2n-6 = 0.66 All significant p&lt;0.0001</td>
<td>FFQ vs. 7d FR 1st trimester</td>
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<td>Primagravid; singleton pregnancy; diastolic blood pressure &lt;90 mm Hg; not diabetic, no proteinuria, no renal or cardiovascular disease. Belgium</td>
<td>Semi-quantitative Interviewer administered with colored photographic booklet to estimate portion sizes (adapted Dutch FFQ) Past month intake</td>
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<td>Total fat = -1.5 g/d SFA = -1.2 g/d MUFA = -3.7 g/d PUFA = 1.0 g/d 18:2n-6 = 2.6 g/d (p=0.05) 83% classified in the same quartile with FFQ and FR</td>
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Table 2.2. Validation of dietary assessment methods in pregnant women, continued

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<td>Erkkola et al., 2001 (20)</td>
<td>Pregnant women 113 in 3rd trimester</td>
<td>181-item FFQ Semi-quantitative Self-administered Past month intake</td>
<td>2 5d FRs, at least 1 wk. apart</td>
<td>From August 1995 to July 1996, 113 women completed the FFQ at the beginning of the 8th mo. and 1 mo. after delivery, and FRs for two 5d periods separated by at least 1 wk. during the 7th mo. of pregnancy. Another group of 111 women completed FFQ twice at 1 mo. intervals at beginning and end of 8 mo. of pregnancy.</td>
<td>Pearson correlation. Energy and Attenuation Adjusted 24HR &amp; FFQ Kcal = 0.50 Range of 0.04 to 0.86 for foods; 0.22 to 0.74 for nutrients.</td>
<td>FFQ vs. FR 138% higher than 10d of FRs; FFQ2 136% higher. FFQ mean estimate for kcal 125% higher than FRs. Other results: An average of 70% (52-94%) of women were classified by both methods into the same or adjacent quintiles according to their food intake, and an average of 69% (58-81%) were classified as such according to nutrient intakes.</td>
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<td>Rifas-Shiman et al., 2000 (21)</td>
<td>Pregnant women 185 after prenatal visit (1st trimester)</td>
<td>Harvard FFQ modified for use in pregnancy Semi-quantitative Self-administered 1st trimester intake = intake since last menstrual period</td>
<td>Red blood cell concentrations of fatty acids, alpha carotene, lycopene, lutein, and gamma-tocopherol</td>
<td>Mean nutrient intakes in each of eight categories of HFFQ-estimated intake (energy-adjusted nutrient specific deciles 1,2,3, 4+5, 6+7, 8, 9, 10) compared with level of the same nutrient in a blood specimen composed of pooled blood from all of the subjects in that HFFQ category. Separate pools were created for black and white participants.</td>
<td>Spearman correlation coefficients (r) N-3 fatty acids = 0.98 white; 0.93 black Trans fatty acids = 0.75 white; 0.57 black; alpha-linoleic acid = 0.07 white; 0.07 black; lycopene = 0.88 white; -0.02 black; lutein= 0.95 white; 0.52 black; gamma-tocopherol = 0.29 white; 0.81 black</td>
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Table 2.2. Validation of dietary assessment methods in pregnant women, continued

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<td>Brown et al., 1996 (22)</td>
<td>Diana Project Pregnant women 56 in mid pregnancy 51% of eligible and willing women; 94% with &gt;HS education; 96% white, 72% employed full time; healthy Minnesota</td>
<td>Harvard FFQ Semi-quantitative Self-administered Modified to reflect intake over past 1-mo. period and to include 3 additional foods (custard, decaffeinated coffee, and broth-type soups)</td>
<td>4d weighed FR FFQs self-administered and returned by mail @ 65±87 d pre-conception and 135±39 d after conception. The 4d FR mailed to participants along with food-weighing scale @ 79±84 d pre-conception and 123±36 d after conception. Participants were women served by a large health maintenance organization in the Minneapolis-St Paul, Minn. area.</td>
<td>Spearman rank correlation Ranged from .75 for vitamin C to .02 for cholesterol and averaged .48. It was .45 for energy-adjusted values. Correlations greater than 0.5 for energy and 7 of 15 nutrients.</td>
<td>FFQ vs. 4d FR Prepregnancy 8% kcal underestimated 1758 ± 533 vs. 1909 ± 404 kcal/d FFQ intake lower for all nutrients except calcium Mid-pregnancy 10% kcal underestimated 2031 ± 613 vs. 2258 ± 344 kcal/d FFQ intake lower for all nutrients except iron and calcium Prepregnancy to mid-pregnancy change FFQs vs. 4d FR Mean energy −76 ± 466 kcal Protein −0.2 ± 19.8 g Iron 0.7 ± 7.3 mg</td>
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Table 2.2. Validation of dietary assessment methods in pregnant women, continued

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<td>Robinson et al., 1996 (23)</td>
<td>Pregnant women 569 in 2nd trimester</td>
<td>100-item FFQ</td>
<td>4d estimated FR</td>
<td>In 1991-92, women with first prenatal visit before 17 wks. visited in home at 15 wks. for FFQ administration by interviewer followed by prospective 4d FR. At a second home visit one wk later, FRs were reviewed and edited. Non-fasting blood sample taken at first prenatal visit to estimate serum vitamin C.</td>
<td>Spearman rank correlation</td>
<td>FFQ vs. 4d FR 23.5% kcal overestimation</td>
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<td>Community-based sample; mean age 26.4 yrs.; equal distribution among SES groups; 100% white</td>
<td>Semi-quantitative</td>
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<td>Median energy intake with 25th and 75th percentiles = 9.76 (7.89, 16.4) vs. 7.9 (6.57, 9.28) MJ/day</td>
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<td>UK</td>
<td>Interviewer-administered</td>
<td>Past 3-month intake</td>
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<td>FFQ mean intakes higher than 4d FR for all nutrients. Both FFQ and 4dFR were correlated with fasting serum Vitamin C (0.227 FFQ) and 0.38 FR, both p&lt; 0.001. Using serum vitamin C as an independent biomarker of intake, the percentage of individuals classified to the correct quarter of intake was similar for the FFQ and FR (34% and 37%) with 8% (FFQ) and 6% (FR) miss classified.</td>
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| Forsythe and Gage, 1994 (24) | Pregnant and Lactating women 80 | 82 item multicultural FFQ Semi-quantitative Self-administered Modified Harvard FFQ for African and Caribbean foods. Time period not specified, but designed to assess weekly patterns of food intake | 3 24HR 1st in-person following FFQ, 2nd and 3rd by telephone Bogalusa Heart Study protocol | Evaluated an FFQ developed for pregnant and lactating women of Caribbean and African descent at 8 centers in US. Three hours after FFQ administered, first in-person 24HR completed. Within 3 wks, 2nd and 3rd 24HR completed by telephone. 24HR used Bogalusa Heart Study protocol. In a random subset, FFQ and 24HR protocol repeated. | Not Reported | **FFQ vs 24HR** 34% kcal overestimation (p<.05) 10,755 ± 6030 vs. 8021 ± 2382 kJ/d  
Protein, CHO, fat, calcium iron, zinc, and alcohol estimates all significantly higher on FFQ (p<.05) |
Table 2.2. Validation of dietary assessment methods in pregnant women, continued

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<td>FNS, USDA, 1994 (25)</td>
<td>Pregnant women 150 Breastfeeding (BF) women 150 Postpartum (PP) women 150 Children 1-4 yrs. 150 WIC participants distributed evenly between black, white, and Hispanic ethnic groups</td>
<td>Harvard Women FFQ (WFFQ) NCI-Block HHHQ Self-administered Intake period not specified in Executive Summary</td>
<td>3 24HR by telephone</td>
<td>Data collection from July 1993 through January 1994. In each category, half the sample received WFFQ followed by 3 non-consecutive telephone 24HR 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.</td>
<td>FFQ vs. 24HR</td>
<td>Not specified</td>
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<td>Greeley et al., 1992 (26)</td>
<td>Pregnant women 50 Followed longitudinally during 2nd and 3rd trimester 20-35 yrs.; healthy; 40% 1st pregnancy, 74% employed; race ethnicity not specified</td>
<td>Harvard FFQ 2 times. Semi-quantitative Self-administered Modified to evaluate daily food intake during past 2 mo. period</td>
<td>4 24HRs</td>
<td>Between June 1988 and February 1989, convenience sample from an urban community in eastern ND recruited. 24HR interview completed in the home 4 times (16, 21, 30 and 35 wks.). Recall days at convenience of participant so weekdays/weekend days was 4/1. 24HR were conducted with a single-page form that included a checklist for five food/beverage categories, time of day, quantity, and preparation. FFQ completed in home at 21 and 35 wks.</td>
<td>Pearson correlation</td>
<td>HFFQ vs Mean 24HR</td>
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**FOOD FREQUENCY QUESTIONNAIRE (FFQ), CONTINUED**

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Other results:
HHHQ more valid for white and black women than WFFQ
Neither FFQ valid in Hispanic women or in children
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<td><strong>FOOD FREQUENCY QUESTIONNAIRE (FFQ), CONTINUED</strong></td>
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<td>Suitor et al., 1989 (27)</td>
<td>Pregnant women 295</td>
<td>Harvard FFQ</td>
<td>3 24HR on randomly selected subset of 95 women</td>
<td>HFFQ administered twice, 2 wks. apart. In recall subset, HFFQ followed by 3 24HR by telephone or in-person and then completed a 2nd HFFQ. The second HFFQ in both groups sent to participants by mail for return by mail. Return rate for second FFQ 60% and not representative of total sample (mostly white women with HS education and above poverty level).</td>
<td>Observed and Adjusted Pearson correlation 24HR &amp; 1st HFFQ Energy = 0.47, 0.54 95% CI = 0.30, 0.71 Pro. = 0.44, 0.54 95% CI = 0.27, 0.73 Calcium = 0.60, 0.71 95% CI = 0.48, 0.84 Iron = 0.43, 0.55 95% CI = 0.26, 0.76 (Values also reported for Zn, vit A, B6, and C)</td>
<td>HFFQ1 vs. 24HR 13% kcal overestimation 2518 ± 921 vs. 2226 ± 709 kcal (outliers excluded)</td>
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<td>Trimester = 12% 1st, 40% 2nd, and 47% 3rd; aged 14-43 yrs.; low income; 48.3% white; 27.5% black; 24.2% Hispanic; 13% &lt;18 yrs.)</td>
<td>2D Food Portion Visual</td>
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<td>Wei et al., 1999 (28)</td>
<td>Pregnant women 101</td>
<td>Harvard FFQ</td>
<td>24HR (at least one of 3 completed)</td>
<td>The purpose of the Wei study was to broaden the scope of the 1989 validation by assessing the validity of the HFFQ for 17 additional nutrients. This analysis included a randomly selected sub-sample of 101 participants who had provided at least one 24HR and reported intake of less than 4,500 kcal.</td>
<td>Pearson Correlation, Energy-Adjusted and Corrected for Measurement Error: Range of .07 (B12) to .90 (zinc). Mean correlation for 17 nutrients = 0.47; 54% were over 0.4.</td>
<td>HFFQ1 vs 24HR Mean kcal ± SD 11% kcal overestimation 2561.5 ± 893.9 kcal vs. 2276.6 ± 782.2</td>
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<td>(same data set as Suitor, 1989)</td>
<td>Trimester = 54.4% 1st, 26.5% 2nd, and 19.1% 3rd; aged 14-43 yrs.; low income; 63.4% white; 18.8% black; 17.8% Hispanic; 13% &lt;18 yrs.)</td>
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