Reproducibility of reported nutrient intake and supplement use during a past pregnancy: a report from the Children's Oncology Group

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Summary

Maternal diet and nutrition have been thought to play a role in many childhood conditions. Studies using food frequency questionnaires (FFQ) have reported associations with maternal diet, but these findings are difficult to interpret because the reliability and validity of the FFQs for diet during a past pregnancy are not known. We determined the reproducibility of reported diet and supplement use during a past pregnancy in a subset of mothers interviewed for a case–control study of maternal diet in relation to the risk of childhood brain tumours. Cases were Children's Oncology Group patients, diagnosed at age <6 with medulloblastoma or primitive neuroectodermal tumour from 1991 to 1997. Area code, race/ethnicity, and birth date matched controls were selected by random-digit-dialling.

Case and control mothers completed a modified Willett FFQ a mean of 5 years after the index child's birth.A mean of 3.6 months later, a subset of mothers consisting of 52 case and 51 control mothers repeated the interview; these comprise the reproducibility study population. The mean intra-class correlation was 0.59 (range 0.41, 0.69) for energy-adjusted nutrients from dietary sources only; it was 0.41 (range 0.06, 0.70) when supplements were included. Agreement for reporting multivitamin use during pregnancy by time period and pattern was good to very good (kappa = 0.66–0.85). Overall, the reproducibility of nutrient estimates and supplement use in pregnancy was good and similar to that reported for adult diet.

Keywords: *diet*, *food frequency questionnaire*, *previous pregnancy*, *reproducibility*, *dietary supplements*.

Introduction

Maternal nutrition and diet have been thought to play a role in many common childhood conditions including allergy, asthma, cognitive development and obesity,[1–4] with most findings coming from cohort studies. Maternal nutrition may also affect the risk of less common diseases of childhood, where retrospective assessment of diet using case–control designs will be necessary. For diseases such as childhood cancers, because they are rare and

occur years after birth, researchers must usually use a case–control study design and rely on maternal recall. In case–control studies, aspects of mothers' diet and supplement use during pregnancy have been associated with the child's risk of cancer: specifically multivitamins with lower risk of brain tumours,[5–8] leukaemia[9] and neuroblastoma; [10] infrequent eating of vegetables with higher risk of retinoblastoma;[11] frequent eating of foods containing DNA toposiomerase II inhibitors with higher risk of specific subgroups of infant leukaemia; [12,13] and frequent eating of cured meats with higher risk of brain tumours.[14–17] However, the veracity of the findings depends on the reproducibility and validity of the retrospectively collected dietary data.

The dietary information (except for supplement use) in these studies was collected using food frequency questionnaires (FFQ),[18] the primary method for retrospectively assessing diet in case–control studies. FFQs have been found to be reasonably reproducible and valid for assessing past adult diet,[19–22] but their limitations are also well known,[23] and their accuracy for assessing diet during a past pregnancy has not been studied appropriately. Ideally, pregnant women would complete a non-FFQ dietary assessment, such as several 24 h recalls, and then complete the FFQ several years later. Food and nutrient intake would be compared using the dietary assessment that took place during the pregnancy as the 'gold standard.' However, the situation of a large enough group of women whose diet was studied during pregnancy and who are available for study several years later is rare. In the absence of this ideal situation, other comparisons can be made that begin to address the accuracy of reporting diet during a past pregnancy. However, we know of only our previous study and one other that evaluated reproducibility of FFQs for recalled pregnancy diet.[24,25] We know of no previous studies on the reproducibility of reported supplement use during pregnancy and no studies that have directly assessed validity of reported diet or supplement use during a past pregnancy.

In our previous study of FFQ reproducibility, we concluded that pregnancy diet was recalled about as well as adult diet generally.[24] In this study, women who had completed FFQs during pregnancy were re-contacted 3–7 years later and asked to complete the same self-administered FFQ or a different FFQ administered as a telephone interview. However, the sample represented a rather select group, limiting the possibility of generalising these results to a more diverse population: two-thirds of the women were college graduates, 97% were white, and all had completed multiple FFQs during their pregnancies as part of their participation in a research study. Further, our previous analysis did not report on the reproducibility of reported supplement use. To extend the findings of our previous analysis, we performed a second study of reproducibility, in which mothers who had completed a FFQ as part of their participation in a national case–control study of childhood brain tumours were re-interviewed 3 months later. Here, we report on the reproducibility of their reported nutrient intake and supplement use during pregnancy.

Methods

Study population

A case–control study of medulloblastoma (MB) and primitive neuroectodermal tumour (PNET) was conducted to investigate the role of maternal diet during pregnancy.[26] Eligible patients were diagnosed with MB/PNET in the brain before age six, between 1991 and 1997,

and registered with the Children's Oncology Group through institutions previously affiliated with the Children's Cancer Group.

Controls were identified through random-digit dialling (RDD) and individually matched to cases on area code, child's race/ethnicity (non-Hispanic white, non-Hispanic black, other) and child's date of birth (within 6 months for cases with age of diagnosis <1 year, within 1 year for all others). Details about the main study's exclusions have been reported previously.[26] The main study population consisted of 315 case–control pairs.

Participants in the reproducibility study were drawn from the 146 mothers of cases and controls who completed the telephone interview for the main study between September 1996 and June 1997. Three months after completing the interview, each of these mothers was sent a letter asking her to repeat the interview and offering her $20. Of the 146 mothers eligible for the sub-study, 104 (71%) completed the second interview. The reasons for non-participation were refusal, inability to locate and contact by phone, and inability to interview before study ended. One case mother was excluded from the analysis because of missing data. The final sample consisted of 52 case mothers and 51 control mothers, including 17 matched case–control pairs. We obtained approval from the institutional review boards of all participating institutions and all participants provided informed consent.

Data collection

Trained personnel conducted telephone interviews that included a modified Willett FFQ[18] with 112 items to assess diet during two time periods: the year prior to pregnancy and during the second trimester of pregnancy. This analysis examined nutrient data from the second trimester.

Mothers were also asked about their use of supplements (multivitamins, vitamin A, vitamin C, vitamin E, calcium, selenium, iron, zinc and folate) in the year before and during pregnancy. Supplement users were asked about duration and frequency of use, whether they were taking the supplement when they became pregnant, brand and type (multivitamins), dose (individual supplements), month during pregnancy when use began and ended, prescription or non-prescription (multivitamins). If the mother remembered only part of the brand/type of prenatal multivitamin, the interviewer read common product names containing the remembered words from a list to prompt further recall.

The micronutrient content of multivitamins was assigned based on brand/type.[18] When the brand/type was not known or not in the database, the multivitamin was categorised as prescription or non-prescription, prenatal or regular, based on the answers to the relevant questions. A prescription prenatal multivitamin of unknown brand and a non-prescription prenatal multivitamin of unknown brand were assigned micronutrient amounts typical in the years of the index pregnancies.[27–29] For single micronutrient supplements, we used the dose reported by the mother or, if not known, a typical dose (500 mg vitamin C, 400 International Units (IU) vitamin E, 400 mg folate, 60 mg iron and 200 mg calcium).

To determine whether a supplement was used close to conception, before most women knew they were pregnant, we asked mothers who reported use in the year before the pregnancy whether they were taking the supplement when they became pregnant. Mothers who answered yes were considered to have used the supplement close to conception. Some mothers who did not report use in the year before pregnancy stated they were taking the supplement before the pregnancy began, in response to the question about when during the pregnancy use started. These mothers were considered to have close to conception usage.

Statistical analyses

Analyses were performed for case and control mothers combined and separately using SAS version 9.1 software (SAS Institute Inc., Cary, NC, USA) and SPSS Base 12.0 (SPSS Inc., Chicago, IL, USA). Daily intake of selected micronutrients from food was calculated by summing the content across all foods. The Willett FFQ standard portion[18] was assumed as portion size was not collected. Nutrient intake was estimated from food only and from food plus supplements and the estimates were energy-adjusted using the residual method.[30]

Reproducibility of nutrient estimates

Intra-class correlations (ICC) and 95% confidence intervals [CI] were calculated to assess the reproducibility of estimates of nutrient intake from the FFQs in the first (FFQ1) and second (FFQ2) interviews. These measures were calculated for crude and energy-adjusted estimates of intake from food only and food plus supplements.

We also assessed the reproducibility of quartiles of nutrient intake using the weighted kappa (k) coefficient, which accounts for the ordinality of the quartiles. Quartile was assigned based on the distribution of nutrient intake among case and control mothers combined for analyses of all mothers, and based on the distribution of case mothers only and control mothers only for separate analyses. Exact and adjacent quartile agreement was calculated for each nutrient (crude and energy-adjusted) using FFQ1 as the reference. The observed quartile agreement was compared with the expected agreement of 0.25 for exact quartile agreement and 0.625 for adjacent quartile agreement using a one-sample proportion test with alpha set at 0.001 because of the large number of statistical tests performed.

Reproducibility of reported supplement use

The agreement of reported supplement use between the two questionnaires was assessed by kappa coefficients. Multivitamin use at any time during the pregnancy, use during each portion of pregnancy (around conception, first trimester, second trimester and third trimester), and patterns of use (never took multivitamins, started taking multivitamins around conception and continued until delivery, started taking during the first trimester and continued until delivery, and started taking during the second trimester and continued until delivery, other) were analysed. For single nutrient supplements, only 'any use during the pregnancy' was analysed because of the small number of users.

Results

Table 1 shows descriptive characteristics of the reproducibility study population (n = 103). Case and control mothers differed only in ethnicity (Hispanic: 25% of cases vs. 4% of controls, P = 0.02). As the results in this report did not change appreciably when the analyses were limited to non-Hispanic whites, we present the results for all races/ethnicities combined. Additionally, no systematic differences between case and control mothers were observed and, thus, only results for the combined group of 103 mothers are presented. The original interview took place, on average, 5.0 years (range 0.3, 9.4; SD = 2.1) after the index child's birth and the second interview 3.6 months (range 2.3, 8.6; SD = 1.1) later.

The reproducibility study population of 52 case mothers and 51 control mothers was similar to the main study population of 315 cases and 315 controls in child's age at first

interview, race and education except that proportionately, there were more Hispanic case mothers in the subgroup (25% vs. 10%).

Nutrients without supplements

The mean ICC for crude nutrients without supplements was 0.62 (range 0.45, 0.72) (Table 2). Overall, the ICCs for energy-adjusted nutrient estimates were slightly lower with a mean of 0.59 (range 0.41, 0.69).

The exact quartile agreement of energy-adjusted nutrients without supplements ranged from 39% to 54% and kappa coefficients ranged from 0.32 to 0.57 (Table 3). The agreements for all nutrients except polyunsaturated fat and vitamin B6 were statistically significantly different from the expected of 0.25 at a = 0.001.A total of 77–91% of mothers fell into the same quartile or the adjacent quartile for both FFQs. The adjacent agreements for all nutrients except polyunsaturated fat and linoleic acid were statistically significantly different from the expected of 0.625 at a = 0.001. Results were similar for crude nutrients (not shown).

Nutrients with supplements

The mean ICC for crude and energy-adjusted nutrients with supplements was 0.47 (range -0.03, 0.69) and 0.41 (range -0.06, 0.70), respectively (Table 2). With supplements, energy-adjusted vitamin E (ICC = -0.02, [95% CI -0.21, 0.17]) and iron (ICC = -0.06, [95% CI -0.25 0.13]) had lower ICC than without supplements and the lowest ICC of all nutrients. Without vitamin E and iron, the mean ICC for nutrients with supplements was 0.49 (range 0.33, 0.70), somewhat lower than for nutrients without supplements.

We performed analyses of subsets of mothers to determine whether inconsistent reporting of supplement use contributed to the low reliability for vitamin E and iron. For vitamin E, intake including supplements was reproducible for mothers who reported the same multivitamin in both interviews (n = 62, ICC = 0.71) but not for those who reported different multivitamins (n = 39, ICC = -0.08). Four mothers who reported vitamin E supplement use were excluded from the subset analyses because of their small number. Similar analyses for iron intake with supplements did not reveal an interpretable pattern.

Kappa coefficients were similar for crude (not shown) and energy-adjusted nutrients (Table 3). Exact quartile agreement for energy-adjusted nutrients with supplements ranged from 31% to 59% with kappa coefficients ranging from 0.06 to 0.59 (Table 3). The exact agreements for all except vitamin E and calcium were statistically significantly different from the expected of 0.25 at a = 0.001. The range for adjacent agreement was 63–91%, with all statistically significantly different from the expected of 0.625 (a = 0.001) except vitamin E, calcium and zinc.

Multivitamin use

Agreement for reporting any multivitamin use was 0.71 (Table 4). Agreement ranged from 0.66 to 0.85 for time period of use and from 0.73 to 0.75 for the two common patterns of use. Of multivitamin users, 63% (60/95) consistently reported the same brand/type.

Individual micronutrient supplements

Agreement for use of calcium and iron supplements was 0.61 and 0.65, respectively (Table 4). No mothers reported taking beta-carotene, vitamin A, or selenium and too few reported taking vitamin C, vitamin E, or folic acid to permit separate analyses.

Most mothers who took individual supplements did not remember their dose. For example, six of the 27 iron supplement users reported a dose in FFQ1 and four of 22 in FFQ2. Only one mother reported the same dose in both questionnaires.

Discussion

This study is one of only a few to evaluate the reproducibility of self-reported dietary intake during pregnancy, [24,25] and the first to our knowledge to evaluate the reproducibility of self-reported supplement intake during pregnancy. We found that ICCs for energyadjustedmnutrient intake from food alone averaged 0.59 (range 0.41, 0.69), while the average ICC for nutrients including supplements was lower, 0.41, with a wider range (-0.06, 0.70) because of low correlations for vitamin E and iron. We also found good reproducibility for reporting of use of multivitamins and of iron and calcium supplements, although estimating supplement dosages was difficult.

Our ICCs for nutrients without supplements are similar to those from the one study of recalled pregnancy diet (range 0.4, 0.8)[25] and to those from studies of the general adult population (range 0.5, 0.7).[22] Our results for nutrients with supplements are also comparable to those in the general adult population except for vitamin E and iron, particularly after energy adjustment. The low correlations for vitamin E with supplements occurred among mothers who reported different multivitamins in the two interviews. The vitamin E content of prenatal multivitamins varied from 0 to 30 IU and was generally high compared with the median intake from food (9 IU) in this population. Therefore, multivitamins made a large contribution to vitamin E content and the inconsistent reporting of brand/type may explain the poor reliability. For iron, the explanation for the poor reliability is less certain. It may be relevant that over 20% of mothers reported taking a separate iron supplement and that the variability in iron content of multivitamins was large (40– 120 mg) compared with the median intake from food (14 mg). The fact that the crude ICC for iron with supplements was similar to those for other nutrients and dropped only with energy adjustment suggests misreporting of iron supplement intake in relation to energy intake, an observation we cannot explain. The moderately high quartile agreement for energyadjusted iron with supplements suggests that the low ICC may be due to misreporting by a small proportion of mothers.

The reproducibility of reported multivitamin usewas high for any use (k = 0.71); for most time periods and common patterns of use, the agreement was good to very good (range 0.66, 0.85).[31,32] We know of no data on a past pregnancy with which to compare our results, but some data are available on non-pregnant adults. In a study of older adults, participants completed a questionnaire twice, 3 months apart, concerning their supplement use in the last 10 years;[33] the observed agreementwas good (k = 0.78) for average frequency of multivitamin use. Although not about pregnancy, the interval of recall and the finding that multivitamin use is reproducibly reported were similar to ours. Iron and calcium had good reliability for any use of these supplements (k = 0.61 and k = 0.65, respectively). In another study of older adults, Murphy *et al*. observed similar levels of reproducibility for commonly used single nutrient supplements,[34] although the participants reported their use over the past year, unlike our study.

The mean interval between FFQs was 3.6 months; thus, our results are likely to reflect the reproducibility of the mothers' reported diet and not simply their ability to recall their previous responses.[22] The reproducibility of estimates of intake including supplements, however, may be overestimated for some micronutrients. Mothers who did not remember

the brand/type of multivitamin they took and mothers who did not remember the dose of the individual supplements they took were assigned doses typical of the reported products. For example, a mother who did not remember the brand and name of the multivitamin she took was assigned the same typical doses for both questionnaires. By assigning typical doses when the dose was unknown, we have overestimated the similarity of the estimates from the two questionnaires.

Our findings indicate that estimating dosage for supplements in a past pregnancy is problematic. In childhood cancer case–control studies, mothers are asked to report their supplement use during a past pregnancy, at a time when most are not pregnant, unlikely to be using the same product as during pregnancy, and therefore unable to obtain the brand/type and dose from the label. This is clearly a disadvantage in obtaining accurate data retrospectively. In our sample, less than one-third of mothers reporting use of single supplements could provide a dose and even fewer reported the same dose in both questionnaires. Thus, our findings suggest that questionnaires on supplement use during a pregnancy several years in the past need not ask about dose because it cannot be reported reliably; assigning a standard dose would seem the better approach. Other potential sources of error in reporting supplement use deserve discussion. Some mothers may have inconsistently reported their use of individual supplements because they did not understand that we were asking about supplements apart from multivitamins. Another concern is determining the brand and type of multivitamin used. The quantities of nutrients can vary widely between the many brands and individual products within brands of prenatal multivitamins, both over-the-counter and prescription. As a result, misreporting a brand or within-brand type can lead to substantial error in estimating dose. In our study, for example, misreporting a brand or type greatly reduced correlations for vitamin E. Providing photographs of the bottles and the pills of the most commonly used products might improve reporting.

Differences between case and control mothers in reliability of reporting could introduce differential bias into studies. However, our sample size was not large enough to assess the important question of case– control differences. We hope that future studies with larger sample sizes address this issue.

Neither our study nor any previous studies have directly assessed validity of recall of diet during a past pregnancy. Such a study would require collection of dietary information using a referent method during the pregnancy. In our previous work, we compared women's recall of their diet during a pregnancy 3–7 years in the past with their diet as they reported it during the pregnancy.[24] We found that women recalled their diet during pregnancy with similar accuracy as in the general adult population.[24] Other studies have reported reasonable validity of FFQ data on diet as long as 10–15 years in the past.[19–22] Overall, these studies provide indirect support for the validity of FFQ data in studies on maternal diet during pregnancy.

As more epidemiological studies of childhood cancer and other conditions focus on diet and supplement use during pregnancy, the need for data directly evaluating the performance of dietary questionnaires is growing. Our data reported here contribute to the sparse literature on the performance of an FFQ to assess diet during a past pregnancy. We observed levels of reproducibility for most nutrients similar to those seen for adult diet generally. Difficulty in reporting brand and dosage information for multivitamins may have contributed to reduced correlations for vitamin E, but did not explain the low iron correlations. Mothers' use of multivitamins, including timing and patterns of use, and

common individual supplements was reliably reported. Our results indicate that data on maternal intake of most nutrients and common supplements during a past pregnancy can be reproducibly collected in case–control studies of childhood cancers and other rare childhood diseases.

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Table 1. Descriptive characteristics of the 103 mothers in the reproducibility study of reported nutrient intake

Characteristic	Mean (SD)	Min, max	% (*n*)
Time interval between FFQ1 and FFQ2 (months)	3.6 (1.1)	2.3, 8.6	
Time interval between child's birth and FFQ1 (years)	5.0 (2.1)	0.3, 9.4	
Mother's age at time of child's birth (years)	29.2 (5.6)	16.7, 40.9	
Mother's race/ethnicity			
White			80 (83)
Hispanic			14 (14)
Black			4 (4)
Asian			2 (2)
Mother's education			
Less than high school			12 (12)
High school			24 (25)
Some post-high school			29 (30)
College graduate			26 (27)
Professional or graduate degree			9 (9)

FFQ, food frequency questionnaire.

Table 2. Intra-class correlations (ICC) of nutrients without and with supplements among mothers in the reproducibility study (n = 103)

	Without supplements		With supplements	
Nutrient	Energy adjusted ICC [95% CI]	Unadjusted ICC [95% CI]	Energy adjusted ICC [95% CI]	Unadjusted ICC [95% CI]
Calories (kcal)	–	0.63 [0.50, 0.73]		
Animal fat (g)	0.59 [0.59, 0.70]	0.64 [0.51, 0.74]		
Vegetable fat (g)	0.63 [0.50, 0.73]	0.70 [0.59, 0.79]		
Saturated fat (g)	0.63 [0.49, 0.73]	0.69 [0.57, 0.79]		
Monosaturated fat (g)	0.67 [0.55, 0.77]	0.68 [0.56, 0.77]		
Polyunsaturated fat (g)	0.42 [0.24, 0.56]	0.64 [0.51, 0.74]		
Linoleic acid (g)	0.44 [0.27, 0.59]	0.64 [0.51, 0.74]		
Oleic acid (g)	0.68 [0.56, 0.77]	0.68 [0.56, 0.77]		
Omega 3-fatty acids (g)	0.66 [0.54, 0.76]	0.72 [0.61, 0.80]		
Protein (g)	0.63 [0.49, 0.73]	0.68 [0.48, 0.72]		
Animal protein (g)	0.59 [0.45, 0.70]	0.61 [0.47, 0.72]		
Cholesterol (mg)	0.65 [0.52, 0.75]	0.62 [0.49, 0.73]		
Carbohydrate (g)	0.57 [0.42, 0.69]	0.60 [0.46, 0.71]		
Dietary fibre (g)	0.64 [0.51, 0.74]	0.62 [0.48, 0.72]		
Alcohol (g)	0.63 [0.49, 0.73]	0.62 [0.49, 0.73]		
Vitamin A (IU)	0.51 [0.35, 0.64]	0.58 [0.43, 0.69]	0.52 [0.37, 0.65]	0.58 [0.44, 0.70]
Retinol (IU)	0.54 [0.38, 0.66]	0.56 [0.41, 0.68]	0.55 [0.40, 0.67]	0.56 [0.41, 0.68]
Thiamine (mg)	0.58 [0.44, 0.70]	0.57 [0.42, 0.68]	0.33 [0.14, 0.49]	0.32 [0.14, 0.49]
Riboflavin (mg)	0.54 [0.39, 0.67]	0.63 [0.50, 0.73]	0.42 [0.25, 0.57]	0.46 [0.29, 0.60]
Vitamin B6 (mg)	0.57 [0.42, 0.69]	0.61 [0.48, 0.72]	0.70 [0.58, 0.78]	0.69 [0.58, 0.78]
Vitamin B12 (mg)	0.61 [0.48, 0.72]	0.65 [0.52, 0.75]	0.55 [0.40, 0.67]	0.59 [0.45, 0.70]
Vitamin C (IU)	0.65 [0.53, 0.75]	0.67 [0.52, 0.75]	0.48 [0.32, 0.62]	0.48 [0.32, 0.62]
Vitamin D (IU)	0.58 [0.44, 0.69]	0.65 [0.53, 0.75]	0.51 [0.35, 0.64]	0.51 [0.35, 0.64]
Vitamin E (IU)	0.51 [0.36, 0.64]	0.56 [0.41, 0.68]	–0.02 [–0.28, 0.26]	0.04 [–0.27, 0.27]
Calcium (mg)	0.63 [0.50, 0.73]	0.67 [0.55, 0.76]	0.44 [0.27, 0.58]	0.43 [0.26, 0.57]
Iron (mg)	0.50 [0.34, 0.63]	0.50 [0.34, 0.63]	–0.06 [–0.25, 0.13]	0.65 [0.52, 0.75]
Zinc (mg)	0.51 [0.35, 0.64]	0.54 [0.39, 0.66]	0.49 [0.33, 0.62]	0.46 [0.30, 0.60]
Folate (mg)	0.69 [0.58, 0.78]	0.68 [0.56, 0.77]	0.46 [0.30, 0.60]	0.47 [0.30, 0.60]

IU, International Units.

Table 3. Energy-adjusted nutrient agreement for quartiles of intake among mothers in the reproducibility study ($n = 103$)[a]

	Without supplements			With supplements		
Nutrients	Weighted kappa [95% CI]	Exact agreement[b]	Adjacent agreement[c]	Weighted kappa [95% CI]	Exact agreement[b]	Adjacent agreement[c]
Animal fat (g)	0.49 [0.37, 0.60]	48%	91%			
Vegetable fat (g)	0.48 [0.35, 0.61]	52%	87%			
Saturated fat (g)	0.46 [0.34, 0.58]	46%	89%			
Monosaturated fat (g)	0.57 [0.46, 0.68]	55%	93%			
Polyunsaturated fat (g)	0.27 [0.14, 0.41]	39%	78%			
Linoleic acid (g)	0.31 [0.17, 0.45]	42%	78%			
Oleic acid (g)	0.56 [0.45, 0.66]	52%	93%			
Omega 3-fatty acids (g)	0.45 [0.31, 0.59]	54%	84%			
Protein (g)	0.51 [0.39, 0.62]	51%	90%			
Animal protein (g)	0.46 [0.34, 0.59]	49%	86%			
Cholesterol (mg)	0.44 [0.32, 0.56]	45%	88%			
Carbohydrate (g)	0.49 [0.37, 0.60]	49%	88%			
Dietary fibre (g)	0.41 [0.28, 0.54]	45%	84%			
Alcohol (g)	0.40 [0.27, 0.54]	48%	83%			
Vitamin A (IU)	0.41 [0.28, 0.53]	42%	86%	0.45 [0.33, 0.58]	46%	87%
Retinol (IU)	0.49 [0.35, 0.62]	56%	84%	0.36 [0.23, 0.50]	43%	80%
Thiamine (mg)	0.35 [0.22, 0.48]	40%	81%	0.41 [0.27, 0.55]	52%	80%
Riboflavin (mg)	0.33 [0.18, 0.47]	46%	77%	0.32 [0.18, 0.47]	43%	79%
Vitamin B6 (mg)	0.37 [0.25, 0.50]	39%	85%	0.39 [0.26, 0.53]	47%	82%
Vitamin B12 (mg)	0.42 [0.28, 0.56]	52%	81%	0.39 [0.26, 0.53]	47%	85%
Vitamin C (IU)	0.53 [0.41, 0.65]	54%	87%	0.59 [0.47, 0.70]	59%	91%
Vitamin D (IU)	0.39 [0.25, 0.53]	49%	81%	0.42 [0.28, 0.55]	49%	85%
Vitamin E (IU)	0.38 [0.25, 0.52]	45%	83%	0.06 [–0.09, 0.20]	31%	63%
Calcium (mg)	0.44 [0.31, 0.57]	49%	83%	0.27 [0.12, 0.42]	39%	76%
Iron (mg)	0.39 [0.25, 0.53]	50%	80%	0.45 [0.31, 0.59]	52%	83%
Zinc (mg)	0.32 [0.18, 0.46]	41%	79%	0.35 [0.20, 0.49]	48%	75%
Folate (mg)	0.45 [0.32, 0.59]	51%	85%	0.34 [0.20, 0.48]	44%	79%

[a]FFQ1 used as reference.

[b]Exact agreement for all nutrients except polyunsaturated fat, vitamin B6 without supplements, vitamin E with supplements and calcium with supplements were statistically significant at $\alpha = 0.001$.

[c]Adjacent agreement for all nutrients except polyunsaturated fat, linoleic acid, vitamin E with supplements, calcium with supplements and zinc with supplements were statistically significant at $\alpha = 0.001$.

IU, International Units. FFQ, food frequency questionnaire.

Table 4. Reported supplement use before and during pregnancy among mothers in the reproducibility study ($n = 103$)[a]

	FFQ1		FFQ2		Agreement
Supplement	*n*	%	*n*	%	Kappa [95% CI]
Multivitamins any use during pregnancy	97	95%	96	94%	0.71 [0.40, 1.00]
Time period					
Conception	39	38%	41	40%	0.77 [0.65, 0.90]
First trimester	91	89%	90	88%	0.66 [0.42, 0.89]
Second trimester	95	93%	95	93%	0.85 [0.64, 1.00]
Third trimester	91	88%	93	90%	0.80 [0.60, 0.99]
Pattern					
Never	5	5%	5	5%	–[b]
Starting at conception	39	38%	40	39%	0.73 [0.60, 0.87]
Starting at first trimester	48	47%	47	46%	0.75 [0.62, 0.88]
Starting at second trimester	2	2%	5	5%	–[b]
Other	7	7%	4	4%	–[b]
Total	101	98%	101	98%	0.68 [0.52, 0.85]
Vitamin C	7	7%	5	5%	–[b]
Vitamin E	3	3%	1	1%	–[b]
Folic acid	6	6%	5	5%	–[b]
Iron	27	26%	22	22%	0.65 [0.48, 0.82]
Calcium	18	18%	12	12%	0.61 [0.39, 0.83]

[a]'Don't Know' responses treated as missing values.
[b]Not calculated due to fewer than 10 mothers reporting use.
FFQ, food frequency questionnaire.