

Food and nutrient intakes among pregnant women in rural Tamil Nadu, South India

Lena Theilgaard Andersen¹, Shakuntala Haraksingh Thilsted^{1,*}, Birgitte Bruun Nielsen² and Suguna Rangasamy³

¹Research Department of Human Nutrition, The Royal Veterinary and Agricultural University, Rolighedsvej 30, 1958 Frederiksberg C, Denmark: ²Perinatal Epidemiological Research Unit, Department of Obstetrics and Gynaecology, Aarhus University Hospital, 8200 Aarhus N, Denmark: ³1/81 E Thoppukkadu, Gnanasubramani Nagar, Fairlands, Salem 636016, Tamil Nadu, India

Submitted 31 August 2001: Accepted 25 June 2002

Abstract

Objectives: To study pregnant women's diet at food and nutrient levels and how these match recommendations; to describe how factors such as education level, economy and folk dietetics influence the women's food choice; and to give suggestions for the improvement of nutrition education in the existing antenatal care systems.

Design and subjects: Thirty pregnant women in the last trimester were interviewed three times using a 24-hour dietary recall with weighing of foods and recipes of dishes. Interviews regarding health, nutrition and socio-economic status, and measurements of weight and height of the women, were conducted.

Setting: Rural parts of Salem District, Tamil Nadu, South India.

Results and conclusion: The women's diet (without supplements) was insufficient in energy and all nutrients except fat, compared with the Indian recommendations. Aggravating low intakes of micronutrients were found which were reflected in low intakes of foods other than rice. Eating customs and economy appeared to influence the women's food choice negatively in relation to recommendations while factors such as education level, family type, pregnancy number and folk dietetics did not seem to have a negative effect. The amounts of foods recommended, especially green leafy vegetables, must be shown to the women. The nutrition advice given by all levels of health providers must be the same and based on cheap, local, commonly consumed foods.

Keywords
Maternal nutrition
Food intake
Folk dietetics
Nutrition education
Tamil Nadu
India

During pregnancy, the foetus relies entirely on the mother for energy and nutrients and the woman not only needs to gain weight but also must maintain an optimal intake of essential nutrients. In Western countries, women gain on average 10–12 kg during pregnancy, while weight gain during pregnancy in low-income countries has been shown to be in the range of 2–7 kg¹. Maternal malnutrition during pregnancy can lead to intrauterine growth retardation and has been shown to be a major determinant for reduced birth weight^{2,3}. Especially in the last trimester of pregnancy, maternal malnutrition impairs the foetus's ability to gain weight. A low-birth-weight baby (birth weight \leq 2500 g) is more prone to disease and thus has less chance for survival than a normal-weight baby (birth weight $>$ 2500 g). If low-birth-weight babies survive, their cognitive development may be impaired and they are more likely to be malnourished^{1,2,4,5}.

In India, the average birth weight ranges from about 2700 to 2800 g, and is one of the lowest in the world⁴. Also, the proportion of low-birth-weight children is among the

highest: 30% in Tamil Nadu. This figure has not declined during the past three decades⁶.

Some studies from India have provided data only on the intake of nutrients while others have also included a few socio-economic parameters such as economy and education^{7–11}. Other studies have provided information solely on the motives that determine women's food choices as well as information on a few food items that play a significant role, for example food items that increase the women's body heat (heating effect)^{12–15}. Hutter has presented results for nutrient intakes in women in rural South India as well as qualitative data on beliefs of foods¹⁶. However, there are no studies in which the food and nutrient intakes of pregnant women in India have been reported in relation to recommendations, as well as combined with qualitative data regarding socio-economic status, health and nutrition.

The aims of this study were to investigate whether the pregnant woman's diet at food and nutrient levels matches the Indian recommendations; to describe how factors such

*Corresponding author. Email sht@kvl.dk

as education level, economy and folk dietetics influence the woman's food choice; and to suggest ways to improve nutrition education in the existing antenatal care systems, taking into consideration cultural and practical possibilities.

Methods

Study area

The study was conducted in rural areas of Salem District, Tamil Nadu, South India. The government provides health care through health sub-centres, each serving an average population of 5000 people. In each health sub-centre catchment area, one village health nurse and three nutritional teachers provide health care¹⁷. The present study was undertaken approximately 15 km from the main town of Salem District, in several small villages and farmhouses around the villages. The catchment area of one health sub-centre and one-third that of another health sub-centre comprised the study area, with a population of 7000.

Participants

The village health nurses who register pregnant women and the nutritional teachers assisted in identifying the women for this study. To avoid potential selection bias, all pregnant women were identified by questioning all contacts, such as the women already registered and their relatives, ensuring that not only women in contact with the local health authorities were included in the study. To estimate the gestational age of the individual woman, the last menstruation date was recorded. The date was checked in the woman's antenatal care card, if available, and in the village health nurses' registration books. All women were in the last trimester of pregnancy when interviewed. Six women were not included due to delivery or because they had gone to their mothers' homes for delivery, outside the study area, and three women were not found in their homes even after several visits. Six women who came to their mothers' homes for delivery in the study area were included. Initially, 32 women were recruited for the study. However, two women were excluded, one due to doubt about gestational age and one due to delivery. Therefore 30 women were included in the study. The data collection was carried out from 22 October to 7 December 1998.

Dietary assessment

Three non-consecutive 24-hour dietary recalls were carried out for each woman. The visits were unannounced. Food intake was not measured on festival days, when special foods are eaten. Still, an important religious festival (Diwali) was celebrated at the beginning of the interview period and leftover snacks and sweets could have influenced intake. Monday to Saturday were considered normal weekdays with similar normal diets.

Sundays were considered special, probably with more consumption of animal foods. Thus Sundays (interview on Mondays) were weighted with 1/7 of the total number of interviews.

The group's mean intakes were calculated on the basis of each woman's mean intakes.

To estimate the portion sizes, cooked rice and a pulse were brought to every interview. The woman showed the portions she had eaten in her own utensils and used water for estimating the volumes of the liquids and thin sauces. If she had leftover food, this was weighed. Recipes of all dishes eaten were estimated in the same way. A Soehnle electronic baking and domestic scale, with a precision of 2 g from 0 to 2000 g and 5 g from 2000 to 5000 g, was used. A standard weight table of weights of ordinary food items was constructed. Standard sizes, small, normal and big, were estimated from the mean of three samples purchased from the local markets. Recipes of purchased sweets, snacks and cakes were obtained locally. If the woman did not know the recipe of the food eaten, a standard recipe based on an average of a similar dish from the other women participating was used. The dietary data were transformed from household measures and estimated into grams using the weight table. Evaporation and water uptake during cooking were taken into account. DanKost 2000 (version 1.4c, Dansk Catering Center A/S, Denmark) was used as a calculation tool, supplemented with nutritive values of food items from *Nutritive Value of Indian Foods*¹⁸. The water content in boiled rice was estimated as 66%¹⁹. Dry condiments and spices except chilli and tamarind were not included in the calculations. *Ganichi* and *nees thanni* (beverages made with rice and water) were estimated to consist of mostly rice starch and water. All nutrients and food calculations were done without including supplements. On the macronutrient level, intake values were also calculated with the inclusion of the dietary supplement *laddu* (made of cereals, pulses, sugars and groundnuts and fortified with micronutrients).

Anthropometric assessment

All measurements were conducted at the first visit. Weight was measured to the nearest 500 g using a Krups bathroom scale. To measure height, the woman stood upright against a straight wall, a ruler was placed on her head and a mark was made on the wall. Height was measured with a measuring tape to the nearest cm. All women wore a thin sari and blouse and were barefooted.

In-depth interview

A semi-structured interview guide regarding reproductive history, health, food and socio-economic status was used. All information given by the women was recorded. In many cases, similar information was given and this was grouped and described verbally. When some women gave very different information, this was described if considered important. All interviews were conducted by the

Table 1 Characteristics of women* in the study

	Mean (median)	SD	Range
Woman's age (years)	22.9 (22)	3.5	17–30
Gestational age (months)	7.9 (8)	0.8	7–9
Height (cm)	152 (153)	5.0	139–161
Weight (kg)	51 (50)	6.5	42–74
Years of marriage	4.7 (4)	3.4	1–13
Number of pregnancy	2.3 (2)	1.2	1–6
Parity	1.2 (1)	1.4	0–5
Number of living children	1.0 (1)	1.1	0–4
Number of visits to healthcare facility†	4.4 (4)	1.9	2–9

SD, standard deviation.

* $n = 30$.

† Visits in present pregnancy; healthcare facility covers village health nurse, doctor and hospital.

investigator and the research assistant. The research assistant translated the interviews from English into Tamil and vice versa during the interviews. Emphasis was placed on understand the meaning of the data collected at each interview and double-checking the translation in *Winslow's Tamil–English Dictionary*²⁰ and the food dictionary in *Nutritive Value of Indian Foods*¹⁸.

Statistical analyses

Mean values, standard deviations and confidence intervals were calculated using Microsoft Excel (version 97). Associations between dietary data and socio-economic factors were analysed by univariate analysis of variance (ANOVA) using the GLM procedure in SAS (version 6.12, SAS Institute Inc., Cary, NC). Residuals were tested for normal distribution using a Shapiro–Wilk test supplemented by a stem–leaf plot. Normal distribution of

nutrient, fruit and vegetable intakes was achieved by logarithmic transformation.

Results

Participants

Thirty women, 17–30 years old and in the third trimester of pregnancy, were included in the study (Table 1). Twenty-nine women completed all three interviews and one woman finished only two.

The educational level of most women and their husbands ranged from 6 to 10 years of schooling, but still 20% of women and 25% of husbands were illiterate. The economic status of the families was very diverse. The reported income ranged from Rs 100 (US\$ 0.42) to Rs 2400 (US\$ 10.13) per week. The majority of families were poor: 65% of the families earned less than Rs 500 (US\$ 2.11) per week. Most families owned no land and only four families owned more than one acre. Most of the women lived in a nuclear family and belonged to the lower castes in the Hindu community. One woman was Muslim. None of the women did very hard physical work, such as fieldwork, in the third trimester.

Dietary supplements

Eighty per cent of the women consumed some kind of supplement. Sixteen (53%) women consumed *laddu*, with 11 (37%) reporting eating the recommended amount of 2 pieces per day. Nineteen (63%) women took strength tablets, which presumably contained iron and folic acid and perhaps calcium. The content of the tablets is usually unknown as they are sold in small paper bags without

Table 2 Actual food intake* and recommended daily intake of foods for a balanced Indian diet

Raw food item	Actual intake (g day ⁻¹), mean (SD)	Recommended intake (g day ⁻¹)	
		Adult pregnant woman†, vegetarian, moderate work	Adult pregnant woman†, non-vegetarian, moderate work
Cereals	360 (90)	385	385
Vegetables, total‡	228 (188)	360	345
Pulses	26 (16)	85	70
GLV	9 (13)	125	125
Other vegetables	–	75	75
Roots and tubers	–	75	75
Fruits§	130 (86)	30	30
Milk	129 (113)	300	200
Oil and fat	17 (8)	35	40
Sugar and <i>jaggery</i>	19 (16)	40	40
Meat and fish	24 (–)	–	30
Meat	17 (31)	–	–
Fish	4 (14)	–	–
Poultry	3 (9)	–	–
Eggs	2 (6)	–	30

SD, standard deviation; GLV, green leafy vegetables; –, no value.

* Supplements are not included.

† The recommendations for a balanced diet are for a reference woman weighing 45 kg²¹.

‡ Total vegetables include pulses, GLV, other vegetables and roots and tubers.

§ Fruits include sugar cane, groundnut and coconut.

labelling. Twelve (40%) women reported consuming both *laddu* and strength tablets or other supplements.

Food intake

The actual food intake of the women, excluding supplements, is shown in Table 2. The diet was dominated by cereals, mainly rice, followed by vegetables, mainly non-green leafy vegetables. The average intake of green leafy vegetables (GLV) was very low, 9 g woman⁻¹ day⁻¹.

Fruit intake was more than three times higher than the recommended amount. However, in this study fruits also included sugar cane, groundnut and coconut, due to categorisation of these food items in the food calculation program used. The most commonly consumed fruit was banana. There was a wide range in the amount of food of animal origin consumed, 0–144 g woman⁻¹ day⁻¹ with an average of 24 g woman⁻¹ day⁻¹. None of the mean food intakes, except for fruit, reached the recommended amounts. The intakes of pulses, milk, oil and fat, sugar and *jaggery* (raw sugar) and egg were below half of the recommendations.

Nutrient intakes

Intakes of energy and selected nutrients are presented in Table 3. Calculations were done both with and without *laddu* supplement. The women's mean energy and nutrient intakes did not fulfil the Indian recommendations, except for fat. The mean energy intake increased by 9% with the *laddu* supplement. On average, 73% (standard deviation (SD) \pm 8%) of the total energy intake was provided by carbohydrates, mainly from rice, while fat and protein contributed 17% and 10%, respectively. Cereals also provided 57% (SD \pm 14%) of the protein intake and 46% (SD \pm 13%) of iron intake. The diet was alarmingly low in micronutrients, ranging from 26% of recommendations for vitamin A and iron, to 75% for vitamin C.

Food and nutrient intakes and socio-economic factors

The statistical analysis of potential linkages between intake of food items, nutrients and socio-economic factors showed only few significant associations. In the statistical analysis, the following socio-economic parameters were included: pregnancy number, the woman's education level, family income, family type, *laddu* consumption and number of visits to a healthcare facility. Both household income and number of visits to a healthcare facility were positively associated with riboflavin ($P = 0.021$ and $P = 0.009$, respectively) and calcium intakes ($P = 0.009$ and $P = 0.009$, respectively). The effect of number of visits to a healthcare facility was dependent on household income.

For every Rs 100 extra in family income, the riboflavin intake increased by 0.02 mg woman⁻¹ day⁻¹ and the calcium intake by 17 mg woman⁻¹ day⁻¹. For every visit to a healthcare facility, the intake increased by 0.08 mg woman⁻¹ day⁻¹ for riboflavin and 43 mg woman⁻¹ day⁻¹ for calcium. Furthermore, a negative association between fruit intake and pregnancy number was found ($P = 0.007$). For each pregnancy, the fruit intake was reduced by 1.4 g woman⁻¹ day⁻¹.

Health and well-being

Few women reported that they faced some problems regarding dizziness, giddiness, vomiting and stomach pain that made them eat less in the past week. Two-thirds of the women reported that they felt well in their pregnancy. Few of these women felt good despite vomiting or pain. Few women felt unwell due to stomach or back pain and difficulties in general. The women reported the opinions of doctors or other health providers consulted about their pregnancies as follows: two-thirds were good, very few were good except leg pain or less blood and few were bad due to pain, less blood and less strength. For most women

Table 3 Indian recommendations for pregnant women and the average daily intake of energy and selected nutrients with and without *laddu* supplement

Energy and nutrient intakes	Indian* recommendation	Group mean without <i>laddu</i> (with <i>laddu</i>)	SD	Range	95% CI
Energy (kJ)	10 555	8645 (9463)	2211	4763–13 130	7854–9436
Fat (g)	30	41 (44)	19.1	14–90	33.9–47.6
Protein (g)	65	50 (56)	16.8	28–89	44.3–56.3
Carbohydrate (g)	490†	369 (405)	91.3	201–611	336.9–402.2
Vitamin A (RE)‡	600	156	103.0	46–432	119.0–192.7
Vitamin C (mg)	40	30	19.6	5–99	22.9–36.9
Riboflavin (mg)	1.5	0.6	0.26	0–1	0.51–0.69
Calcium (mg)	1000	523	168.5	246–910	462.9–583.6
Iron (mg)	38	10	3.5	5–20	8.6–11.1

SD, standard deviation; CI, confidence interval.

* Recommended dietary allowances for Indians: reference woman – pregnant with a pre-pregnancy weight of 50 kg, moderate work²¹.

† Calculated from given values.

‡ 6 μ g carotene = 1 RE (retinol equivalent).

(four cases with discrepancies), the woman's own opinion about her pregnancy and that of the health providers were similar.

Nutritional advice

All except one woman received nutritional advice in their pregnancy. The local health providers, family and friends gave the advice. In general, the advice was to eat more GLV and vegetables such as carrots, beetroot, bottle gourd and ladies fingers. *Nees thanni*, fruits, eggs, milk, curd, meat, fish and *laddu* were also mentioned by more than one woman. Some of the women were also advised to eat more food in general. The advice given by family and friends focused more on animal foods while doctors' advice was to consume fortified drinks and fruits such as dates, oranges and apples, and in three cases to take strength tablets without any mention of foods.

Food habits and pregnancy

Most of the women changed their food habits in pregnancy. They reported that they ate the following foods more frequently and/or in larger amounts: vegetables, GLV, fruits, meat, eggs, milk, curd and buttermilk and fish. *Dhal*, bread, millet, snack, 'wheat kalli' (dough dish made of wheat flour and water), Boost (fortified drink powder) and food in general were also mentioned by more than one woman. Some women explained that the change in food habits was beneficial for 'own health', 'baby's health' or 'safe delivery', while others combined the above reasons. Half of the women changed their food habits in pregnancy by excluding some food items. The reasons given by most women were vomiting and the excluded food items being classified as 'gas-producing'. These foods were cabbage, *dhal*, potato, beans and oily foods. One woman mentioned that she avoided buttermilk, glucose and tender coconut because these foods would make the baby grow big, resulting in a difficult delivery. Very few mentioned exclusion of papaya due to its 'heating' effect on mother and baby.

Diet and body nature

The women characterised their body nature as follows: half of the women had a 'heat' body, few had either a 'cold' or a 'normal' body, while very few did not know. Very few had either a 'cold' body or a 'heat' body due to pregnancy. Some of the women mentioned curd, milk and buttermilk as foods for reducing 'heat'. Tender coconut, water, *nees thanni*, glucose drink (glucose mixed with water), fruit and lemon juice were also mentioned as reducing 'heat'. Very few women informed that eating warm foods instead of hot (temperature) also reduced 'heat'. Few women mentioned food items with heating effect that should be avoided, especially during pregnancy, such as pepper (green), chicken and papaya. Half of the women said that their body nature did not have any influence on their food

choice. All of the women with a 'cold' body said that their body nature did not influence their choice of food.

Diet and economy

Two-thirds of the women expressed other wishes about food choice if they had more money. One-third reported that they would eat more fruits, a few more vegetables, fortified drink powder or snacks, sweets and bottled drinks. Very few would eat more bread or milk. Very few women said they would eat as advised by the health provider if they could afford it.

Discussion

The present dietary survey was conducted among 30 pregnant women in their last trimester in rural Tamil Nadu, South India, at the end of the rainy season and the beginning of winter 1998. All women except one weighed >42 kg and had a height >145 cm, cut-off values that are considered to be a risk during pregnancy by the Government of India^{6,22}. However, using the cut-off value of 51 kg, which Mavalankar *et al.*²³ found to be a risk for having a small-for-gestational-age baby, 19 (63%) women had a critical weight.

Evaluated as group means, the women's intake was low for almost all food items in comparison to the Indian food recommendations. The intake of GLV was extremely low, <10% of the recommendation. This is of great concern as GLV are an important potential source of micronutrients in the Indian rural diet. Energy intake, both without and with the *laddu* supplement, was lower than the Indian recommendation. Based on basal metabolic rate for Indian women²⁴ and moderate physical activity²⁵, the energy requirement of the women was calculated to be lower than the Indian recommendation. However, it is of great importance to ensure an adequate energy intake, especially in pregnancy, when the woman needs sufficient energy for herself and her foetus as well as to gain fat for the lactation period. The mean energy intake (without *laddu*) of 8.6 MJ woman⁻¹ day⁻¹ in the present study was markedly higher than in other studies^{7-10,16}, in which the mean energy intake ranged from 4.9 to 7.6 MJ woman⁻¹ day⁻¹. The protein intake of 50 g woman⁻¹ day⁻¹ (without *laddu*) was, however, similar.

The intakes of vitamin A, riboflavin, iron and calcium were alarmingly low. Few studies have investigated the intake of nutrients in India. Bhatia *et al.*⁷ reported an average intake of 472 RE woman⁻¹ day⁻¹ compared with the very low value of 156 RE woman⁻¹ day⁻¹ found in this study (RE, retinol equivalents). Likewise, the consumption of iron was much higher in other studies^{7,9,10,16} compared with the 10 mg woman⁻¹ day⁻¹ found in this study. Of three studies^{9,10,16} that investigated calcium intake, only Hutter¹⁶ found a low calcium intake of 302 mg woman⁻¹ day⁻¹ compared with the intake of 523 mg woman⁻¹ day⁻¹ calcium in the present study. However, the two

other studies were conducted in the northern parts of India where milk and milk products are consumed in larger amounts than in Tamil Nadu²⁶. The very low intakes of micronutrients are reflected in the extremely low intake of micronutrient-dense GLV. The high intake of fruit did not contribute markedly to micronutrient intakes, as the most consumed fruit was banana.

The 24-hour recall method combined with weighing used in this study is an accepted method for determining mean food and nutrient intakes. In addition, it is quick and does not interfere much with the woman's daily life. In combining weighing of foods and recipes of dishes, as well as using repeated recalls (three times), greater accuracy as well as precision of the data was obtained. A flat slope syndrome has been shown to occur in 24-hour recalls, with high intakes of foods such as staple foods being underestimated while low intakes of other foods such as relishes are overestimated²⁷.

Since it was quite time-consuming to locate pregnant women in the last trimester in this rural setting, the sample size was limited to 30 women. The in-depth interviews were conducted prior to the first 24-hour recall. This was not considered as having an effect on the collection of food intake data since the 24-hour recall is information on consumption the prior day. However, information about food habits in general could perhaps be influenced by the women's wish to give the 'right' answers. The few significant associations found between food items, nutrients and socio-economic factors might have been a result of the relatively small sample size.

Most of the values for energy and nutrient intakes were calculated on the basis of a diet without supplements, even though most women reported that they consumed some kind of supplement. This was done for several reasons. The content of the women's strength tablets was unknown since they were given in small bags without labelling. Hutter¹⁶ found that, when asking women if they took strength tablets and tonics, they confirmed initially. However, in in-depth interviews it became clear that most women did not really take any supplements. In this study, half of the women reported consuming *laddu* and two-thirds strength tablets or other supplements. If these women actually consumed the supplements, this would have led to some improvement in their energy and micronutrient intakes. However, one-fifth reported not taking any kind of supplement at all.

Body nature seemed to play a large role since about half of the women reported that their body nature influenced their food choice. Half of the women reported having a heat body, of whom two women reported a change from a normal or cold body to a heat body due to pregnancy. This finding was surprising because, in the literature, pregnancy is defined as a heat state and more women with a heat body could have been expected^{12–15}. A heat feeling was explained as a heat burning sensation, and, to reduce that feeling, the women consumed milk products, fruit,

drank water and avoided hot and very spicy foods and papaya. Having a cold body did not seem to influence the women's food choice.

Change in food habits in relation to pregnancy is a common practice in both developing and developed countries. In this study, most of the women reported that they included food items because of their pregnancy and half that they excluded food items. This is markedly higher than that found in the study of Mavalankar *et al.*²³, in which 50% of the women reported a change in diet. In the present study, half of women reported adding vegetables, one-third adding GLV and a few adding milk and milk products to their diet. The reasons given by the women for including these foods were related to the health of both the woman and her baby, as well as for a safe delivery. Mavalankar *et al.*²³ found that 26% of women reported adding milk and milk products and 15% GLV to their diets.

In this study, food items often excluded were those considered as 'gas-producing', such as cabbage, *dbal*, potato, beans and oily foods. The reason for avoiding these food items was that the women felt like vomiting and not, as Nichter and Nichter¹³ reported, that gas-producing food items give less space for the baby to grow. Only one woman reported avoiding food items (buttermilk, glucose drink and tender coconut) that were considered nutritious for fear of having a big child and a difficult delivery.

In general, the women's knowledge about proper foods in relation to pregnancy was good with regard to both the food items they reported to include in their diet and the advice received about food to eat during pregnancy. The dietary advice given by health personnel, relatives and neighbours was mostly relevant. The advice given by the local nurse and nutritional teachers was to eat cheap food items available in the local area. The advice given by the doctors was often related to expensive food items and in some cases not based on foods but fortified drinks and supplements.

Despite the women's knowledge about foods and which food items should be included in pregnancy, the nutrient contents of their diet were alarmingly low. The reason for this could have been, as one nutritional teacher explained, that the women did not understand the importance of nutritious food and diet supplements, or perhaps as another nutritional teacher said, it was caused by lack of time and money. However, most of the women did no other work than moderate housework and the price of GLV was low.

The eating customs may be an obstacle for consuming the recommended amounts of foods. The diet consists mainly of rice, meals are eaten using fingers and a large amount of rice is mixed with a small quantity of sauces, which contain other food items. Therefore, adding much more sauce, for example with GLV, to a meal may give it an undesirable consistency. There seemed to be a positive association between nutrients (riboflavin and calcium) found in foods of animal origin and income. However,

even if the women imagined that they had more money, they did not express wishes about eating more foods of animal origin, and very few women mentioned milk. The women possessed good qualitative knowledge regarding the proper foods for pregnancy and this knowledge was important for them in their strategy of obtaining a safe delivery and a healthy child. However, their understanding of the quantity of foods, in particular GLV, necessary for meeting recommendations seemed to be lacking. Thus, every opportunity when the woman is in contact with a health provider should be used to show her the amounts of foods that are recommended. She must be shown the space that the recommended amount of cooked foods occupies on commonly used kitchen utensils. More emphasis should be given to the cheap, nutrient-dense, local fruits. The health providers should ensure that the woman understands the importance of consuming the dietary supplements, *laddu* and iron/folic acid tablets, distributed through the healthcare facility and how these can help her to achieve her goal of a safe delivery and healthy child. Furthermore, it is essential that the nutrition advice given by all levels of health providers, especially doctors, is based on cheap, local, commonly consumed foods that are nutrient-dense, so that the woman is assisted in making best use of her scant economic resources to improve her diet.

Acknowledgements

The women and local health staff who made this study possible are thanked for their co-operation and understanding. Many thanks are extended to Dr P. Krishnammall, Sri Sarada College for Women, Salem, Tamil Nadu for her guidance and assistance.

References

- Ghassemi H. Women and nutrition – issues in need of a global focus. ACC/SCN Nutrition Policy Discussion Paper No. 6. *Women and Nutrition* 1990; **6**: 145–66.
- Norton R. Maternal nutrition during pregnancy as it affects infant growth, development and health. *SCN News* 1994; **11**: 10–4.
- McGanity WJ, Dawson EB, Fogelman A. Embryonic development, pregnancy, and lactation. In: Shils ME, Olson JA, Shike M, eds. *Modern Nutrition in Health and Disease*, 8th ed. London: Lea Febiger, 1994; 705–27.
- Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. *WHO Bull.* 1987; **65**: 663–737.
- United Nations Children's Fund. *The State of the World's Children 1998*. New York: Oxford University Press, 1998; 6–131.
- Government of Tamil Nadu. State programme of action for the child in Tamil Nadu, India. Third draft, 1993
- Bhatia BD, Banerjee D, Agarwal DK, Agarwal KN. Dietary intakes of urban and rural pregnant, lactating and non-pregnant, non-lactating vegetarian women of Varanasi. *Ind. J. Med. Res.* 1981; **74**: 680–7.
- Bhatnagar S, Dharamshaktu NS, Sundaram KR, Seth V. Effect on food supplementation in the last trimester of pregnancy and early post-natal period on maternal weight and infant growth. *Ind. J. Med. Res.* 1983; **77**: 366–72.
- Hira CK, Pathak V, Murgai V. Nutritional status of pregnant Punjabi women in relation to education and economic level. *Ecol. Food Nutr.* 1986; **19**: 147–53.
- Panwar B, Punia D. Nutrient intake of rural pregnant women of Haryana State, Northern India: relationship between income and education. *Int. J. Food Sci. Nutr.* 1998; **49**: 391–5.
- Rao S, Yajnik CS, Kanade A, Fall CHD, Margetts BM, Jackson AA, *et al.* Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune Maternal Nutrition Study. *J. Nutr.* 2001; **131**: 1217–24.
- Ferro-Luzzi GE. Food avoidance of pregnant women in Tamil Nadu. *Ecol. Food Nutr.* 1973; **2**: 259–66.
- Nichter M, Nichter M. The ethnophysiology and folk dietetics of pregnancy: a case study from South India. *Hum. Org.* 1983; **42**: 235–46.
- Nichter M. Cultural dimensions of hot, cold and sema in Sinhalese health culture. *Soc. Sci. Med.* 1987; **25**: 377–87.
- Pool R. Hot and cold as an explanatory model: the example of Bharuch district in Gujarat, India. *Soc. Sci. Med.* 1987; **25**: 389–99.
- Hutter I. *Being Pregnant in Rural South India. Nutrition of Women and Well-being of Children*. Amsterdam: Thesis Publishers, 1994.
- Nielsen BB. *To deliver a small baby is easy, but to save a small baby is difficult: community studies on antenatal care in rural Tamil Nadu, South India*. Ph.D. thesis, University of Aarhus, Denmark, 1998.
- Gopalan C, Rama Satri BV, Balasubramanian SC. *Nutritive Value of Indian Foods*. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research, 1996.
- Dibba B, Weaver LT, Hudson GJ. Water content of cooked rice is related to variety and cooking method. *Nutr. Res.* 1991; **11**: 1397–402.
- Winslow M, Hutchings S, Knight J, Spaulding L. *Winslow's English–Tamil Dictionary*. New Delhi: Asian Educational Service, 1994.
- Gopalan C, Rama Satri BV, Balasubramanian SC. *Nutritive Value of Indian Foods*. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research, 1987.
- Nutrition Foundation of India, 1985. <http://www.nutritionfoundation.org/ARCHIVES/JAN85A.htm>
- Mavalankar DV, Gray RH, Trivedi CR, Parikh VC. Risk factors for small for gestational age birth in Ahmedabad, India. *J. Trop. Pediat.* 1994; **40**: 285–90.
- Piers LS, Shetty PS. Basal metabolic rates of Indian women. *Eur. J. Clin. Nutr.* 1993; **47**: 586–91.
- World Health Organization (WHO). *Energy and Protein Requirements*. Report of a Joint FAO/WHO/UNU Meeting. WHO Technical Report Series. Geneva: WHO, 1985.
- Swaminathan M. Diet and nutrition in India. In: *Principles of Nutrition and Dietetics*, 2nd ed. Bangalore: Bangalore Printing and Publishing Co. Ltd, 1997; 279–85.
- Ferguson EL, Gadowsky SL, Huddle J-M, Cullinan TR, Lehrfeld J, Gibson RS. An interactive 24-hour recall technique for assessing the adequacy of trace mineral intake of rural Malawian women: its advantages and limitations. *Eur. J. Clin. Nutr.* 1995; **49**: 565–78.