Infant Mortality and Birth Intervals

ANNE RETEL-LAURENTIN AND DANIEL BENOÎT

The results presented in this paper are derived from a medico-demographic survey carried out by Dr Retel-Laurentin in nine villages inhabited by the Bobo-Oulé. The object of the survey, which was carried out in 1971, was to discover the reasons for the low fertility in this group in the West of Upper Volta.

THE SURVEY

It was intended to trace the reproductive histories of all the women in the villages. We hoped that an offer of a medical examination and consequent treatment for any conditions discovered during the examination would lead to the creation of a climate of confidence between the author and the women who were examined, and that accurate information about the outcome of previous pregnancies, including those which ended in abortion, premature birth or stillbirth could thus be obtained.

This aim was achieved. There was not a single refusal to attend; all those invited to come attended for the medical examination. On the first visit, the women were asked to state the number of children they had borne: this information was checked against the census schedule for the village and, where possible, against vital registration data. Where this was not possible, the information was checked against the known ages of other children in the same village. This list was then checked with the woman concerned, and she was then examined by the author, who was accompanied by a Bobo-Oulé midwife. After the medical examination had been completed in her house the woman was asked questions about any abortions or stillbirths she had had. If she seemed reluctant to answer questions on these topics the subject was taken up again a day or two later when medical treatment was given. Once confidence had been established, many women confessed that they had not originally meant to supply this information. This is not surprising, because it is the norm in the local culture to keep knowledge about abortions from others. Even older women, or women living in the same family compound are not called in when a pregnancy ends before the foetus has become visible. As a result of this many women tend to suffer from the sequelae of miscarriages, even a long time after these originally occurred.

Although this method of obtaining information is expensive in time, very consistent results relating to fertility are obtained (except for women who were over 70 years old at the time of the survey), and it would seem that respondents had a good recall of the outcomes of previous pregnancies.

The villages selected were in three different regions. Moko, a village in an area well known for its high fertility, served as a control. The other two village groups seemed to exhibit average conditions for low-fertility areas during the last census. However, during the course of the survey it appeared that Karba, the second area which was near to Houndé, had benefited considerably as a result of the campaign for the introduction of penicillin in 1955–56. This campaign had not, however, penetrated into the third rural area, because this was some 15 kilometres distant from the health centre.

The analysis showed that there was a clear correlation between fertility levels and the prevalence of venereal disease, particularly syphilis.[1]

[1] Cf. *Population*, **28**, 1973. Nos. 4–3, pp. 793–815. A. Retel-Laurentin, 'Fécondité et syphilis dans la région de la Volta-Noire'.

Population Studies, **30**, 2. Printed in Great Britain

TABLE 1. *General results from the 1971 survey*

	Region 1 Moko	Region 2 Karba	Region 3 Rural zone
General fertility (per 1,000 women aged 15–49)	236	166	134
Per cent with syphilis[2]	8·3	18·4	31·5
Per cent 50 and over childless	7·2	21·6	28·6
Per cent abortions and stillbirths: 45 and over	18·8	23·0	24·1
All ages	22·2	33·4	31·0

The high quality of the information obtained to some extent compensates for the smallness of the sample. In this paper we present information relating to infant and child mortality and to birth intervals in the three areas, based on a total of 2,263 pregnancies reported by respondents.

Clearly, in the absence of reliable vital registration, information on the dates when the pregnancies and infant deaths occurred is liable to error. In particular, we noted a tendency to bring forward in time events which had actually occurred in the more distant past. We used two checks to correct this tendency: first, a comparison of results relating to events which occurred during the past five years with those occurring more than five years previously; and, secondly, a special analysis of vital events taking place in 1972, twelve months after the first survey, in order to see whether any difference could be seen.[3]

The second check proved possible, because 67 pregnancies of six weeks' duration or longer had been diagnosed during the previous year by medical examination and pregnancy testing. Nurses and midwives were able to check on the outcome of these pregnancies. Thus, the fall in the number of miscarriages found in 1972 is likely to be real. In 1971, 580 pregnancies were reported to have ended either in miscarriage or stillbirth, i.e. 30 per cent of the total. In 1972, the proportion was only 14·5 per cent, a reduction which was noticed by the inhabitants of Moko themselves, who spontaneously mentioned this decline to the interviewers. The proportion of stillbirths and premature births (11·5 per cent) had increased slightly, but this increase had occurred mainly in Karba and in the rural areas.

Overall, the maternity and child welfare services which were provided as a by-product of the survey had a beneficial effect on the outcome of pregnancies, particularly in Moko.

Thus, in spite of the smallness of the sample, it proved possible to obtain useful information on intra-uterine mortality in a rural area.

I. INFANT MORTALITY

1. *Mortality rates*

The infant mortality ratio for deaths occurring during the five years immediately preceding the survey was significantly different from that applying to deaths occurring more than five years previously. (The difference was significant at the one per cent level, when tested by the chi-square test.) As events occurring in the more remote past are more likely to be forgotten, it may be regarded as an established fact that infant mortality has been declining.

[2] As diagnosed by Nelson's test and by immunofluorescence.

[3] Fertility rates for 1972 were affected by the provision of medical care and differed from those for the two previous years. Overall fertility was high at 199. It was 315 in Moko and 158 in Karba, though in the latter area more women were pregnant than gave birth during the year. In the rural area, the rate was 1/3 and eleven women were pregnant, six of whom had previously been unable to conceive following abortion.

TABLE 2. *Mortality rates by age and period of observation*

Age of Child	Date of occurrence	
	1966–71 (Within previous five years)	Before 1966 (More than five years previously)
0–1 years	0·157	0·245
1–3 years[4]	0·126	0·127

There are, however, two reasons for believing that the fall in mortality has not been confined to the first year of life. First, respondents tended to underestimate the age at death of the children they had lost, particularly when the death had taken place some time previously (Cf. Table 3). This transfer of deaths from the older to the younger age groups tends to increase the registered mortality in the first year of life relatively to that of the next higher age group. It would, thus, be reasonable to conclude that mortality has also declined in the age group 1–4 years.[5] This conclusion is supported by the fact that the infant mortality rate found in a demographic survey in the Western region of Upper Volta in 1960–61 amounted to 163 per thousand. This value is very close to that found among the Bobo-Oulé during the last five years.

In part these declines may be attributed to the increase in the number of local dispensaries which have recently been opened and to an increased use of antibiotics. To illustrate: when one day I was short of drugs, I asked the village chief whether it would be possible to borrow some for a serious case of illness. Shortly afterwards, some villagers appeared and gave me packs of penicillin, some of which, admittedly, were too old to be effective. They said that they kept these supplies in order to have them available for urgent cases.

2. *Causes of death*

The analysis of cause-specific mortality is based on answers given by the respondents, diagnosis being controlled by the physician from a description of the symptoms. Rates for the three regions in which differential fertility was studied were compared (Table 3). A comparison of the causes of deaths which took place more recently with those taking place earlier (Table 4) gives an indication of the nature of the differences.

[4] As the numbers aged four were very small in the case of deaths taking place less than five years previously (47 cases), no rates were calculated for that age.

[5] A comparison between observations relating to the recent past and those relating to earlier periods shows two changes. First, the proportion of deaths reported to be taking place on the first day of life has increased among deaths reported to be taking place within the first month. This transfer is probably due to the delay in naming the child. As in other African countries, the Bobo-Oulé do not give a name to a sick child until eight days after its birth: they wait until it has either died or recovered. Similarly, the number of deaths at ages under twelve months increases relatively to those taking place at ages 1–4 years, no doubt because the distinction between these two groups is marked by weaning.

Age at Death	Deaths occurring			
	Within last five years		More than five years previously	
	Number	Per Cent	Number	Per Cent
Less than 1 day	5	1·6	61	4·5
1 to 30 days	18	5·8	134	9·8
1 to 11 months	22	7·2	140	10·3
1 to 4 years	22	7·2	145	10·5
Total under 4 years	67	21·8	480	34·9
Survivors 0–4 years	480	100·0	1374	100·0

The total number of infant deaths, amounting to 380 cases, may be divided into the two following large groups (Table 4).

(a) *Peri-natal mortality.* (Mortality during the first 24 hours of life.)

There were 66 such deaths, or 17·5 per cent of the total, of which 25 were premature births, including five who 'died immediately after birth'; twelve cases of birth injuries or 'macerated' children, the latter possibly being due to syphilis (nine of these were found in the third region where syphilis was most prevalent); eight cases of difficult labour, one of malformations and 20 where the cause of death was unknown.

In the third region, where the incidence of disease was highest (syphilis, rickettsial diseases, goitre and bilharzia), the proportion of deaths taking place very soon after birth was highest (see Table 3). But once the peak mortality of the immediate period after birth was past, the proportion of other deaths was highest in the first region, even if allowance is made for the tendency to understate the age at death.

TABLE 3. *Distribution of deaths during the first year of life*

Age at Death	Region 1	Region 2	Region 3	Total
0–1 day	16	22	28	66
1 day to 1 month	35	48	24	107
1 to 11 months	93	64	50	207
Total under 1 year	144	134	102	380
1 to 4 Years	72	58	40	170
Total 0–4 years	216	192	142	550
Per cent 0–7 days	7·4	11·5	20·0	12·0

(b) *Mortality after the first day of life but before the first birthday*

There were altogether 314 such cases, among which tetanus was by far the most common cause of death. 133 deaths, or 35 per cent of all deaths during the first year of life, were attributed to this cause. The most common period when these deaths took place was at the end of the first week of life (91 cases). It is possible that some deaths which were due to tetanus may have been wrongly assigned to other causes, such as meningitis or encephalitis, of which 17 cases were reported. However, tetanus which the natives call 'bird disease' is a precise nosological concept and well recognized, no doubt in view of the frequency of its occurrence. The Bobo-Oulé diagnose this disease by noting, as Western doctors do, that the child's jaws contract when it attempts to suckle. This characteristic sign which is called trismus is the prelude to muscular spasms which, at a later stage, affect the whole body. The incidence of this disease is high in some villages, but it barely exists in others. In Karba (Region 2) we noted 52 deaths from tetanus during the first year of life (40·6 per cent of all deaths in that age group) and seven deaths at ages 1–4. In Ouankan, a small village in the third region which is close to Karba, twelve out of a total of 22 deaths were due to this cause. The incidence is also high in the village of Moko in the control area, 55 deaths or 38·3 per cent of the total in the age group 0–1 were assigned to this cause.

In other villages this cause of death is exceptional. However, it is well established in general epidemiology that there may be considerable geographical variations in the incidence of a disease. Tetanus is common in some villages and rare in others, even where the presence of horses might be thought to increase the risk. Moreover, the custom of the Bobo-Oulé of rubbing the umbilical cord with soil is likely to increase the risk of contracting tetanus. As the number of maternities increases, the number of deaths from tetanus does not fall appreciably:

TABLE 4. *Number of deaths at ages 0 to 4, by cause and region*

Cause	All regions				All deaths aged 0–4			
	Under 1 Year		1 to 4 Years		Moko Region 1	Karba Region 2	Rural Area Region 3	Total
	No.	Per Cent	No.	Per Cent	No.	No.	No.	No.
1. Tetanus	133	35·0	9	5·4	60	59	23	142
2. Diarrhoea and Vomiting	41	10·5	57	34·3	49	29	20	98
3. Fevers	37	9·8	17	10·3	28	16	10	54
4. Meningitis	17	4·5	10	6·0	17	7	3	27
5. Pulmonary Disease	21	5·5	3	1·8	2	10	12	24
*6. Epidemic Diseases	10	2·6	27	16·3	26	6	5	37
7. Infections, Sores	10	2·6	7	4·2	4	6	7	17
8. Sudden Deaths and Accidents	9	2·6	6	3·6	4	7	4	15
†9. Sequelae of Birth: Diseases of Foetus	21	5·5	—	0·0	3	5	13	21
10. Prematurity	25	6·6	—	0·0	11	8	6	25
11. Ill-defined Causes	56	14·8	30	18·1	11	40	35	86
Total	380	100·0	166	100·0	215	193	138	546

* In order of frequency: measles, smallpox.
† E.g. injured, oedema of newborn, one case of malformation.

14 cases were noted during the five years preceding the survey, amounting to 21 per cent of all deaths. The persistence of this disease suggests that there is need to educate the native population in the care and hygiene of the newborn and to intensify the programme of immunization.

The other principal causes of infant mortality are (in decreasing order of importance):

Diarrhoea and vomiting: 41 deaths or 10·5 per cent of the total, six of which are linked to malnutrition and kwashiorkor:

Fevers: 37 deaths, or 9·8 per cent of the total: some of these deaths are linked to malaria.

Pulmonary Diseases: 21 deaths, or 5·5 per cent of the total.

TABLE 5. *All deaths between the ages of 0 and 4 years. Comparison of causes of death taking place within the last five years with those taking place earlier*

Cause of Death	Deaths occurring between 1967 and 1971		Deaths occurring before 1967		Total	Difference
	Number	Per Cent	Number	Per Cent		
1. Tetanus	14	21·2	128	26·7	142	−5·5
2. Diarrhoea and Vomiting	13	19·7	85	17·7	98	+2·0
3. Fevers	2	3·0	52	10·8	94	−7·8
4. Meningitis	2	3·0	24	5·0	26	−2·0
5. Pulmonary Disease	5	7·6	20	4·2	25	+3·4
6. Epidemic Diseases	10	15·2	27	5·6	37	+9·6
7. Infectious Diseases, Sores	4	6·1	13	2·7	17	+3·4
8. Accidents	—	0·0	15	3·1	15	−3·1
9. Peri-natal Deaths	7	10·6	38	8·1	46	+2·5
10. Indeterminate Causes	9	13·6	77	16·1	86	−2·2
Total	66	100·0	480	100·0	546	—

Meningitis and Convulsions: 17 deaths, or 4·5 per cent of the total.

Skin Diseases and Epidemic Diseases: 20 deaths, or 5·5 per cent of the total.

Sudden and Accidental Deaths: nine deaths, or 2·6 per cent of the total. Two of these deaths are due to the curious custom of giving the infant lukewarm or cold water to drink, either by nose or by mouth.

In 56 cases, or 14·8 per cent of the total, the cause of death was ill-defined or unknown. In these cases the parents either did not note the symptoms, or the physician was unable to determine the cause of death from their description of the symptoms. Less frequently, the parents' answer was: 'I don't know'.

In Table 5 we compare the causes of recent deaths (those taking place within the last five years) with those taking place earlier. This table demonstrates both the persistence of the two major causes of death (tetanus and diseases of the digestive system) as well as the fluctuations in mortality. Among the earlier deaths, fevers seem to have been more important than epidemic diseases. However, the frequency of epidemics will vary over time, and fevers (which include malaria) may have become relatively less important as a result of the measures that have been taken to improve maternity and child welfare.

(c) *Deaths taking place between* 1 *and* 4 *years of age* (Table 4)

The risks of death change after the child has passed its first birthday. Between the ages of 1 and 4, tetanus is a much less frequent cause of death than in the first year of life (nine deaths, or 5·4 per cent of the total, as against 35 per cent among infant deaths). Diarrhoea and vomiting, on the other hand, becomes the most important cause (57 deaths, or 34·3 per cent in the 1–4 year group, against 40 deaths or 10·6 per cent of the total among infants). In the same way, deaths from epidemic diseases which are relatively infrequent during the first year of life are second in order of importance among deaths occurring in the next age group (2·6 per cent under one year, 16·3 in the second age group).

3. *The Demographic Point of View*

In spite of the significant change in mortality among births taking place before 1967 and those occurring in 1967 and later, the two groups have been amalgamated, in order to increase the

TABLE 6. *Life table for all areas*

	Children born in 1967–71 (Within last five years)			Before 1967 (More than five years ago)			All		
	l_x	d_x	q_x	l_x	d_x	q_x	l_x	d_x	q_x
0–5 months	1000	106	0·106	1000	184	0·184	1000	171	0·171
6–11 months	894	51	0·057	816	61	0·075	829	60	0·072
1 year	843	40	0·048	755	43	0·057	769	42	0·055
2 years	803	47	0·059	712	33	0·047	727	36	0·049
3 years	756	19	0·025	679	20	0·029	691	20	0·029
4 years	737	67	0·091*	659	9	0·014	671	11	0·017
5 years	670			650			660		
$_2q_0$			0·157			0·245			0·231
$_2q_1$			0·126			0·127			0·127
$_3q_1$			0·205			0·139			0·149
$_4q_0$			0·263			0·341			0·329
No. of live births			307			1374			1684

* 47 cases only.

TABLE 7. *Differential mortality between regions*

	Region 1	Region 2	Region 3
$_1q_0$	0·276	0·223	0·191
$_3q_1$	0·203	0·129	0·102

number of observations, and to make it possible to compare the mortality of the three areas (Table 7). The bias is the same in each area.

When we compare the mortalities of the three zones, we note differences. The first region exhibits the highest mortality, higher than that for Upper Volta as a whole.

When tested by the χ^2-test, the differences in the value of $_1q_0$ are significant at the two per cent level, and those in the value of $_3q_1$ at the 0·1 per cent level.

Children in the first (control) region therefore suffer a high mortality not only during their first year of life but also during the next three years. This observation differs from trends

TABLE 8. *Mortality by regions*

Age	All causes			All causes, except tetanus			All causes, except epidemic diseases		
	l_x	d_x	q_x	l_x	d_x	q_x	l_x	d_x	q_x
Region 1. Moko (524 live births)									
0–5 months	1000	192	0·192	1000	92	0·092	1000	190	0·190
6–11 months	808	84	0·104	908	86	0·095	810	74	0·092
1 year	724	53	0·074						
2 years	671	51	0·076						
3 years	620	30	0·048	822	164	0·200	736	110	0·150
4 years	590	13	0·023						
5 years	577			658			626		
$_1q_0$			0·276			0·178			0·264
$_3q_1$			0·203			0·200			0·150
Region 2. Karba (621 live births)									
0–5 months	1000	173	0·173	1000	91	0·091	1000	170	0·170
6–11 months	827	50	0·060	909	53	0·058	830	48	0·058
1 year	777	54	0·070						
2 years	723	23	0·032						
3 years	700	18	0·026	856	99	0·116	782	91	0·117
4 years	682	5	0·008						
5 years	677			757			691		
$_1q_0$			0·223			0·144			0·218
$_3q_1$			0·129			0·116			0·117
Region 3. Rural Areas (537 live births)									
0–5 months	1000	147	0·147	1000	114	0·114	1000	147	0·147
6–11 months	853	44	0·052	886	40	0·045	853	40	0·047
1 year	809	23	0·029						
2 years	786	33	0·042						
3 years	753	11	0·015	846	82	0·097	813	76	0·093
4 years	742	16	0·022						
5 years	726			764			737		
$_1q_0$			0·191			0·154			0·187
$_3q_1$			0·102			0·097			0·093

Probability of death from tetanus alone

	Region 1	Region 2	Region 3
0–5 months	0·110	0·088	0·035
5–11 months	0·009	0·002	0·007
1–4 years	0·002	0·013	0·005

TABLE 9. *Death rates when mortality from certain causes is eliminated*

	Causes excluded	Region 1	Region 2	Region 3
0–11 months	Tetanus	0·178	0·144	0·154
1–4 years		0·200	0·116	0·097
0–11 months	Epidemic	0·264	0·218	0·187
1–4 years	disease	0·150	0·117	0·093

observed elsewhere in Africa. But, in the INSEE publication *Démographie comparée* it is shown that many countries with high fertility experience relatively low mortality.

Consider the causes of high mortality in a high-fertility country among children during the first five years of life. As is shown in Table 4 there are two predominant causes: tetanus during the first year of life and epidemic diseases during the next four years. But these two causes are more important in Regions 1 and 2 (tetanus is important in Regions 1 and 2 and epidemic diseases in Region 1). It is therefore, interesting to compare regional mortality when the effects of these causes have been eliminated. This is done in Table 9.

(a) *Probability of death when tetanus is eliminated*

After the elimination of deaths due to tetanus the regional differences in the ${}_1q_0$ values are no longer significant. But for the ${}_3q_1$ values the probabilities do not change much and the differences remain significant at the 0·1 per cent level. The high infant mortality of Region 1 is reduced when deaths from tetanus are excluded, but mortality remains high in the age group 1–4.

(b) *Probability of death when epidemic diseases are eliminated*

Epidemic diseases are important causes of death among children aged 1–4. If death rates due to epidemic diseases were eliminated, the difference between regions would remain significant at the five per cent level when tested by the χ^2-test in the age group 1–4, and at the one per cent level for infants.

Thus, the high mortality of the first region is not caused solely by these two predominant causes. Fertility and mortality are positively correlated, except for mortality *in utero*, where the correlation is negative. In other words, high fertility and safe outcome of pregnancies are linked (Table 10). Mortality rates in childhood are, however, directly related to fertility, particularly in the age group 1–4 years. It would seem that an increase in the number of children born leads to an increase in the risk of dying.

However, a careful study of Table 3 shows that this relationship does not hold for neo-natal mortality, which varies inversely with fertility, i.e. directly with the number of abortions. The figures thus give the impression that there is a discontinuity in mortality rates which occurs not immediately at or after birth, but after the first few days of life. This is an important finding. It would seem that among the Bobo-Oulé the risks of foetal death and of death among the newborn are directly related to the causes of infertility, and these are primarily the venereal infections (Table 1).

TABLE 10. *Pregnancies ending in live births*

	Region 1	Region 2	Region 3
Fertility rate per 1000			
Women aged 15–44 years	187	154	132
Live births per 1000 pregnancies	790	750	710

Once the child has survived the two first days after birth, its risk of dying becomes independent of endogenous pathological factors and will depend much more on its environment. But what is to be included under this heading? Population density which increases the risk of contagion? The greater quality of child care, when children are rare and therefore more highly prized? If we except tetanus, excess mortality in the areas of higher fertility seems to be caused primarily by the three following causes: epidemic diseases, meningitis and diseases of the digestive system. High mortality from these causes is not compensated by the lower frequency of deaths from infectious or pulmonary disease. This would indicate that the greater danger of contagion, rather than lack of care, is the primary cause (Table 4). It is also possible that miscarriages operate selectively[6] and are particularly frequent in areas of lower fertility. These considerations suggest the need for further research with larger samples.

II. BIRTH INTERVALS

There are several reasons for studying birth intervals. For example, if birth intervals were to increase after a couple had had the number of children they desired, this might suggest the practice of family planning. This does not seem to occur among the Bobo-Oulé, where, on the contrary, birth intervals seem to decrease after the fifth pregnancy.

TABLE 11. *Birth intervals by parity*

Parity	1–2	2–3	3–4	4–5	5–6	6–7	7 and over	Total
Interval in months	33·8	36·8	33·2	34·6	32·5	32·7	32·4	34·1

In an African non-contracepting society, intervals between births seem to be to more closely related to fecundability. All women marry and are exposed to the risk of pregnancy from a young age except during the period immediately following a birth, for sexual relations are not permitted until after the child has been weaned. As in many other African societies, this abstinence increases the probability of survival of the child to whose care the mother devotes herself entirely for a period of a year or more. Some people believe that if they indulge in sexual relations the mother's milk will be poisoned, hence the period of abstinence corresponds to the period of lactation. Others who recognize that the child will be dependent on its mother believe it necessary to abstain from conjugal relations until such time as the child can walk.

[6] The distribution of miscarriages by length of gestation and sex reported by women under 60 years of age have suggested this hypothesis.

Duration of pregnancy at termination	Sex of foetus: Male No	Male %	Female No	Female %	Unknown No	Unknown %	Total No	Total %
4½ to 5½ months	20	31·3	39	60·9	5	7·8	64	100·0
6 to 7 months	25	34·7	42	58·3	5	6·9	72	100·0
7½ to 8½ months	33	44·6	39	52·7	2	2·7	74	100·0
All	78	37·1	120	57·1	12	5·8	210	100·0

Thus, female foetuses seem to be at lower risk of being miscarried before 7½ months' duration of pregnancy.

We shall attempt to estimate the length of the period of abstinence by analysing the distribution of birth intervals in the three regions. Though the number in the sample is small, we would stress again that the information given is likely to be accurate, because the attempt to make a medical survey roused considerable interest among the respondents and permitted an insistence on accurate replies. Moreover, the second round of interviews which took place in 1972 made it possible to check on the accuracy of the information that was given earlier.

1. *Data relating to the Bobo-Oulé*

As a first step, cases of stillbirth or neo-natal death have been eliminated from the analysis as there is no period of abstinence from sexual relations in such cases. In the five years preceding the survey, the mean interval between successive live births comes out at 36 months, which appears very high.

TABLE 12. *Mean birth intervals*

Period of birth	Region 1 Moko	Region 2 Karba	Region 3 Rural Areas	Total
0–5 years before 1971	35·7	37·3	35·3	36·2
1971–72	32·6	39·3	35·6	35·8

2. *Factors making for variation in intervals*

As a second step, if all the cases in which there is a miscarriage or other accidental termination of pregnancy between two successive live births are excluded, the mean birth intervals are reduced (Tables 12 and 13). But if we compare the mean birth intervals for women who have had a miscarriage between two live births with those of women who had two successive live births, it will become apparent that the influence of miscarriage on inter-birth intervals is more complex than would appear at first sight.

TABLE 13. *Birth interval between two successive live births (excluding women who had a miscarriage between two live births)*

Last birth in	Region 1 Moko	Region 2 Karba	Region 3 Rural Areas	Total
1966–71	32·5	35·2	34·8	34·1
1971–72	27·2	34·2	35·6	32·4
Difference	−5·3	−1·0	+0·8	−1·7

Abortions play an important part in lengthening inter-birth intervals: between 1966 and 1971 the interval was increased by 2·1 months, and in 1971–72 by 3·4 months.

At first sight, the *number* of miscarriages would seem to be important. The average interval between two live births with a intervening miscarriage is 42 months, i.e. eight months in excess of the interval when there is no miscarriage, for the births of 1966 to 1971.[7] For

[7] After this paper was written we noted that the figure of eight months was also obtained by A. Romaniuk in his study of the James Bay Indians. See: *Revue Canadienne de Sociologie et Anthropologie;* **11** (4), 1974, p. 350.

TABLE 14. *Change in birth intervals when miscarriages between two successive live births are eliminated*

Date of birth	Region 1 Moko	Region 2 Karba	Region 3 Rural Area	Total
0–5 years before 1971	−3·1	−2·1	−0·5	−2·1
1971–72	−5·4	−3·1	0·0	−3·4

births taking place earlier, the intervals between live births in which there is an intervening miscarriage rises to 47½ months, but this very long interval is due to the existence of repeated miscarriages.[8] Where two live births are separated by a stillbirth the mean birth interval becomes 4½ years. This is the reason why birth intervals are shortest in the most fertile region, even though the period of sexual abstinence is the same. But why do miscarriages not affect the mean interval in the third region where miscarriages are most frequent, except in 1972? There are two reasons for this.

In the first place the mean birth interval between successive live births is shorter in 1972 than it was during the preceding five years (Table 13). This is likely to be an accurate reflection of events, for all the births were checked against vital registration data. One explanation could be that the post-natal period of sexual abstinence was reduced in some households.[9]

In the second place, the medical treatment provided as a result of our survey is likely to have affected birth intervals for births taking place in 1972. But the effect of this may have worked in opposite directions. In some cases women conceived as a result of our treatment after having experienced long periods of sterility, in some cases lasting between six and twelve years. In such cases the effect of treatment would have been to increase the length of the birth intervals particularly in Regions 2 and 3, where sterility was widespread. In the first region, on the other hand, there was a high incidence of sequelae of miscarriages and of obstetric complications, and in such cases treatment may have had the opposite effect, i.e. shortened the birth interval. Temporary sterility for pathological reasons, lengthened the mean birth interval, as did miscarriages.

The effects of pathology have also been complex. An examination of our data shows that, in the third region, miscarriages may not have affected birth intervals greatly, for most women who experienced a miscarriage became sterile afterwards (Table 15). Treatment given in 1971 can have had little effect, some women admittedly became pregnant in 1972, but only seven had carried the pregnancy to term in 1972, even though the treatment given was the same as in the other two regions. After previous treatments, some women with reversible sterility as a result of previous miscarriage had been sterile for long periods (up to twelve years), so the probability of successful treatment in recent observations seems to have been small.

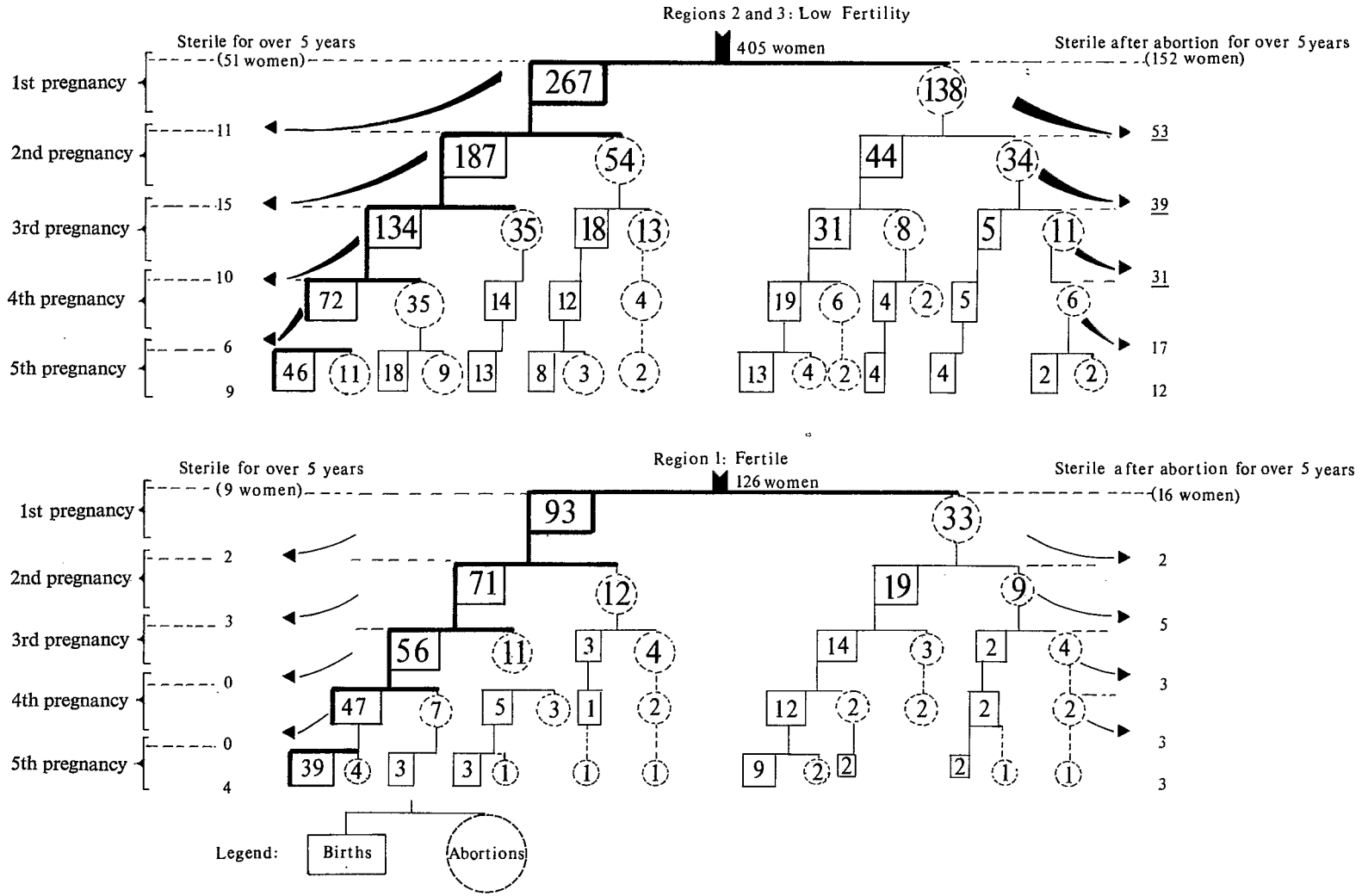
Looking at fluctuations in birth intervals as a whole, it is clear that the figure for the mean birth interval is strongly influenced by the existence of a few long birth intervals. These birth intervals are due to pathological conditions either because miscarriages and premature deaths are not normally mentioned by respondents in demographic surveys provided they do not cause complete sterility, and secondly, by long periods of temporary sterility which can be reversed. The importance of untreated post-abortion sterility in regions with a high prevalence of venereal disease is confirmed by observations I have made among the Nzakara in the Central African Republic.[10] Most of them suffer from gynaecological infections and lesions.

[8] The mean interval between two successive miscarriages is 14·67 months. It is reduced to 11·1 months if cases of overt illness or cases in which there is a change of marriage partners are excluded (5 out of 47). In the latter group the spouse may well be sterile.

[9] However, the miscarriages which often followed the shorter period of abstinence might have had a deterrent effect.

[10] A. Retel-Laurentin, *Infécondité et maladie. Les Nzakara.* INSEE, Collection Rectangle, Paris, 1974.

TABLE 15. *Distribution of abortion by pregnancy order*



As regards the future, we note that abortions have actually almost disappeared in the third region, but that permanent sterility has not been decreasing. This is probably due to the high prevalence of gonorrhoea which is a cause both of male and of female sterility. On the other hand, in the Moko region which we have used as a control region and where fertility is high, the proportion of miscarriages is higher than in the two infertile regions between 1967 and 1971. This leads us to fear that pathological miscarriages, which had been rare in that region up to that time, may become more frequent in the future.

3. *The effect of sterility on birth intervals*

In spite of the small size of our sample, the information we have collected on pregnancies which have not been carried to full term and on the pathology of infertility make it possible to interpret the birth interval data in a manner different from that in previous demographic surveys.

According to Romaniuk, there is a strong correlation in Zaïre between the length of birth intervals and the period during which sexual relations are prohibited after birth: the mean is 34·7 months among the Bandibu, who observe an extended period of abstinence, 27·9 months among the Bashi where the period of abstinence is shorter, and 26·5 months in Kinshasa, where the interdiction on sexual relations after childbirth is much less observed.[11]

Other authors believe that the length of the period of abstinence is not sufficient in itself to explain the existence of long birth intervals. They reason as follows: The observed mean birth interval is close to three years, of this, twelve months may be accounted for by sexual abstinence until the child is walking, and a period of nine months for the duration of the next pregnancy. There is, therefore, an unexplained interval of 15 months, and it is thought that this may be explained by the practice of contraception.

The information we have collected about the Bobo-Oulé suggests a different interpretation. It is not true, as scholars used to believe, that there is a uniform period during which sexual relations are prohibited after childbirth in an African society. The official criterion is that the infant is toddling or that the mother has ceased lactating, but when Bobo-Oulé women with young children are questioned, they report that they resume sexual relations not after a fixed period from the birth of their last child, but within periods ranging from six to 31 months after the birth, with a modal interval of 17–18 months.[12] The average length of abstinence is 17½ months, but there is considerable variation about this mean.

It is true that weaning implies a sharp separation between the mother and her infant, but the resumption of conjugal relations by the mother is only one aspect of this phenomenon. For the infant it means a break in the contact with the mother's breast and body (including contact at night), and a substantial change in the nature of its food. After a child is five months

TABLE 16. *Duration of sexual abstinence after childbirth (112 households)*

Age of Child	Resumption of Conjugal Relations
0–10 months	2 out of 47 households
11–14 months	4 out of 16 households
15–20 months	15 out of 26 households
21–29 months	10 out of 14 households
29 months and over	9 out of 9 households

[11] A. Romaniuk, *Fécondité Congolaise*. Mouton, Paris, 1967, p. 285.

[12] This method of calculation agrees well with estimates obtained from questioning couples whether conjugal relations were resumed before or after the reappearance of menstruation, whilst lactating. Similar findings have been made in other African societies.

old, its breastfeeds are increasingly supplemented by other food, and gradually the mother's milk is of symbolic rather than of nutritional value.[13] What criteria are used in deciding when the infant is to be weaned? In part, it is the child's ability to walk. Between the period when it takes its first steps and the time when it can toddle about without its mother's help, there is a period of several months during which the decision to wean or not to wean is taken.[14]

At that age, breast feeding does not add substantially to the child's nutrition. If the infant is not doing well, however, breast feeding may be continued until the danger to its life has passed. Four couples among the Bobo-Oulé continued abstaining from conjugal relations beyond the 21st month of the child's life for this reason. Moreover, in the sample, the mean duration of amenorrhoea due to lactation is $14\frac{1}{2}$ months, i.e. three months less than the period of sexual abstinence. In this case sub-fecundity due to lactation does not appear to affect the risk of exposure to pregnancy.

As the number of months of exposure to pregnancy has normally been estimated for populations which are healthy, we need to take account of the diseases prevalent in an unprotected population. Among the Bobo-Oulé we need take account of two factors: miscarriages between successive live births, particularly in the first region, and temporary sterility due to pathological conditions in Regions 2 and 3.

TABLE 17. *Hypotheses on the constitution of birth intervals*

	Hypothesis		Bobo-Oulé	
	A	B	Region 1	Regions 2 and 3
A. Mean Observed Birth Interval	36	34·7	35·7	37·5
B. Theoretical Birth Interval	12	12	17	17
Period of Abstinence				
Risk of Exposure	0	6	5	6
Miscarriages	—	—	3·3	1·25
Disease & Change of Partner	—	—	0·3	5·25
Next Pregnancy	9	9	9	9
Total B	21	27	35·8	38·5
Difference A − B	+15	+ 7·7	−0·1	−1·0

The difference A − B is the number of months unexplained.

The period exposed to risk of pregnancy is normally estimated at six months where the mother is not breast feeding. More recent researches suggest that fertilization may occur more often than had been thought, but that nidation of the fertilized ovum is subject to many checks. But the diagnosis of miscarriages during the first 15 days of pregnancy needs complex tests.

Table 17 shows that if allowance is made for these factors the observed intervals correspond well with expectation. In Regions 2 and 3, the observed mean interval is even one month less than would be expected. This may not be unconnected with recent tendencies to reduce the period of sexual abstinence and therefore also the birth intervals. Anyway the data enable us to assert that in this population with low fertility, contraception is not practised.

In conclusion, we would stress that it proved possible in a medical demographic survey taken in an area with little vital registration to engage the interest of respondents and obtain

[13] This accounts for the relative infrequency of breast abscesses among African women.

[14] We have made similar observations among the Nzakara, and M. Hochegger in his thesis 'Norme et Pratiques Sociales chez les Buma (R. du Zaïre)', Paris, 1973, confirms. P. Cantrelle and H. Léridon (*Population Studies* **25**, 3, November, 1971 pp. 503–533) have observed that children dying between the ages of two and three years were weaned later than children who survived. They concluded that breast feeding was extended in the case of children with poor health. However, unfortunately they did not distinguish between periods when the child was entirely breastfed and periods of mixed feeding.

information about past infant deaths and miscarriages. But, the data on intervals which depend on norms different from those we are used to need to be specially interpreted.

These new data lead to certain hypotheses. Foetal and neo-natal mortality among the Bobo-Oulé is related to the level of sterility, no doubt on account of the prevalence of venereal disease. However, after the peak of neo-natal mortality has been passed, external factors become most important. During the first month of life, tetanus is the most important cause of death. But between the ages of one and four years, epidemic diseases and diseases of the digestive system are the two most important causes of death. If tetanus and epidemic diseases are excluded the mortality during the first four years of life seems low. But these two causes are not sufficient to explain the excess mortality of the more fertile region, which is due to a variety of causes. The hypothesis has been put forward that child care is improved, when children are scarce. In fact, in the absence of preventive health services it would seem that the risk of contracting an epidemic and even endemic disease is reduced when the density of the child population is low. Lastly, it is not impossible that the high level of pre-natal mortality may mean that those who are carried to term and survive are stronger and more resistant to disease.

The nature of birth intervals is better understood if account is taken of miscarriages and temporary sterility. The data collected enable us to allow for differences existing within the same group and to cast doubt on the existence of contraceptive practices, which are sometimes believed to be explanations of low fertility. We conclude that long birth intervals found among the Bobo-Oulé are due to factors other than contraception.