ADEQUACY OF LACTATION: DYSREFLEXIA *vs.* MATERNAL NUTRITION

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SUMMARY

Problems with assessing the effect of maternal nutrition and lactation performance are presented in relation to a conceptual mathematical **ziggurat.** *Difficulties, variations and flaws are to be found in stages of this sequence of "logic" (e.g., assessment of maternal nutrition, volume and composition of breast milk, nutritional satisfactions of the nursling). It is concluded that the various steps in this process of reasoning are subject to much more variation and adaptation than appreciated. Much so-called "faltering" in the second trimester is physiologically normal ("pseudo-faltering").*

INTRODUCTION

The four major influences on the adequacy of lactation, as far as the mother is concerned, are (Fig. 1) **maternal reflexes,** her **practical knowledge concerning management,** her **health** (which includes nutritional status, but also the infectious burdens she bears and such stresses as overwork), and, much less frequently, **pharmacological effects** (e.g., oestrogen-containing contraceptives and nicotine).

This presentation concentrates on the two most important of these – dysreflexia (difficulties with the lactation reflexes) and maternal nutrition, as a major aspect of the mother's health.

As long ago as 1847, Anthony Trollope noted: "How it is that poor men's wives, who have no cold fowl or port wine on which to be coshered up, nurse their children without difficulty, whereas the wives of rich men who eat and drink everything that is good cannot do so, we will leave for the present for the doctor and mothers to settle between them". In other words, this observant novelist recognized almost a century and a half ago that the worst lactators in the world are often the best-nourished women.

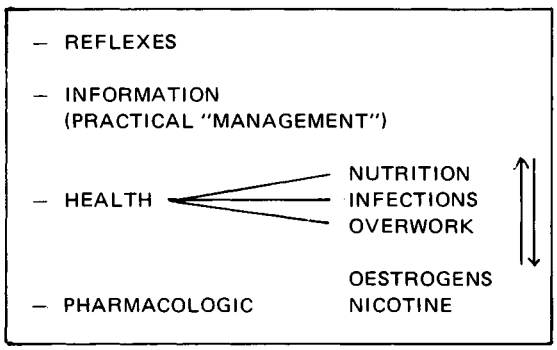

Fig. 1 Maternal influences and adequacy of lactation.

DYSREFLEXIA

A major aspect of successful lactation is an unimpaired reflex interaction between the mother and the baby.[1] This is often disregarded, minimized or under-appreciated by scientists investigating lactation, particularly those concerned with nutritional studies. In fact, much of the inadequacy of lactation found in different parts of the world is completely or in some measure related to dysreflexia. This can occur as a result of limitation of sucking stimulation and prolactin secretion, and/or anxiety, which can inhibit the let-down reflex.

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Conversely, practical experience demonstrates that very frequent sucking and confidence can lead to the secretion and availability of much larger amounts of breast milk than is often stated dogmatically in the more mathematical nutritional textbooks. For example, a series of 45 twins of well-motivated, well-nourished mothers recently investigated,[2] grew well on exclusive breastfeeding (with no other traditional foods) for the first six months of life (Table I). Likewise, a small series of similar women who had to feed their babies on one breast for various reasons, such as scarring from a prior burn or other pathology, were able to do so surprisingly well for the first six months of life (Table II). In other words, frequent sucking is of the highest importance, as is confidence in the mother.

Anxiety can have the opposite effect, inhibiting the let-down reflex and leading to a downward spiral – the "anxiety-nursing failure syndrome". In fact, if a mother thinks she has not got enough milk, it is likely that this will be the case – a self-fulfilling prophecy.

The commonest reasons given by mothers in many parts of the world for lactation failure are "not enough milk", "milk too thin", or "baby wasn't satisfied". All of these can be explained in many circumstances, but not all, as being related to dysreflexia.

NUTRITION-LACTATION INTERACTIONS

Current views concerning the relationship between maternal nutrition and lactation is complicated and can be compared to a *ziggurat* – that is, an ancient Assyrian flat pyramidal temple tower, very complex, and built one floor upon another, leading up to the centre of the top storey, which was believed to be nearer to eternal truth.

TABLE I

GROWTH DATA, SHOWING MEDIAN WEIGHTS AND LENGTHS, IN 45 EXCLUSIVELY BREAST-FED MALE TWINS DURING FIRST SIX MONTHS COMPARED WITH NCHS REFERENCE DATA, WITH WELL-NOURISHED, HIGHLY MOTIVATED U.S. MOTHERS[2]

Age (months)	Mean weight (kg)	NCHS centile	Mean length (cm)	NCHS centile
Birth	2.41	5	49.07	40
1	3.65	30	52.65	40
2	4.66	50	55.57	40
3	5.22	40	58.87	40
4	5.91	50	61.23	40
5	6.37	40	63.70	40
6	6.88	40	64.94	40

TABLE II

GROWTH DATA, SHOWING MEDIAN WEIGHTS AND LENGTHS, IN NINE EXCLUSIVELY UNI-LATERALLY FED INFANTS (MALES AND FEMALES COMBINED) DURING FIRST SIX MONTHS COMPARED WITH NCHS REFERENCE DATA, WITH WELL-NOURISHED, HIGHLY MOTIVATED MOTHERS[2]

Age (months)	Mean weight (kg)	NCHS centile	Mean length (cm)	NCHS centile
Birth	3.69	80	52.9	90
1	4.92	90	57.7	95
2	5.44	75	60.2	90
3	6.45	80	62.9	75
4	7.08	75	65.7	90
5	7.76	75	69.9	95
6	8.19	75	70.9	90

Note: Mean birth weight: girls 3.4 kg, boys 3.81 kg.
Mean birth length: girls 53.34cm, boys 52.7cm.
Mean period exclusive breastfeeding: 5.6 months ± 1.43 SD.

Without being over-fanciful, it would seem that conceptually, a mathematical *ziggurat* has been developed regarding the supposed effects of maternal nutrition on breastfeeding (Fig. 2). However, closer examination suggests that far from being scientifically logical, a mathematical mythology has been created. In fact, this conceptual *ziggurat* is both flawed in its assumptions and fallible in its numerical calculations. This can be demonstrated by considering the "blocks" making up each level.

Maternal Nutrition

The bottom level of the *ziggurat* comprises three aspects of maternal nutrition – dietary intake and RDA (Recommended Dietary Allowances), maternal growth and stores, and clinical nutritional status.

An initial need is to appreciate that the term "maternal malnutrition" covers a great range of different conditions in terms of chronicity, types of single or multiple nutritional deficiency and a whole host of other variables. Maternal malnutrition is obviously not a uniform condition. The term includes, for example, very severe calorie deficiency (as in a famine), seasonal moderate malnutrition (as occurs in the "hungry season" in some agricultural communities), chronic life-long inadequate nutrition (with considerable stunting of

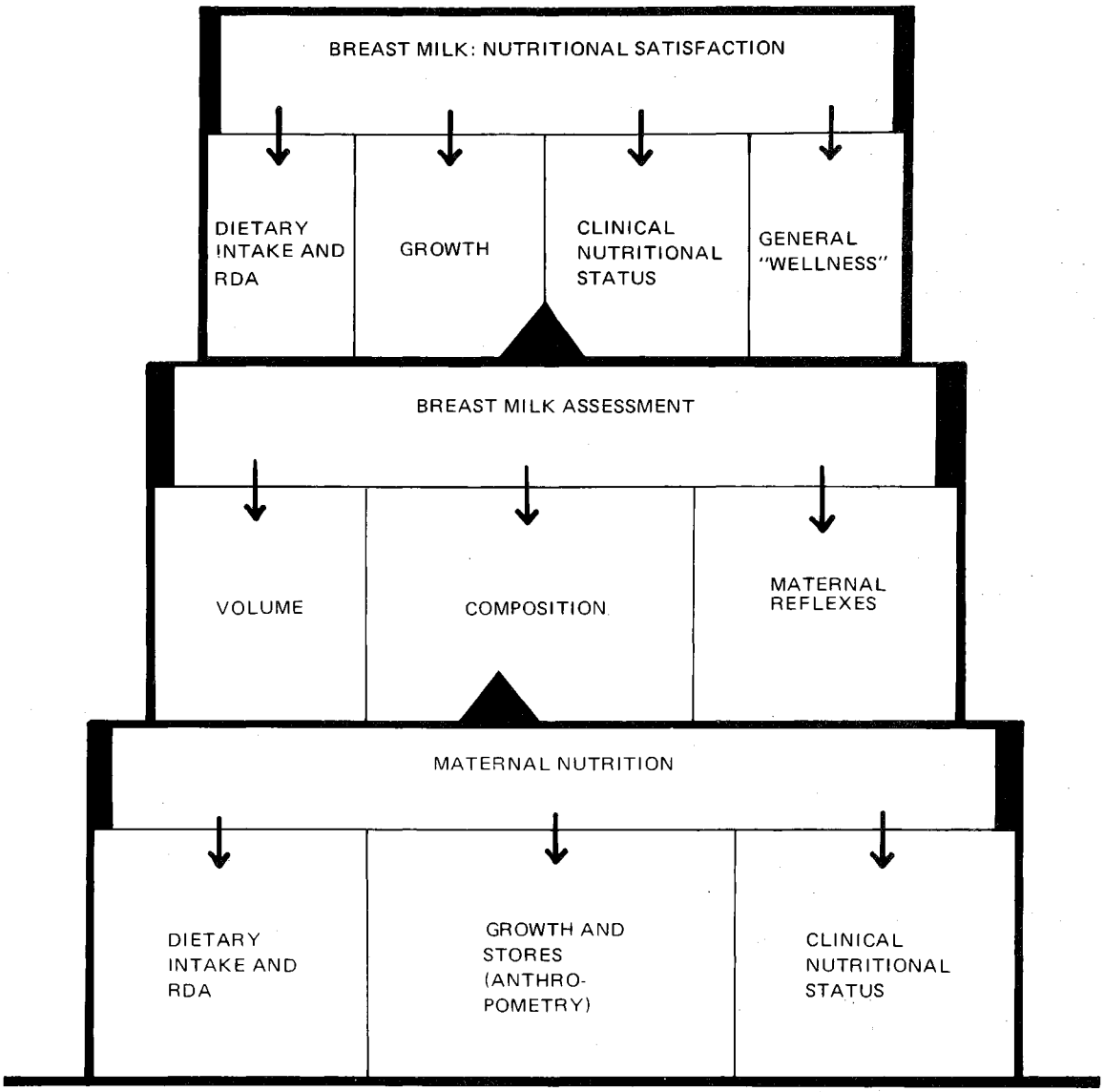

Fig. 2 Conceptual mathematical *ziggurat*.

growth) and very many other situations. Initially, then, there is the need to try to differentiate various levels of maternal nutrition in the continuum of pregnancy and lactation. In itself, this is a very difficult task, but can be attempted by estimating dietary intake compared with RDA, by anthropometry or by examination for clinical signs.

RDA. Recent studies from all over the world have demonstrated that the RDA usually quoted for pregnancy and lactation are overestimates. In other words, variation and adaptation during pregnancy and lactation are much more marked than previously believed. This has been described in both technically more and less developed countries, including, for example, the Gambia,[3] India,[4] Taiwan,[5] and the USA.[6]

Maternal Growth and Stores. The reference data concerning the effect of lactation on maternal growth and stores (anthropometry) again are often overestimated. Frequently, there is no significant change in body weight in prolonged lactation in inadequately nourished women. On the other hand, sometimes there is a notable decrease in body weight, especially in prolonged lactation,[7] and

sometimes this change is cumulative with repeated reproductive cycles. In other words, again, there is more adaptation and variation than currently appreciated.

Clinical Nutritional Status. This is only of value in severe malnutrition and with specific deficiencies — for example, with beri-beri or aniboflavinosis.

The point is that the bottom layer of the *ziggurat* is made up of these three "blocks", which are all very uncertain and variable. Despite this, information on these subjects is presented with great certainty, as though they were some type of absolute truth instead of very variable approximations.

Breast Milk Assessment. The second level of the *ziggurat* is concerned with breast milk assessment — that is to say, volume, composition, and the influence of maternal reflexes on these.

Initially, measuring the **volume of breast milk** produced is very difficult, and all methods available are very far from satisfactory. Both older methods such as test weighing or expression, and new techniques, such as the deuterium method,[8] and the use of a flow meter[9] have major limitations. Probably the best practical compromise is with 24-hour test weighing using a very sensitive scale. With this procedure, the mother needs to stay in hospital or some other medical facility, or the investigator has to remain with the mother through the 24 hours. This rarely is feasible, and, as with all procedures, there is a great likelihood of inhibiting the let-down reflex.

With regard to the **composition of milk,** there has recently been considerable discussion, and numerous research workers have pointed out that there was little standardization of methods, and that the timing of the sample, collection and storage procedures and the method of analysis could all give considerable variation in results, making comparability of data difficult.

The **utilization** of nutrients from a highly complex biological system, such as human milk, is also particularly difficult or perhaps even with some nutrients almost impossible to assess. Certainly when one looks at figures on the RDA for infants, this is underappreciated. Even the amount of a nutrient in breast milk thought to be ingested by a child is not the only concern. More importantly is how will this nutrient be absorbed and used by the body. So there are many difficulties in estimating the nutrients and the volume in lactation.

An underappreciated "red herring" with regard to breast milk volume is the frequently mentioned "normal" figure of 850 ml/day. Tracking down the origins of this often quoted figure, one finds that it is an arbitrary number suggested at an international meeting on calorie requirements held in the 1950's.

In fact, it is appreciated nowadays that the volume of milk secreted and ingested varies considerably in well-nourished, well-motivated women with well-nourished babies.

The volume and composition of breast milk in women with different forms and levels of malnutrition is difficult to assess for reasons mentioned. As might be expected with different maternal circumstances and methods of investigation, there is great variation in reports. As an over-simplified generalization, in women with moderate protein-energy malnutrition, the amount of milk that is produced is usually slightly less than usual.[10] However, if malnutrition is severe, such as occurs in famines, or if there is a chronically severely malnourished community,[11,12] there can be a greater decrease.

In malnourished communities, the volume of breast milk can be increased by improving the diet in pregnancy and lactation. Uncertainty is sometimes voiced as to whether this is so. Variation in volume at different seasons, especially a decrease in the "hungry season", would seem to demonstrate this as an "experiment in nature".

As regards **composition,** the main constituents of breast milk are hardly changed in malnourished women. If there is any change in the "proximate principles", there may be a slightly lower fat content.

With regard to vitamins, if the mother's diet and stores are both very low, this can be reflected by somewhat decreased water soluble vitamins or vitamin A in breast milk of such women. Nevertheless, clinical vitamin deficiency disease in breastfed babies in the earlier months of life is uncommon, except where **severe** deficiency of thiamine or vitamin B_{12} occurs. This can lead to infantile beri-beri[13] or the syndrome of tremors.[14]

Estimating the nutritional impact of the maternal reflexes on breast milk volume and composition is not usually given much attention. In fact, they play an important part in the volume secreted and the volume **available** to the baby. In addition, they have a significant role in the composition. Mainly, this is because if the let-down reflex is inhibited, the hind-milk, which is rich in fat and calories, will not be ingested, as opposed to the low-fat fore-milk. These maternal reflexes are very hard to measure in any mathematical sort of way. Definitions of units of anxiety are difficult; levels of prolactin secretion from sucking are only possible in very specialized endocrinology laboratories.

Taken together, this means that the second layer of the *ziggurat* is also full of uncertainties and variations with regard to the assessment of breast milk.

Breast Milk: Nutritional Satisfaction

The top layer of the *ziggurat* is concerned with estimating the nutritional satisfaction gained from breast milk with regard to the dietary intake compared with the RDA of young children, with regard to growth, with regard to clinical nutritional status and with regard to general "wellness".

Clinical Nutritional Status. The presence or absence of clinical signs usually plays little part in judging the adequacy or otherwise of breastfeeding in the first six months of life. As noted earlier, exceptions only occur with **severe** maternal deficiency of certain vitamins.

General "Wellness" A characteristic of many recent papers concerning the assessment of the nutritional satisfaction of breastfeeding is what may be called "qualificatory remarks". This occurs when research workers describing growth of breastfed babies insert a qualificatory comment, such as "appears well and contented" or "generally well". In actual fact, this is exactly what happens in practice. The experienced mother or paediatrician does not rely on weight gain alone, but on inspection and general observations. However, this is difficult to express in a numerate scientific fashion, that is, to quantify wellness in nanograms or milliosmols or other units.

DIETARY INTAKE AND RDA

For these reasons, objective assessment of the nutritional satisfaction from breastfeeding has usually been obtained from observations of the supposed dietary intake compared with the RDA, and on growth compared with selected reference data.

However, if one looks at the validity of the RDA for young breastfed infants during the first six months of life, it is readily apparent that they are completely artificial. Firstly, they are derived data from bottle-fed babies who had been given either pasteurized or fresh pooled breast milk or cow's milk — or soy-based formulas. Secondly, it is under-appreciated that such RDA have an additional percentage added as a "safety factor". Thirdly, the RDA for breastfed babies are based on the assumption that 850 ml is the normal volume taken in the early months of life. As already mentioned, this figure is quite arbitrary and, in fact, much less is often ingested by healthy well-nourished infants. Fourthly, the difference in detailed composition and especially the bio-availability of nutrients between breast milk and formula is not taken into account. Fifthly, there is much more variation in nutrient needs among individuals, and perhaps between communities. Certainly, healthy babies can grow on volumes of breast milk which differ two or threefold.

It seems clear that the RDA for young breastfed babies are inaccurate overestimates,[15] indeed, 15 years ago, they were termed the "RDA hoax".[16] Recent metabolic studies have reconfirmed the incorrectness and variability of the RDA for breastfed young infants, as emphasized, for example, by studies on nutrient intakes.[17]

GROWTH

Assessment of nutritional satisfaction in breastfed babies has been distorted and clouded by some common misunderstandings. Firstly, it is seldom appreciated that the reference data with which growth is often compared are derived from comparatively small numbers of mainly non-breastfed babies of some decades past when high-solute formulas were used and the early introduction of semi-solids in the first weeks of life was advocated. This applies to all the reference data commonly used, including the Harvard (Boston), or the 1959 UK Ministry of Health, or the more recent NCHS levels.

Secondly, there is sometimes a faulty understanding of the mathematical significance of the term "percentile". For example, a recent publication notes adversely that 8% of breastfed infants at a certain age were below the tenth percentile. In fact, with a normal population, ten children would be below the tenth percentile.

Thirdly, newer studies indicate that "catch-up growth" is much more unlikely in chronic, small-for-dates newborn, even when optimally fed. The importance of this in interpreting growth curves is apparent, as the majority of low birthweight babies in less technically developed countries fall into this category rather than being "preterm".

Fourthly, and principally, is the recognition that growth velocity in the second trimester is frequently less than in the first three months of life. It is this so-called "faltering"[18] which has caused more confusion and uncertainty in relation to breastfeeding in general, and in inadequately nourished mothers in particular. In fact, recent work on healthy, exclusively or predominantly breastfed babies of well-fed mothers in Australia, Europe and the USA (Table III) has shown a growth velocity in the second trimester which is much lower than the supposed "standard" and more similar to breastfed babies in less technically developed countries. In other words, what is considered to be "faltering" is really a "pseudo-faltering" and physiologically normal.

CONCLUSION

The mathematical *ziggurat* postulated is in actual fact full of flaws and faults, and all of the numerical bases on which it is constructed need re-considering. This is not to say that inadequate nutrition at the breast cannot occur. It can and it does, but very much less commonly than often believed. It is necessary to take into account much greater adaptation and varia-

TABLE III

SECOND TRIMESTER WEIGHT GAIN (KG): SHOWING SIMILAR LEVELS IN EXCLUSIVELY OR PREDOMINANTLY BREASTFED BABIES AND THIRD WORLD RESULT.18

	UK[1] (1959) (M)	Australia[2] (1981) (M)	UK[3] (1978) (M)	USA[4] (1984) (M & F)	Finland[5] (1985) (M & F)	TLDC[6] (Quoted 1980)
QUARTER 1st (0.3 mths)	2.49	2.50	2.17	2.4	2.3	2.47
QUARTER 2nd (over 3-6 mths)	2.13	1.70	1.53	1.5	1.8	1.56

QUARTERLY GROWTH INCREMENTS (kg)

1. Ministry of Health, U.K. (1959)
2. Hitchcock *et. al.* (1981)
3. Davies (1978)
4. Isaccs *et. al.* (1984)
5. Salmenpena *et. al.* (1985)
6. Quoted Waterlow *et. al.* (1980) (17 technically less developed countries)

tion than previously realized, and, in particular, a normally slower growth velocity after the initial first trimester growth spurt. In other words, a second trimester deceleration is a normal phenomenon. However, the unanswered question is now to sort out young infants who show serious growth failure from those who are showing a normal physiological slowing of growth, which misguidedly has been labelled as abnormal.

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