

that the nutritional status has been evaluated for the corresponding periods.

The relation between nutrition and fertility can only be explained if the intermediate mechanisms of the relationship have been taken into account. Dietary deficiencies can be considered to intervene in several different ways:

1. by acting directly upon the frequency of sexual relations;
2. by creating a climate favorable to the occurrence and persistence of infectious diseases, which would, in turn, affect the subject's risk of exposure to sexual relations and to conception;
3. by prolonging the period of postpartum amenorrhea, or, indirectly, by shortening the duration of breast-feeding and, therefore, of postpartum amenorrhea;
4. by increasing the risk of spontaneous abortion;
5. by any influence that the mother's nutritional status might have on infant and child mortality which would have a direct repercussion on the birth interval.

Needless to say, any relationship can only hold true in the absence of contraception and of non-nutritionally-caused sterility or infertility.

It should be noted that a less favorable nutritional status can have either a positive or a negative effect on fertility according to the intermediate mechanism invoked. While the first three imply a lengthening of the interval between conceptions, the fourth tends to shorten it; however, in all of these cases, the interval between live births would be lengthened. The fifth, on the other hand, would imply the shortening of the birth interval and, consequently, an increase in fertility.

Among the different lines of reasoning suggested above, there is one which would appear to be particularly interesting to pursue: that is, to compare, for different nutritional levels, the length of postpartum amenorrhea, which is an essential factor in determining the birth interval under the conditions we have in mind. It has been found that the length of postpartum amenorrhea after a stillbirth or the death of an infant in its first week remains approximately the same, that is 40-60 days, in observations based on what is probably a wide range of nutritional situations (1). Prolonged breastfeeding, bringing with it increased nutritional needs, would tend to cause more noticeable differences in length of amenorrhea.

Pole 4

IBISCUS BDR 0683

Extrait de Nutrition and Human Reproduction  
 Edited by W. Henry Mosley  
 Plenum Press, New York, 1978.

23.0687

THE INFLUENCE OF NUTRITION ON FERTILITY  
 U.S.T.O.M. Fonds Documentaire  
 THE CASE OF SENEGAL  
 N°: 21267

Cpte B 83 M

Pierre Cantrelle and Benoit Ferry

Office de la Recherche Scientifique et Technique

Outre-mer, Paris, France

#### INTRODUCTION: THE THEORETICAL FRAMEWORK

We can consider the relationship between nutrition and fertility as having a double direction: numerous or closely-spaced pregnancies can have an effect upon the nutritional status of the mother; and, conversely, the woman's nutritional status can have an effect upon her risk of conceiving and upon the outcome of the pregnancy. We will limit ourselves here to the latter case, that is, the influence of nutrition upon fertility.

In order to identify the relationships that may exist between two factors, both a careful description of the factors and a specification of the analytical framework are necessary. Nutrition can be assessed directly or indirectly: directly, by the nutritional status of an individual, measured according to clinical, anthropometric or biochemical criteria; indirectly, by consumption, rarely determinable on an individual level because of measurement difficulties, and therefore most often measured at the household level, and, less precisely, by measuring production and the flow of foodstuffs at the level of the overall population.

As far as fertility is concerned, different measures are applicable: at the individual level, measures based on number of children, at any given age, or on birth intervals; at the global level, measures of current fertility rates. It should be clear that the actual number of children is a result of a past situation and therefore cannot be related to the present nutritional status. On the other hand, birth intervals are a good indicator, provided

B 21267

the afflicted regions are, unfortunately, few and far between. Observations have, however, been carried out over a 10-year period in an area situated at the edge of the zone touched by the drought. This area is composed of a group of villages surrounding Ngayorhem, in the Sine region. A multiple-round survey carried out annually from 1963 to 1972 permitted the keeping of a population register, and thus the entire population of the villages (about 4400 inhabitants) was the object of follow-up observation (2,3).

The series of data on rainfall, natality, infant mortality and child mortality (1-3 years) are presented in parallel in Table 1 and illustrate the precariousness of this approach to the subject. We do not have at our disposal data on variations in food production and even less on variations in consumption. The indicator tied here to production is rainfall. The recent years of marked drought in Africa have been 1968, 1970 and 1972, with the subsistence crisis being felt especially in the years following the bad harvest, i.e., in 1969, 1971 and 1973. But measures of rainfall are not available for 1968; in addition, the small size of the demographic sample diminishes the significance of the results.

As far as natality is concerned, a drop from 55 to 43 per thousand can be noted after the dry year of 1968; but this rate of 43 does not seem to be exceptional, and there is no significant drop after the dry year of 1970. In addition, we should emphasize that a household's expectation of a subsistence crisis following upon a bad harvest can have an effect on its fertility behavior, without the actual nutritional status coming into cause. On the other hand, it is probable that the highest mortality observed during the famine of 1969 (infant mortality of 388 per thousand and child mortality of 246 per thousand) is closely related to the food crisis.

#### Breastfeeding, Amenorrhea, and Nutrition

Two other surveys offer somewhat more solid data about the nutrition-fertility relationship by taking into account the variables of postpartum amenorrhea and breastfeeding. In the first survey, observations were carried out on three groups of about 700 women, one an urban group in Pikine, suburb of Dakar, one semi-urban in Khombole, a small market town located 100 km from Dakar, and one rural, in villages of the arrondissement of Thienaba, neighboring the locality of Khombole.

The method followed is of the same type as described above, i.e., longitudinal observations, by even more frequent rounds, every four months, but only over a two-year period (1968-69). At

It is rare to have available at the same time data on nutrition and fertility, as well as on the intermediate variables, and this is even rarer on the individual level. Detailed data exist, to be sure, but, for the most part, they relate only to one element of the relationship: often nutritional surveys will include numerous parameters but none on fertility; and, conversely, fertility surveys most often have no nutrition input. This state of affairs is due to the generally different aims of these respective types of study, as well as to the research teams in charge of carrying them out. To this can be added the constraints imposed by comparing different sample sizes.

#### THE CASE OF SENEGAL

The case of Senegal is, no doubt, not an exceptional one in respect to data limitations and will thus be taken here as an example. We will first briefly discuss the various possible sources of data and indicate which seem to be the most solid.

#### National and Regional Survey Data

Several nationwide surveys were carried out at about the same time, some providing fertility levels (1960-61) and others nutritional levels (GINAM survey 1960). However, the results of the demographic survey were unreliable and the size of the sample in the nutritional survey only provided average indications (clinical and anthropometric) at the regional level; a correlation at this level (seven regions) would, therefore, hardly be worthwhile.

Let us cite as an example a regional survey in the Senegal river valley (MISOES 1957-58), practically the only multiple-objective survey in Senegal, during which observations were made, for the same period and on the same samples, on demography, budgets, consumption, production, and health status. In this case, however, the nutritional investigation, which was clinical and anthropometric, was only carried out on children of less than 15 years, and not on the women. It is still possible, then, to set up a comparison of the different fertility levels according to different categories for which food consumption levels have been calculated, but the data were not tabulated with this in mind, and it is doubtful that we could go back to the original archives.

#### Longitudinal Surveys

It is known that the exceptional Sahelian drought of recent years affected parts of Senegal, but precise demographic data for

Table 2

Comparison of Fertility Related Variables in  
an Urban Setting, Dakar, Senegal.

	Dakar-Pikine 1968 (Months)	Whole Dakar 1972 (4) (Months)
Breastfeeding mean	18.9	18.9
median	19.3	17.6
Postpartum amenorrhea	12.3	9.8
Mean birth interval	32.5	31.8
Mean age at menarche	14.5 years	14.3 years

Table 3

Comparison of Fertility Related Variables  
in Rural Settings, Senegal

	Thienaba 1968-69 (Months)	Sine 1963-68 (Months)	Saloum 1963-68 (Months)
Breastfeeding mean	23.2	24.3	24.5
median	23.7	24.8	24.3
Mean birth interval	32.6	30.9	31.3

If we now compare the three samples, urban, semi-urban and rural, observed according to the same methodology, we notice appreciable differences from one milieu to the other (Table 4). The difference between the median lengths of breastfeeding and amenorrhea is slightly greater in the urban than the rural setting, 6.9 months as against 5.8 months. In other words, the length of amenorrhea is relatively longer in the rural setting. This difference is somewhat longer in the Dakar survey, where it reaches 7.6 months (Table 2).

Table 5 relates the duration of amenorrhea to the length of

each round, the female investigators took note of the situation with regard to breastfeeding, amenorrhea and postpartum abstinence.

The second survey (4) was carried out in 1972 on an urban sample, representative of the whole of the city of Dakar. The national demographic survey provided the basis for the sample of 1460 women. In a retrospective interview each woman was asked questions about the length of breastfeeding and postpartum amenorrhea corresponding to her last childbirth.

While these two surveys contribute precise data on fertility in the form of information on birth intervals, postpartum amenorrhea and breastfeeding, their objective was not centered on the nutrition-fertility relationship. Thus, there were no observations on the nutrition or health status of the mothers. Nevertheless, certain global data on the nutrition of the populations in the areas concerned can be used.

A comparison between the two urban surveys (Table 2) shows a rather close concordance of fertility related variables. This is also the case for the rural zone (Table 3). The area of Thienaba, whose inhabitants belong to the Wolof and Serer ethnic groups, compares similarly with other rural observations made in 1963-68 in the Sine-Saloum region which were carried out, to a great extent, on the same ethnic groups. These similarities in results increase the credibility of the studies.

Table 1

Observations in Rural Ngayorhem,  
Sine Region, Senegal, 1962-1972.

Year	Rainfall (mm)	Birth Rate (per 1000)	Infant Mortality (per 1000)	Child Mortality Rate 1-3 Years (per 1000)
1962	485	---	---	---
1963	740	51	206	119
1964	850	52	366	173
1965	562	45	193	144
1966	807	49	341	162
1967	729	44	194	70
1968	---	55	192	81
1969	742	43	388	246
1970	422	54	194	113
1971	681	50	---	---
1972	227	52	---	---

breastfeeding. This also reveals the tendency towards a relative lengthening of postpartum amenorrhoea for a given length of breastfeeding when passing from an urban to a rural environment.

What is the situation relating to nutritional levels in these respective settings? The clinical data are too heterogeneous to have much comparative value. For Dakar, the report of the Medina Center for Maternal and Child Health, the most important of the city, indicates that the proportion of cases of kwashiorkor noted among the patients between 1969 and 1972 was, year by year, 0.3, 0.4, 0.1, 0.5 and 0.4%, while in one of the villages in the rural sample, M'Bourwaye, only 1% was noted in 1965 and none in 1966 (5).

Measures on food consumption, on the other hand, are more precise. A balance sheet done for all of Senegal in 1974 (6) shows an appreciable difference between urban and rural settings (Table 6). Per capita calorie and protein intake appears higher in urban areas, as does the proportion of animal proteins in the diet, even though the theoretical needs are, no doubt, very similar in the two settings. However, these are only estimates based on an evaluation of available food supplies.

Again for the city of Dakar, a budget sample survey carried out in March 1974 (7) gives only the monetary value of the products consumed, and the quantities consumed are estimated from a price list (6): 2594 calories and 71.9 grams of protein per person and per day, figures which agree with the evaluation for urban areas previously mentioned.

In the semi-urban area under consideration, Khombole, a nutritional sample survey was carried out in early 1967, covering 56 households (512 persons) (8). This was a survey done by weighing foods for four days in each household and was carried out by investigators under the supervision of a doctor/nutritionist. In the rural setting, a nutritional survey was also made in one of the villages, M'Bourwaye, on the same sample used for the fertility survey (5). This, too, was a weighing survey for five days in each household, carried out in 1965 and then one year later, in 1966, in the same households. Table 7 gives the results of these observations in Khombole and M'Bourwaye.

In spite of the interest of weighing surveys in evaluating consumption levels, their limits are apparent in the present case, for they are confined to a particular moment of time, whereas important seasonal variations exist in the rural milieu, as is shown by the results (Table 8) of a 1958 survey in three villages located 30 km from M'Bourwaye, in the Sine region (9). In addition, the period of the fertility survey and that of the nutrition survey do not coincide, thus limiting even further the implications of their conclusions.

Table 4

Comparison of Fertility in Related Variables in Three Different Settings of Senegal 1968-69

	Urban Dakar-Pikine (Months)	Semi-Urban Khombol (Months)	Rural Thienaba (Months)
Breastfeeding mean	18.9	19.7	23.2
median	19.3	19.9	23.7
S.D.	4.3	3.8	3.8
Complete breast- feeding mean	7.4	5.7	6.1
PP Amenorrhoea mean	12.3	15.4	17.3
median	12.4	14.4	17.9
Differences between medians	6.9	5.5	5.8
Correlation (r) between breastfeeding and amenorrhoea	0.34	0.32	0.29

Table 5

Mean Duration of Postpartum Amenorrhoea by Duration of Breastfeeding in Three Different Settings of Senegal

Breast Feeding Duration (Months)	Whole Daker *		Dakar Pikine		Khombole		Thienabe	
	Months	N	Months	N	Months	N	Months	N
1-8	3.8	17	4.2	9		2		-
9-14	6.1	53	7.8	24	12.8	13		3
15-20	10.6	367	11.8	180	14.4	164	15.2	44
21-26	13.2	154	16.1	80	16.6	111	18.5	160
26 +			17.9	11	18.9	5	20.0	38
			12.3	304	15.4	295	17.3	275

\* The categories of breastfeeding duration are not exactly the same, 1-9, 10-14, 15-19, 20-24 months.



236, 1974.

3. Waltisperger, D. Le fichier de population de N'Gayokheme (Sénégal). Analyse des données 1963-70. ORSTOM, Centre de Dakar, 109 p., 1974.
4. Ferry, B. Données récentes sur la fécondité à Dakar (Sénégal). Population, 717-722, 1976.
5. Larivière, M., Cros, J., Debroye, A., Diallo, S. Anémie, parasitose intestinale et nutrition. In: Conditions de vie de l'enfant en milieu rural en Afrique. Centre International de l'Enfance, Paris, 201-205, 1968.
6. Anonyme - Rapport de mission. Travaux de groupe mixte Sénégal/FAO. Rome, Sept.-Oct. Ministère de Plan et de la Coopération, CANAS, Dakar, multigr., 1976.
7. Anonyme - Etude: budget consommation. II-Enquête budgets familiaux. Université de Dakar, Institut Universitaire de Technologie, Division tertiaire, Juin 1976.
8. Cros, J., Quenum, C. Enquête alimentaire à Khombole (Sénégal) Janvier-Avril 1967. Bull. Soc. Med. Afr. Noire (langue fr.), 70-78, 1968.
9. Hellegouarch, R., Giorgi, R., Monjour, L. and Toury, J. Enquête de consommation alimentaire dans une zone pilote du Sénégal (1968). ORANA, Dakar, 1970, 22 p. multigr.