ELEVENTH SCIENTIFIC MEETING—FIFTH SCOTTISH MEETING

INSTITUTE OF PHYSIOLOGY, UNIVERSITY OF GLASGOW,
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THE INFLUENCE OF DIET ON PREGNANCY AND LACTATION IN THE MOTHER, THE GROWTH AND VIABILITY OF THE FOETUS, AND POST-NATAL DEVELOPMENT.

PART 2. LACTATION

Chairman, Professor G. B. FLEMING

Professor G. B. Fleming (Royal Hospital for Sick Children, Glasgow): The discussion at the last Scottish meeting on the effect of diet on pregnancy was, from a practical point of view, of special interest to the obstetrician; the present discussion is of the greatest importance to the paediatrician. I should like to mention some of the problems with which we are confronted.

I think it is probably true to say that the foetus *in utero* has first call on the food and food reserves of the mother. It is a striking fact that even grossly undernourished mothers have apparently well nourished babies. Even after the birth of her child an undernourished mother may provide adequate nourishment to her infant but too often in these circumstances the milk supply fails. But this failure is not confined to the undernourished, for even those who are well fed and apparently in perfect health are often unable to feed their infants. Diet is not everything. Not enough is known about the physiology of human lactation; I do not think it has been studied in the thorough way that bovine lactation has. The scientific breeding and feeding of cattle, perhaps because it is a commercial proposition, has led to enormous improvement in the quantity and quality of milk yielded by dairy cows. It is strange that a process of natural selection has not produced a race of women who are good milkers. One would have thought that as breast fed infants have a far better chance of survival than those artificially fed, the offspring of bad milkers would gradually have been eliminated. Actually, before the middle of the 19th century almost all artificially fed babies died. But it is a melancholy fact that fewer mothers seem able to nurse their babies now than 100 years ago and I do not think they were better fed then than now. In recent inquiries it has been found that only about 50 per cent. of mothers of the artisan class breast feed their babies after 3 months, and I think it is probable that still fewer of those in the wealthier grades of society can do this. There can be no doubt that anything we can do to get breast feeding more universally employed will have important results on our infant mortality and on the health of young children.

We are here today to consider the factors influencing lactation and its effect on the nutrition of the child.

There are two ways in which the secretion of milk may be modified, quantitatively and qualitatively. For my part, and I would be interested to hear what others have to say on the subject, I feel that the qualitative alteration in breast milk caused by diet or other factors is of far less importance in infant feeding than the quantitative. It is better for a baby to receive the milk of an undernourished mother, even though in quality it does not reach the highest standard, than to be fed with cow's milk. We are often told that the baby has been weaned because the milk did not suit it. Doctors and midwives do this far too light heartedly. For example, we often find that in congenital pyloric stenosis the baby has been weaned because he vomited the breast milk. In this case and many others the fault is with the baby, not with the milk.

But when we turn to the consideration of the amount of milk secreted, that is where the usual difficulty lies. The usual reason for weaning is that the milk failed. The maintenance of a sufficient supply of breast milk is one of the chief problems for those dealing with the care of young babies.

I think the main factors influencing the quantity of milk secreted are: (1) diet, and in this I include fluid intake; (2) hormonal influence. Under this heading I include nervous control, *e.g.*, the reflex stimulus of sucking; (3) emptying of the breast; (4) frequency of milking; (5) physical exertion; (6) nervous influence. I have put diet at the top of the list only because I have included fluid intake under this heading.

The farmer is well aware of the importance of most of these factors. He knows the importance of diet and sufficient water intake and of stripping the last milk from the cow. He knows that within limits the more frequent the milking the greater the yield. No farmer would think of working his dairy cows.

In the papers we are to hear I hope we will have some interesting light thrown on the influence of these and other factors on human lactation. The subject is of the greatest importance and is of special urgency in this city with its very high infant mortality rate and its high incidence of certain preventable diseases, many of which are related to incorrect feeding.

Doctors, medical students, midwives and health visitors must be given definite and dogmatic instructions regarding lactation, and I hope our discussions today will do something to crystallize our ideas and give us definite lines to go on.

The Effect of Diet on Lactation in Animals

Dr. J. A. B. Smith (Hannah Dairy Research Institute, Kirkhill, Ayr)

Provided that the mammary gland has been adequately prepared during pregnancy, that the lactation promoting hormones are secreted in adequate proportions and that other factors are favourable, maximum lactation will result only if the diet is adequate in energy, proteins, vitamins, and minerals.

Energy. The energy efficiency of milk production has been studied in much detail by Brody and Proctor (1935) and Brody and Cunningham (1936, 1, 2). The gross efficiency of lactation in cows, *i.e.*, the energy

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of the milk expressed as a percentage of the energy of the total digestible nutrients appears to average about 30 per cent. It may fall to 20 per cent. for low yielders and may rise to as much as 45 per cent. with very exceptional animals. By the technique of simultaneous arterial and venous blood sampling the efficiency of the mammary gland itself has been shown to be about 90 per cent. (Graham, Houchin, Peterson and Turner, 1938). This means that for every 100 Calories removed by the gland from the blood, 90 are secreted in the milk. When, however, experiments are made to find how much food must be allowed in the diet in addition to the ordinary maintenance requirements to produce, say, one gallon of milk, it is found that for every 60 Calories in the milk, 100 Calories must be fed in the form of digestible nutrients. The net efficiency of milk production in the cow is therefore only about 60 per cent. Why is this net efficiency so low, when the efficiency of the gland itself is 90 per cent.? At least three factors may be involved, (1) the specific dynamic action of the extra protein in the diet, (2) the energy required to convert the nutrients in the food into milk precursors in the blood, and (3) an increase in the basal metabolic rate of the lactating animal compared with that of a non-lactating animal of the same weight. Recent experiments prove that the third of these is by far the most important, for a substantial increase in basal metabolic rate has been shown to occur during lactation in both the rat and the cow (Washburn, Brody and Ragsdale, 1939). In the cow it may amount to a 20 per cent. increase when one gallon of milk is being produced. If then the basal metabolic rate of a dry cow were 12,000 Calories, a 20 per cent. increase would amount to 2,400 Calories. The energy in one gallon of milk approximates to some 3000 Calories. The net efficiency of milk production would thus be $\frac{3000 \times 100}{5400}$ or 56 per cent. which approximates to the 60 per cent. found in practice where 2·5 lb. starch equivalent is allowed for the production of one gallon of milk with a fat content of 3·7 per cent. If similar reasoning may be applied to human lactation, calculation will show that the League of Nations standards (League of Nations Health Committee. Technical Commission, 1936) and those estimated by Garry and Stiven (1936) for energy requirements, though probably sufficient, are certainly not too liberal.

Protein. A deficiency of nitrogen in the diet of the cow brings about an immediate decrease in milk yield. The protein of the diet must be sufficient in both quality and quantity. One gallon of cow's milk contains about 0·35 lb. protein. Provided the dietary protein is of first class biological value and the amount fed daily is accurately known, this 0·35 lb. can be produced by an allowance of 0·4 lb. of digestible protein in the diet. This is equivalent to a 90 per cent. efficiency in the production of milk protein. In actual practice where diets can rarely, if ever, be mixed with great accuracy and where the protein will not always be of first class biological value, it is safer to allow 0·5 lb. of digestible protein for each gallon of milk, a milk protein production efficiency of some 70 per cent. The old standard was 0·6 lb. but this seems to have been unnecessarily high (Mackintosh, 1938). In human lactation, for a production of some 12 g. milk protein, 20 to 40 g. dietary protein are allowed in the estimations of Garry and Stiven (1936) and 60 g. in those

of the League of Nations Health Committee (1936). These protein allowances should certainly prove sufficient.

The necessity for protein of high biological value in lactation has been shown in several experiments by Fowler, Morris and Wright (1934) who found the intake of the amino-acid lysine to be of great importance. Proteins such as those of blood meal, which are rich in lysine, were found to be much superior for milk production to the proteins of other feeding-stuffs such as linseed cake which is poor in lysine. Other workers (Wright and Haag, 1939, 1, 2) have shown that the cystine content of the diet can also be a limiting factor. Thus on a diet believed to be adequate and containing protein from lucerne the average gain in the litter weight of young suckling rats was 36 g. and the average loss in the weight of the mothers 58 g. For a corresponding group in which the diet of the mothers was supplemented with 0·2 per cent. cystine the average increase in litter weight was 56 g. while the loss of weight of the mothers was only 42 g. For normal lactation in rats on a diet containing peanut meal as the sole source of protein, methionine and not cystine is required as a supplement.

Vitamins. It is convenient to regard the vitamins which may be required during lactation as falling into two classes, (*a*) those which may be required as specific lactation factors without which normal lactation is impossible, and (*b*) those which are required to maintain an adequate concentration of vitamins in the milk.

(*a*) Between 1933 and 1939 Nakahara and Inukai (1933, 1934), Nakahara, Inukai and Ugami (1935, 1937, 1938, 1939), Nakahara, Inukai, Kato and Ugami (1936) published papers in which they claimed to prove the existence of specific lactation factors. They fed to rats a diet consisting of 75 per cent. polished rice, 10 per cent. fish protein, 10 per cent. butter, 5 per cent. McCollum's salt mixture with 5 g. yeast per 100 g. of diet. They found that satisfactory lactation could not be obtained on this diet unless it was supplemented with yeast or rice polishings in amounts which were several times greater than those required for growth. They prepared extracts from liver and also from yeast and found that normal lactation resulted when the basal diet was supplemented with the portion of these extracts not adsorbed on fuller's earth. The active principle from liver was termed L_1 and that from yeast L_2. Apparently these factors were only necessary to cause milk secretion in the *first* lactation. Thereafter their presence in the diet was unnecessary. Folley, Ikin, Kon and Watson (1938) tried to confirm this work but could obtain no evidence whatever for the existence of these specific lactation factors. The Japanese workers Nakahara, Inukai and Ugami (1939) declared that the failure to confirm their results was due to the use of the wrong type of yeast. Folley, Henry and Kon (1942), however, have recently investigated this question again in still greater detail and have succeeded in rearing three generations of rats on a diet which they believe should be free from the factors L_1 and L_2. Sure (1941) has also claimed to show the existence of a new dietary factor essential for lactation which he calls "Bx," B because it appears to relate to the vitamin B complex and x because its precise nature is unknown. Inositol and *p*-aminobenzoic acid are two of its constituents. Kon (1942), however, in abstracting this paper, rightly points out that these two

substances cannot be regarded as specific for lactation since they are already known to be required by non-lactating rats.

There appears therefore to be little reliable evidence at present to suggest that any specific lactation food factor exists.

(*b*) References to work on the effect of diet on the vitamin content of milk have been discussed in a recent review by Kon (1940). They are much too numerous to be dealt with here. It will suffice to point out that with most animals there is probably a slight increase in vitamin requirements during lactation as a result of the lactation process itself with the increased metabolism which it involves and also for ensuring that the levels of the various vitamins in the milk are as high as dietary sufficiency can make them. Actually with some animals, *e.g.*, the cow, the concentration in the milk of some of the vitamins such as B_1 and C is independent of feeding (Kon, 1940).

At least one worker (Perla, 1937) has claimed to show that excess of a vitamin, vitamin B_1, may be as harmful to successful lactation as a deficiency, but the amount required to show any inhibitory effect is some hundred times higher than the usual maximum amounts available in the diet. In practice, therefore, there is no danger whatever of the vitamin intake being excessive.

Calcium. Unlike a deficiency of protein, calcium deficiency in the diet of cows will not usually bring about a decrease in milk yield until some 20 per cent. of the body reserves of calcium have been used. Due to the great amount of calcium secreted by high yielding cows these animals cannot readily be maintained in positive calcium balance at the height of lactation, but provided the animals receive adequate supplies of calcium later in their lactation and particularly during the dry period, they will readily replace the reserves which they have partially depleted, without any ill effect. Further details of mineral requirements are given in various reviews such as those of Garry and Stiven (1936) and Owen (1941).

The Effect of Diet on the Composition of Milk. (*a*) *The Major Constituents.* In the formation of milk from the blood precursors, fat, sugar, calcium, potassium, phosphorus and magnesium are all concentrated in varying degrees, while protein, chlorine and sodium are diluted. This selective function of the mammary gland, at least in the cow, seems to be little affected by changes in diet, so that even when alterations in diet are sufficient to cause alterations in milk yield, the concentrations of the major constituents of the milk are frequently very little changed (Owen, Smith and Wright, 1943). Severe inanition, however (Smith, Howat and Ray, 1938) brings about a substantial decrease in yield which is accompanied by a marked increase in fat content and a very much smaller increase in the content of solids not fat.

(*b*) *The Minor Constituents.* The concentation of many of the minor constituents of milk is directly dependent on the amount of these constituents in the blood and frequently therefore on the amount in the diet. Urea (Owen, Smith and Wright, 1943) and various non-protein nitrogenous compounds fall into this category, their concentration in the milk being almost identical with that in the blood. This is true also of certain drugs such as sulphanilamide.

Summary

(1) Of the many factors which affect lactation in animals probably the most important are hormones and diet.

(2) For maximum milk yield the diet must be sufficient in energy, first class protein, vitamins and minerals. The yield of milk is particularly sensitive to changes in protein intake.

(3) The concentration of the major constituents of cow's milk is not readily altered by relatively small changes in the diet.

(4) The amounts of many minor constituents present in milk are greatly dependent on the concentrations of these substances in the blood and these in turn are frequently governed by the amounts in the diet.

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Hormonal Influences on Lactation

Dr. G. H. Bell (Institute of Physiology, University of Glasgow)

Within recent years there has been a great increase in our knowledge of hormonal influences on lactation. Unfortunately most of the information relates to animals; very little, relatively, seems to be known

about these processes in the human being. To make matters worse, we are faced throughout this subject with the two major difficulties in interpretation of all work on reproductive physiology: first, the very marked differences between the responses of different animals to any one procedure, and second, the very great uncertainty as to how far information from animal experiments is applicable to the problems of lactation in women.

The mammary glands prepare for lactation and secrete mainly under hormonal influences but it is likely, although the matter has received little attention, that the nervous system has an important though secondary role. Basch (1910) and Stricker (1930), using dogs and rabbits, respectively, have shown that the transplanted gland can produce milk and can undergo the variations seen in the normally placed organ. The famous case of the pygopagous Blazek sisters (Basch, 1910) serves further to emphasize the importance of the hormonal control of lactation in woman. One of these sisters became pregnant; the breasts of both sisters enlarged, and after parturition both sisters secreted microscopically similar milk. These observations, however, should not be taken to mean that the breasts are independent of the central nervous system. Indeed psychological influences on lactation, especially to its detriment, are well known. It is likely that there are afferent nerves from the breasts, woman is the only animal in whom reflex contraction of the uterus on suckling has been described; whether there are efferents to the breasts, apart from vasomotor nerves, is not clear.

The mammary glands increase in size at puberty presumably because of the increase in ovarian and pituitary activity at that time. Proliferative changes occur at oestrus in many animals and during pseudopregnancy there is often a further increase in the size of the mammary gland, and a premenstrual enlargement in women, but the full development of pregnancy is not reached. In the rabbit and bitch a small amount of milk is produced during pseudopregnancy.

Although lactation itself does not usually commence till after parturition, preparations for the process begin very early in pregnancy. Since these changes are brought about to a great extent by the ovarian hormones it is important to study the effect of the pure hormones on mammary function. The injection or inunction of oestrin into animals usually causes an increase in the size of the glands and in some cases may bring about actual secretion of milk. In the monkey, Gardner and van Wagenen (1938) found that injection of oestradiol for 30 weeks was necessary to bring about full development. MacBryde (1939) was able to produce an increase in the size of the mammary glands in women by injection of oestradiol, 35 mg. subcutaneously per week, or by rubbing in an ointment containing 2·5 mg. of oestradiol per day. Enlargement of the glands of animals can also be obtained by means of testosterone or even of desoxycorticosterone. Oestrin usually produces a growth of the duct system; if oestrin and progestin are combined the lobule-alveolar system develops in addition. Progesterone by itself is ineffective. In women oestrone and progesterone together produce a greater increase in the size of the breasts than oestrone alone (Werner, 1935). Effkemann (1937) described the treatment of a group of pregnant women with underdeveloped breasts, as judged by size and weight and by retraction

of nipples, who were not likely to produce an adequate supply of milk. During the last two months of pregnancy they were given about 60 mg. of oestradiol benzoate and 25 to 50 mg. of progesterone and it was stated that lactation was uniformly increased in comparison with controls. Very large quantities of oestrogens and progesterone are metabolized towards the end of pregnancy judging by the urinary excretion of oestrogens and pregnanediol; it is thus somewhat difficult to understand why the injection of a few extra mg. should produce such striking results.

Whether the action of these ovarian hormones on the breast is direct or indirect by way of the pituitary is not by any means clear; there is evidence to support both views but the majority of observers find that the ovarian hormones are inactive in the absence of the pituitary gland. Herold and Effkemann (1939) reported that oestrogens had no effect in normal male and castrated female rats after severance of the pituitary stalk; they suggested that oestrin acts by way of the diencephalon from which impulses reach the pituitary and cause it to secrete a mammary growth factor. Dandy (1940) on the other hand has described a case in which he cut the pituitary stalk and yet the woman went through two pregnancies and lactated normally.

Although it is more than probable that the pituitary gland plays a part in the development of the mammary gland during pregnancy (mammogenic effect) it is very difficult to get satisfying proof of this. Robson (1936) found that when a rabbit was hypophysectomized during pregnancy but was carried through pregnancy by injections of *corpus luteum* hormone the mammary gland did not develop as in a normal pregnancy. Since in the rabbit the full mammary development typical of pregnancy cannot be produced by oestrone and progesterone treatment this experiment suggests that there is some pituitary influence on mammary growth in normal pregnancy. On the basis of quite different experiments claims for pituitary mammogenic hormones have been made by Gomez, Turner and Reece (1937). They found that the implantation of pituitaries from oestrin treated donor rats into completely hypophysectomized guinea-pigs stimulated mammary growth; glands from untreated donors were ineffective. On the other hand, Reece and Leonard (1939) found that treated and untreated donors were equally effective in promoting mammary growth. As if to add further to the confusion Nelson (1938) reported that implants from untreated donors might be more effective.

There is much better evidence that the anterior pituitary gland possesses lactogenic hormones, *i.e.*, hormones having an influence over the actual secretion of milk. Stricker and Grüter (1929) and Corner (1930) were the first to demonstrate this effect. Corner found that injection of sheep pituitary extract into ovariectomized rabbits produced in fourteen days about the same size of gland as is seen at the end of pregnancy, and some milk secretion. After fourteen days, however, there was a tendency for the glands to diminish in size and for the output to decline. Riddle and Bates (1933) described an impure extract of the anterior pituitary, prolactin, which seemed to contain the hormone responsible for the initiation and maintenance of lactation. Provided that the conditions in the animals are not too abnormal from the metabolic point of view, prolactin preparations will cause secretion of milk in mammary glands which have been developed by the ovarian hormones;

experiments of this nature have been reported with goats, dogs and bitches, and monkeys. If either the suprarenal cortex or the hypophysis has been removed the general metabolic level falls and the conditions become too unfavourable for the demonstration of the effect of prolactin. The general deterioration following adrenalectomy has also been responsible for the difficulty in demonstrating a lactogenic hormone in the suprarenals; it now seems likely (Spoor, Hartman and Brownell, 1941) that there is such a hormone, but its relative importance is not yet known. Prolactin seems to be produced while lactation is in progress; if the pituitary gland is removed while lactation is in full swing then the secretion of milk ceases quite soon. If animals are hypophysectomized during pregnancy and go on to full term, either with or without treatment by ovarian hormones, there may be a small amount of milk secreted after parturition. The placenta may be the source of the prolactin in this case.

The method of assay of prolactin by its effect on the growth of the pigeon crop glands seems to imply that the hormone responsible for this effect is the same as that responsible for the initiation of milk secretion in mammals. It is found in fact that the more the prolactin preparations are purified the less effective they become towards mammals. Folley and Young (1938) used extracts of the anterior pituitary which had little prolactin activity as judged by the pigeon test but which nevertheless stimulated lactation in cows; they suggested that prolactin is not the only lactogenic hormone.

There is a considerable amount of evidence that, in the cow, anterior pituitary extracts will stimulate an already established lactation. Ross (1938) described beneficial effects of prolactin injections in women but the differences between treated and control series were not analysed statistically. Stewart and Pratt (1939) found that there was no difference between 14 women receiving injections and 10 control cases. All these writers and Werner (1935, 1939) describe severe general and local reactions after injection of prolactin preparations, induration at the injection site, fever up to 102° F., and anaphylactic oedema; they all declare further that the present preparations of prolactin are too toxic for human use. Kenny and King (1939) have given a very hopeful report of prolactin therapy; their preparations were made by two firms in this country from sheep and beef pituitaries and no toxic effect was seen. The milk output was increased in 68 per cent. of treated women and in only 19 per cent. of controls to the point where it became sufficient for the whole need of the child till weaning. In some cases treatment was begun a few weeks *post partum*.

The fact that milk does not appear till shortly after parturition suggests that the products of gestation inhibit in some way the secretion of milk until they are expelled. Large amounts of oestrin are present in the blood and are excreted during pregnancy and it is well known that these substances can inhibit lactation; indeed it has now become the routine practice to give one of the oestrogens, or even testosterone, where lactation has to be brought to an end. This explanation of the inhibition of lactation is not wholly satisfactory when it is recalled that lactation may persist for a considerable time during a subsequent pregnancy. The material responsible for the inhibition may be produced by the placenta.

Once more there is doubt as to whether these inhibitory effects occur by direct or indirect action on the mammary glands.

The importance of the thyroid gland in relation to milk secretion is not easy to assess. Thyroidectomy, like hypophysectomy, depresses many functions of the body and so tends to lower milk output in an unspecific fashion. Administration of thyroid to cows and of di-iodotyrosine to women seems to increase the flow of milk.

It has been known for long that suckling has an important role in the maintenance of lactation. It may be that it is the emptying of the breasts which is of importance; or it may be that the suckling acts through some nervous and hormonal mechanism by which the anterior pituitary lobe is stimulated to secrete its lactogenic hormone. In support of the latter view Selye (1934) found that, in rats, suckling was more important than emptying of the glands. But lactation usually comes to an end in spite of continuous suckling and complete emptying of the breasts. The reason for this is not known.

Gunther (1942) has recently summed up the situation in these words: "Although great progress has been made in analysing the processes involved, the picture is still far from complete and our knowledge has so far added little to management of lactation except to give us a method of bringing it speedily to an end."

Summary

Preparation for lactation begins early in pregnancy. Experimentally, oestrin and progesterone do not bring about the full development of the mammary glands. Presumably the anterior pituitary gland as well as the ovaries is involved in the final stages of the process. During pregnancy lactation is inhibited by the large amounts of oestrogens in the circulation. After parturition the oestrin secretion ceases and the pituitary hormones can now initiate lactation. Lactation is maintained by suckling provided the anterior pituitary is intact.

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Human Lactation and Infant Dietetics

Professor C. McNeil (Department of Child Life and Health, University of Edinburgh)

The first chapter in human dietetics is the period when milk is the sole and sufficient food of the infant. It is a short period lasting from six to nine months, but its successful management is of vital importance. For practical purposes only two kinds of milk are available, human milk, entailing breast feeding, and cow's milk which calls for the dietetic method of bottle feeding. A fair comment on this first short chapter of dietetics would be that both these methods of feeding show far too many records of mismanagement and failure.

Breast Feeding. In the great majority of cases, breast feeding is given the first trial. Statistical investigations on the incidence of breast feeding show that at the age of three months, about one-half the number of babies surviving at that age have been weaned and are bottle fed. Moreover clinical experience shows that many babies weaned in the early months of life, and especially in the first month, continue to give difficulty when the feeding is changed to cow's milk.

There is general agreement that breast feeding is the ideal and the better method. Human milk is specially adapted for the digestion and nutrition of the baby; it also protects from alimentary infection and from other infections, and especially respiratory infection. Breast feeding is less troublesome, less time wasting and less costly than bottle feeding; it promotes maternal health in the puerperium, and gives satisfaction and happiness to the mother throughout the lactation period.

Against this list of advantages stands the practical result of failure in many thousands of cases. It is obvious that breast feeding is not a simple automatic process, set going after birth and running smoothly on like a wound up clock. Some of its failures are due no doubt to the mother's deliberate refusal; but the great majority are due to the complicated nature of breast feeding and to many difficulties that arise in its inauguration. These difficulties depend upon disturbances in the many different elements that make up the complex of breast feeding, and it must be admitted that neither the physiological processes nor their disturbances are sufficiently understood by doctors and nurses who advise and supervise the mother in the early days and weeks of breast feeding. The subject of breast feeding and its management is indeed a great and complicated problem, and the fundamental elements of the problem must first be analysed.

The Three Component Processes of Breast Feeding: Lactation, Suckling, Digestion. The earlier papers in this symposium have dealt with

interesting aspects of lactation in animals. In the human mammal, lactation is also an essential process, but it is true to say that lactation in the woman has not received the careful clinical and experimental study that has been given to lactation in cows. Further, suckling and digestion are two other processes that are important in attaining the objective of successful nursing. In breast feeding three processes, all of them important, are involved: lactation, the production of milk in the mammary glands; suckling, the transfer of the food from the mother's breast to the baby's stomach; and digestion. And each of these processes is subject to upset by nervous influences, direct or indirect. The doctor and nurse supervising breast feeding, and encountering some difficulty, must be able to relate it to the process from which it has arisen.

Lactation. In this short paper it will be possible to deal only with lactation, and only with certain aspects of lactation. The preparation for lactation begins in early pregnancy with the active formation of new breast tissue, and the extent of this new activity is determined by the general health of the mother and by the adequacy of her diet. In this preparatory phase there is no actual secretion of milk, or at least of the characteristic element in milk, casein. Immediately after birth, active secretion, or true lactation begins; it proceeds for many months so long as active suckling continues, always provided that the formation of new breast tissue in pregnancy has been adequate, and that the general health and diet of the mother during lactation are satisfactory. But lactation will quickly diminish and come to an end in two ways; if the maternal condition is unsatisfactory, and if the stimulus to lactation is not maintained by effective suckling by the baby. I have already said that the problem of human lactation has not received the attention and study it deserves. I shall confine myself to discussing the phase of active lactation in the first two or three weeks after birth. The great majority of failures in breast feeding occur in these early critical weeks. Some of these failures are due to an essential lack of lactation potential; some are due to mismanagement of a healthy lactation process, on account of the mother's ignorance, or wrong advice given to her, or faults in the baby.

Lactation, Normal and Abnormal, soon after Birth. Lactation may be normal, and even abundant, in both the early and later years of the reproductive period, in young mothers of 18, and in primiparae over 40, although of course success is less common in the later ages.

In a case of a second pregnancy in a nervous woman of 41, who had lost her first baby 20 years before, lactation was barely sufficient but was maintained for four months, the deficiency being made good by small supplements of cow's milk. This case belonged to the group of hypogalactia, where there is an essential lack of lactation capacity; and breast feeding in this type, in its severer degrees, is doomed to failure.

But there are also cases where lactation is scanty in the first week, and becomes adequate and even abundant later. The cause of this initial insufficiency is often hard to find, but in other cases of this type, the early scanty lactation is obviously due to shock or weakness either in mother or baby, and the milk yield quickly increases when this general condition in mother or baby is put right. Besides these cases of initial scanty lactation, there is a fairly large group where the milk yield suddenly falls off when the mother gets up and undertakes the full load of household

duties; these cases of failing lactation in the second or third week after birth are often only temporary and until full lactation is restored, breast feeding needs supplementing with cow's milk. Weaning in these circumstances is often carried out and could easily be avoided. On the other hand where the milk yield fails at a later period, in the second or third month, this is generally due to true involution of the breast tissues, and attempts at restoration of the supply, either by general or local measures, have little chance of success and need not be continued for more than a week.

Abundant lactation may set up digestive disturbance in the baby, especially flatulence, and this digestive upset in the baby can easily reduce the milk production to an insufficient level. Overfeeding is not sufficiently recognized as a cause of dyspepsia in the baby.

Abnormal conditions of the breast and nipple in the first week of lactation may seriously interfere with its progress. Massive engorgement of the breast is an important example. Retraction of the nipple and fissure of the nipple are two other important and common conditions; they do not directly affect milk output, but indirectly they do so by interfering with, and often preventing, the suckling of the breasts.

Suckling and Digestion. Suckling and digestion, the two other processes of breast feeding, are linked inseparably with lactation. Suckling is a deliberate act of co-operation between mother and baby, and has its technique which must be managed expertly by both partners; if it is mismanaged, and this often happens, the activity of lactation is quickly reduced. Digestion is a new and complicated process for the baby, and in its early operation is liable to many disturbances which can easily interfere with the primary process of lactation. Further details cannot be given here, but they are important in any consideration of the whole problem of breast feeding.

Conclusion

Breast feeding is one of the two methods of infant feeding, and lactation is the first of the three processes included in it. Breast feeding cannot succeed without good lactation, *i.e.*, a steady and sufficient secretion of milk by the mammary glands. To ensure good lactation, attention must be first given to the health and diet of the mother in pregnancy, and this must be followed by expert supervision of both mother and baby in the first weeks after birth. The present widespread failure of breast feeding is partly due to our lack of knowledge of the fundamental elements of the problem, but it is also in great part due to the scanty instruction given in our medical schools to doctors and nurses responsible for its control in practice. The prevalent mismanagement of breast feeding is accompanied by equally poor management of bottle feeding. The present practice of infant dietetics is on a low standard, but the fault does not lie with the practitioners, doctors and nurses. The fault lies in the British medical schools. Until the whole subject of infant dietetics, and especially the problem of breast feeding, is given the place of study and teaching in our medical schools which its importance deserves, we cannot expect much improvement in its practice.

Some Observations on the Relative Incidence of Breast and Artificial Feeding and its Significance

Dr. J. M. Mackintosh (Health Department, 4 Albyn Place, Aberdeen)*

As a Child Welfare Officer, my approach to this subject is in terms of the community rather than the individual patient. It is my job to act as liaison officer between the scientists and the specialists who make the discoveries and the general public who are to be persuaded to give these findings practical expression. Viewing the field as a whole in this way certain points seem to me worthy of note and therefore I would like to classify my remarks under four headings: (1) the incidence of breast feeding at the present time; (2) has breast feeding declined in recent years? (3) the social incidence of breast feeding; (4) the influence of breast feeding on infant mortality and morbidity.

Incidence of Breast Feeding at the Present Time. A number of recent studies has been made in this country. Spence (1938) reviewed inquiries made in Edinburgh, Newcastle and Liverpool. Other studies have been made in Liverpool by Robinson (1939), in Newbiggin-on-Sea, Northumberland by Hughes (1942) and in Ilford by Gordon (1942). The results of these studies are shown in Table 1 together with the result of some recent

TABLE 1

INCIDENCE OF BREAST FEEDING AT DIFFERENT AGES

Place and period[1]	Number of cases	Percentage incidence of breast feeding at:			
		2 weeks	1 month	3 months	6 months
Edinburgh	3000	87	—	55	38
Liverpool 1937 ..	439	86	—	48	29
Newcastle 1938 ..	1326	—	—	58	34
Newbiggin 1940 ..	112	67	—	32	19
Ilford 1938 ..	793	73	—	—	44
Aberdeen City 1941–42..	1932	75	—	47	37
Aberdeen County 1941–42..	1548	—	—	52	42
Evanston, Illinois 1936 ..	437	—	38	19	7

[1] Sources of information are given on p. 58.

inquiries made in the City and County of Aberdeen. From this it will be seen that by the third month only about 50 per cent. of infants are breast fed and that at the sixth month still fewer children are breast fed. It is interesting to note that Newbiggin, a mining area where the average wage is £3 a week, compares unfavourably with the other areas. The figures given by Blessing (1937) in a study of well to do patients in the United States remind us that there are other factors besides nutrition which have a bearing on lactation.

Has Breast Feeding Declined in Recent Years? Gordon (1942) compared the incidence of breast feeding in the borough of Ilford in the years 1920-24 and the year 1938. Robinson (1939) in Liverpool made comparison between the years 1918 and 1937. In the annual report

*Present address: Public Health Department, Birmingham

of the Medical Officer of Health for the City of Aberdeen for the year 1926 (1927), the percentage incidence of breast feeding at six months is given. This is shown along with the result of the other investigations in Table 2. From these data it would appear that there may have been

TABLE 2

TREND IN THE INCIDENCE OF BREAST FEEDING OVER THE LAST 20 YEARS
HISTORICAL COMPARISON

Place and period[1]		Number of cases	Percentage incidence of breast feeding at:		
			2 weeks	3 months	6 months
Ilford	1920–24 ..	1014	87	—	58
	1938 ..	793	73	—	44
Liverpool	1918 ..	294	79	52	33
	1937 ..	439	86	48	29
Aberdeen City	1926 ..	1902	—	—	52
	1941–42 ..	1805	—	—	37

[1] Sources of information are given on p. 58.

a decline in breast feeding over a period of years. It is doubtful, however, how much value should be attached to such data. Robinson (1942) in a later paper analysed the history in relation to breast feeding of 1000 women who had borne two or more children. She found that these mothers could be divided into four groups. Group 1, containing 41 per cent. of the mothers, fed all their babies to nine months or over; group 2, containing 24 per cent. of the mothers weaned all their babies during the first few months; group 3, representing 13 per cent. of the total, weaned their elder children during the first few months but usually succeeded in feeding the younger ones to nine months; and finally group 4, representing 22 per cent., consisted of the mothers, who fed their elder children to nine months but usually weaned their younger children during the first few months. She concluded that the variation in the incidence of breast feeding from year to year in any area depends on the variation in the percentage of these types bearing children during that year, and that no valid conclusion can be drawn from the study of the incidence of breast feeding over a period of years.

The Social Incidence of Breast Feeding. Gordon (1942) examined the data for breast feeding in a well to do district in Ilford and in a poorer district and found the same incidence, 79 per cent., at two weeks. At six months 51 per cent. of the babies in the good district and 41 per cent. in the poor district were breast fed. In Aberdeen the figures for a nursing home where the patients are well to do were examined. Of 205 babies 87 per cent. were breast fed when they left the home. Of 189 about whom particulars were available, at three months 81 per cent., and at six months 80 per cent., were still breast fed. Two hundred and five cases were selected at random from one of the poorest districts of Aberdeen where the infant mortality rate over the past seven years had averaged 101 per 1000 live births, and 38·67 per cent. of the houses were found to be overcrowded in 1935. The contrast between the two groups

is shown in Table 3. From this it will be seen that while there is comparatively little difference in the incidence of breast feeding at two weeks, the state of affairs is very different at three and six months. About 55 per cent. of the poor mothers were delivered in hospital. These results would appear to support Robinson's (1941) contention that economic factors do not directly affect the ability to breast feed but affect it only indirectly. After studying the variation in the incidence of breast feeding in different social groups over a period of years, she concluded that variations in prosperity have only a remote effect on breast feeding, appearing only after two years, and even then not manifesting themselves until the third month of lactation.

TABLE 3

SOCIAL AND DIETARY INFLUENCE ON BREAST FEEDING

Place and circumstances[1]		Number of cases	Percentage incidence of breast feeding at:		
			2 weeks	3 months	6 months
Ilford	Good district	549	79	—	51
	Poor district	487	79	—	41
Aberdeen City	Nursing home	205	87	81	80
	Poor district	205	81	47	29
Toronto	Low income group:				
	poor diet	—	78	49	24
	supplemented diet ..	—	91	63	39
	good diet	—	84	60	38

[1] Sources of information are given on pp. 59, 60.

Are we justified then in concluding that the difference in incidence of breast feeding in these two social groups is due to the better state of nutrition of the well to do mothers? From animal experiments it seems reasonable to assume that a woman on an adequate, well balanced diet is more likely to breast feed her infant satisfactorily than a woman on an inadequate diet, and this assumption is supported by evidence given by Ebbs and Kelley (1942) from an experiment in Toronto. The result of this enquiry is shown in Table 3. There is a close parallelism between the poor diet group in Toronto and the group from the poor district in Aberdeen.

There are several others factors, however, which come into play besides nutritional deficiency in the successful establishment and maintenance of breast feeding. In Table 4 data are given which have been extracted from the report for 1922-23 of the Medical Officer of Health for the City of Aberdeen (1924). It will be noticed that the incidence of the establishment of breast feeding tends to decline as the size of the home increases, and that this is true over a period of years. It is reasonable to assume that the people in the larger homes were better off than those in the smaller homes.

One very important factor, ranking in my opinion equal in importance to nutrition, is the mental attitude of the mother to breast feeding. The

TABLE 4

FEEDING OF INFANTS IN RELATION TO SIZE OF HOME IN ABERDEEN CITY[1]

Year	Number of registered births	Number of infants visited	Per cent. breast fed (wholly or partly)	Incidence of breast feeding (whole or part) in homes of: 1 room		2 rooms		3 rooms		4 rooms	
				Number visited	Per cent. breast fed	Number visited	Per cent. breast fed	Number visited	Per cent. breast fed	Number visited	Per cent. breast fed
1917	2946	2127	81	301	89	1102	83	548	74	176	70
1918	2794	1977	82	232	93	1047	84	538	80	160	69
1919	3458	2461	86	461	87	1236	89	561	81	203	78
1920	5010	3787	87	823	91	1866	87	793	84	305	82
1921	4326	3485	87	830	92	1693	87	649	83	313	86
1922	4038	3268	88	801	92	1635	88	580	84	252	82
1923	3852	3177	89	916	92	1525	89	503	83	233	87
1917–1923 Average	3707	2767	85	529	90	1389	86	618	80	231	77

[1] Medical Officer of Health, City of Aberdeen (1924).

mother may not wish to breast feed because she is not prepared to have her freedom restricted in this way or because, as one woman put it, she finds the process disgusting. Husbands, too, sometimes do not want their wife's freedom restricted or are jealous of too much attention being given to the baby. One husband told me he did not want his wife to breast feed as it would spoil her figure. Then we have the case of the highly strung mother who is over anxious to feed and who is plunged into the depths of despair at the slightest sign of what she thinks is a diminution in the quantity or quality of her milk. Until very recently this type of woman was more likely to be found among the well to do. Anxiety or nervous strain has a tendency to diminish the supply of breast milk. Gordon (1942), however, came to the conclusion that in Ilford air raids and evacuation appeared to have had little effect on breast feeding. Waller (1938) deals with this point in his book and states that there may be an actual outpouring of the mother's milk during an air raid which he considers analogous to primitive maternal behaviour in the face of danger.

It has been stated that confinement in hospital militates against breast feeding as the sudden transition from the ease and comfort of hospital to the strain of looking after a home and a new baby tends to diminish the supply of breast milk, temporarily at least. My health visitors tell me that frequently they come across women who were breast feeding their babies when they left hospital but who weaned them very soon after their return home because they either did not wish to breast feed or imagined their milk was defective in either quantity or quality. In consequence I thought it would be of interest to examine the records of 161 Aberdeen women who were confined in the Maternity Hospital between 1st October and 31st December 1942. I found that 90 per cent. were breast feeding at the fourteenth day; two weeks later the percentage had dropped to 70. A somewhat similar result was obtained when the records of 132 women delivered in the district during the same period were examined; 81 per cent. of these women were breast feeding at two weeks but only 66 per cent. at one month. It would not appear that there is much difference in the incidence of breast feeding in patients delivered in hospital and those delivered at home. Health visitors also tell me that so many young mothers have, at the present time, to live with their relatives or in sub-let rooms where neighbours complain if the baby cries, that their task of encouraging breast feeding is made much more difficult. This point is also made by Robinson (1939) who found that the incidence of breast feeding was higher in women living in houses of their own, where they were subject to less interference from neighbours, and that this was especially evident in primiparae.

I think it would be generally agreed that the standard of nutrition of the people has risen over the past twenty years, yet the incidence of breast feeding does not appear to have improved. The reason is, I think, to be found in these other factors which I have mentioned. In the report of the Interdepartmental Committee on Physical Deterioration (1904), the decline in breast feeding was commented on and the point noted that it appeared to be common to all classes. If the data in Table 4 are a true index of the state of affairs in Aberdeen during and immediately after the last war, then the incidence of the establishment of breast

feeding would appear to have been less among the well to do, that is if it is reasonable to assume that the more comfortably off lived in the larger homes. Be that as it may, in recent years and especially since the outbreak of war, I have formed the impression, although I have no data to prove it, that more women among the well to do have breast fed their babies; whether this is due to the campaign for better nutrition, through improving the health of the mothers and creating a desire to breast feed, or whether, as one cynical general practitioner put it to me, they have nothing else with which to occupy their time at the moment, remains to be seen. I think it would be true to say, therefore, that although we know that, other things being equal, the woman on a well balanced diet throughout pregnancy and lactation is more likely to breast feed her infant successfully than a woman poorly fed and, in consequence, we urge upon Government and Local Authorities the importance of ensuring that the expectant and nursing mother receives an adequate diet, yet we are in fact only at the beginning of our task. We have to "sell" breast feeding to the mothers, make it fashionable.

Has Breast Feeding an Influence on Infant Mortality and Morbidity? Infant mortality has decreased steadily in recent years but the incidence of breast feeding does not appear to have increased. Grulee, Sanford and Herron (1934) made a survey from birth to nine months of 20,061 infants of whom 48·5 per cent. were totally breast fed. They found that the total morbidity of the breast fed group was 37·4 per cent., of the partially breast fed 53·8 per cent., and of the artificially fed group 63·6 per cent. Spence and Miller (1941) in a recent study of infant deaths in Newcastle found that of 93 infants who died from infections of various kinds only 18 per cent. were breast fed until six months or until death. On the other hand, Ebbs and Mulligan (1942) analysed the case records of 1500 children under 12 months admitted to hospital with infections and found that, although fewer babies entirely breast fed for at least 8 months, 15 per cent. as compared with 55 per cent. artificially fed, were admitted with infections, yet the percentage of deaths among totally breast fed babies was 18·5 as compared with 16·4 per cent. of deaths in the artificially fed. Friedman (1935) reviewed some of the literature on this subject and pointed out that while Huenekens (1924), McKay (1924) and Richet (1927) consider that mortality is greater among artificially fed babies, yet Glazier (1931) considers that infant mortality and frequency of infection are more definitely related to economic and hygienic conditions than to the type of feeding, and Faber and Sutton (1930) give it as their opinion that neither absolute nor relative immunity to infection is increased by breast feeding.

This question of the influence of breast feeding as compared with artificial feeding on infant mortality and morbidity is difficult to decide as a number of factors contribute to infant mortality and morbidity. How much of the passive immunity with which the majority of infants are endowed is acquired from their mothers through the placental membrane and how much from the colostrum? How much of that immunity is specific for the sort of infection which causes death and morbidity among young infants? Topley and Wilson (1936) state that at birth the majority of infants are endowed with circulating diphtheria antitoxin which they have acquired passively from their mothers, if

immune, mainly by passage of this antibody through the placental membrane, in part, perhaps, with the colostrum in the early days of suckling. They quote Mason, Dalling and Gordon (1930), who assess the importance of placental transmission in the rodents, apes and man, as much greater than that of transmission by colostrum. On the other hand some recent experiments made by Culbertson (1940) on rats and mice seemed to show that the placental transmission of protective substances against the trypanosomes used in the experiment was limited in comparison with the transmission through the milk. Whether this is true of other haemo-chorial mammals has not yet been determined. At the same time the rather obvious fact should not be forgotten that the artificially fed baby is at a disadvantage in that the possibilities of error in the quality and quantity of feeds are greater and the chance of faulty hygiene with its consequent risk of infection is also greater.

There is one further question to be considered. Is breast milk, apart from the initial advantage, if any, of the colostrum, a better food for infants than cow's milk suitably modified? Time does not permit of a discussion of this subject but it is as well to remember that there are quite a number of people who think that, provided the infant can digest the feed, there is nothing to choose between breast milk and cow's milk suitably modified. It seems to me, therefore, that before we can arrive at any true estimate of the effect of feeding with breast milk on infant mortality and morbidity we must make further progress towards elucidating some of the points I have mentioned.

Conclusions

(1) The incidence of breast feeding in the country as a whole would appear to be about 50 per cent. at 3 months and between 30 and 40 per cent. at 6 months.

(2) There may have been a slight fall in the incidence of breast feeding over the past twenty years.

(3) The social incidence of breast feeding is influenced by the nutrition of the mother but there are psychological factors which also have an important influence. Although every effort should be made to ensure that expectant and nursing mothers receive an adequate diet to enable them to breast feed, yet the mere improvement of the diet is unlikely to produce the desired results unless the mothers and the fathers are convinced that it is the best thing to do, and if I were cynical I might add, the fashionable and correct thing to do. A great deal more propaganda is required.

(4) When considering the influence of breast feeding on infant mortality and morbidity, it is well to remember that it is possible that the value of breast feeding to the child may lie as much in the greater likelihood of freedom from infection as in the inherent superiority of breast milk over cow's milk suitably modified.

(5) Lastly, the psychological importance to the child of being suckled and cared for by its own mother should not be forgotten.

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Nutritional Defects in Infancy

Dr. S. G. Graham (Royal Hospital for Sick Children, Yorkhill, Glasgow, C. 3)

Observations on the incidence of undernourishment, iron deficiency, anaemia and rickets were made at the Royal Hospital for Sick Children, Glasgow, over a period of twelve months from 1st September 1940 to 1st September 1941.

Undernourishment. Observations on the state of nutrition were obtained in 295 cases and are quoted in Table 1.

TABLE 1

STATE OF NUTRITION (295 CASES)

Percentage of expected weight	No. of cases	Per cent. of total	Deaths	Mortality per cent.
Over 90	98	33·2	22	22·5
70 to 90	135	45·8	24	17·7
under 70	62	21·0	27	43·5

Apart from congenital abnormalities and certain infections, the commonest cause of undernourishment in the infant depends on the fact that he has never received sufficient food to enable him to maintain his proper weight. In other words, he has been underfed.

Iron Deficiency Anaemia. Information as to the incidence of anaemia in 245 patients is available (Table 2). Unfortunately the haemoglobin estimations were made on admission to hospital and there is an error introduced by the presence of dehydration. It can be taken that the

incidence shown in the table is underestimated by approximately 20 per cent. There is abundant evidence that this iron deficiency anaemia is widespread throughout the infant population. Davidson, Fullerton and Campbell (1935) found anaemia in 41 per cent. of infants under 2 years of age in Aberdeen. Hutchison (1938) examined the blood of 300 infants

TABLE 2

HAEMOGLOBIN ESTIMATIONS (245 CASES)

Group	Haemoglobin level	No. of cases	Per cent. of total	Deaths	Mortality per cent.
1	Above normal	52	21·2	19	36·5
2	Less than 10 per cent. below normal	78	31·8	12	15·4
3	10 to 20 per cent. below normal	64	26·1	8	12·5
4	More than 20 per cent. below normal	51	20·8	12	23·5

attending a Child Welfare Centre in Govan. All these infants were regarded by their mothers as healthy, yet 26 per cent. of the breast fed, and 35 per cent. of the artificially fed, infants gave haemoglobin values 10 per cent. or more below Mackay's (1933) standard figure. In the 6 to 12 months period no less than 70 per cent. were classed as anaemic. McIntosh and Morris (1941) published similar findings for Glasgow as a whole.

Rickets. In attempting to estimate the incidence of rickets in a community the difficulty arises of deciding what is to be considered as falling within the definition of the disease. Observations were divided into four different groups and the results are recorded in Table 3. Craniotabes

TABLE 3

ANALYSIS OF SIGNS OF RICKETS IN 300 CASES

Method of assessment	Number examined	Number positive	Percentage
Examined clinically (including craniotabes)	269	76	28·3
Examined radiologically	208	49	23·6
Serum phosphorus estimated	203	89	43·8
Plasma phosphatase estimated	202	57	28·2

was included as a clinical manifestation. The lower limit of normality of serum phosphorus was taken as 3 mg. per 100 ml. It is interesting to note that, if 3·5 mg. per 100 ml. were taken as the lower limit of normality (and this is accepted by most workers), the percentage showing low serum phosphorus would rise from 43·8 to 66·5. It can be taken that at least one-quarter of the infants admitted to the Sick Children's Hospital suffer from some degree of rickets.

It must be remembered that the above figures refer to infants admitted to hospital and that the incidence in the general infant population as a whole will be much lower. Nevertheless, they indicate a grave state of affairs and one which could be readily corrected.

These nutritional defects, which predispose to infection, are in the main preventable and it seems reasonable to assume that, if they were prevented, the morbidity as well as the mortality from such infections as gastro-enteritis and bronchopneumonia would be materially reduced.

Diet in Relation to Stillbirths. During the summer of 1942 a record was made of the food intake of 300 women: 100 mothers of stillborn infants, 100 mothers of prematurely born infants and 100 mothers of full term infants. No selection of cases was made in any way, and the causes of the stillbirths were not considered. The standard of prematurity was a birth weight of 2·5 kg. or less. The evaluation of the diet was made by a retrospective questionnaire as to the nature of the diet before parturition.

The composition of the diet of each of these mothers was estimated in terms of intake of calories, carbohydrate, fat, protein, calcium, phosphorus and iron (Table 4).

TABLE 4

COMPOSITION OF THE DIET TAKEN DURING PREGNANCY BY MOTHERS OF STILLBORN, PREMATURE AND FULL TERM BABIES

	Stillbirths	Premature births	Full term births
Calories	1644	1710	1946
Carbohydrate (g.)	207	217	217
Fat (g.)	61·9	64·9	80·4
Total protein (g.)	52·4	54·5	72·1
First class protein (g.) ..	27·4	29·9	45·9
Calcium (g.)	0·76	0·80	1·22
Phosphorus (g.)	0·91	0·93	1·37
Iron (mg.)	9·0	9·0	11·0
Average age (years)	32·1	28·4	28·6
Average parity	4·2	2·9	3·12

These values indicate the superiority in every respect, of the diets of the mothers with full term infants, particularly in first class protein, calcium and phosphorus.

Statistical analysis of the data indicated that the superiority of the diets of mothers of full term infants was definitely significant but that the minor differences between the diets of the stillbirth and the premature birth group were without significance.

The biochemical work was carried out by Miss Olive D. Peden at the Royal Hospital for Sick Children, and the dietary survey by Miss C. S. Cameron at the Glasgow Royal Maternity Hospital.

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Tetany Following Prolonged Lactation on a Deficient Diet

Dr. A. B. Anderson (Glasgow Royal Infirmary)

The case was one of osteomalacia and tetany in a woman of 42, the mother of 7 children of which 6 were alive and well (Anderson and Brown, 1941). There was a history suggesting tetany in childhood but, since then, health had been excellent. The first 6 children had been breast fed for 9 months; the last was still being nursed at the age of 21 months. Careful questioning about diet, which included porridge without milk for breakfast, potatoes, with meat and a milk pudding occasionally for dinner, an egg once a week, and bread and tea, showed that milk consumption probably did not exceed ½ pint weekly. Radiography showed uniform decalcification of the extremities of the long bones with thinning of the cortex. Biochemical and metabolic observations were made. On an adequate diet, calcium absorption was high and recovery rapid. Here the calcium deficiency was brought to light by the occurrence of tetany but there is no doubt that it is an example, unusual only in degree, of a common deficiency in lactating women under similar conditions.

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