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Dietary assessment of a population of pregnant women in Sheffield, UK

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The present study examined the dietary intakes of a population of pregnant women living in the North of England. The objectives of the paper were to assess and describe the dietary intakes of the population and relate the findings to existing data on the diet of pregnant and non-pregnant women in the UK. A total of 250 pregnant women attending their first antenatal appointment at the Jessop Wing Hospital, Sheffield, UK were recruited. Information on their diet was assessed by an interviewer-administered semi-quantified food frequency questionnaire (FFQ). The mean intakes as assessed by the FFQ were similar to other studies of UK pregnant population; however Sheffield pregnant women had lower intakes of calcium and folate. Study findings were also related to the National Diet and Nutrition Survey and to the Estimated Nutrient Intakes (EAR). Of the study participants, 40 % did not meet the EAR for calcium, 67 % for iron and 69 % for folate. Subgroup comparisons suggested lower nutrient intakes of participants living in the 40 % most deprived electoral wards. The study findings suggest that the diet of pregnant women in Sheffield is characterised by low intakes of important nutrients for pregnancy such as folate and nutrient variations by electoral wards.

Diet: Pregnancy: Food frequency questionnaire: Nutrient intakes

The quality of the maternal diet during the pre- and periconceptional period is of significant importance because of its association with pregnancy outcome, e.g. low folate status is associated with an increased risk of neural tube defects (NTD; Medical Research Council Vitamin Study Research Group, 1991; Scholl & Johnson, 2000). Increasing evidence indicates that maternal nutrition might not only affect the immediate pregnancy outcome, but also the well-being of the infant later in life (Godfrey *et al.* 1996; Godfrey & Barker, 2001). Barker (1992) suggested that 'fetal under-nutrition at critical periods of development in *utero* and during infancy might lead to permanent changes in body structure and function'. These changes may result in increased adult susceptibility to CHD and non-insulin-dependent diabetes mellitus.

In the UK, the quality of a woman's diet during pregnancy tends to fall with income (Bull *et al.* 2003) and mothers from low-income households are nutritionally vulnerable and may go short of food in order to feed their children (Dobson *et al.* 1994; Dowler & Calvert, 1995). A small number of studies, which describe the diet of pregnant women in the UK, have been published (Mathews & Neil, 1998; Rogers *et al.* 1998*a*) and few have investigated the association between maternal diet quality and income (Rogers *et al.* 1998*b*). Up-to-date information on the diet, eating habits and dietary patterns of this potentially vulnerable group is necessary for future planning of nutrition-related interventions locally and nationally such as the Healthy Start initiative to reform the Welfare Food Scheme (Department of Health 2004).

The objective of the study was to assess the diet of pregnant women living in Sheffield, as the key to the development of a nutritional screening tool for low-income pregnant women. Sheffield, the fourth largest city outside London, is a city of stark contrasts. Since the decline of the steel industry in the 1970s, Sheffield's 0·531 million population have continued to face considerable economic difficulty, with rising unemployment causing a widening division between the richest and poorest areas. Deprivation is one of the most powerful determinants of health and almost all health indicators are adversely affected by poverty.

Deprivation indicators bring together a range of social and material deprivation factors to produce an overall summary score. By using these scores, areas can be ranked by their degree of relative disadvantage or affluence. These rankings are used in resource allocation calculations for health and local authority services. Sheffield's score is 26·1, which ranks it the twenty-fifth most deprived out of 354 local authorities in England. Within Sheffield, thirteen electoral wards are among the 10 % most deprived wards in the UK (Gordon, 2001).

In this paper we report the dietary intakes of a population of pregnant women and relate them to similar studies which included a pregnant population; the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC) conducted in the county of Avon describing the diet of 11 923 pregnant women at 32 weeks of gestation using a self-administered semi-quantified food frequency questionnaire (FFQ; Rogers *et al.* 1998*a*) and the Mathews' study (Mathews & Neil, 1998) conducted in Portsmouth, which reported information on the nutrient intakes

Abbreviations: ALSPAC, Avon Longitudinal Study of Pregnancy and Childhood; EAR, Estimated Nutrient Intakes; FFQ, food frequency questionnaire; LNRI, Lower Recommended Nutrient Intakes; NDNS, National Diet and Nutrition Survey; NTD, neural tube defects.

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of 774 pregnant women between 9 and 20 weeks of gestation using a self-completed 7 d food diary. The present study findings are also related to the latest National Diet and Nutrition Survey (NDNS) of British adults aged 19–64, using a 7 d weighed-intake dietary record (Henderson *et al.* 2002) and to the Estimated Nutrient Intakes (EAR) and the Lower Recommended Nutrient Intakes (LRNI) relevant for individual nutrients (Department of Health, 1991).

Materials and methods

Subjects and study design

Study participants were women attending their first appointment at the antenatal booking clinic at the Jessop Wing Hospital, Sheffield, UK. Eligibility was defined as being between 14 and 18 weeks of pregnancy and of Caucasian ethnic origin. Women were also excluded if they did not speak English, or if they had any nutrition-related pre-existing medical conditions such as diabetes or coeliac disease.

The choice of the specific gestational age was opportunistic because attendance of the first antenatal appointment usually takes place between 14 and 18 weeks of gestation. Additionally, we have considered evidence from the literature indicating that the diet of pregnant women is affected less by nausea and vomiting which is known in the first trimester and decreases at the beginning of the second trimester (Huxley, 2000).

A number of different ethnic groups lives in the low-income areas of Sheffield, i.e. Pakistani, Indian, Somali and Afro-Caribbean, however, their eating habits are not similar to the Caucasian population. An attempt to document their diet using an identical FFQ most likely would have been unsuccessful due to large geographical and religious variations in the diet of these groups by region of origin (Kassam-Khamis *et al.* 1999; Vyas *et al.* 2003) as well as because of the questionable suitability of an identical FFQ to assess the diet of different ethnic groups (Gibney *et al.* 2004).

The pregnant women were approached by the researchers at the waiting area of the antenatal clinic. A face-to-face interview was conducted with each subject, with each interview lasting at least 30 min. A closed-question questionnaire was used to obtain socio-demographic and anthropometrical data (gestational age, self-reported height and pregnancy weight). Some of the variables used to obtain information on the socio-economic background of the participants included maternal highest educational qualification level, maternal occupation, partner's occupation and receipt of benefits. Behavioural data collected included smoking habit and periconceptional and during pregnancy multi-mineral/multivitamin supplement usage. Other data included information on cooking skills and main household cook. All the interviews were conducting by the same trained nutritionists (T. M. and F. P.).

Subgroup comparisons were facilitated by the use of the Index of Multiple Deprivation. Each subject's postcode was used to indicate whether they lived in the 40 % most deprived wards, or elsewhere within the Sheffield district, and information from the Index of Multiple Deprivation was used to identify them. The Index of Multiple Deprivation combines six separate domains: income, employment and health deprivation, education, skills and training, housing, and finally geographical access to services (Gordon, 2001).

Ethical approval

All subjects gave informed consent to participate in the study. The North and South Sheffield Local Research Ethics Committees approved the study protocol.

Dietary assessment

Dietary intakes of all women were determined using a validated interview-administered semi-quantified FFQ (Mouratidou *et al.* 2006). The Sheffield FFQ is an adaptation of the FFQ developed and evaluated by (Rogers *et al.* 1998*a*) for the ALSPAC study. The ALSPAC FFQ contains questions about the weekly frequency of consumption of forty-three foods and additional questions about bread, types of fat and milk, and consumption of coffee, tea and sugar.

After being piloted with 110 women in Sheffield, the list of foods was then revised by eliminating some items found not to be consumed or to be consumed very rarely locally, e.g. liver, liver pate and peanuts. The revised food list of the FFQ included sixty-two quantitative and qualitative questions, forty of which were about the frequency of consumption of meat, poultry, fish and seafood, common vegetables and fruits, cereals and confectionery. There were also detailed questions about the type and amount of spreading fat, bread, alcohol and milk consumed. Frequency options included: never or rarely, once a fortnight, one to three times a week, four to seven times a week and more than once a day. To increase the simplicity and the inclusion of a wide range of foods eaten, no portion size quantification was asked, thus standard portion sizes were used throughout.

Nutrient calculations

Mean nutrient intakes were calculated from foods only. Q-Builder (Questionnaire Design System version 1.0; Tinuviel Software, Anglesey, UK) was used to analyse daily intakes of energy, nutrients and food items obtained from the FFQ. Q-Builder is a questionnaire design program which incorporates nutritional analysis. It enables generation of any type of open or closed questions, e.g. the type of food, frequency of consumption and the amount consumed. It includes an up-to-date food composition database with the nutrient contents of approximately 5000 foods, and a database of portion sizes for 3800 foods.

The nutritional analysis of Q-Builder is based on the UK food tables (Holland *et al*. 1988, 1989, 1991 *a*,*b*, 1992 *a*,*b*, 1993; Chan *et al*. 1994, 1995, 1996; Food Standards Agency, 2002). Information on food consumption collected by the FFQ is converted by the Q-Builder into a list of foods and weights, to generate mean daily food and nutrient intakes. The approximate daily intake was calculated by multiplying the weekly frequency of consumption of a food by the nutrient content of a standard portion. Each one of the frequency options of the questionnaire allocated was mapped as follows: never or rarely = 0, once a fortnight = 0·5, one to three times a week = 2, four to seven times a week = 5·5 and more than once a day = 14.

Statistical analysis

The Statistical Package for Social Sciences version 12.1 (SPSS Inc., Chicago, IL, USA) was used to analyse the data.

The statistical analysis included means and standard deviations of absolute intakes for energy, macro- and micronutrients, obtained from the FFQ. Regression analysis was also used to model the value of a dependent scale variable, e.g. energy based on its linear relationship, to one or more predictors, e.g. employment, and provide the variable or variables that best predict the value of the dependent variable.

An Independent Sample *t* test was used to compare mean nutrient intakes of those participants living in the 40 % most deprived wards (Group 1) to those living in the rest of the electoral wards (Group 2) within Sheffield and a χ^2 test was used to compare the maternal characteristics.

Results

Population characteristics

Mean gestational age was 14·4 weeks. Table 1 presents the anthropometric characteristics of the study participants. The mean age of the women was 27·0 (SD 7·4) years and mean height and weight were 163·9 (SD 7·2) cm and 69·8 (SD 17·4) kg, respectively. Table 1 also presents some of the behavioural characteristics of the population. Of the 250 participants, 61 % had planned their pregnancies, but only 26 % reported periconceptional vitamin or mineral supplementation; 92 % claimed that they could cook, however, only half of them were regularly cooking at home.

The comparison of the characteristics of the low-income and the rest of the Sheffield women suggested some differences although many of these differences were not statistically significant. However, the low-income women were significantly younger ($P=0·001$), more likely to smoke ($P=0·001$), less well educated ($P=0·001$), less likely to eat takeaway food ($P=0·006$) and less likely to have planned their pregnancy ($P=0·001$) and taken periconceptional folic acid supplements ($P=0·001$). Forward regression analysis was used to test if the highly significant differences in nutrient intakes between the two Sheffield groups could be explained by these characteristics. The results indicated that although the differences in nutrient intakes could partly be explained by whether or not the pregnancy was planned, lower socio-economic status was still a major contributor to lower maternal dietary intakes.

Daily intakes

Of the 257 women invited to participate, 250 (97 %) agreed to complete the study, four (2 %) refused to participate but reported no reason and three (1 %) were excluded from the analysis because of incomplete data. Complete dietary information was provided by 250 pregnant women. The data for the majority of the nutrients were normally distributed. Mean daily intakes and standard deviations of energy, macronutrients and micronutrients assessed by the FFQ are given in Table 2.

Table 3 reports approximate mean intakes related to the ALSPAC study (Rogers *et al.* 1998*a*), the Mathews' study

Table 1. Anthropometric, demographic and behavioural characteristics of study participants (*n* 250)

	Mean	SD	Range
Age (years)	27·0	7·4	15–43
Weight (kg)	69·8*	17·4	40–33
Height (cm)	163·9†	7·2	142·1–182·1
Maternal highest educational qualification level (%)			
Degree	14·4		
Higher Education below degree	13·6		
'A' Levels	6·8		
GCSEs	36·8		
No or other qualifications	28·4		
Maternal employment (%)			
Full-time	30·8		
Part-time	29·2		
Unemployed	16·8		
Economically inactive‡	23·2		
Self-reported smoking status (%)			
Non-smoker	71·6		
Current smoker	28·4		
Pregnancy planning (%)			
Yes	61·2		
No	38·8		
Periconceptional supplement usage (%)			
Yes§	26·4		
No	73·6		
Folic acid supplements during pregnancy (%)			
Yes	92·0		
No	8·0		
Cooking skills (%)			
Yes	92·0		
No	8·0		

* *n* 235.
† *n* 243.
‡ Includes students, housewives and disabled.
§ Percentage of participants taking supplements of folic acid alone is unknown.

Table 2. Mean daily macronutrient and micronutrient intakes based on the food frequency questionnaire (*n* 250)

	Mean	SD	95 % CI
Energy (kJ)	7800	2·16	7530, 8070
Protein (g)	74·2	23·9	71·2, 77·1
Total fat (g)	83·5	27·9	79·5, 86·5
Carbohydrate (g)	217	62·1	210, 225
Saturated fat (mg)	29·2	11·2	27·8, 30·6
Sugars (g)	78·1	34·2	73·8, 82·3
Starch (g)	139	39·8	134, 144
Englyst fibre (g)	12·4	4·70	11·8, 13·0
Sodium (mg)	2508	762	2413, 2603
Calcium (mg)	692	222	664, 720
Magnesium (mg)	220	68·4	212, 229
Phosphorus (mg)	1187	351	1143, 1231
Iron (mg)	10·2	3·77	9·76, 10·7
Zinc (mg)	7·4	2·35	7·16, 7·74
Iodine (μg)	92·5	39·9	87·5, 97·5
Retinol (μg)	271	159	251·1, 290
Carotene (μg)	1446	841	1342, 1551
Vitamin D (μg)	2·6	1·66	2·43, 2·84
Vitamin E (mg)	4·1	1·98	3·87, 4·37
Thiamine (mg)	1·2	0·44	1·21, 1·32
Riboflavin (mg)	1·0	0·45	1·02, 1·14
Niacin (mg)	18·0	6·20	17·2, 18·8
Vitamin B_6 (mg)	1·8	0·61	1·73, 1·88
Vitamin B_{12} (μg)	4·5	2·50	4·22, 4·85
Folate (μg)	204	71·2	196, 213·8
Pantothenic acid (mg)	3·4	1·20	3·28, 3·58
Biotin (μg)	15·1	6·69	14·29, 15·9
Vitamin C (mg)	67·4	34·2	63·1, 71·6
Alcohol (g)	1·74	5·61	1·04, 2·45

Table 3. Approximate daily energy, macronutrient and micronutrient mean intakes based on the food frequency questionnaire, in comparison to the results from the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC; Rogers *et al.* 1998*a*), Mathews study (Mathews & Neil, 1998) and the National Diet and Nutrition Survey (NDNS; Henderson *et al.* 2002)

	Whole group	ALSPAC	Mathews	NDNS
Energy (kJ)	7800	7700	8500	6870
Protein (g)	74·2	66·3	73·5	63·7
Total fat (g)	83·5	70·4	85·7	86·5
Carbohydrate (g)	217	–	255	203
Sodium (mg)	2508	–	–	2302
Calcium (mg)	692	953	921	777
Magnesium (mg)	220	253	–	229
Iron (mg)	10·2	10·4	10·5	10·0
Zinc (mg)	7·4	8·3	8·2	7·4
Vitamin D (μg)	2·6	–	2·6	3·7
Vitamin E (mg)	4·1	8·4	9·0	15
Thiamine (mg)	1·2	1·4	1·5	1·5
Riboflavin (mg)	1·0	1·7	1·7	1·6
Niacin (mg)	18·0	15·8	–	30·9
Vitamin B_6 (mg)	1·8	1·8	–	2·0
Vitamin B_{12} (μg)	4·5	–	3·9	4·8
Folate (μg)	204	250	242	251
Vitamin C (mg)	67·4	80·3	83·3	81·0
Alcohol (g)	1·74	–	1·5	9·3

(Mathews & Neil, 1998) and the NDNS (Henderson *et al.* 2002). In the ALSPAC study nutrient intakes were calculated from food sources; however, in the Mathews and the NDNS surveys estimated nutrient intakes were calculated from both food and all sources. The findings of the present study are related to the nutrient intakes resulted from calculation from food sources only. As seen in Table 5, mean macronutrient intakes were similar. Micronutrient intakes, however, were slightly lower for calcium, vitamin C, folate and for the majority of the vitamins examined.

The dietary intakes were matched up to the EAR (Department of Health, 1991) for women aged 19–50 with the addition, where appropriate, of an increment for pregnancy. Table 4 reports the mean intakes of selected nutrients chosen because of their importance in pregnancy related to the EAR and LRNI, and the percentage of the women below the EAR and LRNI.

A comparison of the mean nutrient intakes (*P* value) of those participants living in the most deprived wards (Group 1) to those living in the rest of the city (Group 2) suggested significantly statistical differences for some of the nutrients examined (Table 5). Pregnant women living in the most deprived electoral wards had lower intakes of Englyst fibre ($P=0·001$), iron ($P=0·004$) and most of the vitamins examined including folate ($P=0·001$) and vitamin C ($P=0·045$). Women assigned at Group 1 had lower but non-significantly lower intakes of energy, total fat, carbohydrate and calcium, and higher intakes of protein and vitamin B_{12}.

Discussion

This paper describes the diet of a population of Caucasian pregnant women living in the North of England and relates their diets to those reported from recent, relevant studies from the UK. The decision to exclude Black and minority ethnic groups came from evidence suggesting possible difficulties related to the applicability within different ethnic groups of an identical FFQ. A questionnaire with appropriate foods and portion sizes for one group might not be appropriate for another as a significant number of foods consumed in ethnic diets might not be covered by the questionnaire (Gibney *et al.* 2004). Vyas *et al.* (2003) attempted to evaluate the dietary intakes of different ethnic groups with specifically developed FFQ and pointed out potential limitations such as missing data from the food composition tables and underreporting related to portion sizes and grouping of mixed dishes.

The FFQ method was used to assess the habitual nutrient intakes of the study population. There were several reasons for this decision. The ALSPAC study (Rogers *et al.* 1998*a*), in which the questionnaire was used initially, is the largest study conducted in pregnant women (nearly 12 000) in the UK, therefore clear evidence existed to support the administration and effectiveness of a food frequency method on pregnant population. Secondly, this method is increasingly used in epidemiological studies even though there are concerns related to its use, i.e. assessment of absolute intakes, intakes of mixed dishes and food grouping (Gibney *et al.* 2004). The simplicity of the technique, its cost-effectiveness and the low respondent burden, however, made it a more sensible and suitable method to use in the present study. Unlike food records which are more precise in terms of assessing absolute intakes, the high level of motivation and high respondent burden required might have had an effect on the response rate (Willet, 1998).

When interpreting the results of the present study, the use of standard portion sizes for the first part of the questionnaire has to be considered. Portion size information was not included which might have led to under- or over-representation of

Table 4. Mean group intakes, Estimated Nutrient Intakes (EAR; Department of Health, 1991) for non-pregnant women aged 19–50 years, suggested increments during pregnancy, percentage of women below the EAR and Lower Recommended Nutrient Intakes (LRNI; Department of Health, 1991) and percentage of women below the LRNI for selected nutrients

	Group intakes	EAR	Increments for pregnancy	% Below EAR	LRNI	% Below LRNI
Energy (kcal)	1880	1940	200†	60	–	–
Calcium (mg)	692	525	0·0	40	400	10
Iron (mg)	10·2	11·4	0·0	67	8·0	30
Riboflavin (mg)	1·0	0·9	0·3	61	0·8	38
Folate (μg)	204	150	100	69	100	4
Vitamin C (mg)	67·4	25	10*	19	10	1

* Third trimester only.

Table 5. Comparison of the mean daily macronutrient and micronutrient intakes based on the food frequency questionnaire for Group 1 (*n* 174) and Group 2 (*n* 76)

	Group 1		Group 2			
	Mean	SD	Mean	SD	95 % CI	*P* value*
Energy (kJ)	7700	2260	7800	1910	−80, −200	0·717
Protein (g)	76·0	25·5	70·0	19·4	−0·46, 12·4	0·069
Total fat (g)	81·9	28·2	85·5	27·3	−11·2, 3·9	0·344
Carbohydrate (g)	215	66·1	222	51·8	−24·1, 9·5	0·395
Saturated fat (mg)	27·6	10·2	33·0	12·5	−8·66, −2·19	0·001
Englyst fibre (g)	11·7	4·58	14·2	4·56	−3·71, −1·26	0·0001†
Sodium (mg)	2559	817	2391	607	−37·5, 374	0·109
Calcium (mg)	676	222	729	221	−113, 6·56	0·080
Magnesium (mg)	213	69·3	236	63·7	−41·2, −4·59	0·014†
Iron (mg)	9·78	3·81	11·2	3·50	−2·49, −0·48	0·004†
Vitamin D (μg)	2·61	1·74	2·69	1·48	−0·53, 0·35	0·698
Thiamine (mg)	1·17	0·44	1·49	0·39	−0·43, −0·20	0·0001†
Riboflavin (mg)	0·96	0·41	1·36	0·43	−0·51, −0·28	0·0001†
Vitamin B_6 (mg)	1·72	0·62	2·01	0·55	−0·04, −0·12	0·001†
Vitamin B_{12} (μg)	4·99	2·71	3·50	1·56	0·94, 2·01	0·0001†
Folate (μg)	193	71·1	230	64·9	−56, −18·5	0·0001†
Vitamin C (mg)	64·8	36·3	73·4	28·4	−17·0, −0·18	0·045†
Alcohol (g)	2·45	6·65	0·14	0·13	0·80, 3·81	0·0001†

* Independent sample *t* test for equality of means.
† Difference is significant.

intakes for those women who consume relatively smaller or larger portions of foods. For the second part of the questionnaire (including foods that come with typical units such as slices of bread, cups of tea) specification of portion size as part of the frequency consumption provided further information and clarity. The nutrient calculation of the FFQ presumes that the participants consume a selection of the foods described by each question but in fact they might only eat one of the items described by each question, resulting in a wider range of estimated nutrient intakes. We are confident, however, that the questionnaire provided useful estimates of nutrient intakes as demonstrated by results of the validation study where the FFQ performed well for most of the nutrients and had acceptable agreement compared to the mean intakes of two consecutive 24 h recalls (Mouratidou *et al.* 2006).

Examination of the maternal characteristics for the total sample has shown that 61 % of the participants reported planning their pregnancy but this varied from 83 % in the higher-income group down to only 53 % of the low-income Sheffield women; 26 % of the total group of Sheffield women reported taking periconceptional folic acid supplements but again there was a statistically significant difference according to income, i.e. only 14 % of the low-income group took them compared to 54 % of the higher-income women.

It is estimated that half of all pregnancies in the UK are unplanned which limits the usefulness of periconceptional supplements in reducing the risk of NTD (Botting, 2001). A small percentage of the total participants, i.e. 8 %, reported not having taken folic acid supplements at all during pregnancy. We know that these folic acid supplements were not started periconceptionally but when the pregnancy was confirmed and then up until 12 weeks gestation, which would have been too late to reduce the risk of NTD but would have made a significant contribution to maternal folate status. The present results suggested that both the low-income and higher-income Sheffield women have low folate intakes, as can be seen in Table 4. Low folate status in pregnancy has been related to other poor pregnancy outcomes as well as NTD (Vollset *et al.* 2000).

Recent data from the Health Survey of England (Blake *et al.* 2003) provides the most up-to-date information on the use of folic acid supplements prior to and during pregnancy by women of childbearing age. Information on folic acid supplement intake was collected prior to pregnancy from mothers who had planned their pregnancy, who comprised two-thirds of the interview sample. Over half (55 %) reported taking supplements or modifying their diet to increase folate intake. However, only 43 % of mothers in the most socially deprived areas were likely to increase folate intakes compared to 70 % of mothers from the least socio-economically deprived areas.

Small differences in macronutrient intakes were observed between the Sheffield women and the other studies. Intakes of energy, protein and total fat were relatively higher for the Sheffield women than those from the ALSPAC pregnancy nutrition study and the NDNS. However, when the Sheffield women were compared to the Mathews study (Mathews & Neil, 1998), mean daily intakes of energy and macronutrients for the Sheffield women were lower with the exception of protein. Nutrient intakes for calcium, riboflavin, vitamin C and for most of the vitamins including folate were comparatively lower in the Sheffield women than those reported in the ALSPAC and Mathews studies.

Similar trends were also found in comparison with the NDNS. Differences observed may be partly explained by differences in the stage of pregnancy when the questionnaires were administered, a 10-year gap between the two studies, different dietary assessment methodologies, and vastly differing sample sizes and population characteristics. As seen in Table 4, 60 % of the Sheffield women failed to reach the EAR for energy; 40 % failed to meet the EAR for calcium, 69 % did not meet the folate recommendations, 61 % the riboflavin suggested intakes and 67 % failed to meet those for iron.

Although the whole group of Sheffield women showed similar trends in nutrient intakes in comparison with the results from other studies, when the Sheffield women were divided into two groups according to socio-economic status, a very different trend emerged for the low-income group, i.e. those living in the 40 % most deprived electoral wards had significantly lower intakes of saturated fat, fibre, magnesium, iron, thiamine, riboflavin, vitamin B_6, vitamin B_{12}, vitamin C and folate than the women living in the rest of Sheffield. The subgroup comparisons reflect the results of a previous pregnancy study (Rogers *et al.* 1998*b*), which identified a relationship between financial hardship and nutrient intakes.

In the present study we have attempted to assess the habitual nutrient intakes of pregnant women living in Sheffield, using a semi-quantified FFQ. The present findings show similar trends to those from previous studies in the UK that have reported low iron, calcium, vitamin C and folate intakes in pregnancy. However, the low-income sample had worryingly low intakes of the majority of micronutrients in a similar fashion to the results of Rodgers *et al.* (1998*b*) which showed that out of twenty nutrients studied only three were unaffected by financial difficulty.

In late 2005 the National Institute for Health & Clinical Excellence (2005) was asked by the Department of Health to develop public health programme guidance on maternal and child nutrition. The guidance will provide recommendations for good practice and be based on the best research evidence available from a range of methodological traditions including quantitative, qualitative and economic analyses. It is designed for implementation by those working in the National Health Service but will also be relevant to local authorities and the wider public, private and voluntary sectors.

The guidance clearly states that ‘there is a recognised need to optimise nutritional status before pregnancy, during pregnancy, the post partum period and breastfeeding, and in the early years of life . . . Folic acid supplementation, both before pregnancy and in the first 12 weeks of pregnancy, is particularly important as it significantly reduces the risk of NTD. Optimising nutritional status before, during and after pregnancy is important to the mother herself, both in the short term and the long term. She needs to have sufficient energy and nutrient supply from diet and reserves to maintain her own health as well as to provide for the fetus and the breastfed infant (National Institute for Health & Clinical Excellence, 2005, p. 2).

From a date to be notified in late 2006, the long-standing UK Government Welfare Food Scheme for low-income pregnant women and children, which provides liquid and formula cow’s milk, is to be replaced by an initiative called ‘Healthy Start’ (Belton, 2005) which will include fresh fruit and vegetables as well as liquid cow’s milk and infant formula. The findings of the present study provide valuable information about the eating habits and nutritional status of a pregnant population in Sheffield, which will need to be taken into account before planning any dietary or nutrition education intervention such as the introduction of Healthy Start in Sheffield.

The present study will make a valuable contribution to our aim of developing a validated nutrition-screening tool, which will incorporate discriminant foods, i.e. foods for which intakes have been shown to make a significant contribution to the dietary intakes of low-income Sheffield women. Practitioners with little nutrition training such as midwives or Sure Start workers do not currently have any instruments available that have been developed and validated for nutritional screening in pregnancy to identify those at nutritional risk. Those women identified as being at nutritional risk can then be referred as appropriate for advice to improve their dietary intake, cooking skills and food shopping behaviour.

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