

INFANT FEEDING

By HARRY BAKWIN, M.D.*

INFANT feeding has been greatly simplified during the past 25 years. Precise calculation of the caloric needs and of the percentage of the various dietary constituents, at one time regarded as essential in "scientific" infant feeding, has gone by the board. It has become evident that there is no more rationale for the daily balancing of the nutritional requirements of infants than for the daily balancing of profits and losses in a business.

Recent years have witnessed an increasing interest in the psychologic aspects of infant feeding. The types and amounts of food and the intervals between feedings are being re-evaluated in the light of a clearer understanding of the principles underlying child development. The need for individualization is recognized, and the effort is made to adjust feeding to the needs of the infant and the temperament of the mother.

It would be a mistake however, to assume that the strictly nutritional aspects of infant feeding have been solved. Some of the obscurities in this field are illustrated by a comparison of the different responses of babies to feeding with human and cow's milk.

BREAST FEEDING

The composition of human and cow's milk is dissimilar, both qualitatively and quantitatively, in every known constituent.¹ The amount of protein in human milk is less than half that of cow's milk. The lactalbumen component is somewhat higher in cow's milk, the casein content is much lower. By electrophoretic analysis casein can be separated into two or possibly three fractions of different

chemical composition. The amounts of these fractions are different in human and cow's milk. Cow's milk casein can be further differentiated from human milk by immunologic reactions and by *in vitro* digestion analysis.

The percentages of fat are about the same in the two milks but the fats differ in composition, human milk fat containing about 7 per cent linoleic acid, cow's milk little or none.

The salt content of cow's milk is much higher than that of human milk and the relation of the salts, notably calcium and phosphorus, is different. The milks are also unlike in their content of the B group of vitamins and in vitamin C. Since cow's milk is generally pasteurized, it contains only a small amount of ascorbic acid. It is of interest that neither milk, unless artificially reinforced, contains appreciable amounts of vitamin D or iron.

Perhaps more important than the dissimilarities in composition are the differences in the metabolic responses of infants receiving the two milks.² Though the percentages of ingested nitrogen, calcium, and phosphorus which are retained are smaller in infants receiving cow's milk than in those on human milk, the absolute amounts retained are greater. Consequently the body compositions of the two groups of babies are different, those who receive cow's milk having more nitrogen, calcium, and phosphorus in their make-up than the breast-fed. Nevertheless, tetany, a manifestation of hypocalcemia, is much more frequent in the cow's milk-fed infant; and rickets, in which calcium phosphate deposition in bone is interfered with, is apt to be more severe. The greater frequency of tetany in infants receiving cow's milk is probably related to its relatively high phosphate content. Many years ago Finkelstein³ was able to show that the clinical manifestations of tetany in infants can be allayed by substituting human

From The Department of Pediatrics, College of Medicine, New York University-Bellevue Medical Center, New York, N. Y.

*Professor of Clinical Pediatrics, New York University-Bellevue Medical Center.

for cow's milk in the diet. Bakwin⁴ has shown that phosphate feeding in newborns leads to a reduction in the serum calcium, and he suggests that artificial feeding is a factor in the pathogenesis of tetany in the newborn. Gardner and his co-workers⁵ have confirmed and extended these observations.

Breast-fed infants are less prone to gastrointestinal disturbances and respiratory infections than are the artificially fed. It is not, however, to be assumed that immune bodies are transferred to the babies through the milk. In certain species, notably the ruminants, immune bodies reach the offspring through the colostrum, and newborn calves, deprived of colostrum, die of colon bacillus septicemia. The human infant receives its immunity from the mother before birth by way of the placenta.

Eczema is less frequent in breast- than in bottle-fed infants.

A difference also exists in the responses to ingested vitamin C. Infants on human milk maintain a "normal" level of ascorbic acid in the blood plasma when the mother takes the usual amounts in her diet. The baby on cow's milk requires very large amounts (approximately 75 to 100 mg., or the amount of ascorbic acid in 5 to 7 ounces of orange juice) to maintain a similar level. The difficulty in maintaining a normal blood level is probably related to the high protein content of cow's milk, the need for ascorbic acid rising as the protein intake increases.

Natelson, Kramer, and Sherman⁶ have demonstrated a difference in the blood sugar responses to the two milks, the blood sugar rising to a higher level in infants receiving human milk than in those on raw or evaporated cow's milk formulas containing the same amount of lactose.

Artificially fed infants, then, are unlike the breast-fed in their chemical constitution, in their reaction to certain infections of the respiratory and intestinal tract, in their response to sunlight deficiency (tetany and rickets), in the greater frequency of eczema, generally regarded as an atopic disease in infants, and in their responses to ingested sugar and ascorbic acid. Involution of the uterus pro-

ceeds more rapidly in the mother when she suckles her baby.

Though claims as to the significance of breast-feeding for the emotional development of the child are, in general, exaggerated, it is reasonable to assume that the experience has some meaning for mother and child and that, in certain instances, it may be a significant factor in setting the pattern for future parent-child relations. Most mothers who nurse their babies derive therefrom a feeling of satisfaction and a sense of achievement not readily obtainable otherwise. In addition, the nearness of the infant and the physical contact during nursing help to establish an early intimacy between mother and child which becomes more and more meaningful to him as he grows older.

Pediatricians are agreed, in the main, that breast milk is the preferred food for infants. Though the available evidence, as outlined above, shows that there are definite differences in body make-up and physiologic response between breast-fed and artificially fed infants, it is not possible to assert that one group is superior to the other. Under the circumstances, one can but defer to nature and recommend the milk specially designed for humans.

PRACTICAL CONSIDERATIONS

It is unwise to urge a mother to nurse her baby unless she wants to. Such discussion is not only futile; it may induce feelings of guilt and it will certainly antagonize her against the physician who is overly insistent.

A mother who is doubtful as to whether or not she wants to nurse her baby may be told that breast-feeding is preferred by physicians because it is the natural way, that she and the baby will come to enjoy the experience, that, for a few months at any rate, she will not have to prepare formulas or sterilize bottles. She need not eat excessively nor drink large amounts of milk, she can smoke, drink alcoholic beverages, and exercise in moderation, and her figure will not suffer.

Success in breast-feeding depends to a large extent on how strongly the mother desires to nurse and on the attitude of her husband, the



obstetrician, the hospital personnel, and the pediatrician. Above all, the woman who is planning to nurse her baby needs encouragement and a certain amount of information. Even before the birth of the baby she should understand that the amount of milk which the baby will get during the first few days of life will be negligible and that the baby, physiologically, loses weight regardless of what sort of food he is given. The breasts during the first week or so will be engorged and the nipples difficult to grasp. Knowing this, the mother will be less apt to be discouraged by the baby's often fruitless efforts.

Beginning about six weeks before birth she may massage her breasts, nipples, and areolae daily with cocoa butter, lanolin, or cold cream.⁷ When the nipples are flat or inverted she is shown how they may be drawn out several times a day to make them more prominent. At the same time, the correct way to manually express the breasts is demonstrated. The mother with small, flat breasts during pregnancy may be assured that this is no reason why she cannot nurse just as effectively as others. All these measures serve a useful purpose, if only in focussing parental interest on breast-feeding.

During the first two or three days of life, before the milk comes in and while the infant is losing weight, the mother needs reassurance that everything is proceeding normally. If she is living under "rooming-in" conditions where she has her baby close at hand, she may feed him when she thinks he is hungry. Under these circumstances, the baby will be awake and will probably suck vigorously, whereas, when he is put to the breast "on schedule," he may be apathetic or sleepy and he will consequently suck weakly or not at all, thereby discouraging the mother.

Factors in some hospitals which militate against breast-feeding are the antagonistic attitude of many nurses, who find that breast-feeding (especially a night feeding) interferes with their routine, the daily weighing of babies (which is unnecessary, indeed unwise, since it is a means of spreading infection), the routine use of sugar solutions to prevent dehydration fever, and the early resort

to complementary feedings to promote weight gain. Supplying the baby with a bottle containing water or food blunts the appetite and consequently the intensity of sucking which is the best stimulus to the flow of milk.

In discussing breast-feeding one should avoid stressing its importance to such a degree that the mother will feel inadequate or guilty if she finds it impossible to nurse her baby.

ARTIFICIAL FEEDING

The large majority of infants will thrive on a formula consisting of two-thirds whole milk, one-third water, and sugar in the proportion of one ounce in 20 ounces of total volume. This formula may be started on the third day of life (earlier feeding is unnecessary and unphysiologic) and continued until three or four months of age, when the infant is transferred to whole milk. Evaporated milk (one part to two parts of water with added sugar) is widely used in the preparation of formulas and has the advantages that it is of good quality, constant composition, sterile, cheap, and readily obtainable almost anywhere. The cheapest sugar (sucrose) is as good as the most expensive.

The only added vitamins necessary during infancy are C and D. Ascorbic acid may be started at one month as orange juice in teaspoon doses diluted with an equal amount of water. The orange juice is given once a day and increased rapidly to 2 or 3 ounces. At two months the orange juice may be given undiluted. For infants who cannot tolerate orange juice a daily supplement of 50 mg. of synthetic ascorbic acid may be given instead. It is dropped into the milk just before feeding.

Of the available preparations of vitamin D we prefer percomorph oil since it is a natural oil. It may be started at about two weeks of age. Five drops once a day (about 1000 units of vitamin D) are ample during the first year. Additional amounts of vitamin D are ordinarily obtained in evaporated milk (about 400 units per 13-ounce can), in whole milk which is reinforced with the vitamin, and in other foods. Vitamin D supplements should not be given during the summer months (April



15 to September 15) except under special circumstances. (I see no use whatsoever in giving vitamin D to a private patient during the summer months. Given a dark-skinned child who is not taken outdoors, the situation would have to be handled individually.)

SELF-REGULATION

The wisdom of allowing the infant to eat when he likes, what he likes, and as much as he likes, has been widely debated. Advocates of this technique hold that it is reasonable to feed infants according to their demands rather than by standards based on averages, and that infants fed in this way seem better satisfied and cry less. Moreover, infants acquire a hunger rhythm as part of the development process and spontaneously put themselves on a schedule.

Self-regulation or self-demand relates to (1) the interval between feedings, (2) the amount of food, and (3) the type of food.

During the first two weeks of life hunger contractions are almost continuous and the feeding demands are irregular. Therefore, self-demand has little meaning at this age. A hunger rhythm appears at about two weeks of age.

The early cry is not specific. According to Sherman,⁸ experts were unable to distinguish the hunger cry from crying for other reasons. Only at about one month is it possible for the mother to recognize the hunger cry (Gesell).

Mothers who feed their babies on self-demand find that their babies put themselves on a schedule, but that sometimes the daily rhythm begins at 8 a.m., on other days at 6 or 7 a.m., and so on. It is difficult to run an orderly household with a routine which changes unpredictably each day.

Experience has taught that the large majority of young babies will adjust to a 4-hour schedule starting at the same time each day and, since this suits well the convenience of most homes, it seems to be a wise procedure. However, this should not imply rigid adherence to a time schedule. It is well to keep in mind that a certain number of young babies will be unhappy with a 4-hour interval and one should, therefore, be prepared to make

changes whenever they appear to be necessary.

Elimination of the night feeding, usually at 2 a.m., depends on the appearance of a long sleep period of about 8 hours. This ordinarily takes place at three to eight weeks. As with other developmental phenomena, the change does not appear abruptly. Over a period of some weeks there may be considerable shifting back and forth between the old and new routines until the new way becomes established. The evening feeding (10–11 p.m.) is omitted when the infant acquires a longer sleeping period, ordinarily at about 16 to 26 weeks.

Another aspect of self-demand—allowing the baby to eat as much as he likes at a feeding within reason—seems to us to be sensible. Babies on the breast vary their intakes widely, sometimes taking as little as 2 ounces at one feeding and 8 ounces at another. It has been our practice to prescribe a regular amount of formula per 24 hours, to be divided equally among the feedings. The mother is then told about the varying appetite of the baby at different times of the day and she is instructed to give more at a feeding when the baby is hungry and not to insist on a full feeding when the baby does not seem to want it. In our experience, this is more satisfactory than having the mother fill an 8-ounce bottle with formula and letting the child take as much as he will.

A word of caution is necessary. The effort, in self-demand feeding, is to satisfy the hunger-demands of the baby in a natural way. It is not possible to duplicate a "natural" situation when feeding cow's milk from a bottle to a baby. Even many breast-fed babies take more than they can retain; hence the old saying that a vomiting baby gains well. The cautious physician, aware of the tendency of young babies to stool frequency, may hesitate to give a month-old baby all the cow's milk that he seems to want.

A modified self-demand feeding schedule is satisfactory in most instances, but its success depends, to a large extent, on the personality of the mother and her reaction to self-regulation.⁹ For one reason or another many mothers find the task of individualizing child



rearing a source of great anxiety. In certain instances, the fault lies in deep-seated emotional difficulties, and parenthood simply gives direction to the mother's inner tensions. But most of these anxious mothers are quite normal as indicated by their much more relaxed attitude toward subsequent children. Unaided by the sanction of a traditional approach, they are overwhelmed by a task which they are, for the time being, unable to handle.

The method of child rearing must suit the maternal temperament and cultural background. Individualization is fully as necessary in dealing with the mother as it is with the child. If the physician is convinced that self-regulation is going to make the mother overly anxious or otherwise unhappy, more or less specific directions should be given. An approach which she finds uncongenial will not only disturb her emotionally, it will make her task more difficult and will probably create unnecessary tensions in the child. It is unwise to try to coerce a mother who, by training, previous experience, or temperament, needs detailed instructions. Insistence that she take on, at once, the full responsibilities implied in motherhood serves only to increase her uncertainty, to undermine her self-confidence, and to lessen her efficiency.

This is not to say that we are to yield readily to mothers who prefer to shift their maternal responsibilities onto the physician. Most of us find it easier to take orders than to make decisions. Parenthood, after all, necessitates taking responsibility and parents will do well to learn this lesson early. But the physician will need to discriminate between those mothers who are ready for self-regulation and those who need the extra support which they get from more or less precise prescriptions.

The third aspect of self-regulation—more or less free choice of the type of food—ordinarily becomes a consideration only after the introduction of solid foods. Though the taste apparatus is well developed at birth the mixtures offered young infants are accepted without great regard for their taste.

According to Gesell and Ilg,¹⁰ cereal is usually a favorite food during the first year of life, but even here preferences as to the type

of cereal may appear as early as 24 weeks. Bananas and "jello" are general favorites during the first year. Likes and dislikes are shown early for vegetables. These attitudes are not necessarily permanent and considerable shifting back and forth may take place. Consistency and temperature of the food may be factors as well as taste.

When solid foods are introduced, the parents are told that no particular food is essential for the infant. If a food is refused, the method of preparation and administration should be investigated. If these are satisfactory, a substitute may be offered. If the child continues to refuse, attempts at giving solid foods may be deferred for several weeks and the parent told that the age at which infants are ready to accept solid food varies considerably. The parent should be warned against being too insistent or showing too much concern.

THE INTRODUCTION OF SOLID FOOD

The optimal time to introduce solid foods is when the oral musculature of the infant is ready to receive it, generally between three and four months. This is not to say that solid food cannot be fed earlier. It can and often is. But, because the infant is not ready, feeding is difficult, the baby often ejecting the food owing to awkwardness of the tongue and lips. The mother may become tense, anxious, worried. This is unnecessary and can be avoided if the physician is willing to wait for the proper time.

Young infants push vigorously with the tongue against a spoon or solid food placed between the lips. At about three to four months, a change takes place. When food is brought to the child's mouth, the lips part, the tongue carries the food to the back of the mouth and swallowing follows. This is the optimal time to introduce solid food, and nothing is to be gained by earlier administration.

Gesell and Ilg find that solids are best accepted in the beginning at the evening meal when the infant is "more sociable and more experimental in mood." Once the child has been accustomed to taking solid food, all of the mushy foods may be given.



Foods that require chewing may be introduced at seven to nine months, even though no teeth are present. An undue delay here is sometimes associated with poor chewing later on.

SUMMARY

Infant feeding is reviewed in the light of current knowledge about child development.

Breast-feeding is recommended. Aside from the psychologic implications, which may be significant in individual instances, breast- and bottle-fed infants show definite somatic differences in chemical constitution, in metabolic response (to lactose and to ascorbic acid administration), and in resistance to disease.

A modified self-demand feeding is recommended which relates to the amount and, later on, the types of food, the intervals between feedings being kept fairly constant.

In giving advice for infant feeding, it is fully as important to consider the personality of the mother as the child.

The optimal time to introduce solid foods is when the infant is developmentally ready, as shown by a change in oral behavior—about 12 to 16 weeks.

REFERENCES

1. (a.) MACY, I. C., WILLIAMS, H. H., PRATT, J. P., AND HAMIL, B. M.: Human milk studies. *Am. J. Dis. Child.* 70: 135, 1945.
- (b.) LAWRENCE, J. M., HERRINGTON, B. L., AND MAYNARD, L. A.: Human milk studies: XXVII. Comparative value of bovine and human milks in infant feeding. *Am. J. Dis. Child.* 70: 193, 1945.
2. STONE, S., AND BAKWIN, H.: Breast feeding. *J. Pediat.* 33: 660, 1948.
3. FINKELSTEIN, H.: Zur Kenntnis der Tetanie und der tetanoiden Zustände der Kinder. *Fortschr. d. Med.* 20: 665, 1902.
4. BAKWIN, H.: Pathogenesis of tetany of the newborn. *Am. J. Dis. Child.* 54: 1211, 1937.
5. GARDNER, L. I., MACLACHLAN, E. A., PICK, W. TERRY, M. L., AND BUTLER, A. M.: Etiologic factors in tetany of newly born infants. *Pediatrics* 5: 228, 1950.
6. NATIELSON, S., KRAMER, B., AND SHERMAN, M.: Blood sugar changes following the administration of lactose in raw and evaporated milk. *Fed. Proc.* 7: No. 1, 1948.
7. BARNES, G. R., LETHIN, A. N., JACKSON, E. B., AND SHEA, N.: Management of breast feeding. *J. A. M. A.* 151: 192, 1953.
8. SHERMAN, M.: The differentiation of emotional responses in infants. *J. Comp. Psychol.* 7: 265, 335, 1927.
9. BAKWIN, H.: Self-regulation and the mother. *J. Pediat.* 35: 786, 1949.
10. GESELL, A., AND ILG, F. L.: *The Feeding Behavior of Infants: A Pediatric Approach to the Mental Hygiene of Early Life.* Lippincott, Philadelphia, 1937.

RESUMEN

Alimentación infantil

Se considera la alimentación infantil a la luz del conocimiento actual del desarrollo infantil.

El amamantamiento se recomienda. Además de las implicaciones psicológicas que pueden tener importancia en casos individuales, los lactados al pecho y los artificialmente lactados muestran diferencias somáticas cuanto a su composición química y su respuesta metabólica (a la administración de lactosa y de ácido ascórbico).

Se aconseja una modificación de la alimentación autoregulada, cuanto a la cantidad y, más tarde, al tipo de alimento, quedando más o menos constantes los intervalos entre las comidas.

Cuando se hace recomendaciones para la alimentación del lactante hay que tener en cuenta no sólo el bebé sino también la personalidad de la madre.

El momento óptimo para la introducción de los alimentos sólidos se presenta cuando el desarrollo del niño está bastante avanzado, eso es, cuando un cambio en su comportamiento oral lo demuestra—a las 12 o 16 semanas, por lo común.

