

WARTIME RATIONING AND NUTRITION IN PREGNANCY. FIRST COMMUNICATION

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English women, thanks to the efficiency of the rationing system in wartime, not only escaped the hardships of expectant mothers on the Continent, but were able to maintain a satisfactory level of nutrition throughout pregnancy. We have qualitative evidence for this fact. The purpose of this communication is to contribute quantitative evidence.

The figures discussed are limited to total calories, protein, fat and carbohydrates. The calcium intakes, excretions and balances and a discussion of the phosphorus figures have already been published elsewhere (Obermer, 1946, 1947, 1948). Complete food tables, the K, Mg, P, S figures, the acid-base values of the diets and the analytical data from the blood, urine and faeces will be published later.

MATERIAL

The tables were compiled from an analysis of the food ingested by fifty-five women on a self-chosen diet, at different stages of pregnancy, between the beginning of 1943 and the end of 1946.

The women were chosen, for the most part, at the Out-Patient Department of the City of London Lying-in Hospital. An attempt was made to select average, healthy, working-class mothers. Forty-three were primiparae. Four cases, whose general health was good, had previously miscarried or had a stillborn child. The remaining eight had previously given birth to one healthy child.

The age range was from 21 to 34, the weight range from 45.4 to 77 kg.—the majority within the 50–60 kg. range.

Economic and housing conditions varied within a wide range. A few of the women continued to work in order to supplement their husband's pay or allowance for the first few months of pregnancy. Some made shift with a total housekeeping allowance of 30s. per week. A few (three in all) owned their own houses and enjoyed an income of over £5 a week. The average income was £3.

It was difficult to establish a weekly expenditure for food alone. The figures given varied from 17s. 6d. to 30s., with an average of about 25s. per head.

The majority lived in slum areas in two rooms (bedroom and kitchen), some in better, converted, middle-class houses, and a few in their own houses with a strip of garden.

Sixty per cent of the women lived in the East End or northern boroughs such as Finsbury, Hackney, Islington, Bethnal Green, Tottenham, North Finchley, Stoke Newington, Finsbury Park and Wood Green, the remainder in Hammersmith, Hampstead, Hornsey, Enfield and two in Reigate, Surrey.

The conditions reflected average working-class circumstances of the metropolitan and suburban areas during this period. The general level of intelligence of these women may have been above the average, though this factor varied within wide limits. The average woman would not take the trouble to weigh and measure food, collect specimens and fill in forms. The fact that forty-nine out of fifty-five cases co-operated throughout pregnancy and during the first postnatal year presupposes unusual conscientiousness and determination.

METHODS

Each woman was given scales (accurate to $\frac{1}{8}$ oz.), a cardboard plate, a supply of grease-proof paper and a half-pint graduated enamel measure. A detailed instruction sheet and blank meal-forms for 48 hr. were given for each investigation. On the first occasion, a practical demonstration was given, either by a sister or by the writer. Frequent visits were paid to each woman. The specimens and forms were collected from the woman's house on each occasion. It was thus possible to verify the accuracy of the data and ensure continuous and close co-operation. On these occasions stress was laid on the importance of not saving up rations for the period of investigation, but spreading them out over the week in the usual way.

The composition of the diet was calculated from McCance & Widdowson's (1942) Table.

RESULTS

The figures given in all the tables represent intakes over a 24 hr. period, arrived at by halving the 48 hr. figures.

The figures given in Tables 2, 4–7, and 10–12 have been divided into two sections—first and second halves of pregnancy—because of the fact, first stressed by Slemons (1919), that the nutritional

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requirements of the foetus are small up to the eighteenth week. Figures up to the nineteenth week have been included in the sections headed 'First half of pregnancy'.

TOTAL CALORIES

The calorie requirements of a pregnant woman of average weight, i.e. 50 kg., are said to be no less than 2250 during the first half and 2500 during the

intake at different phases of pregnancy. Table 2 shows the distribution. Thus, 49.8% of the series consumed less than 2250 cal. during the first half of pregnancy and 46.9% less than 2500 cal. in the second half and should, therefore, be considered suboptimal. These figures compare favourably, however, with recent American surveys, such as the Toronto (Ebbs, Tisdal & Scott, 1941) and Philadelphia (Williams & Fralin, 1942) surveys, completed just before America entered the war.

Table 1. *Total calories. Fifty-five cases*

| Week of pregnancy | No. of investigations | Mean | Standard deviation | Coefficient of variation | Range |
|--------------------|-----------------------|------|--------------------|--------------------------|-----------|
| 6-12 | 28 | 2176 | 425 | 19.6 | 1431-3621 |
| 13-20 | 59 | 2427 | 460 | 18.8 | 1258-3655 |
| 21-25 | 42 | 2515 | 519 | 20.5 | 1546-4701 |
| 26-30 | 41 | 2639 | 406 | 16.1 | 1912-4040 |
| 31-35 | 38 | 2497 | 561 | 23.4 | 1105-3777 |
| 36-40 | 30 | 2439 | 476 | 19.7 | 1120-3819 |
| Whole of pregnancy | 238 | 2482 | 474 | 19.7 | 1395-3938 |

Table 2. *Total calories*

| Calories | First half of pregnancy | | Second half of pregnancy | |
|-----------|-------------------------|-----------------------|--------------------------|-----------------------|
| | No. of investigations | Per-centages of total | No. of investigations | Per-centages of total |
| 1001-1500 | 5 | 6.3 | 4 | 2.5 |
| 1501-2000 | 21 | 26.3 | 16 | 10.3 |
| 2001-2250 | 14 | 17.2 | 25 | 15.8 |
| 2251-2500 | 11 | 13.7 | 29 | 18.3 |
| 2501-3000 | 20 | 25.3 | 66 | 41.8 |
| 3001-3500 | 6 | 7.7 | 12 | 7.6 |
| 3501-4000 | 3 | 3.5 | 4 | 2.5 |
| 4001-4500 | — | — | 1 | 0.6 |
| Over 4500 | — | — | 1 | 0.6 |

Table 3. *Total protein (in g.). Fifty-five cases*

| Week of pregnancy | No. of investigations | Mean | Standard deviation | Coefficient of variation | Range |
|--------------------|-----------------------|------|--------------------|--------------------------|------------|
| 6-12 | 28 | 78.1 | 17.2 | 22.0 | 44.1-139.0 |
| 13-20 | 59 | 88.5 | 17.4 | 19.7 | 46.0-156.0 |
| 21-25 | 42 | 91.7 | 17.2 | 18.8 | 53.3-130.0 |
| 26-30 | 41 | 92.3 | 13.9 | 15.1 | 57.4-121.0 |
| 31-35 | 38 | 88.8 | 17.1 | 19.3 | 55.8-130.2 |
| 36-40 | 30 | 86.7 | 15.2 | 17.6 | 38.0-124.3 |
| Whole of pregnancy | 238 | 87.7 | 16.3 | 18.7 | 49.1-133.6 |

second half of pregnancy. Older and more recent authorities agree on this (Von Noorden & Salamon, 1920; League of Nations Commission, 1935; U.S. Nat. Research Council, 1941; Wohl, 1945).

These figures show a wide scatter. The detailed figures from which these statistics were compiled show that the scatter is due more to a low or high intake throughout pregnancy (as compared with the mean) than to variations in the individual woman's

PROTEIN

An adequate protein intake during pregnancy is of primary importance. The Committee on Food and Nutrition of the U.S. National Research Council's (1941) standard of 85 g. during the latter half of pregnancy, for a woman weighing 50 kg., can be considered as standard for both halves of pregnancy.

Table 4. *Total protein (in g.)*

| g. | First half of pregnancy | | Second half of pregnancy | |
|----------|-------------------------|-----------------------|--------------------------|-----------------------|
| | No. of investigations | Per-centages of total | No. of investigations | Per-centages of total |
| Under 51 | 3 | 3.7 | 2 | 1.3 |
| 51-70 | 13 | 16.3 | 14 | 8.9 |
| 71-85 | 26 | 32.5 | 48 | 30.3 |
| 86-100 | 27 | 33.8 | 59 | 40.0 |
| 101-125 | 10 | 12.5 | 31 | 17.0 |
| 126-150 | 1 | 1.2 | 4 | 2.5 |

These figures show that 52.5% of the series were below optimum during the first half of pregnancy and 40.5% during the second half of pregnancy.

As Williams (Wohl, 1945) points out, however, a more satisfactory standard is arrived at by calculating the intake in g. of protein per kg. body weight.

Accepting William's standard of 1.25 g./kg. as optimum for the first half of pregnancy and 1.5 g./kg. for the second half, only 33% of the figures in Table 5 show a suboptimal protein intake in the

Table 5. *Protein ingestion (g./kg.)*

| g./kg. | First half of pregnancy | | Second half of pregnancy | |
|-----------|-------------------------|-----------------------|--------------------------|-----------------------|
| | No. of investigations | Per-centages of total | No. of investigations | Per-centages of total |
| Under 1.1 | 7 | 10 | 5 | 3 |
| 1.1-1.25 | 16 | 23 | 20 | 14 |
| 1.26-1.50 | 20 | 28 | 41 | 29 |
| 1.51-1.75 | 14 | 20 | 39 | 28 |
| 1.76-2.0 | 10 | 14 | 27 | 19 |
| Over 2.0 | 4 | 5 | 9 | 6 |

first half and 46% in the second half of pregnancy. These percentages also compare favourably with the results of prewar surveys (McCance, Widdowson & Vernon-Roe, 1938; Tompkins, 1941; Ross, Pearlzweig, Taylor, McBride, Yates & Kondritzer, 1938).

In 44% of the investigations the protein intake accounted for 15% or more of the total calorie intake, which is Williams's optimum figure.

As meat, milk and cheese were rationed throughout the period the protein intake was analysed in more detail, in terms of percentage of animal protein derived from meat, milk, eggs, cheese, poultry and sea-food, as contrasted with vegetable protein—bread, cereals and vegetables. In 79% of the investigations 50% (Williams's (Wohl, 1945) optimum figure) or more of the total protein ingested was animal protein. How was this animal protein consumed?

Milk. The women were given milk certificates, which entitled them to 1 pint per day from the

certification of pregnancy, in addition to the ordinary consumer's ration. Nevertheless, according to the figures in Table 6, in 60% of 'first half' investigations and 48% of 'second half' investigations less than this ration was consumed. In the second half of pregnancy, on the other hand, the consumption was more than the priority pint in 52%.

Table 6. *Milk*

| ml. | First half of pregnancy | | Second half of pregnancy | |
|---------------|-------------------------|-----------------------|--------------------------|-----------------------|
| | No. of investigations | Per-centages of total | No. of investigations | Per-centages of total |
| Less than 300 | 5 | 6 | 5 | 3 |
| 301-450 | 23 | 28 | 24 | 15 |
| 451-600 | 21 | 26 | 48 | 30 |
| 601-900 | 31 | 38 | 67 | 42 |
| 901-1200 | 1 | 2 | 15 | 10 |

As the protein content of cow's milk averages 3.3 g./100 ml. and the average consumption was in the region of 1 pint (568 ml.) milk protein accounted for about 19 g. of the total animal protein.

Cheese. The ration throughout this period was about $\frac{1}{2}$ oz. (15 g.) per day. The figures in Table 7 show that no cheese at all was eaten during 42% of the 'first half' and 45% of the 'second half' investigations. This finding may be accounted for by the unpalatable nature of the only cheese available on the market at the time.

Table 7. *Cheese (in g.)*

| g. | First half of pregnancy | | Second half of pregnancy | |
|----------|-------------------------|-----------------------|--------------------------|-----------------------|
| | No. of investigations | Per-centages of total | No. of investigations | Per-centages of total |
| None | 34 | 42 | 72 | 45 |
| Under 10 | 7 | 9 | 13 | 8 |
| 11-20 | 14 | 16 | 29 | 18 |
| 21-30 | 16 | 20 | 28 | 18 |
| 31-40 | 5 | 7 | 9 | 6 |
| 41-50 | 3 | 4 | 6 | 4 |
| Over 50 | 2 | 2 | 2 | 1 |

The protein content of cheese is high (24.6 g./100 g.). The average consumption of cheese was about 13 g. Thus cheese protein accounted for only about 3 g. of the total animal protein.

FAT

Cooking fats and bacon were in short supply throughout the survey and the ration was small. The figures in Table 8 are, therefore, unexpectedly high.

It should be remembered, however, that fat figures in food tables cannot be relied upon to the same extent as protein or carbohydrate figures. A series of fat analyses carried out by the writer before the war gave uniformly higher figures than the tables. In wartime the reverse might be the case. Hence the figures may err on the high side.

CARBOHYDRATES

The writer shared a widespread impression among observers interested in nutrition that the main error in British diets during the war period was an excess of carbohydrates at the expense of protein and fat. This impression is not supported by the findings in this series.

Bread and potatoes are the staple carbohydrate components of the average diet. Neither of them was rationed during the period under review. The consumption of these foods, for the series, is given in Tables 11 and 12.

Bread. 76 % 'first half' and 75 % 'second half' investigations showed an ingestion of less than ½ lb. (225 g.) per day.

Potatoes. Table 12 shows that 43 % 'first half' and 42 % 'second half' consumed 200 g. (7 oz.) or over/24 hr. The food tables show a mean consumption of 191 g./24 hr. (234 48 hr. periods of investigation) with a minimum of 40 g. and a maximum of 435 g. Some of these women, therefore, would have been adversely affected during the subsequent potato rationing period.

Table 8. *Total fat (in g.). Fifty-five cases*

| Week of pregnancy | No. of investigations | Mean | Standard deviation | Coefficient of variation | Range |
|--------------------|-----------------------|-------|--------------------|--------------------------|------------|
| 6-12 | 28 | 94.1 | 25.6 | 27.2 | 56.5-179.0 |
| 13-20 | 59 | 109.7 | 29.3 | 26.7 | 52.6-173.8 |
| 21-25 | 42 | 111.0 | 34.5 | 30.9 | 53.9-247.3 |
| 26-30 | 41 | 114.3 | 23.4 | 20.3 | 77.7-196.1 |
| 31-35 | 38 | 109.8 | 23.4 | 21.4 | 36.8-178.7 |
| 36-40 | 30 | 105.4 | 24.8 | 23.6 | 35.1-165.4 |
| Whole of pregnancy | 238 | 107.4 | 26.8 | 25.0 | 52.1-190.0 |

Table 9. *Total carbohydrates (in g.). Fifty-five cases*

| Week of pregnancy | No. of investigations | Mean | Standard deviation | Coefficient of variation | Range |
|--------------------|-----------------------|-------|--------------------|--------------------------|-------------|
| 6-12 | 28 | 265.2 | 60.7 | 23.6 | 154.0-578.9 |
| 13-20 | 59 | 278.6 | 73.3 | 26.3 | 119.9-448.6 |
| 21-25 | 42 | 298.5 | 68.0 | 22.7 | 181.5-504.5 |
| 26-30 | 41 | 318.1 | 48.6 | 15.3 | 211.1-461.7 |
| 31-35 | 38 | 298.2 | 65.5 | 22.1 | 134.8-433.7 |
| 36-40 | 30 | 286.7 | 69.4 | 24.1 | 145.1-467.4 |
| Whole of pregnancy | 238 | 290.9 | 64.2 | 22.3 | 157.7-476.1 |

A further table shows the preponderance of carbohydrate intakes below 300 g.

Table 10. *Total carbohydrates (in g.)*

| g. | First half of pregnancy | | Second half of pregnancy | |
|-----------|-------------------------|------------------------|--------------------------|------------------------|
| | No. of investigations | Per- centages of total | No. of investigations | Per- centages of total |
| Under 100 | — | — | 1 | 0.6 |
| 101-150 | 2 | 2.5 | 3 | 1.9 |
| 151-200 | 11 | 12.7 | 5 | 3.2 |
| 201-250 | 19 | 23.6 | 27 | 17.1 |
| 251-300 | 17 | 21.2 | 45 | 28.5 |
| 301-350 | 22 | 28.5 | 46 | 29.2 |
| 351-400 | 6 | 7.75 | 21 | 13.2 |
| 401-450 | 3 | 3.75 | 6 | 3.8 |
| 451-500 | — | — | 3 | 1.9 |
| Over 500 | — | — | 1 | 0.6 |

Other common farinaceous foods were consumed in considerable quantities, usually at the expense of bread. The second column in the following list gives the number of investigations, out of a possible 238, during which these foods were eaten:

| Food | No. of investigations | Mean per 24 hr. | Range (g.) |
|---------|-----------------------|-----------------|------------|
| Cake | 124 | 49 | 10-150 |
| Biscuit | 120 | 32 | 10-155 |
| Pastry | 99 | 43 | 10-250 |
| Pudding | 74 | 67 | 20-185 |

According to Williams's (Wohl, 1945) standards, carbohydrates should account for not less than 50 % of the total calorie intake. In this series 87.5 % of the investigations showed an intake of less than 50 % of the total calories as carbohydrates.

Table 11. *Bread eaten*

| g. | First half of pregnancy | | Second half of pregnancy | |
|----------|-------------------------|-----------------------|--------------------------|-----------------------|
| | No. of investigations | Per-centages of total | No. of investigations | Per-centages of total |
| Under 75 | 2 | 3 | 3 | 2 |
| 76-100 | 5 | 6 | 9 | 6 |
| 101-150 | 12 | 15 | 30 | 19 |
| 151-200 | 24 | 31 | 36 | 23 |
| 201-250 | 16 | 21 | 39 | 25 |
| 251-300 | 14 | 18 | 22 | 14 |
| 301-350 | 3 | 4 | 8 | 5 |
| 351-400 | 2 | 3 | 5 | 3 |
| 401-450 | — | — | 2 | 1 |
| Over 450 | — | — | 2 | 1 |

Table 12. *Potatoes eaten*

| g. | First half of pregnancy | | Second half of pregnancy | |
|----------|-------------------------|-----------------------|--------------------------|-----------------------|
| | No. of investigations | Per-centages of total | No. of investigations | Per-centages of total |
| Under 75 | 9 | 11 | 16 | 10 |
| 76-100 | 10 | 13 | 6 | 4 |
| 101-150 | 12 | 15 | 29 | 18 |
| 151-200 | 15 | 19 | 41 | 26 |
| 201-250 | 14 | 18 | 31 | 19 |
| 251-300 | 15 | 19 | 16 | 10 |
| 301-350 | 2 | 3 | 13 | 8 |
| 351-400 | 2 | 3 | 6 | 4 |
| 401-450 | Nil | Nil | 2 | 1 |

All the women did their own house work and shopping. For most of the period they were subjected to bombing, queuing and worry about their menfolk and friends. There were also the discomforts and extra labour involved in shelter life. The level of carbohydrate intake may, therefore, in many of these cases have been below the minimum requirements.

SUMMARY

1. An analysis is made of 238 total calorie, protein, fat and carbohydrate intakes during wartime. These represent the 24 hr. mean of 48 hr. investi-

gations carried out at six-weekly intervals throughout pregnancy on 55 healthy working-class women on self-selected diets. These investigations were carried out from April 1943 to the end of 1946. Throughout this period, 'wartime' rationing conditions prevailed.

2. The total calorie intake is analysed. 49.8 % of the series in the 'first half' of pregnancy and 46.9 % in the 'second half' of pregnancy were found to be suboptimal according to recognized standards.

3. The protein intake is analysed in terms of (a) total intake, and (b) g./kg. body-weight. The latter analysis showed that 33 % of the figures in the 'first half' of pregnancy and 46 % of the figures in the 'second half' of pregnancy were suboptimal.

4. The percentage of animal protein is contrasted with that of vegetable protein; a satisfactory animal protein percentage is found. The latter is derived partly from the extra pint of milk and partly from adequate quantities of meat, offal and fish. Over 40 % of the women ingested no cheese at all. The remainder consumed relatively small quantities.

5. The total fat intake is analysed. Over 50 % showed a fat ingestion of more than 100 g./day.

6. The total carbohydrate intake is analysed and the average ingestion found to be below 300 g. An analysis of the amounts of bread eaten per day showed a large proportion of intakes below $\frac{1}{2}$ lb. (225 g.) per day—76 % in the 'first half' and 75 % in the 'second half' of pregnancy. The potato intake was relatively higher. The mean daily consumption was 191 g. with a maximum of 435 g. A list is also given of the amounts of the other common farinaceous foods consumed.

7. An analysis is made of the percentage of total calories accounted for by protein, fat and carbohydrates respectively. When the figures are compared with the accepted standards of 15 % protein, 35 % fat and 50 % carbohydrates, the findings are (a) a slight preponderance of low protein intakes, (b) a preponderance of high fat intakes, and (c) a preponderance of low carbohydrate intakes.

8. The figures for all three constituents—protein, fat and carbohydrate—compare favourably with those given in prewar surveys of nutrition in pregnant working-class women.

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