The diets of pregnant and post-pregnant women in different social groups in London and Edinburgh: calcium, iron, retinol, ascorbic acid and folic acid

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Dietary records were obtained twice in pregnancy and once post-partum, from 265 women in all social classes in London and Edinburgh. Some Edinburgh women, and lactating women, showed the higher levels of calcium intake. For iron, retinol, ascorbic acid and folic acid, there was a consistent and significant regional and social class gradient in intakes. This favoured English women in 'non-manual' social groups, leaving the Scottish 'manual' class, after pregnancy, with the lowest intakes. Mean intakes of Ca and Fe were consistently below the current UK recommended daily amount (RDA). Intakes of retinol were all above it, and ascorbic acid intakes ranged above and below the RDA.

Micronutrient intake: Pregnancy: Social group

Although the vitamin and mineral intakes of pregnant and lactating women have been measured in the UK (Smithells *et al.* 1977; Doyle *et al.* 1982; Abraham *et al.* 1985; Black *et al.* 1986), there are no studies of between-region intake differences. The National Food Survey (NFS) does show regional and income group differences in household nutrient consumption, broadly favouring higher income groups and the South of the UK (Ministry of Agriculture, Fisheries and Food, 1987), but it monitors household food consumption, not individual dietary intakes. However, the NFS findings suggest that women in higher income groups in Southern Britain have a greater chance of an adequate micronutrient intake in pregnancy than low-income women in the North. The existence and possible interaction of such regional and social–income group differences have not been explored at the level of individual dietary intake measurements.

The macronutrient and energy intakes of pregnant and post-pregnant women in three social class groups in London and Edinburgh have already been reported (Schofield *et al.* 1987) as has information derived from interviews on experience of cravings and aversions in pregnancy and attitudes to food and health (Stewart *et al.* 1988). The present paper presents findings on the intakes of calcium, iron, retinol (including carotene), ascorbic acid and total folic acid by the same subjects. These intakes are compared with current dietary recommendations (Department of Health and Social Security, 1979).

METHODS

The sample and the dietary survey methodology have been fully described by Schofield *et al.* (1987). The study was approved the Ethical Committees of St George's Hospital, London, and the Royal Infirmary, Edinburgh.

* For reprints.

Table 1. *Design of study of diet in pregnancy*

Round	Group	No. of completed diet records: London	Edinburgh	Period	Process	Location
		—	—	< 14 weeks pregnant	Introductory letter, recruitment questionnaire, round 1 visit booked	Ante-natal clinic
1	1a	53	85	< 14 weeks pregnant (trimester 1)	2 d food diary	Own home
1	1b	84	38	15–28 weeks (trimester 2)	2 d food diary	
2	2	110	107	32–40 weeks (trimester 3)	3 d weighed inventory	Own home
3	3L	22	33	> 2 months post-partum: lactating	3 d food diary	Own home
3	3NL	102	77	> 2 months post-partum: not lactating	3 d food diary	

Table 2. *Distribution of the subjects by social class*

Social class*	London *n*	%	*n*	%	Edinburgh *n*	%	*n*	%
1	20	14	47	34	19	15	45	35
2	27	20			26	20		
3	31	22	72	52	15	12	44	35
4	41	30			29	23		
5	11	8	19	14	25	20	38	30
6	8	6			13	10		
All			138				127	

* Non-manual: 1, professional; 2, management and technical; 3, clerical and minor supervisory. Manual: 4, skilled manual; 5, semi-skilled manual; 6, unskilled manual (Office of Population Censuses and Surveys, 1980).

Study design and sample

Table 1 sets out the study design. Pregnant women were initially recruited into either groups 1a or 1b, depending on the stage of their pregnancy. All these subjects entered group 2, and subsequently moved into groups 3L or 3NL according to the infant feeding method which they had adopted. The total number of subjects was 265, and the sample breakdown is shown in Table 2.

Dietary survey methods

In trimesters 1 and 2, and 2 months after childbirth, the subjects kept an estimated food record (food diary) in terms of household measures, giving recipes where appropriate. This method, being relatively easy for the subject, was selected for use in early pregnancy and after childbirth, when stress on the mother was expected to be greatest. During the third trimester, most subjects carried out a weighed dietary inventory for 3 d: twenty subjects refused to do so, and kept an estimated food record instead. Validation tests on these records have been reported by Schofield *et al.* (1987).

Data analysis

Nutrient intakes were computed using food composition tables (Paul & Southgate, 1978; Paul *et al.* 1980). In the case of total folic acid, it is recognized that use of food composition tables alone will only provide an approximation to the true intake (Paul & Southgate, 1978). However, between-group comparisons may be made, with caution. The same point applies, though with less force, to ascorbic acid, because of unknown variations in cooking losses.

Student's *t* test was used to test for differences among the means of social class and regional groups, and between lactating and non-lactating subjects. Data were aggregated as shown in Table 2, to facilitate social class comparisons. Differences among means for survey rounds 1, 2 and 3 were not tested, as these groups were not independent samples. Spearman's rank correlation, and Wilcoxon's rank sum test were used to investigate differences in the ranking of the sample groups according to intakes of different micronutrients.

RESULTS

Post-recruitment drop-out rates were 4% in London and 9% in Edinburgh. The distributions of intakes of all micronutrients analysed were skewed, so *t* tests were done on the means of logarithmically transformed variables (which showed approximately normal distributions in all cases). Consumption of nutrients from vitamin–mineral supplements is not included: this is particularly relevant to the Fe and folic acid supplement which is routinely available to pregnant women.

Ca

Table 3 shows mean Ca intakes of the sample groups. During early pregnancy some Edinburgh geometric mean intakes were greater than in London, but no significant regional differences occurred. Post-partum, some London intakes were significantly higher than in Edinburgh. No significant social class differences were found in London, although the mean values for classes 1 and 2 were always the highest. In Edinburgh, the mean intake of all lactating women, and of those in classes 3+4, were significantly higher than 'non-lactators'.

Ca was the only nutrient for which some mean intakes were higher in the Edinburgh sample than those of the corresponding group in London.

All mean intakes in pregnancy were below the recommended daily amount (RDA) (Department of Health and Social Security, 1979), and all post-partum intakes were above it (Tables 3 and 8).

Fe

Table 4 shows mean Fe intakes of the sample groups (excluding supplements). In all social class groups, except the lactating women in classes 1+2, the London geometric mean intake exceeded the Edinburgh value. The appearance of significant differences is to some extent a function of group sizes: when all social groups were pooled, London intakes were significantly greater than Edinburgh intakes for all except the lactating women. Whereas in Edinburgh the lactating group had a significantly higher Fe intake than the 'non-lactators', this was not the case in London. Where social class comparisons were significant (mostly in group 2 with larger groups) they favoured social classes 1+2. The lowest

Table 3. *Daily calcium intakes (mg) of pregnant and post-pregnant women in London and Edinburgh*

				London				Edinburgh			
					Geometric				Geometric		
Survey round	Group*	Trimester	Social class†	Arithmetic mean	Mean	SD	n	Arithmetic mean	Mean	SD	n
1	1a	1	All	873	826	1·42	46	964	893	1·50	87
1	1b	2	All	983	920	1·46	91	911	846	1·53	36
2	2	3	All	1045	962	1·53	110	988	908	1·54	107
3	3L	PP	All	880	802	1·48	27	857	791§	1·52	33
3	3NL		All	780	735‡	1·47	97	671	604	1·62	77
1	1a	1	1+2	927	863	1·48	15	1039	975	1·46	33
1	1a		3+4	868	838	1·31	25	992	927	1·46	28
1	1a		5+6	759	698	1·59	6	837	767	1·53	26
1	1b	2	1+2	1017	963	1·39	32	1029	1010	1·22	11
1	1b		3+4	977	907	1·51	46	866	796	1·57	15
1	1b		5+6	919	862	1·43	13	851	761	1·63	10
2	2	3	1+2	1154	1100	1·38	40	1056	995	1·41	44
2	2		3+4	964	897	1·48	55	962	877	1·59	36
2	2		5+6	1056	872	1·91	15	910	818	1·59	27
3	3L	PP	1+2	933	851	1·62	13	918	859	1·46	21
3	3L		3+4	826	765	1·36	13	789	756§	1·39	8
3	3L		5+6				1	673			4
3	3NL		1+2	797	785	1·39	33	802	711	1·68	20
3	3NL		3+4	770	728‡	1·40	49	601	568	1·43	31
3	3NL		5+6	777	657	1·83	15	655	527	1·76	26

L, lactating; NL, non-lactating; PP, post-partum.
* For details, see Table 1.
† Office of Population Censuses and Surveys (1980), see Table 2.
Mean values were significantly different ($P < 0{\cdot}05$) as follows: ‡ between London and Edinburgh in the row indicated; § from value for non-lactating subjects in the group indicated.

Table 4. *Daily iron intakes (mg) (excluding supplement) of pregnant and post-pregnant women in London and Edinburgh*

				London				Edinburgh			
					Geometric				Geometric		
Survey round	Group*	Trimester	Social class†	Arithmetic mean	Mean	SD	*n*	Arithmetic mean	Mean	SD	*n*
1	1a	1	All	14	12·4‡	1·64	46	11	10·5	1·55	87
1	1b	2	All	13	12·5‡	1·39	91	10	10·0	1·40	36
2	2	3	All	12	11·5‡	1·45	110	10	9·4	1·44	107
3	3L	PP	All	11	10·7	1·34	27	12	10·7§	1·59	33
3	3NL		All	11	10·5‡	1·56	97	9	8·4	1·54	77
1	1a	1	1+2	17	14·4	1·73	15	13	11·9	1·57	33
1	1a		3+4	12	11·7	1·45	25	11	10·6	1·42	28
1	1a		5+6	12	9·8	1·89	6	10	9·8‖	1·59	26
1	1b	2	1+2	14	13·7‡	1·37	32	10	10·5	1·35	11
1	1b		3+4	12	12·0	1·39	46	10	9·7	1·51	15
1	1b		5+6	12	11·6	1·35	13	10	9·8	1·27	10
2	2	3	1+2	14	13·1‡	1·46	40	10	10·3	1·25	44
2	2		3+4	11	10·9‖	1·42	55	10	9·6	1·48	36
2	2		5+6	10	10·0‖	1·34	15	8	7·9‖	1·55	27
3	3L	PP	1+2	12	11·6	1·36	13	13	11·7	1·67	21
3	3L		3+4	10	10·4	1·30	13	8	8·3‖	1·23	8
3	3L		5+6	8			1	12			4
3	3NL		1+2	12	11·2	1·52	33	9	9·3	1·43	20
3	3NL		3+4	11	10·4	1·54	49	8	8·1	1·48	31
3	3NL		5+6	10	9·4	1·64	15	9	8·2	1·61	26

L, lactating; NL, non-lactating; PP, post-partum.
* For details, see Table 1.
† Office of Population Censuses and Surveys (1980), see Table 2.
Mean values were significantly different ($P < 0·05$) as follows: ‡ between London and Edinburgh in the row indicated; § from value for non-lactating subjects in the group indicated; ‖ from value for social classes 1+2 in the survey round indicated.

Table 5. *Daily retinol equivalent intakes (μg) of pregnant and post-pregnant women in London and Edinburgh (including carotene)*

				London				Edinburgh			
					Geometric				Geometric		
Survey round	Group*	Trimester	Social class†	Arithmetic mean	Mean	SD	*n*	Arithmetic mean	Mean	SD	*n*
1	1a	1	All	1640	1918	2·51	46	1342	1565	2·68	87
1	1b	2	All	1180	2054‡	2·55	91	793	1221	2·42	36
2	2	3	All	1471	2209‡	2·60	110	861	1545	2·32	107
3	3L	PP	All	1384	2699‡	2·01	27	669	1777§	2·37	33
3	3NL		All	1178	2044‡	2·59	97	1014	1124	2·95	77
1	1a	1	1+2	3027	2961	2·28	15	1396	2013	2·75	33
1	1a		3+4	1103	1796	2·34	25	873	1416	2·46	28
1	1a		5+6	510	849‖	2·19	6	824	1266	2·64	26
1	1b	2	1+2	1306	3080	2·33	32	1244	2049	2·08	11
1	1b		3+4	766	1560‖	2·43	46	595	1050‖	2·00	15
1	1b		5+6	1366	2001	2·60	13	586	867‖	2·78	10
2	2	3	1+2	1648	3173‡	2·16	40	1039	2082	2·14	44
2	2		3+4	1506	1981‖	2·66	55	694	1528	2·09	36
2	2		5+6	869	1253‖	2·61	15	794	964‖	2·43	27
3	3L	PP	1+2	1457	2670	1·98	13	735	2093	2·13	21
3	3L		3+4	1311	2751‡	2·09	13	528	1240	2·26	8
3	3L		5+6				1	601			4
3	3NL		1+2	1269	2420	2·23	33	1234	1829	2·83	20
3	3NL		3+4	1295	2075‡	2·65	49	1349	1235	3·01	31
3	3NL		5+6	598	1344‡	2·71	15	445	691‖	2·36	26

L, lactating; NL, non-lactating; PP, post-partum.
* For details see Table 1.
† Office of Population Censuses and Surveys (1980), see Table 2.
Mean values were significantly different ($P < 0·05$) as follows: ‡ between London and Edinburgh in the row indicated; § from value for non-lactating subjects in the group indicated; ‖ from value for social classes 1+2 in the survey round indicated.

geometric mean intake was in Edinburgh (group 2, social classes 5+6) and the highest was in London (group 1a, social classes 1+2).

When compared with the current RDA, all mean intakes fell short except in London (social classes 1+2) in pregnancy (Tables 4 and 8). Edinburgh mean intakes were mostly less than 75% of the RDA.

In summary, London women had higher mean intakes of dietary Fe than Edinburgh women, and social classes 1+2 in London had the highest mean intakes of all. However, lactating women in Edinburgh maintained a higher Fe intake than 'non-lactators'. Most group mean intakes were below the RDA.

Retinol

Table 5 shows mean retinol intakes for the sample groups. In contrast to other nutrients, the geometric mean intakes were higher than the arithmetic means. With the exception of group 1a (first trimester) the geometric mean intakes in London were higher than in Edinburgh, and significantly so when all social classes were pooled to give larger group sizes. With the exception of the lactating women in London, there was a consistently declining social class gradient in intake, with some significant differences between social classes 1+2 and the others. In Edinburgh, when all social classes were pooled, lactating women had a significantly higher intake than 'non-lactators'. However, 64% of the lactating group were in social classes 1+2, who had high intakes at all times. The mean intakes of all groups were greater than the RDA (Tables 5 and 8).

Ascorbic acid

Table 6 shows mean ascorbic acid intakes for the sample groups. When all social class groups were pooled, significantly higher geometric mean intakes were found in London at all stages of the survey. These differences were also significant within social classes in group 2, and for the non-lactating women. The social class gradient in both London and Edinburgh was mainly due to the large and frequently significant differences between mean intakes of classes 1+2 and the rest. In Edinburgh, lactating women had a significantly higher mean intake than 'non-lactators'. Most of the London mean intakes were above the RDA (Tables 6 and 8), but in Edinburgh it was only the women in social classes 1+2 in early pregnancy, and non-lactating, who had a mean intake greater than the RDA.

Folic acid

Table 7 shows intakes of total folic acid, calculated from food composition tables. Although they do not provide a precise estimate of intakes, it can be seen that the London geometric mean values were consistently higher than those in Edinburgh, that there were consistent social class differences in both locations (favouring classes 1+2) and that lactating women had higher mean intakes than 'non-lactators'.

All mean intakes were well below the Department of Health and Social Security (1979) RDA (Tables 7 and 8).

Ranking of groups by micronutrient intake

Inspection of the group means showed an apparently consistent pattern for all micronutrients except Ca, with a gradient of mean intakes starting from high values for social classes 1+2 in London, in the first two trimesters of pregnancy, and falling to lowest values in social classes 5+6 in Edinburgh, post-partum and non-lactating. The groups in the survey were accordingly ranked for each micronutrient, by the magnitude of the group geometric mean intake. The lactating, social classes 5+6 groups were omitted because of their small size. The ranks are shown in Table 9, where the final column contains the sum

Table 6. *Daily ascorbic acid intake (mg) of pregnant and post-pregnant women in London and Edinburgh*

				London				Edinburgh			
					Geometric				Geometric		
Survey round	Group*	Trimester	Social class†	Arithmetic mean	Mean	SD	*n*	Arithmetic mean	Mean	SD	*n*
1	1a	1	All	97	78‡	1·94	46	80	52	2·73	87
1	1b	2	All	89	71‡	2·04	91	68	50	2·35	36
2	2	3	All	83	68‡	1·94	110	61	44	2·25	107
3	3L	PP	All	65	56‡	1·75	27	48	39§	1·94	33
3	3NL		All	56	44‡	2·12	97	28	23	1·86	77
1	1a	1	1+2	136	108	2·06	15	101	81‡	2·01	33
1	1a		3+4	84	72	1·76	25	76	49‡	2·69	28
1	1a		5+6	56	50‖	1·68	6	57	32‡	3·02	26
1	1b	2	1+2	116	101	1·75	32	103	83	2·09	11
1	1b		3+4	72	57‖	2·04	46	56	41‡	2·40	15
1	1b		5+6	82	65	2·05	13	48	38‡	1·99	10
2	2	3	1+2	109	96‡	1·66	40	77	57	2·18	44
2	2		3+4	74	61‡‖	1·86	55	57	43	2·09	36
2	2		5+6	48	40‖	2·00	15	41	30‡	2·22	27
3	3L	PP	1+2	70	65	1·51	13	57	47‖	1·90	21
3	3L		3+4	62	50	1·94	13	35	30	1·85	8
3	3L		5+6	38			1	29			4
3	3NL		1+2	69	57‡	1·94	33	34	30	1·69	20
3	3NL		3+4	50	39‡‖	2·08	49	26	21‡	1·87	31
3	3NL		5+6	47	34‡‖	2·25	15	25	20‡	1·87	26

L, lactating; NL, non-lactating; PP, post-partum.

* For details see Table 1.

† Office of Population Censuses and Surveys (1980), see Table 2.

Mean values were significantly different ($P < 0{\cdot}05$) as follows: ‡ between London and Edinburgh in the row indicated; § from value for non-lactating subjects in the group indicated; ‖ from value for social classes 1+2 in the survey round indicated.

Table 7. *Daily total folic acid intake (μg) (excluding supplement) of pregnant and post-pregnant women in London and Edinburgh*

				London				Edinburgh			
					Geometric				Geometric		
Survey round	Group*	Trimester	Social class†	Arithmetic mean	Mean	SD	*n*	Arithmetic mean	Mean	SD	*n*
1	1a	1	All	189	164‡	1·63	46	150	130	1·75	87
1	1b	2	All	177	164‡	1·47	91	130	117	1·64	36
2	2	3	All	172	155‡	1·55	110	123§	115	1·46	107
3	3L	PP	All	186	162‡§	1·59	27	138	123§	1·58	33
3	3NL		All	140	127‡	1·56	97	98	87	1·61	77
1	1a	1	1+2	250	200	1·84	15	187	166	1·62	33
1	1a		3+4	164	156	1·38	25	139	127‖	1·53	28
1	1a		5+6	140	124	1·70	6	116	99‖	1·91	26
1	1b	2	1+2	213	202	1·41	32	166	157	1·44	11
1	1b		3+4	157	147‡§	1·43	46	120	106‖	1·68	15
1	1b		5+6	156	145‡§	1·47	13	105	97‖	1·54	10
2	2	3	1+2	206	189	1·48	40	141	134	1·40	44
2	2		3+4	110	141‡§	1·55	55	119	113‖	1·42	36
2	2		5+6	141	132‡§	1·46	15	100	94‖	1·46	27
3	3L	PP	1+2	231	195	1·69	13	154	137§	1·60	21
3	3L		3+4	143	135§	1·38	13	109	106	1·27	8
3	3L		5+6	157			1	111			4
3	3NL		1+2	148	140‡	1·40	33	116	102	1·62	20
3	3NL		3+4	135	122‡	1·55	49	98	88	1·59	31
3	3NL		5+6	138	114‡	1·86	15	83	75‖	1·56	26

L, lactating; NL, non-lactating; PP, post-partum.

* For details see Table 1.

† Office of Population Censuses and Surveys (1980), see Table 2.

Mean values were significantly different ($P < 0·05$) as follows: ‡ between London and Edinburgh in the row indicated; § from value for non-lactating subjects in the group indicated; ‖ from value for social classes 1+2 in the survey round indicated.

Table 8. *Comparison of mean daily calcium, iron, retinol, ascorbic acid and folic acid intakes of pregnant and post-partum women in London and Edinburgh with recommended daily amounts (RDA) (Department of Health and Social Security, 1979)*

	Ca (mg)		Fe (mg)		Retinol (μg)		Ascorbic acid (mg)		Folic acid (μg)	
Group*	RDA	Mean intake†	RDA	Mean intake†	RDA	Mean intake†	RDA	Mean intake†	RDA	Mean intake†
					London					
1a	1200	826	13	12·4	750	1918	60	78·7	500	164
1b	1200	920	13	12·5	750	2054	60	71·3	500	164
2	1200	963	13	11·5	750	2209	60	68·4	500	155
3L	1200	803	15	10·7	1200	2699	60	56·2	400	162
3NL	500	736	12	10·5	750	2044	30	44·3	300	127
					Edinburgh					
1a	1200	893	13	10·5	750	1565	60	52·8	500	130
1b	1200	846	13	10·0	750	1221	60	50·2	500	117
2	1200	908	13	9·4	750	1545	60	44·6	500	115
3L	1200	791	15	10·7	1200	1777	60	39·6	400	123
3NL	500	604	12	8·4	750	1124	30	23·2	300	87

* For details, see Table 1.
† Geometric means.

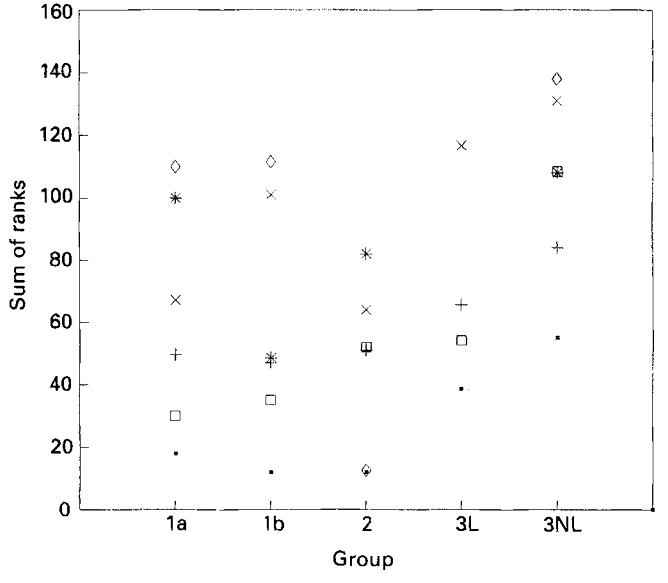

Fig. 1. Sum of rank orders for energy and nutrients (lowest = 'best') by group, region and social class (values from Table 9) of pregnant and post-pregnant women in London (L) and Edinburgh (E). (■), L social classes 1+2; (□), E social classes 1+2; (+), L social classes 3+4; (×) E social classes 3+4; (∗), L social classes 5+6; (◇), E social classes 5+6.

of ranks for all five micronutrients. These summed ranks are displayed in Fig. 1 where they illustrate the social class gradient.

The first hypothesis tested was that the London groups had consistently higher ranks than those in Edinburgh. The Mann–Whitney U test applied to the ranks yielded significant

Table 9. *Rank order of the twenty-eight groups in the sample, ranked by geometric mean micronutrient intakes (low ranks indicate high intakes)*

				Nutrient					
Location	Group	Social class	Energy*	Calcium	Iron	Retinol	Ascorbic acid	Folic acid	Sum of ranks for nutrients
London	1a	1+2	12	11	1	3	1	2	18
	1a	3+4	20	15	6·5	15	6	7	49·5
	1a	5+6	11	25	18·5	27	13	17	100
	1b	1+2	4	5	2	2	2	1	12
	1b	3+4	6	7	4	16	12	8	47
	1b	5+6	5	12	8·5	12	7	9	48·5
	2	1+2	3	1	3	1	3	4	12
	2	3+4	9	8	11	13	9	10	51
	2	5+6	1	10	17	21	19	15	82
	3L	1+2	22	14	8·5	5	8	3	38·5
	3L	3+4	16	20	14·5	4	14	13	65·5
	3NL	1+2	21	18	10	6	10	11	55
	3NL	3+4	24	23	14·5	9	20	18	84
	3NL	5+6	8	26	22	19	22	19	108
Edinburgh									
	1a	1+2	10	4	5	11	5	5	30
	1a	3+4	7	6	12	18	15	16	67
	1a	5+6	19	19	24	20	23	24	110
	1b	1+2	15	2	13	10	4	6	35
	1b	3+4	13	17	20	24	18	21·5	101
	1b	5+6	2	21	18·5	26	21	25	111·5
	2	1+2	14	3	16	8	11	14	52
	2	3+4	17·5	9	21	17	17	20	64
	2	5+6	23	16	28	25	24·5	26	120·5
	3L	1+2	17·5	13	6·5	7	16	12	54
	3L	3+4	25	22	25	22	26	21·5	116·5
	3NL	1+2	21	24	23	14	24·5	23	108·5
	3NL	3+4	27	27	27	23	27	27	131
	3NL	5+6	28	28	26	28	28	28	138
Statistical significance of Mann–Whitney *U* test, London *v.* Edinburgh			NS	NS	$P < 0{\cdot}01$	$P < 0{\cdot}05$	$P < 0{\cdot}01$	$P < 0{\cdot}01$	

NS, not significant.
* Values from Schofield *et al.* (1987).

Table 10. *Spearman rank correlation coefficients for the rank orders shown in Table 9*

	Energy	Calcium	Iron	Retinol	Ascorbic acid	Folic acid
Energy		0·556	0·416	0·145NS	0·493	0·439
Ca			0·554	0·537	0·736	0·700
Fe				0·756	0·855	0·899
Retinol					0·731	0·800
Ascorbic acid						0·948

All correlations significant ($P < 0·05$) except where indicated by NS.

differences between London and Edinburgh for all the micronutrients except Ca; *P* values for Fe, retinol, ascorbic acid and folic acid being $< 0·01$, $< 0·05$, $< 0·01$ and $< 0·01$ respectively. Using the values reported by Schofield *et al.* (1987), it was shown that the Mann–Whitney *U* test did not provide a significant result for energy.

The second hypothesis tested was that the rank orders for each nutrient were in agreement, so that groups with low intakes would be consistently identified. The rank orders (London and Edinburgh combined) were tested in pairs using the Spearman rank correlation test. The results are shown in Table 10, the highest significant positive correlations being found among Fe, retinol, ascorbic acid and folic acid. The rank orders for these four nutrients were then tested for overall agreement using Kendal's *W* (coefficient of concordance), which gave a significant value of 0·88.

These results all indicate a consistent pattern of micronutrient intake, with the London groups generally having higher intakes than the equivalent social group in Edinburgh at the same stage of the survey. However, both social class and stage of survey interact in the rank orders (as shown in Table 9), so that it is the groups early in pregnancy who rank 'higher'. Groups with lowest intakes were consistently the Edinburgh women after childbirth, not lactating, in social classes 3–6. The consistently 'lower' ranking of classes 5+6 is also clearly seen, especially in Scotland.

DISCUSSION

Comparison with other studies and with RDA values

Ca. The arithmetic mean intakes were about 10% lower than those found by Black *et al.* (1986) in non-manual and manual social classes in Cambridge. The geometric means were lower still. Black *et al.* (1986) comment that 'the Cambridge group represent good quality diets... it would be unrealistic to expect an average nutrient intake higher than this from any group eating according to British food patterns...'. Our results showed similarities to those of Smithells *et al.* (1977), and the low socio-economic subjects of Doyle *et al.* (1982), with the exception of one Scottish group whose intakes were higher, but remained below the RDA.

Fe. The intakes of the London women were very similar to those found by Smithells *et al.* (1977) in Leeds, and Black *et al.* (1986) in Cambridge, and higher than those of Barasi *et al.* (1985) in Wales. The Edinburgh values were lower than both, especially post-partum. Whether low Fe intakes during pregnancy and lactation are important is a matter of debate, considering both whether the women begin pregnancy with adequate body Fe and whether they take Fe supplements. The close correlation between Fe and energy intakes is reflected in the present study and the pattern of decreasing Fe intake could be predicted from the energy values (Schofield *et al.* 1987).

Retinol. During pregnancy, the geometric mean values were generally higher than those found by Black *et al.* (1986) and Doyle *et al.* (1982). It is likely that the generally frequent consumption of dairy products by the subjects contributed to their more than adequate intakes.

Ascorbic acid and total folic acid. For both these nutrients, the range of mean values for groups in this survey encloses that of Black *et al.* (1986), the Edinburgh post-partum values being lower than any reported from Cambridge. The low levels of ascorbic acid in Scotland are not necessarily a cause for concern, as the current RDA is set at three times the minimum physiological requirement, plus 10%.

The folate intakes of young non-pregnant women reported by Barber & Bull (1985) are consonant with the London group. The Edinburgh intakes were about 30% lower, probably reflecting the lower intakes of fresh and frozen vegetables, and fruit in Scotland.

Intakes of lactating women

The micronutrient intakes of lactating women in Edinburgh were consistently higher than those of 'non-lactators'. However, before concluding that lactating Edinburgh women are particularly diet-conscious, it should be noted that twenty-one of thirty-three studied were in social classes 1 + 2. The higher nutrient intakes may, therefore, simply be a reflection of the generally higher intakes of that social class group. It was only for Ca that the difference was maintained in another social class group (3 + 4). In London, where the lactating group was a mix of social classes 1–4, no such differences occurred.

Social class and regional differences in intake

Most of the mean micronutrient intakes of the survey groups showed a marked regional social class gradient. This was in contrast to their intakes of energy and macronutrients, as reported by Schofield *et al.* (1987). The exception was Ca, where the Edinburgh women in some cases had higher intakes than the equivalent London group. There was a high level of agreement when the rank orderings of group mean intakes for Fe, retinol, ascorbic acid and folic acid were compared, showing that the 'manual' social class women in Edinburgh, and especially those who were not lactating after childbirth, had consistently the lowest intakes. This non-lactating group is assumed to have reverted to the habitual non-pregnant dietary pattern.

It might be supposed that the lower micronutrient intakes in social classes 5 + 6 were due to under-reporting of food intake, or to incomplete records. However, there were no significant between-class differences in energy intake, and no consistently significant differences in protein or fat intake. Daily energy intakes in group 1 varied between 7·95 MJ (1899 kcal) (classes 3 + 4, London) to 9·61 MJ (2296 kcal) (classes 5 + 6, Edinburgh), and there was no evidence of under-reporting when visits were made and records checked (Schofield *et al.* 1987).

The discrepancies among the findings for the previously mentioned four micronutrients, for Ca, and for macronutrients and energy, can be explained by reference to the women's reported food choices (Wheeler *et al.* 1989). The survey subjects were presented with a list of foods and asked whether they ate them at all and, if so, with what frequency. The only foods which were reportedly eaten by more Edinburgh than London women were certain cooked meats, canned fruit and sweet corn, ice cream, and potato crisps. Those foods which were reportedly used more often by Edinburgh than by London women were mainly processed soups, processed meats, soft drinks and drinking chocolate, potatoes, and liver. Reported use of milk was slightly higher by pregnant women in lower social classes, with no marked regional differences. For all other foods in a list which included fresh, frozen and canned fruit and vegetables, cereals, meats and fish, dairy products and a number of processed foods, more London women reported using them, and more frequently. This general trend also applied when comparing the 'non-manual' with 'manual' social class groups. From a list of 125 foods and food groups, the London women in social classes 1+2 consumed an average of sixty-two, whereas the Edinburgh women in classes 5+6 consumed an average of thirty-six. The Edinburgh women's energy, protein and fat intakes were similar to those of the London women, but derived from a smaller range of foods, and this is reflected in their lower micronutrient intakes.

These findings do not suggest that the women with lower intakes were necessarily at risk of clinical dietary deficiency; they were in apparently good health and produced healthy babies. What the findings do show is a consistently less varied, and less nutrient-dense diet being consumed by poorer women, especially in Edinburgh. While they were not apparently malnourished, they enjoyed less of the protection against malnutrition that a varied diet affords. Both in food variety and in micronutrient intake, their diet can be described as poorer than that of the London group.

This entire group of healthy women, producing healthy babies, appeared to be consuming less than the RDA for Ca and Fe and less than the Department of Health and Social Security (1979) RDA for folic acid (which is no longer in force); and the Edinburgh women fell short of the RDA for ascorbic acid. The highest percentage reported use of the Fe–folate supplement was 82% (London, all groups, early pregnancy) and the lowest was 40% (Edinburgh, classes 4–6, early pregnancy). An RDA should meet the needs of at least 95% of any group: that is, it should represent an increment of approximately 2 standard deviations over a mean requirement. If this is so, and making the arbitrary assumption that the standard deviation of requirement is of the order of 10%, the mean intake of a group should be approximately 80% of any RDA. This criterion was not met by the micronutrient intakes in the case of Ca (both regions), Fe (Edinburgh), ascorbic acid (Edinburgh), and folic acid (both).

In fact, several of the RDA used here have been set at levels considerably higher than 20% over a mean requirement, ascorbic acid being an example (Department of Health and Social Security, 1979). Their usefulness for evaluating the results of surveys such as these must be in considerable doubt, given that they are not defined in relation to a known requirement.

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