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An estimation of periconceptional under-reporting of dietary energy intake

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ABSTRACT

Background The purpose of this cross-sectional study was to examine periconceptional misreporting of energy intake (EI) using the Willet food frequency questionnaire (WFFQ).

Methods Women were recruited in the first trimester. Women completed a semi-quantitative WFFQ. Maternal body composition was measured using eight-electrode bioelectrical impedance analysis. Under-reporters were those whose ratio of EI to their calculated basal metabolic rate fell below the calculated plausible threshold for their physical activity category.

Results The mean age was 30.1 ± 5.3 years ($n = 524$). The mean body mass index (BMI) was 25.4 ± 5.6 kg/m^2, and 16.6% were obese (BMI ≥ 30.0 kg/m^2). Under-reported EI was observed in 122 women (23.3%) with no over-reporters in the sample. Under-reporters were younger ($P < 0.001$), less likely to have a normal BMI ($P = 0.002$) and more likely to be obese ($P < 0.001$) than plausible reporters. Under-reporters had higher percentage of body-fat and lower percentage of body fat-free mass ($P < 0.001$), were more likely to be at risk of relative deprivation ($P = 0.001$) and reported a higher percentage of EI from carbohydrate ($P = 0.02$) than plausible reporters.

Conclusions Observed differences between under-reporters and plausible reporters suggest that the exclusion of these under-reporters represents an important potential source of bias in obesity research among women in the periconceptional period.

Keywords energy intake, periconceptional, under-reporters, Willet food frequency questionnaire

Introduction

Dietary misreporting is an accepted shortcoming in nutritional surveys.[1] The use of external reference measures, such as whole-body calorimetry, and biomarkers, such as urinary nitrogen excretion and doubly labelled water (DLW), have confirmed that misreporting is common in self-reported dietary assessments, with a strong tendency towards under-reporting.[2,3] It has consequently been recommended that all dietary intake studies include an external independent measure of validity.[4] The DLW method, for example, can measure energy expenditure with good accuracy.[5] However, it is costly and unsuitable for large samples.[6] As a result, a method based on the ratio of energy intake (EI) to basal metabolic rate (BMR) (EI/BMR) has been introduced[7] and refined[8] to detect misreporting in weight-stable individuals.

Reporting of EI may be influenced by factors including age, sex, body fat, body mass index (BMI), education level, social desirability and income level.[9–12] Obesity affects one in six women booking for antenatal care in our hospital and is an important modifiable obstetric risk factor.[13] Maternal obesity increases the risk of pregnancy-related complications, such as gestational diabetes mellitus, which is also associated

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with the increased risk of type 2 diabetes mellitus in later life.[14,15] Maternal obesity is associated with an increase in obstetric interventions such as caesarean section[16] and is associated with an increased risk of congenital malformations such as neural tube defects.[17]

Metabolic ill-health in pregnancy has been mainly attributed to high maternal bodyweight,[18] as well as excessive refined sugar intake.[19] Findings of lower micronutrient status in obese pregnant women have prompted speculation that deficits in vitamin D[20] and iron[21] status in obese women may exacerbate their observed metabolic and immunological abnormalities in pregnancy.

As income decreases, consumption of low-cost, energy-dense, nutrient-dilute foods increases.[22] Lower income levels in women have also been associated with more frequent under-reporting of EI.[9] Correction of micronutrient deficiencies in obese and low-income group women might improve their maternal metabolic and inflammatory status, potentially enhancing the long-term health of their offspring.

However, the increased incidence of under-reporting in overweight, obese and low-SES women may obfuscate their actual nutritional risk. For example, many studies exclude mis-reporters from their final analyses or rely on predictive equations to estimate correct EI.[12] Thus, mis-reporters may be either omitted entirely from such nutrient intake analyses introducing systematic bias or may have their nutrient intakes estimated from derived quantitative data, which assume the absence of qualitative bias in these respondents' dietary reporting. Maternal diet and nutritional status can be modified before conception, and given the potential importance of maternal diet in foetal programming and lifelong health, all women in pregnancy or planning pregnancy, who are at risk of micronutrient deficiencies or excessive macronutrient intakes, should be identified and interventions evaluated.[23] The purpose of this cross-sectional study was to analyse the characteristics of women who misreported dietary EI in the periconceptional period according to the validated Willet food frequency questionnaire (WFFQ).[24]

Methods

This cross-sectional study was carried out in the Coombe Women and Infants University Hospital, which is one of the largest maternity hospitals in the EU and cares for women from all socioeconomic groups and from across the urban–rural divide. Women were recruited at their convenience between February and August 2013. The main inclusion criterion was women booking for antenatal care after an ultrasound examination confirmed a singleton ongoing pregnancy in the first trimester. The main exclusion criterion was multiple pregnancies so to reduce the number of confounding variables.

Height was measured to the nearest centimetre using a Seca wall-mounted digital metre stick with women standing in their bare feet. Weight and body composition were measured digitally to the nearest 0.01 kg (Tanita MC 180, Tokyo, Japan) and BMI calculated. Socioeconomic, health behavioural and physical activity data were also collected at the same time using an unsupervised questionnaire. The clinical and health behavioural data included any medical conditions or medications which applied to the individual, or if the individual was taking supplements. Supplement data were not included in the final nutrient estimation.

Food frequency questionnaire

To collect habitual food and nutrient intakes, women were asked to complete a self-administered, semi-quantitative WFFQ at the first antenatal visit. Women were given the WFFQ at the start of their antenatal visit and asked to complete the questionnaire unsupervised. The WFFQ is adapted from the European Prospective Investigation into Cancer and Nutrition (EPIC) study and validated for use in a population of Irish adults.[25–27] The WFFQ has also been validated in an Irish obstetric population.[24]

The adapted WFFQ comprises 170 food and beverage items. Frequency of consumption of a standard portion of each food or beverage item consumed was divided into nine categories, ranging from 'never or less than once per month' to 'six or more times per day'. This instrument captures food and nutrient data reflective of the periconceptional period, as the WFFQ focuses on intake over the previous year. These WFFQ data were entered into WISP version 4.0 (Tinuviel Software, Llanfechell, Anglesey, UK) to convert reported food intakes into nutrient intakes. The food composition tables used in WISP are derived from McCance and Widdowson's Food Composition Tables 5th and 6th editions, and all supplemental volumes.[28]

Other lifestyle information

Questions collecting socioeconomic data were derived from the Survey on Income and Living Conditions.[29] Material indices of disadvantage including 'at risk of poverty' status, relative deprivation and consistent poverty were also calculated. 'At risk of poverty' status was calculated by comparing equalized household income against the 60% median income threshold. Relative deprivation was assessed by determining whether the respondents had experienced the enforced absence (due to financial constraint) of two or more basic necessities from a list of eleven. Consistent poverty was identified if a respondent reported being 'at risk of poverty' in addition to experiencing enforced absence of two or more of the eleven basic markers of deprivation.[29]

Self-assessed habitual physical activity levels (PALs) were also collected using a self-administered, unsupervised questionnaire. Individual PAL was estimated for each participant from 1.45 metabolic equivalents (METs) (seated work with no option of moving around and no strenuous leisure time activity); up to 2.20 METs [strenuous work or highly active leisure time (e.g. competitive athletes in daily training)].[30]

Assessment of energy under- and over-reporting

BMR was calculated using standard equations based on gender, weight and age.[31] EI was calculated using WFFQ data and WISP v 4.0 software (Tinuviel Software). Lowest plausible thresholds for PAL were calculated according to respondents' individual self-reported PAL.[8] Those whose ratio of EI to their calculated BMR (EI/BMR) fell below the calculated plausible threshold for their physical activity category were classified as dietary under-reporters.[7] In all categories, those with an EI/BMR of >2.5 were classified as dietary over-reporters.[3]

Statistical analysis

Data analysis was carried out using SPSS statistics version 20.0 (IBM Corporation, Armonk, New York). Respondent data for weight, height, age, gestational age, BMI, % fat mass and % fat-free mass were all normally distributed. Independent samples *t*-tests were used to compare the mean values for these variables between the plausible reporter and mis-reporter groups. As fat mass and fat-free mass levels were non-normally distributed, differences in their median levels between the plausible reporter and mis-reporter groups were assessed using Mann–Whitney *U* tests. Cross-tabulation with Chi-square analyses were used to test differences between the proportions of plausible reporters and mis-reporters in different socioeconomic and health behavioural groups, e.g. ethnicity, smoking status, reporting the Yates continuity correction for all dichotomous 2×2 tests.

Nutrient data were non-normally distributed; thus, Mann–Whitney *U* tests were used to test differences in median absolute nutrient intakes between plausible reporters and mis-reporters. Nutrient intakes per MJ of EI were calculated according to previously described protocols.[32] Mann–Whitney *U* tests were used to test differences in median energy-adjusted macronutrient and micronutrient intakes between these two groups.

Results

Of the 588 women studied, 524 women were included in the final analysis, for the following reasons: fifty-two women (8.8%) did not complete the PAL self-assessment and 12 women (2.0%) did not complete the WFFQ due to time constraints (response rate 89%). For the total population ($n = 524$), the mean age was 30.1 ± 5.3 years, the mean gestational age was 12.6 ± 2.6 weeks, the mean BMI was 25.4 ± 5.6 kg/m^2, with 16.6% obese, and the mean PAL was 1.75 ± 0.2 METs. Forty-five per cent of the sample was primigravidas.

The mean ratio of EI\BMR was 2.1 ± 0.9 in the underweight BMI category, 1.7 ± 0.7 in the ideal weight BMI category, 1.6 ± 0.7 in the overweight BMI category and 1.3 ± 0.9 in the obese BMI category ($P < 0.001$). Under-reported EI were observed in 122 women (23.3%). There were no over-reporters in the sample. Differences in anthropometric and socioeconomic parameters between the under-reporters and plausible reporters are outlined in Table 1. Under-reporters were less likely to have a normal BMI ($P = 0.002$) and more likely to be obese ($P < 0.001$) than plausible reporters. Under-reporters also had higher body fat percentages and lower body fat-free mass percentages than plausible reporters (both $P < 0.001$). Under-reporters were more likely to be at risk of relative deprivation ($P = 0.001$). Consistent poverty levels were the same in the plausible and under-reporter groups.

Under-reporters reported lower absolute intakes of all macro and micronutrients as per the WFFQ (Table 2). Under-reporters reported a higher percentage of energy from carbohydrate ($P = 0.02$) and higher intakes of riboflavin ($P < 0.001$), thiamine ($P = 0.03$), niacin ($P = 0.001$), vitamin B_6 ($P = 0.002$), folate ($P = 0.006$) and dietary fibre ($P < 0.004$) per MJ of energy consumed according to their WFFQ data. Under-reporters reported lower intakes of calcium ($P = 0.01$), magnesium ($P = 0.03$) and retinol ($P = 0.002$) per MJ of energy consumed as per their WFFQ (Tables 3 and 4).

Discussion

Main finding of this study

This cross-sectional study, using the WFFQ to assess periconceptional diet, found that under-reporting was more likely to occur in obese women. Under-reporting was also positively associated with increasing fat mass and increasing percentage of body fat. The under-reporters were younger than the plausible reporters ($P < 0.001$) and had a higher prevalence of relative deprivation ($P = 0.001$). Therefore, excluding under-reporters introduces a potential bias in assessing the links between food and nutrient intake and obesity among pregnant women. When macronutrients were expressed as percentages of total energy, under-reporters reported a higher percentage of energy from carbohydrate than plausible

Table 1 Characteristics of study subjects

	Plausible reporters (n = 402)	*Under-reporters (n = 122)*	*P*
Weight (kg)[a]	67.1 ± 12.5	76.9 ± 18.3	<0.001
Height (m)[a]	1.65 ± 7.3	1.66 ± 6.2	NS
Age (years)[a]	30.8 ± 5.2	28.0 ± 4.8	<0.001
Gestational age at first visit (weeks)[a]	12.7 ± 2.6	12.3 ± 2.3	NS
BMI (kg/m^2)[a]	24.6 ± 4.7	28.1 ± 6.9	<0.001
Underweight[b]	14 (3.5)	1 (0.8)	–
Ideal weight	225 (55.8)	45 (36.9)	0.002
Overweight	120 (29.8)	33 (27)	NS
Obese	44 (10.9)	43 (35.2)	<0.001
Fat mass (kg)[c]	19 (10)	24 (15.6)	<0.001
Fat mass (%)[a]	29.7 ± 6.6	33.2 ± 7.6	<0.001
Fat-free mass (kg)[c]	46 (6.3)	49 (9.3)	<0.001
Fat-free mass (%)[a]	70.2 ± 6.7	66.8 ± 7.6	<0.001
Parity[c]	1 (1)	0 (1)	–
Cultural background[b]			
Irish	304 (75.6)	100 (82.0)	NS
Other European	69 (17.2)	17 (13.9)	NS
Asian	6 (1.5)	2 (1.6)	–
African	4 (1.0)	0 (0)	–
Other	19 (4.7)	3 (2.5)	–
Have you ceased full-time education?[b]			
Yes	286 (71.1)	88 (72.1)	NS
No	116 (28.9)	34 (27.9)	
Smoking status[b]			
Current smoker	51 (12.7)	14 (11.5)	NS
Former smoker	181 (45.0)	48 (39.3)	
Never smoked	170 (42.3)	60 (49.2)	
Alcohol consumption[b]			
Yes	230 (57.2)	66 (54.1)	NS
No	172 (42.8)	56 (45.9)	
Relative income poverty[b,d]			
At risk	139 (34.6)	30 (24.6)	NS
Not at risk	263 (65.4)	87 (71.3)	
Relative deprivation[b,e]			
At risk	31 (7.7)	23 (18.9)	0.001
Not at risk	355 (88.3)	99 (81.1)	
Consistent poverty[b,f]			
At risk	31 (7.7)	9 (7.4)	NS
Not at risk	355 (88.3)	108 (88.5)	

[a]Mean ± SD.
[b]Number (% of group).
[c]Median (IQR).
[d]Missing data, $n = 5$.
[e]Missing data, $n = 16$.
[f]Missing data, $n = 21$.

Table 2 Comparison between plausible reporters and under-reporters in absolute macro- and micro-nutrient intakes

	Plausible reporters[a] (n = *402)*	*Under-reporters* [a] (n = *122)*	*P*
Protein (g)	94.0 (51)	56.0 (19)	<0.001
Carbohydrate (g)	259 (129)	155 (61)	<0.001
Fat (g)	84.5 (41)	47.0 (21)	<0.001
Saturates (g)	29.0 (15)	16.5 (8)	<0.001
Monounsaturated fat (g)	27.0 (14)	15.0 (8)	<0.001
Polyunsaturated fat (g)	19.0 (10)	10.0 (5)	<0.001
Fibre (g) (AOAC)	30.0 (15)	18.0 (9)	≤0.001
Non-milk extrinsic sugar (g)	35.0 (32)	20.0 (18)	<0.001
Alcohol (g)	1.00 (5)	0.00 (1)	<0.001
Sodium (mg)	2837 (1465)	1655 (982)	<0.001
Potassium (mg)	4292 (6736)	2427 (1108)	<0.001
Calcium (mg)	794 (534)	425 (230)	<0.001
Magnesium (mg)	387 (588)	207 (101)	<0.001
Phosphorus (mg)	1553 (952)	889 (346)	<0.001
Iron (mg)	17.0 (12)	9.00 (5)	<0.001
Copper (mg)	2.00 (1)	1.00 (0)	<0.001
Zinc (mg)	11.0 (5)	6.00 (2)	<0.001
Chloride (mg)	4131 (2028)	2412 (1434)	<0.001
Iodine (mg)	91.0 (48)	53.0 (28)	NS
Retinol (μg)	297 (244)	160 (108)	0.002
Carotene (μg)	6437 (4976)	4016 (4040)	NS
Vitamin D (μg)	3.00 (2)	1.00 (1)	<0.001
Vitamin E (mg)	11.0 (6)	7.00 (3)	<0.001
Vitamin C (mg)	220 (149)	132 (109)	<0.001
Thiamine (mg)	2.00 (1)	1.00 (1)	<0.001
Riboflavin (mg)	2.00 (1)	1.0 0 (0)	<0.001
Niacin (mg)	26.0 (11)	16.0 (7)	<0.001
Vitamin B_6 (mg)	3.00 (1)	2.00 (1)	<0.001
Vitamin B_{12} (mg)	4.00 (3)	2.00 (1)	≤0.001
Folate (μg)	337 (170)	213 (95)	0.006

[a]Median (IQR); AOAC: Association of Organic and Analytic Chemists method used by WISP V 4 to measure fibre content of food.

reporters ($P = 0.02$), possibly reflecting selective biases in their under-reporting behaviour.

Our study has a large sample size. Another strength of our study is that individually reported PAL were used to assess lowest plausible thresholds for PAL.[8] This allowed for the identification of women who were deemed likely to be mis-reporters at an individual level, i.e. if EI/BMR was less than the individual's lowest plausible threshold for PAL, they were considered under-reporters. Many studies use a single PAL value to estimate the group's PAL, which may be considered inaccurate as estimated habitual PALs among free-living individuals vary greatly.[3] It has been suggested that to optimize the accuracy of data collected, a measure of physical activity should be collected, which allows individuals to be categorized into different activity levels for the purpose of stratified EI/BMR threshold calculation.[33] Our study used bioelectric impedance to measure maternal weight and body composition. The accurate assessment of bodyweight is critical as women, in particular obese women, have been shown to underestimate their weight.[13]

Limitations of this study

A limitation of the study is that only one dietary assessment method was used to assess energy and nutrient intakes and that this was a self-reported questionnaire. Studies have shown that accuracy of the food frequency questionnaire (FFQ) can be lower than other methods, with the FFQ containing a substantial amount of measurement error because it makes several assumptions about food portion size and may

Table 3 Comparison between plausible reporters and under-reporters in percentage of EIs from macronutrients

	Plausible reporters[a] *(n = 402)*	*Under-reporters*[a] *(n = 122)*	*P*
Protein (%/MJ/day)	17.3 (5)	17.3 (4)	NS
Carbohydrate (%/MJ/day)	48.1 (10)	49.9 (11)	0.02
Fat (%/MJ/day)	36.2 (7)	35.2 (10)	NS
Saturates (%/MJ/day)	12.0 (3)	11.7 (4)	NS
Monounsaturated fat (%/MJ/day)	11.6 (3)	11.1 (4)	NS
Polyunsaturated fat (%/MJ/day)	7.70 (3)	7.40 (3)	NS
Fibre (g/MJ/day) (AOAC)	3.20 (1)	3.70 (1)	0.004
Non-milk extrinsic sugar (%/MJ/day)	6.70 (5)	6.60 (5)	NS

[a]Median (IQR); AOAC: Association of Organic and Analytic Chemists method used by WISP V 4 to measure fibre content of food.

result in an underestimation of dietary intake due to an inadequate list of food items.[9,34] Nonetheless, the FFQ can be reliably used to rank individuals according to food or nutrient intake and, thus, represents an appropriate tool to analyse the characteristics of mis-reporters.

Our study did not record nausea in the first trimester. Dietary intake should increase during pregnancy.[35] However, common fluctuations in appetite, nausea and vomiting may affect this anticipated increase.[36] Thus, a specific period of pregnancy may not be representative of the whole gestation. It has been shown that a single FFQ administration around the time of delivery was able to capture dietary intake throughout the whole pregnancy among Portuguese pregnant women.[37] These researchers found that the performance of their FFQ was not modified by the presence of nausea and/or vomiting, daily number of meals or weekly weight gain. Similarly, an FFQ given once during pregnancy, between 12 and 34 weeks of gestation, in Irish multigravidas was shown to be representative of dietary intake throughout the whole pregnancy.[24,38] The WFFQ used in this study is representative of the periconceptional period. Further studies are needed to assess the extent and characteristics of women who under-report EI throughout the whole gestation.

What is already known on this topic?

Studies using DLW and urinary nitrogen have confirmed a higher prevalence of under-reporting among obese subjects, as well as differential dietary reporting patterns with respect to different foods.[39–41] Other researchers have also reported that non-pregnant subjects who have higher BMI are more likely to under-report.[12] In a Brazilian study, using DLW as an external validator of energy, there was a positive association between increasing BMI and under-reporting in 65 women. Similarly, in our study, under-reporters were more likely to be overweight or obese.

Lower income levels have been associated with more frequent under-reporting.[9] As income decreases, an increase in energy-dense, nutrient-dilute foods can occur, possibly as a means to maintain EI at a lower cost. If income decreases further, households may decrease EI below daily requirements, resulting in overt deprivation.[22] The current study found that women who under-reported EI were more likely to be at risk of relative deprivation. These women may be consuming an EI below requirements as a means to reduce costs, as opposed to actually under-reporting EI.

In a Canadian study, 43% of participants were classified as under-reporters when evaluated by the Goldberg technique. Female under-reporters were older ($P = 0.01$), heavier ($P = 0.04$), had a higher BMI ($P = 0.02$) and were more likely to report intakes of foods containing a higher percentage of carbohydrate ($P = 0.02$) or a lower percentage of fat ($P = 0.002$), than plausible reporters.[42] Other studies have also observed that older women were more likely to under-report EI than younger women.[43] One study in postmenopausal women identified no effect of age on energy reporting levels.[44] Another study found that younger, postmenopausal women under-reported EI more frequently than older women.[45] In our study, under-reporters were more likely to be younger ($P < 0.001$). There are few studies investigating the effect of age on energy under-reporting in the periconceptional period, and the interpretation of such data is further complicated by the socioeconomic gradient in primiparous age.[46,47]

The EPIC-Postdam study also found that EI/BMR ratios decreased with increasing BMI ($P < 0.001$).[41] In our study, the mean EI/BMR also decreased as BMI increased ($P < 0.001$). EI was measured in the EPIC-Postdam study using a semi-quantitative FFQ, and BMR was calculated using standard equations including weight and age.[48] The EPIC-Postdam study found that a higher proportion of under-reporters reported a higher proportion of energy from protein and carbohydrate, and a lower proportion of energy from fat.[41] Our study also found that under-reporters reported a higher proportion of energy from carbohydrate.

In 436 Australian middle-aged women, the relationship between body fat using dual X-ray absorptiometry and the dietary characteristics of energy under-reporters was

Table 4 Comparison between plausible reporters and under-reporters in percentage of EIs from micronutrients

	Plausible reporters[a] (n = 402)	*Under-reporters*[a] (n = 122)	*P*
Sodium (mg/MJ/day)	308 (84)	313 (114)	NS
Potassium (mg/MJ/day)	653 (508)	451 (165)	NS
Calcium (mg/MJ/day)	86.2 (34)	78.1 (31)	0.01
Magnesium (mg/MJ/day)	41.6 (44)	37.9 (16)	0.03
Phosphorus (mg/MJ/day)	166 (49)	164 (31)	NS
Iron (mg/MJ/day)	1.70 (0.9)	1.70 (0.7)	NS
Copper (mg/MJ/day)	0.20 (0.1)	0.20 (0.1)	NS
Zinc (mg/MJ/day)	1.20 (0.3)	1.20 (0.3)	NS
Chloride (mg/MJ/day)	453 (124)	454 (162)	NS
Iodine (mg/MJ/day)	9.70 (4)	9.90 (4)	NS
Retinol (μg/MJ/d)	33.1 (22)	29.6 (18)	0.002
Carotene (μg/MJ/d)	709 (591)	752 (789)	NS
Vitamin D (μg/MJ/d)	0.30 (0.2)	0.30 (0.2)	NS
Vitamin E (mg/MJ/day)	1.30 (0.4)	1.20 (0.4)	NS
Vitamin C (mg/MJ/day)	22.8 (17)	25.2 (23)	NS
Thiamine (mg/MJ/day)	0.22 (0.1)	0.23 (0.1)	0.03
Riboflavin (mg/MJ/day)	0.17 (0.1)	0.19 (0.1)	<0.001
Niacin (mg/MJ/day)	2.90 (0.9)	3.10 (1)	0.001
Vitamin B_6 (mg/MJ/day)	0.30 (0.1)	0.33 (0.1)	0.002
Vitamin B_{12} (mg/MJ/day)	0.50 (0.2)	0.50 (0.3)	NS
Folate (μg/MJ/d)	37.1 (14)	42.0 (15)	0.006

[a]Median (IQR).

investigated.[49] Women categorized as under-reporters had increased weight ($P < 0.01$), BMI ($P < 0.01$), total fat mass ($P < 0.05$) and fat-free mass ($P < 0.05$) than plausible reporters. However, percentage of body fat did not differ between the two groups. While higher percentage of body fat was seen in women with a lower EI/BMR ratio in the EPIC-Postdam study ($P < 0.001$), the calculation of percentage of body fat in this study was based on derivation using skin-fold measurements.[41,50] In our study, under-reporters had a higher BMI, higher fat mass and body fat percentages and lower fat-free mass and body fat-free mass percentages than plausible reporters, suggesting that both BMI and adiposity are associated with under-reporting.

The characteristics of under-reporters have been well documented in general populations; there are fewer studies investigating the characteristics of under-reporters in the periconceptional period. Periconceptional nutrition is known to be crucial for an optimal onset and development of pregnancy.[51] In 260 Irish multigravidas women, between 10 and 18 weeks of gestation, a high proportion (44%) were classified as under-reporters.[10,38] In 490 Indonesian women, the mean EI/BMR was 1.33, classifying 29.7% as under-reporters in the first trimester of pregnancy.[11] The authors believed that this percentage represented a group with inadequate dietary intake as opposed to under-reporting, as many women reported nausea during the first trimester.

What this study adds

The observed dietary reporting bias in this study, as well as the biases introduced by the exclusion of dietary misreporters or the adjustment of their reported dietary intakes based on exclusively quantitative correction equations, may generate misleading associations between dietary and nutrient intakes and obstetric outcome. The increased incidence of under-reporting in overweight and obese women in particular may result in erroneous conclusions regarding the nutritional status and risk profile of these women. The assessment of body composition allowed us investigate the association between body fat levels in early pregnancy and the likelihood of under-reporting, which as far as we are aware has not been investigated in any previous studies in pregnancy. Women with at risk of relative deprivation may be at particular risk of nutritional deficiencies. Maternal diet and nutritional status can be modified before conception, and given the potential importance of maternal diet in foetal programming and lifelong health, the associations between nutritional intake and status and gestational outcome need to be clearly and accurately articulated. On the basis of these findings, all women who are planning pregnancy or in pregnancy who may be at risk of nutritional deficiencies or excesses need to be accurately identified so that effective interventions can be implemented. Particular emphasis on specialist dietary assessment in overweight and obese women in pregnancy may also be needed to ensure the collection of more robust nutritional intake data from these women. There may also be a need to refine advice given to women who are pregnant or planning a pregnancy.

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