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Report on Health and Social Subjects

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The Fortification of Yellow Fats with Vitamins A and D

Report of the Working Group on the Fortification of Yellow Fats

Committee on Medical Aspects of Food Policy

HMSO

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Preface

In December 1989, at the request of the Ministry of Agriculture, Fisheries and Food, the Committee on Medical Aspects of Food Policy convened a Working Group to advise on the need in the United Kingdom for continued mandatory fortification of margarine with vitamins A and D and whether this requirement should be extended to all fat spreads other than butter.

The Working Group met once and reviewed much information. I am grateful for the care with which the members discharged their duties, for the considerable assistance of the Secretariat and for the timely provision of substantial information by the Ministry of Agriculture, Fisheries and Food which allowed the work to be completed so rapidly.

SIR DONALD ACHESON
Chairman of Committee on Medical Aspects of Food Policy

Committee on Medical Aspects of Food Policy

Working Group on the Fortification of Yellow Fats

Members

Professor H M Hodkinson (Chairman)	Department of Geriatric Medicine, University College and Middlesex School of Medicine, London.
Dr S A Bingham	MRC Dunn Clinical Nutrition Centre, Cambridge.
Professor J Grimley Evans	Department of Geriatrics, Radcliffe Infirmary, Oxford.
Professor D A T Southgate	AFRC Institute of Food Research, Norwich.
Professor B A Wharton	Department of Human Nutrition, University of Glasgow.

Observers

Dr J G Ablett	Department of Health, London.
Dr R Burt	Ministry of Agriculture, Fisheries and Food, London.
Dr P C Clarke	Department of Health, London.
Miss A F Robertson	Department of Health, London.

Secretariat

Mr R W Wenlock (Scientific)	Department of Health, London.
Dr M J Wiseman (Medical)	Department of Health, London.

Mr G Austin (Administrative)	Department of Health, London.
Mrs E Lohani (Administrative)	Department of Health, London.

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The Working Group is indebted to Dr E Lawson of the Institute of Animal Physiology and Genetics Research who acted as a consultant on the issues relating to the levels of circulating vitamin D metabolites in people in the UK and other countries and to the impact of variations in exposure to ultra violet radiation in the various latitudes covered by the United Kingdom.

The Working Group is also indebted to Ms Helen Rose of the Nutrition Branch, Food Science Division of the Ministry of Agriculture, Fisheries and Food for the compilation of most of the tables and figures included in this Report.

Contents

Summary and Recommendations

1 Fortification of Margarine

The Working Group concluded that the mandatory fortification of margarine with vitamins A and D had contributed, to an unknown extent, to the historical decline in the incidence of clinical vitamin A and D deficiencies in the United Kingdom (UK). However the Working Group were concerned that the northern latitudes spanned by the UK make exposure to ultraviolet radiation (UVR), particularly among the elderly, far less than that for most other EC countries and data are available to demonstrate low plasma 25 (OH)D levels in children and the elderly. The Working Group were also concerned that there were insufficient dietary data to reassure them that some vulnerable groups in this country do not rely on fortified margarine to maintain adequate vitamin A and D status, and considered that the lifting of the mandatory requirement for fortification would be unwise. Taking into account this need for caution:

The Working Group recommend that the mandatory fortification of margarines with vitamins A and D in the United Kingdom should continue.

2 Other fat spreads

The Working Group noted that other fat spreads are taking an increased proportion of the UK market for yellow fats and if they are not fortified then the total amounts of vitamins A and D available from yellow fats will fall. Many manufacturers voluntarily fortify other fat spreads to the same levels as required for margarine and the Working Group concluded that while there were insufficient data on which to base a recommendation that mandatory fortification be extended to other fat spreads, it is neither difficult for manufacturers to fortify them, nor likely to be detrimental to the health of the population, and might be valuable for some groups.

The Working Group recommend that manufacturers of other fat spreads be encouraged to continue and extend the practice of voluntary fortification of their products with vitamins A and D to the levels currently required for margarine.

3 Toxicity of Vitamins A and D

The Working Group concluded that the risk of hypercalcaemia reappearing as a manifestation of vitamin D excess in the UK was real and that it would be unwise to increase this risk. The fortification of other fat spreads should not lead to significant increases in the number of individuals taking potentially

toxic levels of vitamin D but the Working Group recommend that the levels of vitamin D currently added to foods should not be increased and the range of foods to which it is added should not be extended.

4 Vitamins for young children

The Working Group endorse the recommendations of the COMA Panel on Child Nutrition of the Committee on Medical Aspects of Food Policy (COMA) that:

vitamin supplementation should be given to infants and young children aged from six months to at least two years and preferably five years and the Government should continue to make supplementary vitamins for infants and young children available under the Welfare Food Scheme.

5 Further research

The Working Group were concerned that they lacked recent data on the vitamin A and D status of large groups of the UK population. There is a need for information for policy development and to enable COMA to assess the implications of this for public health in this country.

The Working Group recommend that research be carried out to determine the vitamin A and D status of the UK population and of the role of contributory food sources in maintaining the nutritional status of population groups, particularly the elderly.

1. Introduction

1.1 Background to the Working Group

The Working Group on the Fortification of Yellow Fats was convened by the Committee on Medical Aspects of Food Policy (COMA) in December 1989. The Ministry of Agriculture, Fisheries and Food (MAFF) had requested advice from COMA on the need in the United Kingdom for continued mandatory fortification of margarine with vitamins A and D and whether this requirement should be extended to all fat spreads other than butter.

1.2 Terms of Reference of the Working Group

'To assess the need for the continued mandatory fortification of yellow fats and to make recommendations.'

1.3 UK Legislation

1.3.1 The composition, labelling and advertising of butter and margarine are controlled in the UK by the Butter Regulations 1966 (SI No 1074) and the Margarine Regulations 1967 (SI No 1867) respectively. These Regulations require a fat content of at least 80 per cent for butter and margarine. In addition margarine produced for retail sale is required to be fortified with 760–940 international units (iu) per ounce of vitamin A and 80–100 iu per ounce of vitamin D. As 1 iu vitamin A is equivalent to 0.3 μg retinol and 1 iu vitamin D is equivalent to 0.025 μg, the levels required in fortified margarines are equivalent to 800–1000 μg/100 g for retinol and 7.05–8.82 μg/100 g for vitamin D. Butter contains 520–970 μg/100 g of retinol and 0.63–1.00 μg/100 g of vitamin D.

1.3.2 Vitamin A is available from foods in two forms — as pre-formed retinol, which is present in some foods of animal origin, such as liver, and as β-carotene, which is produced in plants, particularly carrots and green vegetables. About 6 μg dietary β-carotene is equivalent to 1 μg retinol in the body. The total available retinol is thus pre-formed retinol plus that derived from β-carotene and is expressed as retinol equivalent. β-carotene is permitted in foods as a colour (E160a) and is added by manufacturers to many margarines at levels of about 300 μg/100 g (50 μg retinol equivalent) to give them their characteristic yellow colour. This added β-carotene contributes towards the required vitamin A content.

1.3.3 Food manufacturers have recently developed a range of other fat spreads with fat contents of less than 80 per cent. These products are not subject to specific legislation and are taking a growing proportion of the yellow fats market (Table 3.1 and 3.2). Fortification of these products is not

mandatory but some brands are fortified to the same levels as margarines. Two groups of spreads exist, one containing 40 per cent or less of fat (referred to as low fat spreads) while the other contains 60–75 per cent of fat (referred to as reduced fat spreads).

1.3.4 Legislation controlling yellow fats was last considered in the UK in 1981 before the rapid increase in consumption of spreads shown in Table 3.1. The Food Standards Committee (FSC) recommended in their Report on Margarine and Other Table Spreads that new Regulations on fat spreads be introduced as these products compete directly with butter and margarine.[1] The FSC was advised that the vitamins added to margarine made a significant contribution to the diets of many people in the UK and they recommended that fortification with vitamins A and D should be extended to all fat spreads except butter. Draft UK Regulations on Fat Spread Products were therefore circulated for comment in March 1989 in which mandatory fortification with vitamins A and D was extended to all spreadable products marketed as alternatives to butter. Further progress was not made because the Commission of the European Community (EC) expressed an interest in developing Community Regulations.

1.4 Aspects of European Community legislation

1.4.1 In accordance with the provisions of Council Directive 83/189, as amended, the UK notified the Commission of the draft Fat Spread Products Regulations in March 1989 and comments were received from the Commission, France and Spain. The Commission's opinion was that mandatory fortification in the UK of fat spreads and margarines with specified levels of vitamins A and D would be a technical barrier to trade and therefore the proposals were unacceptable. Exception to this rule may be permitted if a member state can show that there is a public health need (Article 36 of the Treaty of Rome).

1.4.2 In addition, European Trade Associations representing butter and margarine and spread manufacturers had proposed to the EC a scheme for compositional controls on all yellow fat products although the scheme did not address the issue of fortification with vitamins. It was therefore possible that the European Commission might issue their own proposals for legislation in this area which in turn might not address the issue of vitamin fortification. This Report explores the risk to the nutritional status of the UK population if mandatory fortification of margarines were to be discontinued.

1.5 Response of COMA

1.5.1 After considering all these points Ministers concluded that it would be inappropriate to proceed with the Fat Spread Products Regulations which had been drafted in 1989 and decided that a thorough review of the whole yellow fats sector including fat spreads was needed. This review would therefore cover butter as well as margarine and existing fat spreads and also consider possible future developments in the market (eg extra low fat

products). A discussion paper was circulated and responses to this were put to the Food Advisory Committee (FAC) early in 1990 with a view to preparing new draft Regulations soon afterwards.

1.5.2 Advice was requested from the Committee on Medical Aspects of Food Policy (COMA) by MAFF in 1989 as to whether the mandatory fortification of margarines with vitamins A and D should continue. A detailed scientific justification would be needed in order to support any recommendation for mandatory fortification in future discussions with the European Commission. Advice on the extension of fortification to other fat spreads was also needed although butter, as currently defined, was not considered for fortification as it naturally contains vitamins A and D. COMA convened a Working Group to consider this request. The options put to the COMA Working Group for assessment were:

(i) for mandatory fortification to cease; or

(ii) for mandatory fortification to continue for margarine and be extended to other spreads other than butter; or

(iii) for current UK legislation to continue, ie mandatory fortification of margarine only.

The Working Group considered their main task to be to decide whether there was evidence that the mandatory fortification could be lost without adverse effect on the health of the UK population. They recognised that criteria for introducing an extension to the current mandatory requirements would need to be even more stringent.

1.6 Physiological role of Vitamins A and D

1.6.1 *Vitamin A deficiency* Vitamin A is essential for growth, having a key role in many biological processes including the growth, communication and adhesion of cells. It is also essential for normal function of the retina. Deficiency reduces rhodopsin in the rods of the retina and may eventually lead to night blindness. Severe deficiency leads to the loss of specialised functions of epithelial cells of the tear ducts and eventually to xerophthalmia and permanent blindness. Changes also occur in other epithelial linings of the respiratory, gastrointestinal and urogenital tracts. Under normal conditions, the liver contains stores which are readily replenished by diet. It requires many months on severely restricted intakes of both retinol and β-carotene to induce clinical signs of vitamin A deficiency in healthy people.

1.6.2 *Protective effects of vitamin A and β-carotene* Vitamin A and β-carotene have both been proposed to have a protective role in various types of cancer, but dietary case control studies have shown that β-carotene is more likely to have such an effect.[2] Consideration of the potential benefit derived from adequate intakes of vitamin A and β-carotene formed part of the Working Group's assessment of current dietary habits.

1.6.3 *Toxic effects of vitamin A* Vitamin A is toxic to adults at single doses of around 600,000 μg. Among children daily intakes between 30,000 and 150,000 μg over several months have been shown to be toxic. However, in pregnant women intakes from supplements of over 8000 μg/d have been associated with birth defects in their babies. For this reason women in the UK who are, or may become, pregnant have been advised not to take dietary supplements containing vitamin A unless advised to do so by a doctor or ante-natal clinic. Also, because the levels in animal livers have been shown to be on average between 13,000 and 40,000 μg/100 g, women who are, or may become, pregnant are advised as a matter of prudence that they should not eat liver or products made from it such as liver pate and liver sausage for the time being.

1.6.4 *Vitamin D deficiency*

1.6.4.1 Vitamin D has a fundamental role in controlling calcium homeostasis and bone growth and is classically associated with the regulation of calcium absorption from the gut and its deposition in bone. Deficiency of vitamin D affects the processes involved in the growth and metabolism of bone. This is manifested in the diseases of osteomalacia in adults and rickets in children in which there is deficient bone mineralisation.

1.6.4.2 Vitamin D is produced in the body by the action of solar ultraviolet radiation (UVR) of wave lengths of around 300 nm on 7-dehydrocholesterol in the skin but it is also available from the diet. It is transported to the liver where it is hydroxylated to 25-hydroxycholecalciferol (25(OH)D). Further hydroxylation in the kidney produces physiologically active 1,25-dihydroxy-cholecalciferol ($1,25(OH)_2D$).

1.6.4.3 In normal adults, a dietary source of vitamin D may not be needed provided there is adequate exposure of the skin to UVR. Vitamin D deficiency is more likely to occur at times when the requirement is increased, such as periods of rapid growth in infancy, early childhood and puberty. In adult women there is an increased need for vitamin D during pregnancy and lactation, and osteomalacia may develop in susceptible women during their reproductive years. Elderly people are also at risk of vitamin D deficiency because not only does decreasing mobility reduce outdoor activity and exposure to UVR, but also elderly people may obtain only small amounts of dietary vitamin D.

1.7 Historical perspectives

1.7.1 In late Victorian times 50 per cent of children in poor areas in Leeds had marked rickets.[3] In the period between 1926 and 1942 studies in several large towns in Great Britain indicated a prevalence of radiological signs of rickets among young children of 2 to 8 per cent and the evidence suggested that in northern cities such as Glasgow the prevalence was higher than this.[4] A survey of 23 areas in the UK in 1943 showed that, on average, around 2 per cent of infants had radiological signs of rickets and almost 13 per cent showed some clinical signs of the disease although the severe form of the

disease had almost disappeared. Rickets was not restricted to the poor and was less common in rural areas than in the cities.[4]

1.7.2 Voluntary fortification of margarine with vitamins had been practiced by manufacturers since 1925, but in 1940, with the advent of war, the Government took action to safeguard the nutritional status of the nation and the addition of vitamins A and D to all margarine sold for domestic use was made compulsory. This mandatory fortification was justified in view of the evidence that a large proportion of the population, particularly children, were at risk. Although vitamin A was to be added to equate to the levels found in butter, vitamin D levels were required to be higher because it was felt that margarine in the diet was the easiest, and might be the only, means of ensuring an adequate supply of this vitamin to children in some sections of the community.[5]

1.7.3 *Rickets* This policy of fortification together with other factors such as the later Clean Air Acts, improved housing, increasing affluence and longer and more frequent holidays appeared to be effective as rickets virtually disappeared. Between 1963 and 1966 enquiries by the Ministry of Health confirmed a low prevalence of rickets in some industrial cities, notably Glasgow. These data were reviewed in 1969 by the COMA Panel on Child Nutrition who recognised that there was still a possibility of more widespread sub-clinical disease.[6]

1.7.4 *Osteomalacia* Up to 1964 only 3 cases of osteomalacia in the UK had been proven to be due to a lack of vitamin D. Gough *et al* then described 3 additional cases confirmed by bone biopsy.[7] In Glasgow, Anderson *et al* found that some elderly women had osteomalacia on admission to hospital.[8] The results of surveys of elderly people suggested that vitamin D deficiency did contribute to the skeletal rarefaction which occurred in old age.[9] Studies by the COMA Panel on Nutrition in the Elderly also revealed evidence of osteomalacia among the elderly, particularly among those who were housebound.[10, 11]

1.7.5 *COMA review of fortification 1980* Early in the 1970s there were further reports of overt and clinical rickets and osteomalacia in the UK particularly in Asian immigrants. COMA therefore convened a Working Party on Fortification of Food with Vitamin D which reported in 1980. This confirmed *inter alia* that rickets and osteomalacia were problems for Asian children and women. The Working Party recommended that appropriate dietary supplements should be used and, while they did not recommend that fortification with vitamins A and D be extended to any other foods, they recommended that the mandatory fortification of margarine with vitamin A and D should continue.[12]

1.8 Perspective of the Working Group

1.8.1 In view of these previous recommendations from the 1980 Report, the Working Group decided to concentrate on any changes in the consumption

of yellow fats, in the intakes of vitamin A and D and on any changes in nutritional status and relevant demographic characteristics of the population since 1980. The available data have been compiled in Sections 2 to 4.

1.9 Meetings of the Working Group

1.9.1 The Working Group were convened in December 1989 on the recommendation of COMA to consider advice to MAFF and met once.

1.9.2 We are grateful to those who have prepared working papers and have made documents available.

1.10 Form of the Report

1.10.1 We have interpreted many lines of evidence for this Report so that our conclusions are clear to those in the UK Government who are preparing legislation on food. We have also identified those areas where evidence is inadequate or inconclusive and further research is needed. The data from which our conclusions and recommendations are drawn are summarised in Sections 2–4 and the recommendations based upon them in Sections 5–9. References are given in Section 10.

1.10.2 The recommendations put forward were agreed by all members of the Working Group.

2. International Margarine Supplies and Fortification Policies

2.1 **Supply data** Reliable data on the consumption by individuals of margarine and butter are not widely available for many countries since this type of information is only generated by expensive surveys of the diets of large groups of individuals. However, data on the total supplies of individual commodities in industrialised countries are more readily available. The most widely used statistics are those collected by the Organisation for Economic Cooperation and Development[13] and these are shown in Table 2.1 for butter and margarine.

2.2 **Fortification policies** The policies in EC member states and other countries on fortification of margarine are summarised in Table 2.2.

3. Trends in the Consumption of Yellow Fats in Britain

3.1 The National Food Survey

3.1.1 The Ministry of Agriculture, Fisheries and Food's National Food Survey (NFS) provides continuous information on food purchases and nutrient intakes throughout Great Britain. Estimates of household consumption as made by the NFS are lower than estimates of supplies as shown in Section 2 due to inevitable wastage of food in processing and distribution. Also, the amounts of food recorded in the NFS are what are brought into the home, so that meals and snacks eaten outside the home are currently excluded unless they are made from the household supply.[14] Evidence exists to show that foods eaten inside the home are generally richer sources of vitamins A and D than those eaten outside the home.[15] Therefore the tables in this and following sections based on NFS data should broadly represent the situation in this country. Alcoholic drinks and confectionery are also excluded from the NFS, but do not contribute significantly to vitamin A or D intakes. The information from the NFS also offers the advantage that all the fat spreads entering the home are recorded as such and not as, say, cakes or pies when they have been incorporated into them in home baking. Estimates of the consequences of changes in average levels of intake from changes in fortification practice may therefore be more accurate when derived from NFS data than from other types of survey.

3.1.2 The NFS provides data on subgroups of the population as well as for the population as a whole. Table 3.1 gives national averages and average figures for consumption of butter, margarine and low fat spreads by pensioner households (OAPs) over the 13 years from 1976 to 1988. Butter consumption has shown a marked decline, but while national average margarine consumption peaked in the early 1980's, consumption by OAPs has continued to rise. This group record a greater consumption of yellow fats in the home than the national average. Consumption of reduced fat spreads has only been recorded by the NFS since 1986 and the results are given in Table 3.2. Consumption of both low and reduced fat spreads has increased considerably at the expense of both butter and margarine.

3.2 **Consumption by individuals** The MAFF/DH/OPCS Dietary and Nutritional Survey of British Adults aged 16–64 years carried out in 1986/7 gives data on consumption by individuals of the various yellow fats.[15] Spreads used for baking or incorporated into other foods are not included in these data which are summarised in Table 3.3. This survey demonstrated no significant variation in consumption of any fat spreads either with region or

with age, although the age range excluded the particularly vulnerable groups of children and the elderly.

4. Trends in the Contribution of Yellow Fats to Vitamin Intakes in Britain

4.1 The National Food Survey

4.1.1 The following tables concentrate on national average intakes and intakes in households where the head is an old age pensioner (OAP) over the past 13 years. Table 4.1 shows the domestic intakes of retinol equivalent and vitamin D in 1988, and the contributions made by the main types of food. On average, yellow fats provide around half the intake of vitamin D, of which 80 per cent is now from margarine and 15 per cent from low fat spreads. Yellow fats are less important as sources of retinol equivalent, providing on average only 19 per cent of the total intake. However, the other major food sources of both vitamins (namely fatty fish for vitamin D and liver and carrots for retinol equivalent) do not at present contribute substantially to the diets of many people. Fish is a dietary source of vitamin D and fatty fish such as herrings, mackerel, sardines and tuna are especially rich sources (Table 4.2). The consumption of fish is very variable, depending on supply, price, ability to handle bones and personal liking. Between 1951 and 1975 consumption of fish in Great Britain fell by about 50 per cent thereby halving the average intake of vitamin D from this source. Given the variable consumption of fish, this loss of dietary vitamin D, which has persisted over the last 15 years, represents a further deprivation among a population already at risk of inadequate intakes. For them, fat spreads could be major sources of vitamin D.

4.1.2 Many households consume either butter or margarine and Table 4.3 therefore shows the vitamin intakes which would arise if the total yellow fat consumption remained the same, but all of it was butter; or all of it was margarine as presently fortified including the contribution from β-carotene; or all of it was unfortified spreads. If it was all unfortified, but 50 μg/100 g retinol equivalent was added as β-carotene to colour the products, the average intake of retinol equivalent would decrease from the present 1273 μg/d (184 per cent of the recommended daily amount) (RDA)[16] to 1044 μg/d (151 per cent of the RDA), while average vitamin D intake would decrease from 3.09 to 1.56 μg/d. The RDA for retinol equivalent is currently 750 μg/d for an adult male and while no RDA is set for adults for vitamin D it is recommended that children aged under 5 years, pregnant and lactating women and those inadequately exposed to sunlight receive up to 10 μg/d.[16]

4.1.3 Table 4.4 shows trends in the average intakes of retinol equivalent and vitamin D over the same time. The average intake of retinol equivalent has declined over the past 10 years, mainly because of declining liver

consumption, but intakes by OAPs have remained steady. In contrast, intakes of vitamin D have increased both in the population as a whole and among OAPs reflecting the recent rise in consumption firstly of margarine and more recently of fortified breakfast cereals. The percentage contributions made by fat spreads to retinol equivalent and vitamin D intakes from the overall diet in Britain and in OAP households are presented in Tables 4.5–4.8 and illustrated in figures 4.1–4.6. The proportions derived from butter have declined dramatically. The proportion of retinol equivalent derived from margarine has increased but, while its contribution to vitamin D intakes has remained high, it shows no clear trend. Low fat and reduced fat spreads, are, however, providing a steadily increasing proportion of both retinol equivalent and vitamin D intakes.

4.2 Surveys of the diets of individuals

4.2.1 Individual dietary surveys provide quantitative information on food consumption and nutrient intakes of particular groups within the population. Table 4.9 summarises the results of surveys of this type conducted by Government over the past 20 years. It shows the mean intakes of retinol equivalent and vitamin D in each group and in some sub-groups within those populations. These distributions are, however, extremely skewed because of the small proportion of individuals eating large amounts of rich sources of these vitamins.

4.2.2 This skew in the distribution of intakes is illustrated in figures 4.7–4.9 taken from the recent MAFF/DH/OPCS Dietary and Nutritional Survey of British Adults,[15] which shows the degree to which the median intakes of retinol, carotene and vitamin D differ from the means. Intakes of retinol may extend up to 10 times the RDA.

4.2.3 Tables 4.10 and 4.11 show the contributions made by table spreads to the intakes of retinol equivalent and vitamin D by adults in 1986 and 1987[15] and by schoolchildren in 1983.[17] They confirm that fat spreads provided about 30 per cent of adult vitamin D intake and 24–27 per cent for schoolchildren. No data are yet available on range of the contribution of fat spreads to vitamin D intakes from either of these surveys but the consumption by adults of polyunsaturated margarine and low fat spreads averaged 42.9 g/week (sd 70.8) and other margarine and spreads averaged 39.8 g/week (sd 68.7).[15] These results indicate a very wide variation in consumption of fortified margarine and therefore a similar variation in these contributions to vitamin D intakes. However, on average, these fat spreads were not such important sources of pre-formed retinol or retinol equivalent, providing on average 13 per cent of adult retinol intakes and 5–7 per cent of the intakes of retinol equivalent by schoolchildren.

4.2.4 Multiple regression analysis of the data from the MAFF/DH/OPCS Dietary and Nutritional Survey of British Adults also demonstrated that log transformed intakes of retinol equivalent increased significantly with age ($p < 0.01$) and also rose significantly with social class ($p < 0.05$).[15]

5. Implications of Cessation of Mandatory Fortification of Yellow Fats

5.1 Vitamin A

5.1.1 As shown in table 3.1 total yellow fat consumption has been falling in Great Britain. The consumption of low and reduced fat spreads is steadily increasing and as some of these products are not fortified it is possible that the contribution of yellow fats to retinol equivalent and vitamin D intakes will decline. In addition other dietary trends such as lower liver consumption and the switch from full fat to semi-skimmed and skimmed milks and other low-fat dairy produce are also contributing to a reduction in average retinol equivalent intakes (table 4.4). Thus recent dietary trends are towards lower average intakes of retinol equivalent. The consumption of fruits and vegetables which are rich sources of β carotene is particularly low in Scotland.[14]

5.1.2 Women in the UK who are, or may become, pregnant are advised not to eat liver and liver products and there are likely to be other individuals and population groups who rely disproportionately on fortified margarine for most of their intake of retinol equivalent because they do not consume liver or carrots—the richest sources of retinol equivalent. This could be obscured by the very skewed distribution of intakes of both retinol and β-carotene usually encountered and which were recently demonstrated among schoolchildren[17] and adults as shown in Figures 4.7–4.9.[15] Therefore, although the NFS shows national average intakes of retinol equivalent well above the RDA and it has been calculated that this would remain the case even if all fortification of yellow fats were to cease (paragraph 4.1.2), median intakes are sometimes substantially lower than the RDA[15,17] and might be marginal among some groups of people. The Working Group were concerned that data in this specific area were lacking.

5.1.3 Low intake of a nutrient does not necessarily indicate actual deficiency as the nutritional status of an individual depends on long term rather than immediate past intakes and individual requirements vary considerably. There is no evidence of clinical vitamin A deficiency in Great Britain. However, recent data on vitamin A status are sparse and the Dietary and Nutritional Survey of British Adults which measured plasma retinol concentrations in 1987 is the only recent representative study. This found average levels of 2.2 and 1.9 umol/L for men and women respectively, and none were below the level of 0.03 umol/L which is indicative of depletion.[15]

5.1.4 The Working Group took the view that while current average intakes of retinol equivalent in Great Britain appeared adequate this may hide significant numbers of individuals within the overall group with habitually

low intakes. Therefore the potential still exists for vitamin A status to be compromised in those who omit the small number of vitamin A-rich foods from an otherwise varied diet. This would apply particularly if the availability of this vitamin in food were restricted either through continuation of existing dietary trends in Great Britain or through the complete or partial cessation of fortification of margarine and low fat spreads with vitamin A. In the UK women who are, or may become, pregnant are advised against intakes above 2700 μg/d. However intakes of this magnitude are impossible to achieve from margarine as mandatorily fortified. The possible protective effect of vitamin A in carcinogenesis[2] is also still under investigation. The Working Group therefore concluded that there was a need for caution over any change which may reduce vitamin A intakes.

5.2 Vitamin D

5.2.1 The UK has a long history of both rickets and overt osteomalacia (see para 1.7). Even today circulating levels of 25(OH)D are low in UK population groups with 20 to 90 per cent in various studies having low plasma levels (< 10 ng/ml) at sometime in the year.[18-21] The production of 25(OH)D depends on the availability and adequate exposure to UVR which varies with latitude. The Working Group emphasised the geographical location of the United Kingdom which lies between 50°N at Lands End and 60°N in the Shetland Islands, with London at 52°N, Newcastle upon Tyne at 55°N and Inverness at 57°N. Scotland is the most northerly country in the EC, and all of Scotland and Northern Ireland and part of Northern England are at higher latitudes than other EC countries with the exception of Denmark.

5.2.2 A consequence of the northern latitudes of the UK is the considerable decline in the power of the available UVR from the most southerly to the most northerly parts. In addition there is no UVR at latitudes higher than 50°N in winter.[22] Therefore, for the UK population, adequate exposure to UVR of the appropriate wavelength is only possible in the summer months.

5.2.3 It is therefore essential to achieve summer plasma 25(OH)D levels which will last through the winter. For most of the UK population exposure to UVR is adequate to supply the body's need for vitamin D. However, dietary vitamin D can also provide an effective substrate for conversion to 25(OH)D and for groups which have a lower exposure to the available UVR, or have greater needs, dietary sources will be of correspondingly greater importance. Indeed serum 25(OH)D has been found to be correlated with dietary intake of vitamin D in elderly patients.[23]

5.2.4 In Great Britain margarine provides on average about 40 per cent of dietary vitamin D with the rest coming mainly from fish and fortified breakfast cereals (Table 4.1). Data on individual consumption of all foods, including margarine, are lacking but the Working Group were aware that there may be groups of the population who do not eat some or all of these other foods and in these cases margarine may be the main, if not the only, dietary source of vitamin D.

5.2.5 *Pregnant women and their children* In Edinburgh routine welfare distribution of vitamin D supplements to pregnant mothers was stopped in 1964 (see para 7.2 below). Subsequently tetanic convulsions in new born infants appeared to be on the increase.[24-26] In a study of pregnant women in Edinburgh in 1979 Cockburn *et al* found that supplementing mother's diet with vitamin D during pregnancy raised their circulating levels of 25(OH)D, reduced tetanic convulsions in their infants and raised plasma calcium in both mothers and infants compared with unsupplemented controls.[27] In addition infants born to control mothers suffered significantly more from an enamel defect in their teeth in their third year than those born to mothers whose diets were supplemented with vitamin D.

5.2.6 *Asian children* Since 1980, reports of rickets among children of Asian immigrants to the UK have continued.[28-31] The Working Group therefore agreed with the findings of the 1980 COMA Working Party and that Asian women and children living in the UK continue to be at special risk of developing rickets and osteomalacia. However as margarine has not commonly been consumed by Asians in the past, the problem has been successfully addressed, and should continue to be addressed, by the use of appropriate medicinal preparations.

5.2.7 *The elderly*

5.2.7.1 Parathyroid hormone acts as a trophic hormone for the conversion of 25-hydroxycholecalciferol to its active metabolite 1,25-dihydroxycholecalciferol. When vitamin D activity falls parathyroid hormone levels rise. It has therefore been suggested that levels of vitamin D deficiency below those necessary to produce gross osteomalacia may lead to excessive bone loss due to the other effects of parathyroid hormone. It has been shown in several population samples that parathyroid hormone levels show a seasonal fluctuation in inverse proportion to those shown by blood vitamin D levels. It has been suggested that to minimise bone loss associated with ageing it is desirable to maintain vitamin D intake at levels at which seasonal cyclical changes in parathyroid hormone are abolished throughout adult life.

5.2.7.2 A recent study from Massachussets has shown that suppression of the seasonal fluctuation in parathyroid hormone levels requires Vitamin D intakes of the order of 5.5 μg or more per day.[32] Although the relationship between parathyroid hormone secretion rates and osteoporosis must be regarded at present as hypothetical it seems prudent, until better data are available, for elderly people with restricted sunlight exposure to take diets containing sufficient vitamin D to prevent rises in parathyroid hormone levels.

5.2.7.3 Low vitamin D status in the elderly has two consequences. First is the possibility that osteomalacia may be a direct cause of fracture of the proximal femur and second is the possible contribution of relative hyperparathyroidism induced by subclinical vitamin D deficiency to the genesis of osteoporosis.

5.2.7.4 Vitamin D deficiency may be related to the risk of proximal femoral facture in at least four ways. First, osteomalacia may predispose to fracture by weakening of the bones; second it may predispose to falls by producing a proximal myopathy; thirdly the neuropsychological effects of vitamin D deficiency may lead to immobility which is a predisposing factor to falls.[33] Finally the relationship may be concidental, since immobility and being housebound are predisposing factors to proximal femoral fracture as well as to vitamin D deficiency.

5.2.7.5 Studies in the North of Great Britain[34] and Wales[35] in the 1960s and 1970s suggested that 20 per cent or more of elderly patients suffering proximal femoral fracture had histological evidence of osteomalacia, whereas the prevalence appeared to be much lower in London.[36] Although the methodological issues were complex this may have reflected a genuine regional difference in the prevalence of vitamin D deficiency. There was no reason to suppose that the proportion of patients with femoral fracture predisposed to vitamin D deficiency by being housebound differed between the study centres.

5.2.7.6 Mean plasma 25(OH)D concentrations in the elderly in Great Britain are significantly below mean values for younger people. In a study carried out in the UK in 1973 but reported in 1984 by Dattani *et al*, 10 per cent of 479 men and women aged over 75 had the levels of 25(OH)D usually seen in osteomalacia.[37] For some elderly people 25(OH)D levels never rise above 10 ng/ml at any time during the year.[20] Histologically proven osteomalacia has been observed in 2 to 5 per cent of the elderly presenting to hospitals in Great Britain.[38,39] The prevalence of osteomalacia observed in elderly living in residential homes has been estimated at 11.7 per cent in autumn and 47 per cent among patients in long stay geriatric wards in spring.[23]

5.2.7.7 It has been demonstrated that to maintain year round 25(OH)D levels above 8 ng/ml requires a summer 25(OH)D level of about 16 ng/ml.[40] In a study of old people living at latitude 37°S, exposure of the face and lower arms and legs for 30 minutes increased plasma 25(OH)D levels by about 7.4 ng/ml.[41] This suggests that for Northern Britain at latitude 55°N 1–2 hours exposure daily may be necessary to achieve a similar response.

5.2.7.8 However plasma 25(OH)D in the elderly also responds to oral vitamin D intake.[42–44] A vitamin D supplement of 10 μg/d raises plasma 25(OH)D by about 11.0 ng/ml. In those housebound elderly in the UK unwilling or unable to increase exposure to sunlight, intakes of vitamin D from fortified margarines may be vital in preventing overt osteomalacia in what is an already at risk population.

5.2.8 *Vitamin D status in other European countries*

5.2.8.1 The situation in European countries lying further North is similar to that in the UK. In Finland 7.5 to 22.4 per cent of children aged 2 to 17 years had plasma 25(OH)D levels below 5 ng/ml in winter[45] and there were marked seasonal variations.[46] Histologically proven osteomalacia was found

in elderly patients with femoral fractures[47] and low 25(OH)D levels have also been found in other studies of the elderly.[48,49] In Norway low 25(OH)D levels have been recorded among infants and their mothers[50, 51] and Sem *et al* concluded that average vitamin D intakes in Norway of under 3 μg/d are too low.[52] Neither Finland nor Norway mandatorily fortify margarines with vitamin D (Table 2.2).

5.2.8.2 In Denmark which is at a similar latitude to the UK but has a relatively high vitamin D intake and does not fortify margarine with vitamin D (Table 2.2) 50 per cent of 94 geriatric patients in longstay wards had 25(OH)D below 5 ng/ml. This has led to calls for vitamin D supplementation of these patients even though Danish diet is on average high in vitamin D.[43]

5.2.8.3 In other EC countries such as Germany and Ireland, neither of which has mandatory fortification of margarines with vitamin D but generally lie on latitudes to the south of Northern Great Britain, low vitamin D status has been reported among elderly populations.[53,54] Similar findings have been reported in the Netherlands which does have mandatory fortification of margarine.[44]

5.2.9 The Working Group therefore agreed that, given the historical problems associated with vitamin D deficiency in the UK, the continued risk for both rickets and osteomalacia due to the Northern latitudes spanned by the UK and the major role of fortified margarines as a dietary source of this vitamin in the UK, it would be imprudent to take any steps to diminish the availability of this vitamin from food.

5.2.10 The Working Group were aware of the increasing trend towards the uncontrolled taking of dietary supplements by groups of the UK population and considered that any withdrawal of vitamins A and D from the diet due to stopping fortification would tend to encourage further the purchase and use of supplementary vitamins. In the UK, because of the teratogenic potential of vitamin A, women who are, or may become, pregnant are advised not to take dietary supplements containing vitamin A unless advised to do so by a doctor or ante-natal clinic. The Working Group therefore did not wish to be seen to encourage uncontrolled supplement usage, especially of fat soluble vitamins which are potentially toxic, among any population group and considered that low intakes are best rectified by appropriate dietary changes. (Note the exclusion of infants from this conclusion in section 8 below.)

5.2.11 Taking into account their views on the caution needed over current trends in intakes of retinol equivalent and on the prudence necessary over the Northern latitudes of the United Kingdom and the availability of dietary sources of vitamin D:

The Working Group recommend that the mandatory fortification of margarines with vitamins A and D in the United Kingdom should continue.

6. Other Fat Spreads

6.1 The Working Group recognised that other fat spreads are taking an increasing share of yellow fat sales (tables 3.1, 3.2) and that not all of these are fortified with vitamins A and D (paragraph 1.3.3). Nevertheless, manufacturers choose to fortify most of these products and, so far, market penetration by other fat spreads has not led to a significant decrease in the contribution made by the total yellow fats consumed to either retinol equivalent or vitamin D intakes (Tables 4.5–4.8).

6.2 The Working Group also noted that while the current mandatory requirement for the fortification of margarines remains in force there may be some marketing advantage for manufacturers of other fats spreads to fortify their products and to list vitamins A and D as ingredients.

6.3 The Working Group calculated that, if all other fat spreads were voluntarily fortified to the levels required for margarine, the total amounts of both vitamins available from the average diet would not change significantly. The Working Group therefore concluded that while there were insufficient data on which to base a recommendation that mandatory fortification be extended to other fat spreads, it would be neither difficult for manufacturers to fortify them, nor likely to be detrimental to the health of the population and might be valuable for some groups.

The Working Group recommend that manufacturers of other fat spreads be encouraged to continue and extend the practice of voluntary fortification of their products with vitamins A and D to the levels currently required for margarine.

7. Toxicity of Vitamins A and D

7.1 It is known that vitamin A is toxic when consumed in amounts such as a single dose of around 600,000 μg or a daily intake of 30,000 to 150,000 μg over several months. Vitamin A may also be teratogenic at intakes by pregnant women of around 10,000 μg/d. In the UK women who are, or may become, pregnant are advised not to take supplements containing vitamin A unless advised to do so by a doctor or ante-natal clinic. In addition, they have been advised as a matter of prudence not to eat liver or products made from it such as liver pate and liver sausage for the time being.

7.2 There is some evidence that a small proportion of individuals may be at risk from supplemental intakes of vitamin D which are only moderately excessive. However, any risk of high intake from the diet in the UK is considered to be small, and arises from high consumption of certain foods which are particularly rich sources, not from normal consumption of fortified fats. It is known, however, that prolonged consumption of amounts of vitamin D in excess of 2000 μg/d can lead to hypercalcaemia, calcification of soft tissues and serious damage to kidneys and the cardiovascular system. Furthermore, there is evidence that some individuals may be at risk of adverse effects from vitamin D intakes which are much less than this.[12]

7.3 In 1952 a newly recognised disease in infants and young children associated with failure to thrive and occasionally fatal hypercalcaemia was described by Lightwood.[55] It was suggested by Stapleton *et al* that excessive intakes of vitamin D might be a causative factor.[56] At that time, cod liver oil compound, infant milks and cereals were all fortified with vitamin D. The Ministry of Health and the Department of Health for Scotland concluded in 1957 that infants had unnecessarily high intakes of vitamin D and the levels in cod liver oil compound, infant milks and cereals, were reduced.[57]

7.4 Infantile hypercalcaemia subsequently almost disappeared. Nevertheless the Working Group concluded that the risk of hypercalcaemia reappearing in the UK was real and that while it would not be wise to increase this risk, the fortification of other fat spreads should not lead to significant increases in the number of individuals taking potentially toxic levels of vitamin D.

The Working Group recommend that the amounts of vitamin D currently added to foods should not be increased and the range of foods to which it is added should not be extended.

8. Vitamins for Young Children

8.1 In the Third Report from COMA on Present Day Practice in Infant Feeding, the dietary sources of vitamins for infants and young children were reviewed. They concluded that breastfeeding was to be encouraged and that babies breastfed by a mother in good nutritional status and formula-fed healthy infants were unlikely to become vitamin depleted or deficient. They considered that most young infants do not have a physiological need for vitamin supplements.[58] However, because of the importance of maintaining an adequate maternal vitamin D status, vitamin supplements are advised for pregnant and lactating mothers to provide an additional daily intake of 200 μg of vitamin A and 7 μg of vitamin D.

8.2 However, once a mixed diet begins to be consumed from about 6 months, supplements of vitamins A and D are recommended through to age 5 years. The rationale for this longstanding policy takes account of the likelihood of a marginal vitamin D status in those children who are living in the north or who are inadequately exposed to summer sunlight (perhaps due to a cold rainy summer season), or who may be faddy eaters.[59]

8.3 The Working Group therefore endorse the recommendations of the COMA Panel on Child Nutrition that:

Vitamin supplementation should be given to infants and young children aged from six months to at least two years and preferably five years and the Government should continue to make supplementary vitamins for infants and young children available under the Welfare Food Scheme.

9. Further Research

The Working Group were concerned that they lacked recent data on the vitamin A and D status of large groups of the UK population. Should future developments in the European Community lead to changes in the fortification of yellow fats with vitamin A and D in the UK, COMA would continue to lack recent evidence on the implications of this for public health in this country.

The Working Group recommend that research be carried out to determine the vitamin A and D status of the UK population and the role of contributory food sources, in maintaining the nutritional status of population groups, particularly the elderly.

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List of Tables

Table 2.1 *National butter and margarine* supplies, 1985 (g per person per day)*

	Butter	Margarine
Ireland	28.5	16.2
Belgium	26.0	35.1
France	25.4	11.6
Denmark	21.4	47.7
Germany	20.7	21.4
United Kingdom	13.5	20.5
Netherlands	9.8	39.2
Italy	6.8	2.0
Portugal	2.3	19.4
Spain	1.4	3.9
Australia	10.8	25.0
Austria	15.2	25.0 (1983)
Canada	11.0	17.7
Finland	33.5	29.6
Japan	1.8	—
New Zealand	33.3	—
Norway	13.9	37.7 (1984)
Sweden	20.0	43.0
Switzerland	19.1	—
Turkey	5.9	16.7
United States	6.5	13.5
Yugoslavia	1.9	—

Source: Food Consumption Statistics 1976–1985. Organisation for Economic Co-operation and Development[13]

* Excludes low and reduced fat spreads.

Table 2.2 *Policies of EC member states and other countries on fortification of margarine*

Country	Vitamin A µg/100 g	Vitamin D µg/100 g	Notes
Belgium	750–900	6.25–7.5	Mandatory
Denmark	840	—	Mandatory
France	—	—	Not mandatory*
Germany	1000 max	2.5 max	Not mandatory
Greece	750	3.75	Not mandatory
Ireland	—	—	Not mandatory*
Italy	—	—	Not mandatory*
Netherlands	600 min	7.5 min	Mandatory
Portugal	540 max	—	Mandatory
Spain	—	—	Not mandatory*
UK	800–1000	7.9	Mandatory
Australia	850 min	5.5 min	Mandatory
Austria	—	—	Not mandatory*
Sweden	900 min	7.5 min	Mandatory
USA	1000 min	11	Not mandatory*

Source: International Federation of Margarine Associations (1986).

* EC Member states and other countries which do not require the mandatory addition of vitamins usually allow the voluntary addition of vitamins providing their presence is declared on the label.

Table 3.1 *Household consumption of butter, margarine and low fat spreads: national averages and OAPs (g per person per day)*

Year	National average			OAP*		
	Butter	Margarine	Low fat spreads	Butter	Margarine	Low fat** spreads
1976	20.9	12.4	0.2	26.1	15.7	—
1977	19.0	14.1	0.2	24.8	13.7	—
1978	18.4	14.3	0.2	23.7	19.0	—
1979	18.0	14.7	0.5	22.1	20.3	—
1980	16.4	15.5	0.7	20.8	20.7	—
1981	14.9	16.7	0.8	22.1	20.9	—
1982	12.8	17.5	1.1	19.2	20.3	—
1983	13.2	16.5	1.0	18.9	20.3	—
1984	11.6	16.5	1.7	17.6	20.2	2.2
1985	11.5	15.2	1.9	17.9	18.9	2.8
1986	9.2	16.6	2.8	14.8	21.1	3.6
1987	8.7	16.1	2.9	13.7	20.9	3.6
1988	8.1	15.3	2.8	13.2	21.9	3.7

Source: National Food Survey.

— Data not available from the National Food Survey reports.

* Households whose head is receiving an old age pension.

** Excludes reduced fat spreads.

Table 3.2 *Household consumption of reduced fat spreads: national averages and OAPs (g per person per day)*

Year	National average	OAP
1986	1.5	1.5
1987	1.5	1.1
1988	2.6	3.0

Source: National Food Survey.

Table 3.3 *Consumption of yellow fats by British adults aged 16–64 years in 1986/7 (g/week for those consuming the product)*

Type	Males			Females		
	Mean	Median	Per cent who consumed during survey week*	Mean	Median	Per cent who consumed during survey week*
Butter	88	65	57	69	47	62
Polyunsaturated margarine	98	73	34	67	55	32
Low fat spreads	99	73	18	67	49	21
Block margarine	54	28	23	44	20	20
Other soft margarines	95	62	30	58	41	23
Yellow spreads	95	66	10	60	46	12
Other spreads	16	15	5	15	10	4

Source: Dietary and Nutritional Survey of British Adults[15]

* Some people consumed more than one type of fat spread in the survey week.

Table 4.1 *Sources of retinol equivalent and vitamin D in the British household food supply: national averages 1988*

	Retinol equivalent		Vitamin D	
	µg/d	% of total	µg/d	% of total
Cereals	14	1.1	0.39	12.5
of which				
—breakfast cereals	0	0.0	0.28	8.9
Milk and products	208	16.4	0.29	9.2
Eggs	37	2.9	0.29	9.5
Fats, of which	242	19.0	1.59	51.3
—butter	67	5.3	0.06	2.0
—margarine	130	10.2	1.22	39.5
—low fat spreads	25	2.0	0.23	7.4
—reduced fat spreads	21	1.6	0.02	0.6
Meat	407	32.0	0.02	0.7
of which				
—liver	349	27.4	0.01	0.5
Fish and products	2	0.2	0.49	15.7
of which				
—fatty fish	2	0.1	0.47	15.2
Vegetables	347	27.2	0.00	0.0
of which				
—carrots	223	17.5	0.00	0.0
Fruit	6	0.5	0.00	0.0
Beverages	1	0.1	0.03	0.9
Miscellaneous	9	0.7	0.01	0.2
Total	1273		3.09	

Source: MAFF[14]

Table 4.2 *Percentage contribution made by fish to intakes of vitamin D: national averages*

Year	Fat fish		Other fish and fish products		Total fish	
	µg/d	% of total	µg/d	% of total	µg/d	% of total
1951	na	—	na	—	1.10	30.7
1955	na	—	na	—	1.00	27.0
1960	0.33	9.7	0.50	15.4	0.83	25.1
1965	na	—	na	—	0.80	25.6
1970	0.52	18.1	0.05	1.8	0.57	20.0
1975	0.43	16.4	0.05	2.0	0.48	18.4
1980	0.42	14.6	0.01	0.3	0.42	14.9
1985	0.43	14.5	0.01	0.4	0.44	14.9
1988	0.47	15.2	0.02	0.5	0.49	15.7

Source: National Food Survey.

Table 4.3 *Average daily intakes of retinol equivalent and vitamin D if all the fat spread was butter, fortified to the levels in margarine, or unfortified (µg per person per day)*

Type of fat	Retinol equivalent	Vitamin D
Butter	1269	1.78
Margarine*	1275	3.86
Unfortified spread*	1044	1.56

* Containing 50 µg/100 g retinol equivalent added as β-carotene to colour the products.

Table 4.4 *Household intakes of retinol equivalent and vitamin D: national averages and OAPs (μg per person per day)*

Year	Retinol equivalent		Vitamin D	
	National average	OAPs	National average	OAPs
1976	1480	1650	2.69	3.19
1977	1470	1680	2.65	2.89
1978	1490	1740	2.65	3.40
1979	1350	1660	2.72	3.42
1980	1350	1570	2.85	3.53
1981	1340	1560	2.99	3.67
1982	1400	1610	2.96	3.43
1983	1300	1580	2.96	3.51
1984	1380	1730	2.92	3.50
1985	1370	1770	2.96	3.80
1986	1330	1750	3.24	4.20
1987	1280	1670	3.18	3.85
1988	1270	1550	3.09	4.25

Source: National Food Survey.

Table 4.5 *Percentage contribution made by butter, margarine and low fat spreads to intakes of retinol equivalent: national averages*

Year	Butter	Margarine	Low fat spreads
1976	13.9	8.0	0.1
1977	12.7	9.2	0.1
1978	12.3	9.3	0.1
1979	11.0	8.7	0.3
1980	10.1	9.2	0.4
1981	9.2	9.9	0.5
1982	7.6	10.6	0.7
1983	8.4	10.8	0.7
1984	7.0	10.2	1.1
1985	6.9	9.4	1.3
1986	5.7	10.6	1.9
1987	5.6	10.7	2.0
1988	5.3	10.2	2.0

Source: National Food Survey

Table 4.6 *Percentage contribution made by butter, margarine and low fat spreads to intakes of retinol equivalent: OAPs*

Year	Butter	Margarine	Low fat spreads
1976	13.1	7.6	—
1977	12.2	6.5	—
1978	11.3	8.7	—
1979	11.0	9.8	—
1980	11.0	10.5	—
1981	11.7	10.7	—
1982	9.9	10.8	—
1983	9.9	10.9	—
1984	8.4	9.9	1.1
1985	8.4	9.1	1.4
1986	7.0	10.2	1.8
1987	6.8	10.6	1.9
1988	7.0	12.0	2.1

Source: National Food Survey.

— Data not available from the National Food Survey reports.

Table 4.7 *Percentage contribution made by butter, margarine and low fat spreads to intakes of vitamin D: national averages*

Year	Butter	Margarine	Low fat spreads
1976	9.7	36.6	0.6
1977	5.4	42.1	0.6
1978	5.3	43.0	0.5
1979	5.0	43.0	1.5
1980	4.3	43.2	1.8
1981	3.8	44.2	2.1
1982	3.3	47.2	2.8
1983	3.4	44.5	2.6
1984	3.0	45.1	4.8
1985	2.9	41.0	5.3
1986	2.1	40.7	6.9
1987	2.1	40.4	7.2
1988	2.0	39.5	7.3

Source: National Food Survey.

Table 4.8 *Percentage contribution made by butter, margarine and low fat spreads to intakes of Vitamin D: OAPs*

Year	Butter	Margarine	Low fat spreads
1976	6.1	39.1	—
1977	6.4	37.5	—
1978	5.2	44.5	—
1979	4.8	47.0	—
1980	4.4	46.5	—
1981	4.5	45.1	—
1982	4.2	47.2	—
1983	4.0	46.0	—
1984	3.8	45.9	5.0
1985	3.5	39.6	6.0
1986	2.6	39.9	6.8
1987	2.7	43.2	7.4
1988	2.3	41.0	6.9

Source: National Food Survey.

— Data not available from the National Food Survey reports.

Table 4.9 *Average daily intakes of retinol equivalent and vitamin D by different population groups in Britain*

Group (Year of Study)	Age (Years)	Retinol equivalent µg/d			Vitamin D µg/d		
		Males	Females	All	Males	Females	All
Infants (1986)	0.5–0.75	816	748		4.9	4.5	
	0.75–1	711	769		2.3	2.0	
Pre-school children[60] (1967–1968)	1.5–2.5	—	—	750*	—	—	2.9*
	2.5–3.5	—	—	670*	—	—	2.0*
	3.4–4.5	—		720*	—	—	1.8*
Schoolchildren[17] (1983)	10–11	845	691		1.5	1.3	
	14–15	969	801		1.6	1.2	
Adults[15] (1987)	16–24	1164	1051		2.8	2.1	
	25–34	1152	1234		3.2	2.3	
	35–49	1749	1531		3.7	2.6	
	50–64	1897	1655		3.8	2.8	
Elderly[10] (1968)	65–74	1140	1030		3.3	2.3	
	75+	1100	890		2.7	2.1	

Sources: Department of Health and Social Security, 1972; 1975; Department of Health, 1989; Gregory *et al* 1990; MAFF, unpublished.

— Data not available.

* Figures include intakes from supplements.

Table 4.10 *Average contributions of main food groups to daily intakes of retinol equivalent and vitamin D (μg): MAFF/DH/OPCS Dietary and Nutritional Survey of British Adults 1986/7*

	Retinol equivalent		Vitamin D	
	μg	% of total	μg	% of total
Fat spreads	150	10	0.89	30
Cereal products	76	5	0.71	24
Milk and products	167	11	0.19	6
Eggs and egg dishes	45	3	0.28	9
Meat and products	738	49	0.11	4
of which				
—liver and products	664	44		
Fish and fish dishes	15	1	0.65	22
of which				
—oily fish			0.62	21
Vegetables	274	18	0.05	2
of which				
—carrots	202	17		
Fruit and nuts	12	1	0	0
Sugar, confectionery and preserves	1	0	0	0
Beverages	1	0	0	0
Miscellaneous	36	2	0.08	3
Totals	1519		2.96	

Source: The Dietary and Nutritional Survey of British Adults (unpublished data)

Table 4.11 *Percentage contribution of specific foods to retinol equivalent and vitamin D intakes: DH survey of school children, 1983*

Retinol equivalent	Boys aged 10/11	Girls aged 10/11	Boys aged 14/15	Girls aged 14/15
Margarine	6	7	5	6
Butter	6	7	8	5
Carrots	17	19	16	16
Milk	12	11	11	10
Vegetables	6	7	6	8
Cheese	5	6	7	6
Other foods	48	43	47	49
Total intake (μg/d)	845	691	969	801
Vitamin D				
Margarine	24	25	22	27
Eggs	23	21	24	23
Breakfast cereals	16	14	14	9
Other foods	37	40	40	41
Total intake (μg/d)	1.48	1.32	1.63	1.24

Source: Department of Health.[17]

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Figure 4.1 Contribution made by butter to intakes of retinol equivalent

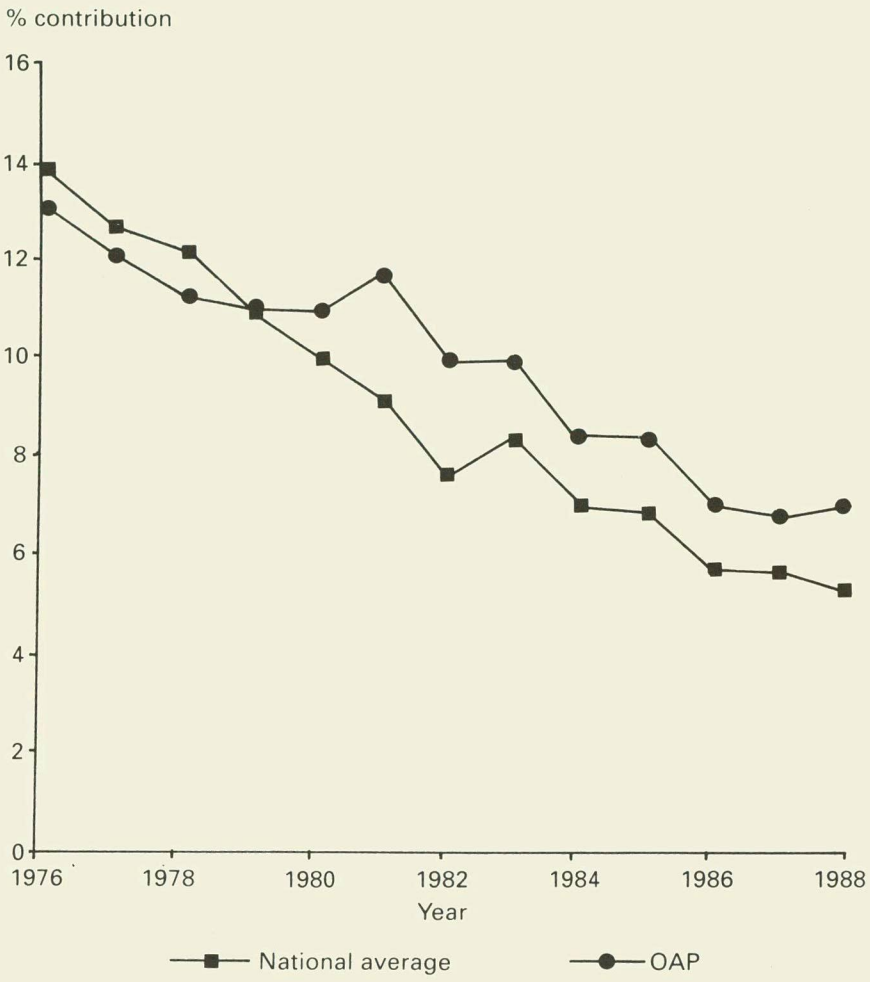
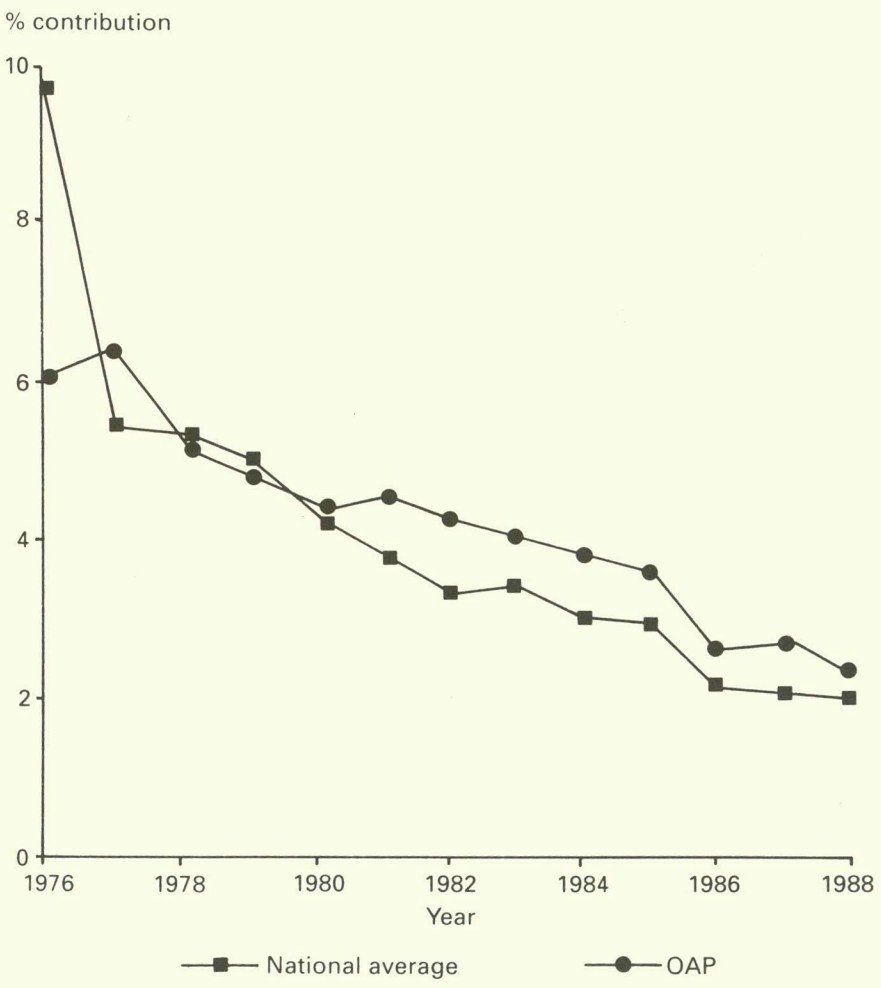


Figure 4.2 Contribution made by butter to intakes of vitamin D



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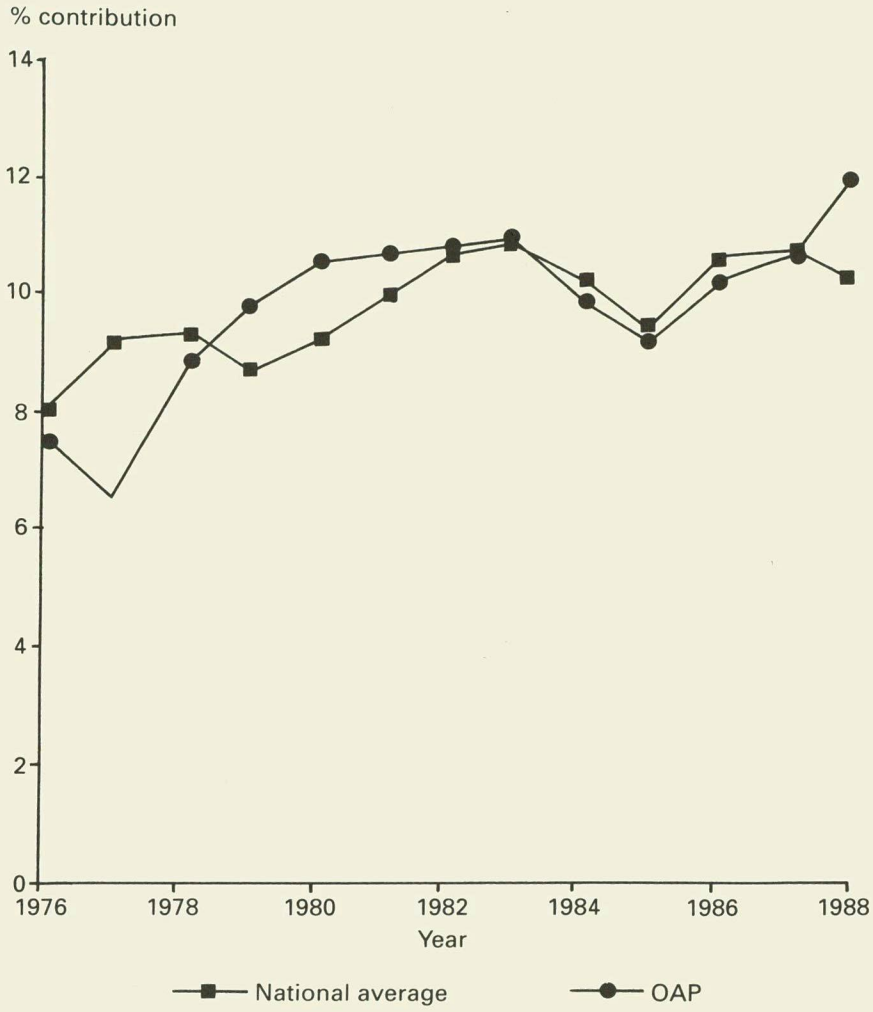

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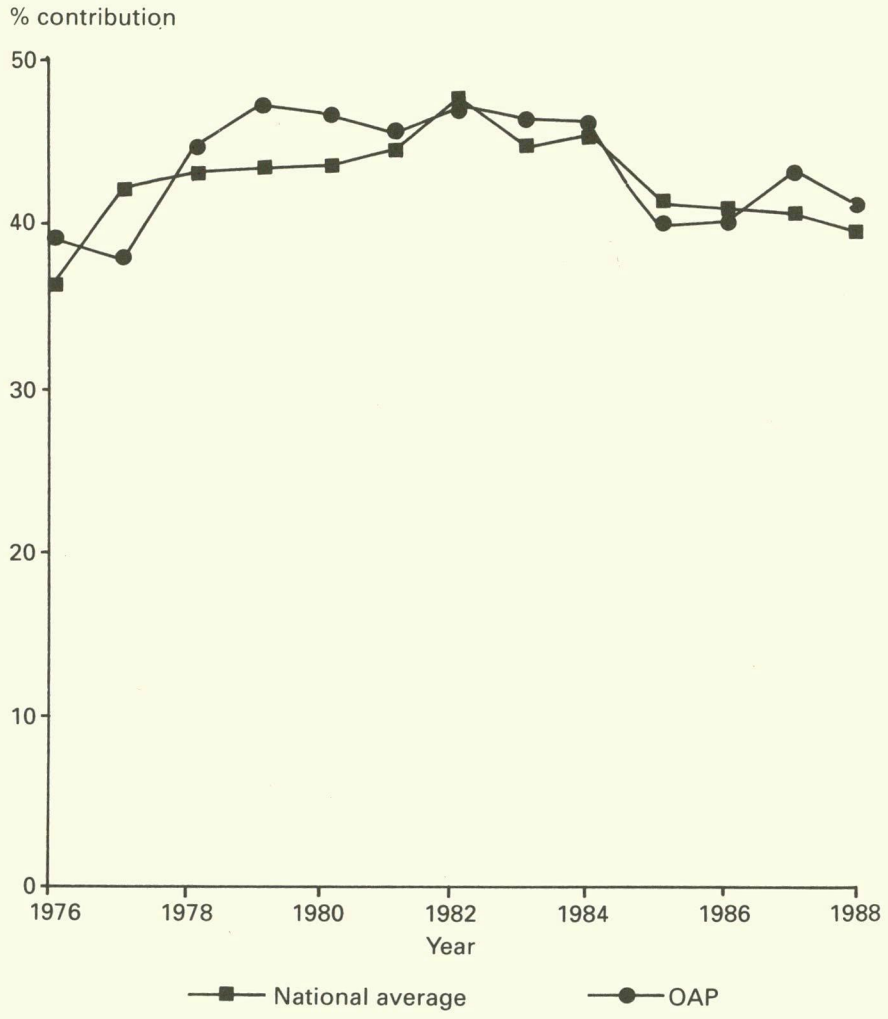

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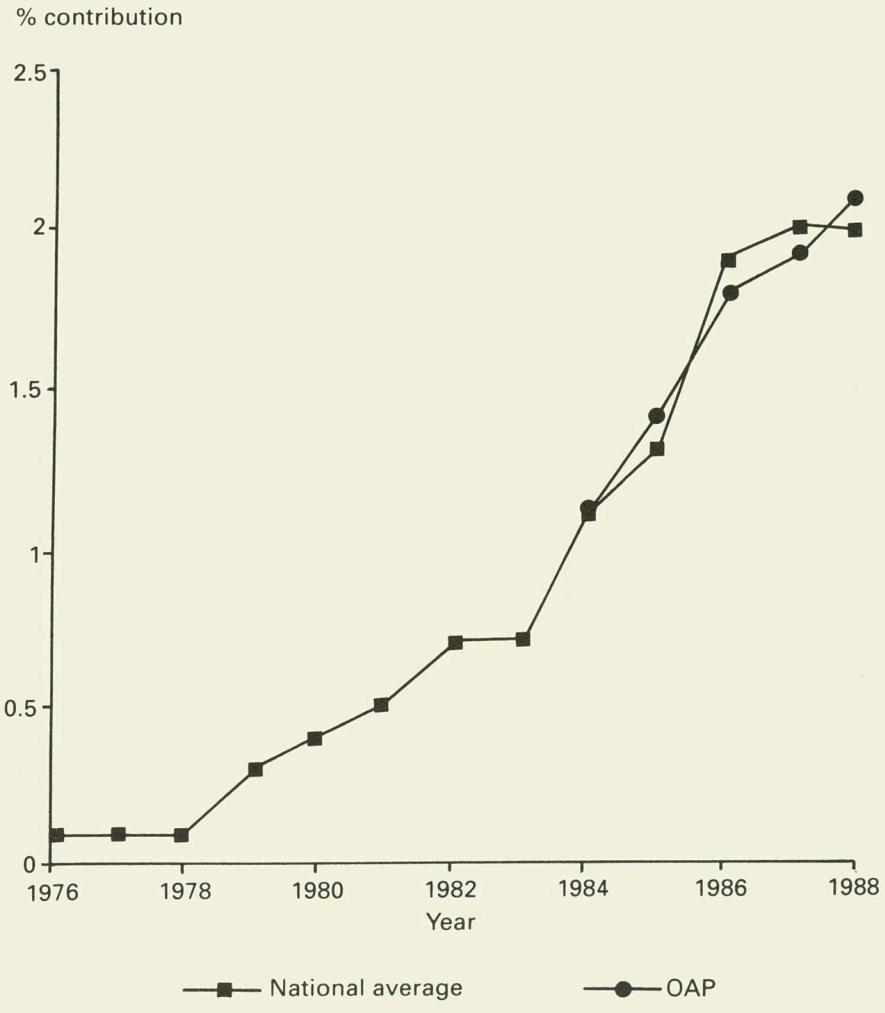

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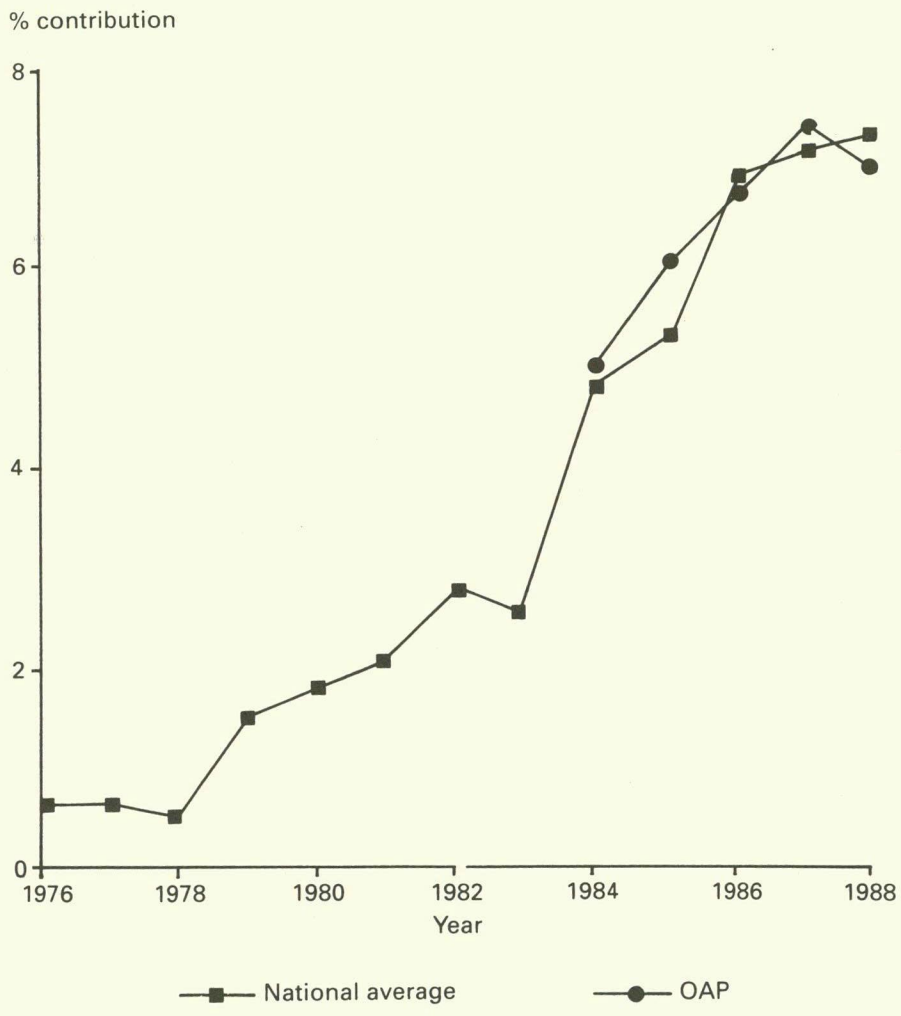

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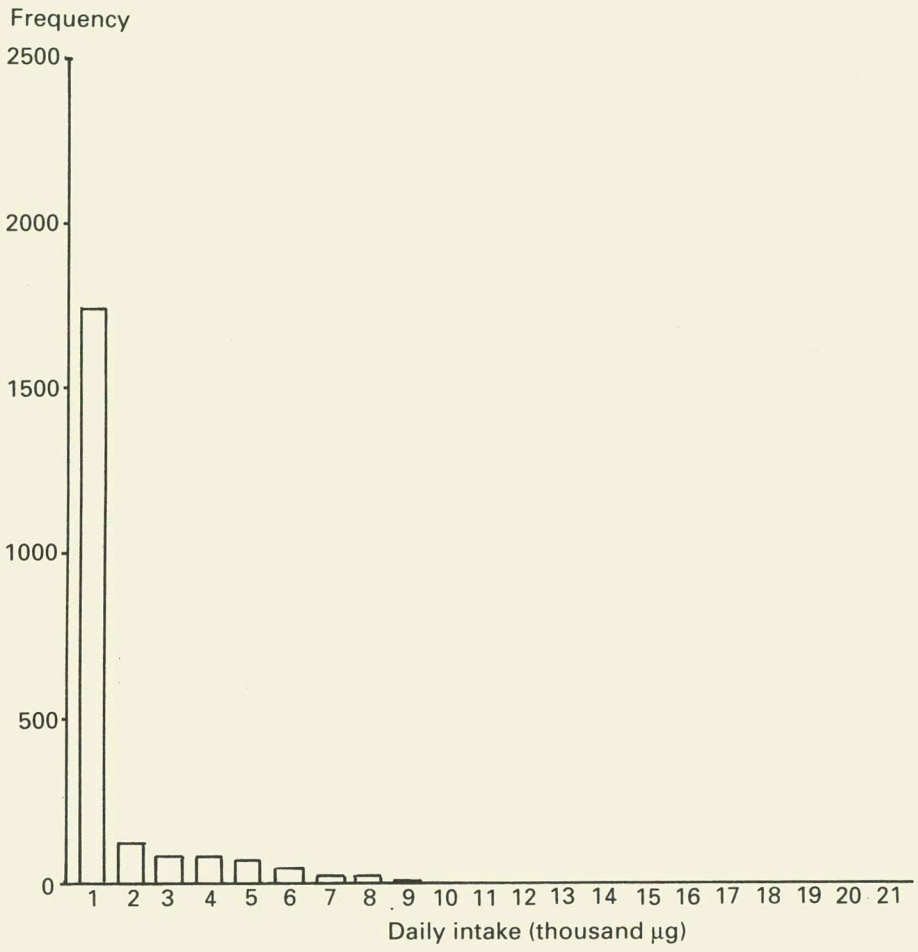

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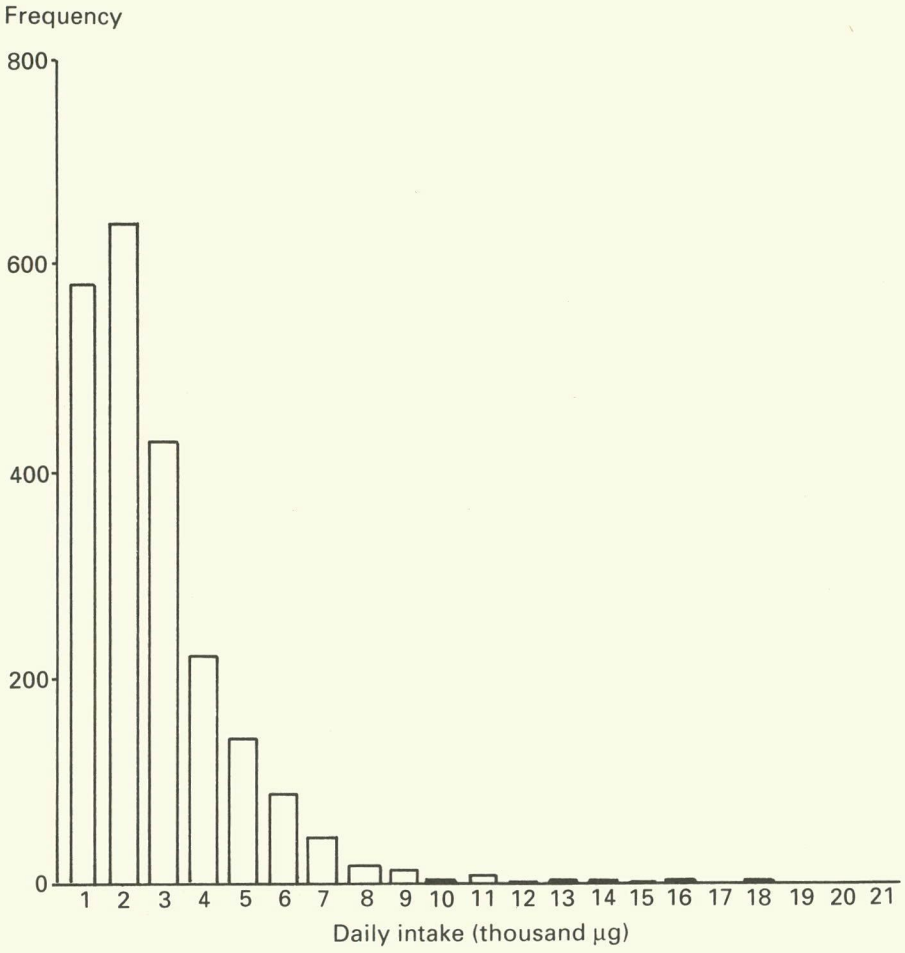

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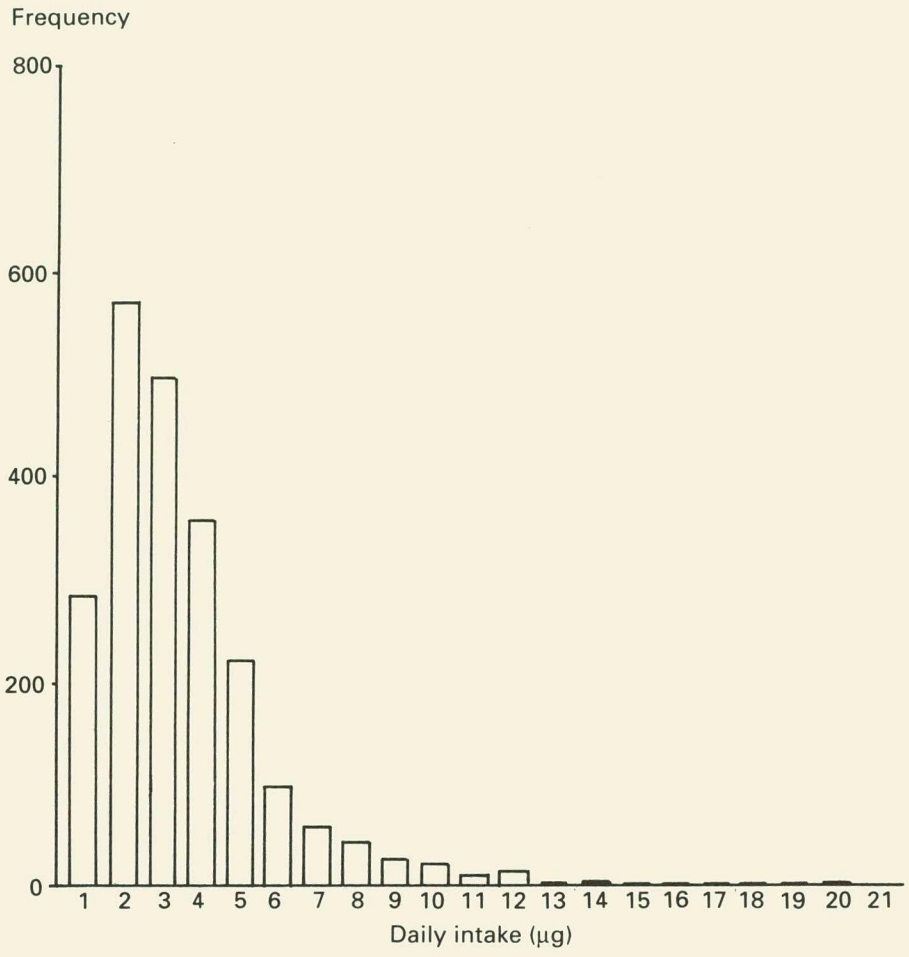

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