Nutrition in the Rural African Woman: Studies from Keneba, The Gambia

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Introduction

Normal healthy adult men and women have different body compositions. Women have both more essential, or non nutritional fat, and more stored fat. Differences in the amount of stored fat and in basal energy requirements (BMR), on average higher in men, may account for greater survival of women from infectious illness and from nutritional stress - *provided everything else is equal.*

Everything else is *never* equal. Pregnancy and lactation impose significant nutritional stresses on women and add childcare to their work. The role of many rural women as chief growers and preparers of food, and as those who look after the household, imposes nutritional requirements which are not easily met. Biological adaptation can prevent the worst effects of inadequate nutritional intakes but such adaptation may reduce the body's ability to respond to further stress, such as infection. The interrelation of nutrition to growth and health in rural women will be discussed from the perspective of one African village.

Background

The Medical Research Council of UK has had a Nutrition Research Unit stationed at Keneba in The Gambia for the past 21 years. Before the nutrition unit was sited there, village surveys for malaria together with documentation of weights and heights of the population, had taken place twice yearly for the previous twenty four years. The MRC had carried out some nutritional studies in The Gambia in the 1940s. This long history of investigation and the present activities of the MRC units within the country, must make the one million residents of the Gambia possibly the most medically studied population in the world. The information we have on the 3000 villagers of Keneba and two neighbouring villages of Manduar and Kantonkunda, must also form one of the most detailed databases for any population in the world. I express the gratitude of myself and all the scientists who have visited Keneba over the past 50 years, to the long-suffering villagers who have willingly, even enthusiastically, participated in this data collection.

The Dunn Nutrition Unit at Keneba has a particular interest in the nutrition of young children and of pregnant and lactating women. I should like to describe the findings of some of the studies relating to adult women and discuss their significance. But first I need to sketch the environment in which these villagers live.

Seasonality

It is impossible to consider health and nutrition in The Gambia without consideration of seasonality. The country is a poor agricultural community in the subSahelian zone of West Africa. The overall climate is hot with temperatures most of the year rising to the higher 30s and into the 40s, except in the coastal strip. There is a relatively cooler period in December - January when temperatures may fall below 20º C, at night, and there is a single rainy season lasting from late June/mid July until early October. Rainfall is intense and usually reaches over 800mm per annum, although annual rainfall decreased by 50% between 1950 and 1980, and there were some years of very low rainfall in the late 1980s. Keneba is about 80 miles up the Gambia river and only a few km from a major tributory the Bintang Bolong, but the rivers are still brackish and tidal.

Irrigation of farming land from the rivers is thus impossible. The population is consequently dependent on the success of the one growing season and the groundnut, millet and rice harvests. Village gardens watered from wells during the early months of the year can supplement the diet with some vegetables such as onions, tomatoes and local spinach.

The staple diet consists of rice grown in the fields by the river margins, cous (millet) and maize, with groundnuts as both chief protein source and cash crop. All these crops are harvested in the later months of the year. Consequently food, particularly after a bad harvest or crop failure, can run very short towards the end of the dry season, and, particularly, early in the rainy season before the first crops are harvested. Energy expenditure in exercise is at its highest level at the point in the year when food is shortest (Table 1).

Table 1. Average energy expenditure of rural Gambian women in agricultural work in each quarter of the year.

June - August	1219 kcal/woman/d
September - November	1088 kcal/woman/d
December - February	799 kcal/woman/d
March - May	301 kcal/woman/d

*Haswell M *Energy for subsistence* Second edition Macmillan London 1985.

Land is being prepared for sowing and women are walking long distances to rice fields where they may work from dawn until dusk. At this time of year only one meal may be eaten, partly due to food shortage, but also because the women are too busy and/or exhausted to prepare more than one meal. As a consequence of the intensive agricultural labour and the concomitant food shortage, the whole population tends to be losing weight prior to the harvest. Yet this is also the time when the incidence of respiratory illness is highest and the malaria epidemic, which occurs every year with the rains, begins its annual onslaught. The period August to November is neither easy nor healthy.

Energy intakes

The typical diet of Keneba citizens is barely adequate even in the season of plenty. The diet is a bulky cereal diet of low energy density with only 25% of energy from fat when food is plentiful and groundnuts readily available, and less than 18% of energy from fat in the hungry season. (Western governments are mostly trying to bring the fat energy in their national diets down below 35% energy from fat!). There is no tradition of offering more food to pregnant or lactating women and these women are not routinely spared from labour in the fields although, when a man has several wives, there may be some distribution of labour between farm and compound. Thus, there are obvious questions about how these women cope with pregnancies and lactations following one after another with an average of over 6 children/woman's lifetime - a mean of $4^1/_2$ years spent pregnant and twelve years spent lactating.

Pregnancy

If we look at what is happening to pregnant women there seem to be very interesting adaptations. Pregnancy in well nourished women is accompanied by a slight fall in BMR around ten weeks and then gradually increasing BMR (Durwin et al 1985). In Gambian women, studies carried out in the Dunn Nutrition Group whole body calorimeter by a team led by Dr Andrew Prentice, show that early pregnancy in malnourished women is

accompanied by a fall in maternal BMR and thus relative saving of energy (Poppitt et al 1993). The women also, perhaps subconsciously, reduce their energy expenditures in activity. They go to the fields less and reduce the amount of time spent walking and performing household tasks. Nevertheless energy expenditures exceed energy intakes during the farming season as the women lose up to 4kg of body fat. There is an associated decline in birth weight from 2944 +- 44g in the dry season to 2743 +- 47g in the wet season (Prentice 1993). The ability of women to adapt to low energy intakes in pregnancy relates to their nutritional status and their nutritional intake. Poorly nourished women with low body fat appear able to reduce the normal increase in metabolic rate that accompanies pregnancy so as to accommodate the acquisition of tissue that accompanies early pregnancy, despite no increase in the already low energy intake. Depending on the stage of pregnancy and the time of year, weight gain may or may not be accompanied by fattening. During the seasons of plenty, pregnancy weight gains average 1.4kg/month but in the hungry season these gains average only 0.4kg/month (Singh et al 1989) (Table 2). Women may fatten in the seasons of plenty and lose weight in the seasons of hunger.

Table 2. Mean energy intakes (standard deviation) in kcals/d of rural Gambian women under different circumstances.*

	Pregnancy	**Pregnancy weight gain kg/mth**	**Lactation 0-3 mths**	**Lactation > 3 mths**
Wet season	1417 (41)	0.4	1474 (42)	1413 (37)
Dry season	1483 (22)	1.4	1773 (31)	1662 (16)

*From Prentice A M Variations in maternal dietary intake birth weight and breast milk output in The Gambia In H Aebi R G Whitehead (editors) *Maternal nutrition during pregnancy and lactation Nestle Foundation Publication Series no 1* Hans Huber Berne; 1980: 167 - 183.

Birthweights

Birthweights of infants are low - on average 2.9 kg compared with 3.5 kg in Western Europe but there is marked seasonal variation in the weight of new-born infants. Infants born to mothers in the last trimester of pregnancy during the hungry season (June - August) weigh, on average, 300g less than those born to mothers in the last trimester of pregnancy during the harvest season of October - January (Singh et al 1989). Several supplementation studies of women in Keneba and in the whole of the District of West Kiang show that this weight difference can be removed by supplementation of pregnant women to the extent of 1200 kcals per day (Prentice 1993).

Table 3: Effect of maternal supplementation (1020 kcals/d) on birthweight and proportion of low birth weight infants in dry and wet seasons.

	Studied in pre-supplement era	With supplement
Mean birthweight kg (wet season)	2.81	3.03
Mean birthweight kg (dry season)	2.94	2.95
% infants < 2.5kg (wet	23.7	7.5

season)		
% infants < 2.5kg(dry season)	12.5	8.6

*From Prentice A Nutrient requirements for growth, pregnancy and lactation: the Keneba experience *South African Journal of Clinical Nutrition* 1993; 6: 33 - 38.

Sadly for the paediatricians amongst us, this improved birthweight, although possibly affecting early growth and survival does not seem to have any effect on long term infant growth and survival. The nutritional problems of weaning are so great that they obscure or remove any advantage of being born relatively large.

Lactation

The long time spent in lactation also presents nutritional problems. Breast milk fat output necessitates production of an average of 25g of fat/day (Sonko et al, to be published) . This may come from fat in the food or from fatty acid synthesis from carbohydrate in the diet. Evidence suggests that the body does not synthesise fat from carbohydrate easily. Although there is an obligatory demand for 25g fat/day in the diet of the lactating woman, if this cannot be met from the diet, it must come from the fat stores, with consequent slimming and loss of nutritional reserve in the mother. Whilst the diet in the harvest season may contain sufficient fat, it is unlikely that this is true of the hungry season, and lactating women waste. Once the harvest comes in, the women begin to lay down subcutaneous fat again, but it may be three months before the volume of milk, which fell during the rainy season, increases again. Thus lactating women go through cyclic fattening and wasting according to season.

Micronutrient deficiencies

The risks of low energy intakes are compounded in pregnancy by the risks of anaemia. Most commonly this is iron deficiency anaemia, although malaria contributes to low haemoglobin levels in the rainy season, and the association of low haemoglobin with overall poor nutrition might suggest that some of the anaemia is due to protein energy malnutrition (Ghoos 1994). Pregnant women who work in the fields are marginally more prone to anaemia, again suggesting that energy deficiency - or possibly untreated malaria - may be contributive malnutrition (Ghoos 1994). Maternal mortality, as in much of sub-Saharan Africa, is very high. This, together with high fertility (mean >6 births/woman), gives African women perhaps 5000 times the risk of women in Western Europe of dying in childbirth. Anaemia contributes to mortality, leading to problems at delivery from which mothers cannot recover, postpartum cardiac failure and postpartum ill health. Our studies show that the risks of anaemia are increased if a woman was anaemic in a previous pregnancy (Ghoos 1994). There is thus a window of opportunity for correction of anaemia in the postpartum period which is probably neglected by the lack of postpartum care for many women in the country.

For many years the Dunn Nutrition Group has had at least one resident midwife working to improve maternity services to the villages. Maternal mortality rates in the three villages with primary health care provided by the Dunn Nutrition Group were considerably lower than in surrounding villages. In 1989-92 a study in the West Kiang district showed that the procedures of more active involvement and communication between midwives and TBAs, with regular haemoglobin monitoring and relatively ready evacuation of women to hospital when complications arose, could reduce maternal mortality over the whole district to the same level as that of the Dunn Nutrition Group's three villages (Foord 1993). Thus maternal mortality in West Kiang was 1.4 /1000 livebirths compared with over 6/1000 livebirths in a similar population with less easy access to health care on the North Bank of The Gambia. The most noticeable

differences between the women in the two surveys was the frequency with which haemoglobin levels were checked, the action taken on finding a low haemoglobin, and the mean haemoglobin measured during pregnancy. Women are at risk from anaemia in pregnancy but attention to iron and folate supplementation, malaria prophylaxis and action to treat significant anaemia when it is detected can diminish this risk (Foord 1993).

The Gambian diet is low in many vitamins and minerals (Powers et al 1986). Iron intakes are low and probably poorly absorbed since the iron is largely derived from plant sources and the vitamin C intake is low for much of the year. Vitamin A and C and riboflavin deficiencies are not commonly overt, but biochemical evidence of inadequate intakes abound except during February/March, when red palm oil may be prepared in nearby villages, and in May/June, when the population are consuming mangoes more or less throughout the day. But perhaps the micronutrient where intakes are most dramatically below those recommended is calcium. Studies show the daily intake of calcium to average 404 mg/d when recommendations are 700mg/d in pregnancy and 1250mg/d during lactation (Prentice et al 1993). Such low intakes might be expected to stimulate mobilisation of calcium from maternal bone to meet the needs of breast milk production. Studies show that the bone mineral content of Gambian women reaches its peak later than for European women, probably as a result of later pubertal development. Bone mineral does diminish with age as in Western women. Bone mineral density and bone mineral content are only about 70% of premenopausal values by the age of 70 years (Aspray et al, in press). Losses are greatest in the bones of the wrist (Table 4).

Table 4. Bone mineral content (g/cm) changes with age in Gambian women.

Age	Lumbar spine	Wrist
45 - 49	3.31	0.737
55 - 59	2.63	0.600
65 - 69	2.33	0.473
75+	2.34	0.300

*adapted from Aspray TJ et al *Proceedings of Nutrition Society.*

(Figures represent a 29% drop in bone mineral content in the lumbar spine and 59% drop at the wrist).

Despite this, clinical evidence of osteoporosis and fractures are very rare. Bone mineralisation may be poor but muscle and tendon strength maintained by the high levels of physical activity of even elderly women protects against damage to the bones.

There are lessons for nutritionists interested in the health of western women. Activity may be more important than calcium intakes in the prevention of the complications of osteoporosis. The policy of eating for two often advised in the past for pregnant women has been refuted in the West for some time. It is clear that adaptation can be made, even when normal intake is very low. But how much is the high incidence of low birth weight amongst those from deprived environments in western Europe for example, indicative of some nutritional deficiency in the pregnant women?

For the women of Keneba and The Gambia as a whole there are areas for action. Management of anaemia in pregnancy is important. Existing systems of care need to be made more effective. Diets should increase in fat content if women are to be able to increase their intakes sufficient to bear children of birthweight closer to European standards, and to lactate without significant weight loss throughout the year. Economically such a change of diet is not possible, even if it were tolerable. Thus an alternative to improving the nutritional intake of women could be to involve men more in

farming activity, so their pregnant wives can rest and have spare energy for nutrition of their fetuses. Such change will not come easily. And although change is needed, change must come without swinging too much towards obesity and its attendant problems; osteoporosis with fracture risk; and the diseases of western civilisation: non insulin dependent diabetes; coronary heart disease; and various cancers.

Bibliography

Aspray, T.J., Prentice, A., Sawo, Y., Francis, R..M.., Reeve, J. "Bone mineral content decreases with age in elderly Gambian women." *Bone (in press).*

Durnin J.G.V.A., Grant,,S., McKillop, F.M., Fitzgerald, G. "Is nutritional status endangered by virtually no extra intake during pregnancy?" *Lancet* 1985: 823-825.

Foord, F. Gambian government, DNU/MRC Safe Motherhood Initiative *Evaluation Report to WHO* 1993.

Ghoos, K. "Possible factors contributing to anaemia in pregnancy in three rural Gambian villages." *Memoire presented for Diplome d'etudes superieur.* University of Montpellier, France 1994.

Poppitt, S.D., Prentice, A.M., Jequier, E., Schutz, Y., Whitehead, R.G. "Evidence of energy sparing in Gambian women during pregnancy: a longtitudinal study using whole-body calorimeter." *American Journal of Clinical Nutrition* 1993; 57: 353-364.

Powers, H.J., Bates, C.J. "Micronutrient deficiencies in the aetiology of anaemia in a rural area in The Gambia." *Transactions of the Royal Society of Tropical Medicine and Hygiene* 1986; 21-25.

Prentice, A., Laskey, M.A., Shaw, J., Hudson, G.J., Day, K.C., Jarjou, L.M.A., Dibba, B., Paul, A.A. "The calcium and phosphorus intakes of rural Gambian women during pregnancy and lactation." *British Journal of Nutrition* 1993; 69: 885-896.

Prentice, A. "Nutritional requirements for growth, pregnancy and lactation: The Keneba experience." *South African Journal of Clinical Nutrition* 1993; 33-38.

Singh, J., Prentice, A.M., Diaz, E., Coward, W.A., Ashford, J., Sawyer, M., Whitehead, R.G. "Energy expenditure of Gambian women during peak agricultural activity measured by the doubly-labelled water method." *British Journal of Nutrition* 1989; 62: 315-329.

Sonko, B.J., Prentice, A.M., Poppitt, S.D., Prentice, A., Jequier, E., Whitehead, R.G. "Dietary fat intake: a possible determinant of seasonal weight changes in a rural subsistence farming community." *To be published.*