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BREAST-FEEDING AND FERTILITY: A SIMPLIFIED METHODOLOGY FOR COMMUNITY-BASED CALCULATION OF THE PROPORTION OF MOTHERS AT RISK OF CONCEPTION BY BREAST-FEEDING STATUS

Prepared by the MCH Working Group on Breast-feeding and Fertility (1984)

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PREFACE

As part of the World Health Organization's activities in the area of infant and young child nutrition and feeding, a global programme of research and programme policy promotion on breast-feeding and fertility has been developed. This programme, which is funded through the World Health Organization Regular Budget and the United Nations Fund for Population Activities (UNFPA), has been set-up in order to:

- enhance family planning programme policies and service capabilities, as an integral part of MCH programmes, especially in high risk populations, by building on natural child spacing associated with prolonged breast-feeding; promoting the timely introduction of appropriate contraceptive methods; and encouraging sound mother and child nutrition;

- disseminate information on, and promote the concept of, lactation amenorrhoea as an important component on child spacing;

- collaborate with national authorities in defining locally, the effectiveness of prolonged, frequent and complete breast-feeding on child spacing, including the duration of lactation amenorrhoea; and in determining the appropriate timing for introduction of specific contraceptive methods;

- identify and promote innovative health care and social support measures that facilitate the effective combination of breast-feeding and contraceptive practices;

- support and coordinate research on the impact of different patterns of weaning on breast-feeding performance, including the volume and composition of milk, the duration of breast-feeding, and postpartum amenorrhoea.

As part of this programme, a simplified methodology has been developed by the MCH Working Group on Breast-feeding and Fertility* in order to assist national MCH and Family Planning administrators in identifying when best, within given social groups, contraception should be promoted and counselling provided so as to complement the natural family planning role of breast-feeding. Wherever possible, the World Health Organization supports national authorities and groups in the application of this, and other methodologies. It also collaborates with other international organizations in their support to national activities in the area of breast-feeding and fertility.

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1. BACKGROUND

1.1 The fourth recommendation of the WHO/U.S. National Research Council (NRC) Joint Workshop and Programme Policy Meeting on Breast-feeding and Fertility Regulation, held in Geneva in February, 1982, proposed that in view of the importance of lactation in helping space pregnancies, everything should be done to collaborate with countries in establishing when best, given group-specific needs, and their breast-feeding and amenorrhoea profiles, other family planning methods should be promoted and provided.

1.2 Lactation amenorrhoea is highly effective as a contraceptive mechanism and is an important source of child spacing in many Third World countries. In many developing countries breast-feeding today still makes a greater contribution to child spacing than do all other modern or traditional family planning methods. This phenomenon, however, may not be readily visible to family planning or other health professionals since they typically see only a selective segment of the population, namely, those for whom the methods are not appropriate or for whom they did not work.

1.3 Indeed, while the importance of lactation in ensuring sound infant nutrition and survival has long been recognized, the acknowledgement that lactation is still the principal regulator of fertility in human society has come much later. Exploration of the interaction between lactation, nutrition and fertility (and fertility regulating agents) began hardly a decade ago and there is, as yet, relatively little information in this regard, especially from a programme policy point of view.

1.4 Ironically, at a time when evidence about the unique role of breast-feeding is increasing, traditional child spacing methods, such as breast-feeding and postpartum abstinence, are declining in some countries and the use of other family planning methods is not increasing in such a way as to compensate for that decline. Yet it is evident that if significant increases in fertility are to be prevented, declines in breast-feeding or other traditional family planning practices will need to be offset by comparable increases in the use of contraceptives and the back-up support provided by MCH and family planning services.

1.5 Until recently lactation amenorrhoea was thought to be only marginally effective as a contraceptive at the individual level. Indeed, depending on the study group in question, between 1 to 13% of breast-feeding women who use no other family planning methods have been reported to be pregnant before a return of their menses; the usual figures cited are 5 to 10%. It has also been noted that even after menstruation some women may not be immediately fertile since early menstrual cycles may be anovulatory; and even if they are ovulatory, they may have a defective luteal phase.

1.6 Nevertheless, from a population point of view, and in situations where breast-feeding is common and prolonged, it is evident that amenorrhoea has a considerable aggregate demographic effect on birth spacing. Bangladesh, for example, is often cited as a country where breast-feeding makes a major contribution to child spacing, and where, for example, in one rural community intensive breast-feeding is associated with a pregnancy rate of no more than five per 100 women years during 18 months of lactation amenorrhoea. So much so, that the WHO/NRC meeting on this subject calculated that in Bangladesh, if breast-feeding patterns were to change to those typical of industrialized countries, the already high fertility rates experienced there could be expected to rise by over 50%. In order to maintain fertility at its current level, a

more than five-fold increase in contraceptive use - from 9% to approximately 52% - would be required.

1.7 Even from an individual use point of view, recent research has suggested that the effectiveness of breast-feeding is quite high while the effectiveness of other family planning methods, as actually used by the general population, may well be less than one would expect based simply on clinical trials. Compared to other family planning methods, as they are currently being used, the effectiveness of lactation amenorrhoea thus compares favourably with other contraceptives.

1.8 From a programme point of view, the difficulty lies in determining and predicting when and for whom ovulation will return and when the risk of postpartum conception increases. For an individual woman, previous experience with postpartum amenorrhoea and her previous and current breast-feeding behaviour may provide information on when other family planning methods should be used. For example, women who breast-feed frequently over a 24-hour period, for long durations, including at night and on demand (rather than on a schedule), and who introduce supplements late, can be expected to resume ovulation later than those who breast-feed for short duration, on a regular timed basis, and with frequent supplementation. Similarly, the nutritional condition of the mother must be taken into account; marginally malnourished women whose diets are supplemented have been shown to ovulate earlier than when on their normal diet, obviously placing them at earlier risk of a subsequent pregnancy, than if they had had to continue with their habitual diet. Meanwhile it has also been demonstrated that certain hormonal preparations, in particular the combined estrogen/progestogen pill, may significantly reduce the amount of milk the mother produces and in so doing interfere with the nutritional and immunological wellbeing of the child.

1.9 It is evident from any discussion on this issue that MCH and family planning policies and programmes need to be closely integrated and to take into account this interrelationship of lactation and fertility regulation, as well as the unique role of breast-feeding in infant health and nutrition. It is equally evident that health and family planning workers need to have relevant information at their disposal on the contraceptive effects of breast-feeding and the need for encouragement and counselling on breast-feeding, child spacing and health.

1.10 Unless steps are taken to provide an integrated approach of this kind, family planning workers may unintentionally interrupt successful breast-feeding and its contraceptive effects. All too often they may concentrate on getting the postpartum woman to introduce contraception without sufficient regard for her breast-feeding status. Similarly, nutrition workers may be inclined to encourage early supplementary feeding without considering that this may lead to a decrease in suckling, and, hence, to an earlier return of ovulation and menstruation without due regard to the need for alternative and complementary contraception.

1.11 Health and family planning workers should also be in a position to help couples assess the risks and benefits of different choices, given what may be seen as competing demands of infant nutrition, prolongation of the anovulatory period, and the use of different family planning methods. Factors such as the mothers intended and/or actual breast-feeding status and behaviour; whether she lives in a society where breast-feeding is typically prolonged; and whether she lives in a society where discontinuation rates of other family planning methods is high; all need to be taken into account in assessing how and on what basis to counsel the couple.

1.12 Unless characteristics such as these are not taken into account, mothers may well be provided with unnecessary double protection or coverage during the immediate postpartum period. Yet by the time breast-feeding no longer confers contraception protection, they may also be beginning to discontinue or inappropriately use contraceptive methods. On the other hand, it must also be recognized that because the time of childbirth is one of the few contacts many mothers have with the health care system, it is, by definition, an opportunity for motivating her carefully to plan a next pregnancy and extend the birth interval in a way that favours her own and her child's health. In some individual cases, initiation of contraception at delivery may be preferable. But this can only be determined on the basis of group-specific information.

1.13 To date, few studies have been undertaken on, or methodologies developed for, the determination of lactation amenorrhoea in small population groups. The World Fertility Survey and the WHO Collaborative Study, which are important sources of information, only gathered national data; they did not attempt to generate information on sub-groups, e.g. working women in peri-urban areas. Yet it is the sub-groups that need to be "described", and described frequently, if breast-feeding and lactation amenorrhoea are to be effectively utilized in family planning programmes.

1.14 There are, of course, several other types of national surveys that provide related information; for example, contraceptive prevalence surveys and national nutritional surveys typically generate information on breast-feeding patterns, contraceptive use during lactation, infant growth and mortality. If data from all these sources could be successfully matched and linked, information on breast-feeding, infant growth, fertility and contraceptive use could be easily obtained. Caution should be followed, however, because sampling techniques and data collection methods may vary considerably between surveys. Unless it is possible to ensure that similar methods are used and unless the populations on whom the investigations are conducted are similar, then comparative analyses may not be justified. In this event, it may be more appropriate to undertake new, group and time specific surveys.

1.15 The simplicity of the methodology proposed here responds to these needs and has also been predicated on the need to be able to add new groups of special interest that emerge or are identified over time, and whose unique character may make it necessary to tailor family planning services to local needs and circumstances.

2. PROPOSED METHODOLOGY

2.1 The _immediate_ purpose of the methodology suggested here is:

> To provide quickly, and at low cost, current status data that can be used to create a distribution on duration of lactation amenorrhoea and to describe patterns of frequency and duration of breast-feeding and lactation amenorrhoea in specific communities.

2.2 The _intermediate_ purpose is:

> To build a community specific pattern of duration of lactation amenorrhoea that can be used by health workers in determining when best to advise women on family planning matters given their postpartum risk of conception.

3. CHARACTERISTICS OF METHODOLOGY

3.1 Two basic kinds of information are necessary in establishing data bases that can be used to organize postpartum family planning programmes and establish surveillance activities:

(a) data that permits rational decisions on the target populations to be included; and

(b) data that permits the development of group-specific guidelines that can be used by health workers in implementing programmes.

3.2 A variety of approaches are possible in generating these types of data. Cross-sectional surveys, however, are particularly useful in providing information on patterns of breast-feeding, including:

- prevalence of breast-feeding at given child ages or postpartum intervals (duration of breast-feeding);
- duration of lactation amenorrhoea and inter-pregnancy intervals;
- timing of introduction of food supplements to infant's diet;
- timing and types of contraceptive use.

3.3 Current status data The basic objective of the proposed methodology is to create a distribution of the duration of lactation amenorrhoea using a current status data method, primarily developed by Smith (1980) and further refined for breast-feeding surveys by Ferry, 1981, and Page et al, 1982. It has also been applied to other postpartum variables, especially lactation amenorrhoea (Ferry and Page, 1982; Singh and Ferry, 1984).

3.4 Using information gathered on current status data only, graphs such as the one below (Figure I) can be drawn and used to identify the proportions of mothers likely to be amenorrhoeic at different postpartum intervals.

3.5 Based on a simple model of this kind, a number of determinations can be made as to what proportion of a given population should be included in the target group given the risk of conception according to postpartum age (time elapsed since the pregnancy outcome). Decisions as to when to introduce contraception can also be made depending upon the proportion of women who are amenorrhoeic at a given time, and the degree of protection that should be sought, given all other factors, including alternative and complementary contraceptive methods, their availability and their known use-effectiveness.

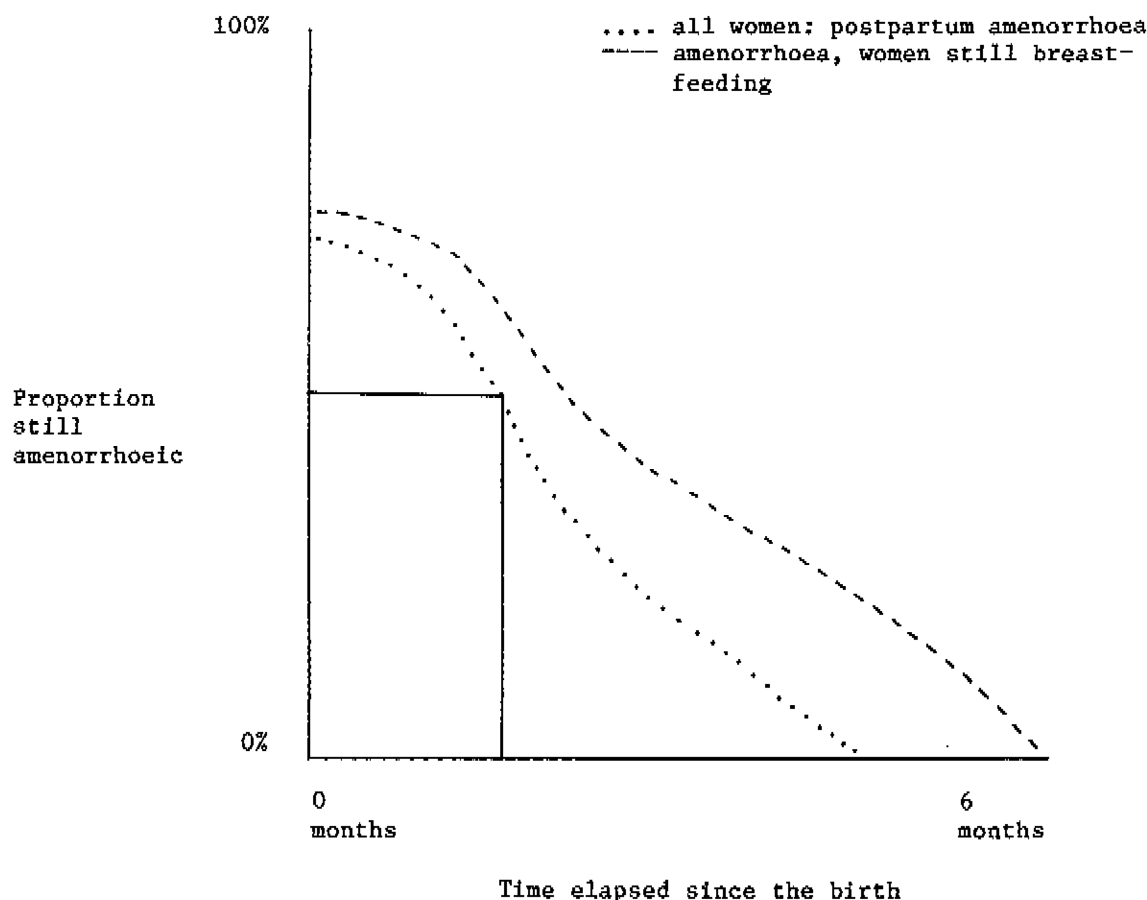
3.6 The use of current status data is proposed because it produces far less biased distributions and indices (see Page et al, 1984) than other methods. The general approach followed in this methodology is:

(a) to report the current amenorrhoea and breast-feeding status for each woman since her last pregnancy ended;

(b) to group women by the time elapsed since their last pregnancy ended; and then

(c) to calculate the proportion of women still amenorrhoeic or breast-feeding by months elapsed since the last pregnancy ended.

FIGURE I



3.7 Provided that the women on whom these proportions are based are truly representative of all those that started out "x" months ago, then the calculations should correspond to the proportions used in a standard life table. In fact, however, because they are derived from a separate cohort of women, each of the proportions within a given time interval can be expected to be independent of the others. Whereas in a "real" life table the proportions in each successive interval decrease monotonically, with current status data they may increase because of real differences between cohorts, or because of sampling variability. Some procedure is thus required to constrain this monotonic decline. The simplest procedure is to smooth the data by taking 3-interval moving averages. If this is done, a good distribution can be generated and indices such as quartiles, median and mean can be calculated (see Annex III).

3.8 Population to be included Women who have completed a pregnancy during a specified period of time (e.g. 24 months preceding the survey date) should be considered eligible for the survey. If necessary, it is also possible to include the entire population of women living in an area, or a sample of them. In the latter case, the expected heterogeneity of a population with regard to pregnancy history, breast-feeding behaviour, and duration of

amenorrhoea will be important factors in determining the size of sample. Only women who are currently reproductive should be included in the survey using the relatively short, fixed reference period approach described in the next section. The information gathered using a fixed reference period will thus reflect current practices, whereas collecting information from all women who have ever reproduced would not.

3.9 Time period to be assessed Experience from the World Fertility Survey and other survey work suggests that a fixed period of time is optimal when asking women to recall pregnancies. The minimum period of time for studying amenorrhoea is 12 months; the maximum should be 24 months. The actual period of time to be covered by the survey, however, must be determined independently for each locale, and must be based on the estimated average duration of lactation amenorrhoea in the populations being studied. The average can then be increased by 1.5 in order to allow sufficient time for longer lactation amenorrhoea and breast-feeding duration data.

3.10 Sample Size In order to determine how many women should be visited in the survey, the proportion of women who ended a pregnancy within the chosen reference time period and the average duration of amenorrhoea in the population must be estimated from existing data sources, or from local wisdom*. The reference period can then be divided for analysis into smaller intervals of from one to three months. At least 50 completed pregnancies for each interval is recommended. In general, most surveys require about 2000 women to be contacted in order to obtain a sufficient number of women with recent pregnancies.

3.11 The size of the sample is based on the assumption that all the information will be obtained from a homogenous population of women, i.e. one in which all mothers are breast-feeding, and in which there are fairly uniform pregnancy rates and durations of lactation amenorrhoea. If there are likely to be substantial variations with regard to characteristics which affect the duration of lactation amenorrhoea (marked social-economic differences, or urban-rural residence) then either: (a) separate samples should be drawn for each sub-group of the population, or (b) a larger sample size should be calculated to reflect and account for possible differences between sub-groups. Approach (a) is preferable, and is described in greater detail in Annex I.

3.12 Information to be collected Four basic or minimum sets of information need to be gathered:

(a) background data on the mothers;

(b) the mother's pregnancy history for the reference time period;

(c) the presence or absence of amenorrhoea at the time of the interview;

(d) the mother's breast-feeding status at the time of the interview and for the most recent pregnancy that ended with a live born child during the reference period.

With regard to "the mother's pregnancy history for the reference time period", this can be used to determine which women qualify for the survey, i.e. those who have had a completed pregnancy (regardless of outcome) during the reference

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* Local midwives, for example, may be able to provide general estimates based on their empirical experience.

period. The use of specific questions on pregnancy history has been found to elicit more reliable information than simply asking the woman if she has, or has not, been pregnant during the reference time period (an example is included in Annex II). The simplicity of the proposed questions on all these four information sets is such that only minimum training in interview techniques should be needed.

3.13 These four basic information sets are suggested as pieces of information relevant to the duration of lactation amenorrhoea and breast-feeding in the total population of women. However, if the group to be studied is not reflective of the total population of women, the questions may have to be rearranged and more items added to determine eligibility for the survey. For example, if only women of age 15-40 years are to be studied, then a screening question about age will obviously need to be one of the first in the survey. Similarly, other questions on family planning practices can be added if desired.

3.14 Data analysis and interpretation Information gathered through these interviews can be transferred to a tabular format and analyzed using standard techniques such as outlined in Annex III. Here the proposed method of analysis is the "current status life table" which is based on the type of prevalence data generated in the interview and which should indicate:

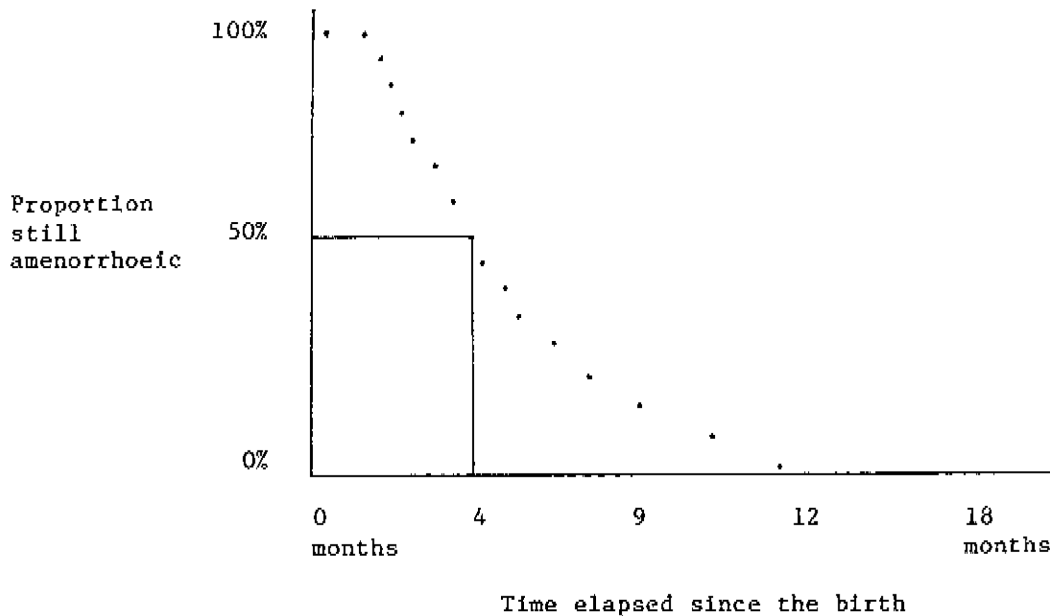
(a) the months elapsed between every pregnancy ending during the reference period and the survey date; and

(b) the amenorrhoea and breast-feeding status of each woman at the time of the survey. The proportion of the group having experienced a return of menses following a completed pregnancy during the reference period can be computed and a graph drawn to show the proportion of the population still amenorrhoeic for the time elapsed since the most recent birth (irrespective of outcome).

3.15 On the basis of the curve outlined in Figure II below, it should be possible to determine for a given population group the best time to begin advising women on family planning, given their risk of pregnancy and also taking into consideration all other available resources and health priorities.

3.16 For each month postpartum there will be information on the graph concerning the proportion of women at risk of conception (i.e. those who are no longer amenorrhoeic). Thus, for example, according to this graph, at 4 months postpartum some 50% of women are still amenorrhoeic and are therefore not immediately at risk of a new conception.

FIGURE II



4. LIMITATIONS OF THE METHOD

4.1 The method being proposed here provides a picture of the frequency and duration of breast-feeding and lactation amenorrhoea in the community. Without additional questions and a more lengthy interview, however, other breast-feeding practices, infant feeding or family planning use cannot be determined.

4.2 Although the analysis is of a "prospective" type, the study design is cross-sectional. This means that a life table approach is applied to information gathered at one point in time and calculations are made based on the mother's recall of her pregnancies and their outcomes over the past two year period, her amenorrhoea status and her breast-feeding status at the time of the survey. This technique is based on the experiences of the World Fertility Survey but the data collected in this way will be only as good as the memories and willingness of the interviewed women to cooperate and provide truthful answers. It should therefore be borne in mind that the intent of the method is not to investigate the causes and outcomes of amenorrhoea and breast-feeding, but is rather aimed at a simple and rapid assessment of the pattern of lactation amenorrhoea in a community at a given time, so as to permit a better "tailoring" of services and a more rational use of resources.

4.3 Births often occur with a seasonal pattern, and in situations where seasons are more pronounced, the seasonal distribution of births will also be more pronounced. The current status approach being proposed here is affected by seasonality. Possibly seasonal practices will affect breast-feeding and the duration of lactation amenorrhoea. Each locale will have to address this issue in its own way depending on its "climate" and the practices of the community.

4.4 It is also important to note that the method is appropriate for making decisions about the delivery of family planning services at a community level, not an individual level. In the case of the individual mother, each woman will have to be assessed for her specific family planning needs in the usual way, and counselled accordingly.

4.5 For the current status method to succeed the date when each pregnancy ends is an important piece of information. All births (i.e. all ended pregnancies regardless of outcome) occurring in the reference period form the denominator for the analysis, and it is crucial that those births be assigned to each interval. Where "calendar dates" are not common, other forms of categorising events in time will need to be developed. These may lessen the reliability of data.

4.6 Because the success of the method hinges on good reporting of the absence of menstruation, interviewers must be trained to help the respondent to differentiate between "normal" post-partum bleeding and menstruation. This is especialy important among women who have recently given birth. Similarly the quality of collection of information on the time elapsed since the last pregnancy is crucial for the success of the method and pre-supposes a good prediction of the number of months that are likely to be covered by the study.

4.7 It should be borne in mind that since ovulation itself is hard to detect, a proxy variable is being used, i.e. the first postpartum menstruation. Although far from being perfectly correlated with ovulation, the first menstruation has the advantage of being both readily observable and highly significant for the individual. This means, however, that the distribution will not distinguish the difference between postpartum amenorrhoea and pathological prolonged amenorrhoea or the apparition of menopause.

4.8 If a long reference period is used, the more fertile women may appear twice or three times and their characteristics may be slightly over-estimated relative to the overall sample.

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ANNEX I

DETAILED METHODOLOGY

Reference time period

The "reference time" period covered by the study should be based on the estimated duration of lactation amenorrhoea in the population of women to be surveyed. The period (R) chosen should not be less than one year. The reference period is calculated by multiplying the expected duration of amenorrhoea by a factor of 1.5; this permits flexibility in the time period and accomodates variations in the population from the expected average. For example, if the average were 9.9 months, as it is in Kenya, (Singh and Ferry, 1984), then by multiplying by 1.5 (9.9 x 1.5) the reference time period would be 14.8 or approximately 15 months.

The reference time period then should be divided into smaller intervals of 1, 2, or 3 month intervals. For example, an 18-month reference period might be divided into 18 1-month periods, or into six 3-month periods*. The size of the smaller intervals depends on the final number of pregnancies available for analysis in each interval. In general the intervals should be no longer than 3 months, otherwise the resulting data points will not lend themselves to an appropriate analysis of amenorrhoea.

Since lactation amenorrhoea may be of relatively short duration in some populations and much of the precision in measuring the speed of its decline in the population is lost with large time groupings, it is advisable to have 1-month intervals with proportions that vary considerably. These can then be smoothed to form 6-month intervals**.

Sample size determination

The basic piece of information needed for the calculation of sample size is the estimated proportion P(d) of women still amenorrhoeic for each time period (d) before the survey. To establish this proportion, the following ratio can be calculated using the following formula:

$$P(d) = \frac{\text{Number of women currently amenorrhoeic after the pregnancy ending exactly d months before interview}}{\text{Number pregnancies ending d months before interview}} = \frac{A(d)}{N(d)}$$

For any useful analysis to be possible, a sufficient number of women with completed pregnancies is required within each time period. The experience of other studies, such as the World Fertility Survey, suggests that an average number of 50 women is a reasonable number for single month intervals. If 3-month

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* The data for each smaller time period will be eventally "smoothed" to form a curve that is more easily interpretable for decision making.

** The period could be divided into four 6-month periods if the frequency of pregnancy is lower than it is in another area of higher frequency of pregnancy where, for example, 2-month intervals are being used.

intervals are to be used then 100 women with completed pregnancies is the necessary minimum. Thus, for example, for a survey with a 12 months reference period (R) studied by single month intervals (d), the minimum number of pregnancies (N) needed for the study would be:

$$N = R * N(d) = 12 * 50 = 600 \text{ completed pregnancies.}$$

Sampling method

Not all women have a pregnancy every year, and some women are likely to be too old or too young to have any pregnancy. Thus, in order to find the number of completed pregnancies needed (N), it will be necessary to contact and screen more women than are likely to be involved in the study *per se*. To do this, two pieces of information need to be estimated:

- the average inter-pregnancy interval; and

- the proportion of the female population that is of childbearing age.

These data are likely to vary from country to country or even from one locale to another within a country; the number of women that will need to be contacted will vary accordingly even though the sample size remains the same.*

To obtain the average inter-pregnancy interval (I), in months, when the estimated average number of pregnancies in the reference period per childbearing woman (C) is known, the following formula can be used:

$$I = R/C$$

where:

R = the reference period: minimum 12 months, maximum 24 months

C = the estimated average number of pregnancies in the reference period per childbearing woman

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* Depending on the information available locally, the estimated average inter-pregnancy interval can be used "as is"; alternatively it can be derived from information on the estimated average number of pregnancies in the reference period per childbearing woman (C), if this is known.

Thus, for example, if:

N	=	600 completed pregnancies	R	=	12
N(d)	=	50 completed pregnancies for each month	(d)	=	one month
C	=	0.7 pregnancies per childbearing woman per year			

$$I = 12/0.7 = \underline{17}$$

17 months is the estimated pregnancy interval.

i.e. In order to achieve the necessary sample size, the number of childbearing women (S) who would need to be contacted can be calculated as follows:

$$\boxed{S = N(d) * I} \quad \text{or} \quad \boxed{S = N/C}$$

for example,

$$S = 50 * 17 = \underline{850}$$

Thus, 850 women of childbearing age would have to be contacted in order to have the required number of completed pregnancies.

In any study situation and according to local patterns and practices of childbearing, there may be differences in how "childbearing" is defined. The fact remains, however, that only a certain proportion of all women will need to be asked about their pregnancies. The total number of females to be contacted (W) in order to find the needed number of ended pregnancies in the reference period must thus be adjusted by an estimate of the proportion of the female population that is of childbearing age (F):

$$W = \frac{S}{F}$$

For example, if F = 50%, then:

$$W = 850/0.50 = 1{,}700$$

Thus, 1,700 women must be contacted in order to acquire the 600 ended pregnancies needed for the analysis.

Finding potentially eligible women (W) may entail clustering of households or stratifying according to a set of pre-determined characteristics. These are decisions which will have to be made by local investigators on the basis of existing conditions; for instance, in some cultures it is common to find more than one woman of reproductive age in one household, while in other cultures this rarely occurs. The decision on whether to use households (or families) as a sampling unit thus may depend on the local situation. The unit of study nevertheless remains the pregnancy that ended during the reference period.

In the example above, to find 600 completed pregnancies (N), over a 12-month period (R), 1,700 females (W) must be contacted. If it is common for there to be two women per household, then 850 households would need to be visited. The way in which households are selected will also need to be determined based on local conditions. A variety of methods can be used as long as a sample of (N) completed pregnancies is achieved and provides an accurate picture of the duration of lactation amenorrhoea over the reference period.

The following table suggests how a calculation can be made of the numbers of mothers that will need to be contacted to achieve the designated sample sizes for various inter-pregnancy intervals and proportions of childbearing women:

Reference period in months	Number of months in each interval	Number of ended pregnancies in each interval (sample size)	Estimated average inter-pregnancy interval	Proportion of all female population of child-bearing age	Total Number of females to be contacted for screening
R	(d)	N(d)	I	F	W
12	1	50	30	.5	3000
12	1	50	33	.5	3300
12	2	100	33	.5	3300
12	1	50	35	.65	2692
12	3	100	35	.40	2917

Remember that W stands in this case for all females (young and old) who need to be contacted in order to find a total sample size (N) of completed pregnancies for the reference period (R) made up of intervals (d) in which N(d) completed pregnancies are needed.

Thus, if intervals (d) of one month are used and 50 ended pregnancies are needed, N(d), over a reference period of 12 months (R), then 600 completed pregnancies is the total analyzable sample size (N). In order to obtain a total of 600 completed pregnancies (N) in a population where childbearing women have an average estimated inter-pregnancy interval of 30 months (I), and an estimated 50% of the female population is of childbearing age (F), a total of 3000 females (W), young and old, it may be necessary to enquire about a pregnancy ending during the 12 month reference period (R).

If an investigator wishes to limit the study group to women 20-30 years of age, then the inter-pregnancy interval (I) would have to be estimated for that age group alone, and (F) would have to be the proportion of all females who are in the 20-30 year age group. Two "screens" would be needed: one to identify the age of women and those in the 20-30 year old age group; the second would identify those with completed pregnancies in the reference period.

Further notes on sampling

If it becomes necessary to decrease the size of the sample, or to increase the proportions (if numbers in an interval are too small), a larger interval of observation (d) can be used (e.g. 2 or 3 months instead of one). The number of women to be observed can then be divided by the number of months (d) and the final formula used to determine the number of women to be contacted thus becomes:

$$W = \frac{N(d) * I}{d * F}$$

It is important to note that in this formula the number of sampling units needed is independent of the length of the reference period, but is related to the inter-pregnancy interval. The minimum number of units is 50; 100 is better, especially when they are to be grouped into 2 or 3 month intervals. N(d) is the average fixed number of completed pregnancies needed in order to build the denomination of the proportion for analysis. To avoid too large a sample (W) we can "experiment" with N(d) and (d). (I) represents the average inter-pregnancy interval in the target population of women; it does not vary much between populations and is generally between 30 and 40 months.

In some situations, health workers may wish the target population to be more specific, for instance women 20-39 years old, or women with a given number of years education, or rural women. If this is so, then the various parameters used in the calculations will have to be specific to the group that is to be reached, rather than "all childbearing women". The calculations will nevertheless be the same, although different approaches may be needed in the sampling methodology in order to achieve the desired sample size.

In summary, a list of all the parameters that will need to be used would include:

(d) = the interval in months used for analysis, minimum = 1 month; maximum = 3 months

N = number of pregnancies in the survey

N(d) = number of women with completed pregnancies in each time interval

I = estimated average inter-pregnancy interval in months

R = reference time period, minimum is one year

C = estimated average number of completed pregnancies per woman

S = number of childbearing women needed to achieve N ended pregnancies

W = total number of women to be contacted by the survey in order to find N

F = % proportion of women in the population who are of childbearing age

ANNEX II

Below are some suggestions on what items and what type of questionnaire could be used in a survey of the kind being discussed here. There are many ways, however, of designing a questionnaire and individual researchers may wish to use a different format that is in keeping with other survey instruments being used in their setting.

The number of items included obviously depends on the purpose of the survey. The ones outlined below probably represent the minimum number it would be useful to include.

MINIMUM QUESTIONNAIRE

		Coding Column DO NOT WRITE IN THIS SPACE
Part I Background Information		
1. Region of country		___ ___
2. Family identification number _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _		___ ___ ___
3. Interviewer identification		___ ___ ___
4. Date of interview completed _ _ / _ _ _ / _ _ _ / (day, month, year)		_ _/_ _/_ _
5. Name of mother		....
6. Address		....
7. Age of mother in years _ _		___ ___
8. Occupation of mother		___ ___
Part II Pregnancy History		
9. Have you given birth to any children during the last _ _ months who are alive today?	yes ☐ no ☐	___
10. If yes, what is the age in months of each child?	(a) last born: ___ months	___ ___
	(b) next : ___ months	___ ___
11. Have you had any other children born alive during the last _ _ months who are now dead?	yes ☐ no ☐	___
12. If yes, how old would each child be today?	(a) last born: ___ months	___ ___
	(b) next : ___ months	___ ___

Coding Column
DO NOT WRITE
IN THIS SPACE

13. Have you had any pregnancies during the last _ _ months? (ending in abortion or stillbirth) yes [ ] no [ ] ____

14. If yes, how many months ago did each pregnancy end?
(a) last born: ___ months ____ ____
(b) next : ___ months ____ ____
(b) next : ___ months ____ ____

IF THE WOMAN HAS HAD NO PREGNANCY IN THE SPECIFIED TIME PERIOD
THE INTERVIEW CAN BE CONCLUDED

15. Are you pregnant now? yes [ ] no [ ] don't know [ ] ____

16. If no or don't know: Have your periods started again since the last pregnancy ended? yes [ ] no [ ] not asked [ ] ____

** INTERVIEWER:

17. Was the woman's last pregnancy a live born infant? yes [ ] no [ ] ____

18. If yes, are you still breast-feeding? yes [ ] no [ ] not asked [ ] ____

END INTERVIEW

Remember that other screening or information items can be included if so desired and considered useful to the local survey.

ANNEX III

Data processing and analysis

Based on the mother's current postpartum amenorrhoea status using the months elapsed between the time of survey and the reproductive events covered by the survey, a series of tables can be constructed in order to calculate the proportion of women who are still amenorrhoeic after a birth in each time interval during the reference time period. Table I is an example of what these should look like.

Table I

(a) Time interval elapsed since the birth (months)	(b) No. of live births or end of pregnancies during the interval	(c) No of women still amenorr-hoeic after birth during the interval	(d) Proportion still amenorr-hoeic during the interval (c)/(d)	(e) Smoothing of the propor-tion (i.e. a moving average)

As an example of how to move the pregnancy history data into the table, data obtained by the questionnaire from several pregnancies are presented below (Table II), using part of the time line for displaying pregnancy histories.

Table II

Mother's Identi-fication	Time intervals in months				Current status at survey time
	18 < 24	12 < 18	6 < 12	0 < 6	
A	LB	LB			A
B	LB			LB	A
C			LB		A
D		LB			P
E			OP		M
F	LB	D	LB		A
G		OP		LB	A

LB = live birth
D = death
OP = other pregnancy

P = currently pregnant
M = menstruating
A = amenorrhoeic

Information on current menstrual status (amenorrhoeic or started menstruating) or current pregnancy status, is entered in Table II column: "Current status at survey time" and "Time intervals". This table is a useful tool for creating Table III columns (b) and (c) (see next page).

Thus, in Table III - column (a): "Time elapsed since birth", the smaller interval that has been chosen to segment the reference period of two years is noted; in this case, six month intervals have been proposed. Information for column (b): "Number of live births or end of pregnancies during the selected time interval", is obtained from Table II by counting the number of live births (LB) and other pregnancies (OP) for each interval.

For example:

- the time interval 0 < 6 months has two concluded pregnancies in it: women B and G

- the time interval 6 < 12 months has three concluded pregnancies in it: two live births (women C and F) and one other pregnancy: women E

- etc.

Information for Column (c) on "Number of women still amenorrhoeic after birth during the interval" is taken from the Column on "Current status at survey time" in Table II. The women who are still amenorrhoeic (A) at the time of the survey are the ones to be entered in Table III, but they must be entered into the time interval when their last pregnancy ended.

For example:

There are five women amenorrhoeic at the time of the survey (A, B, C, F and G):

- two are amenorrhoeic from a pregnancy in the interval 0 < 6 months (women B and G)

- two are amenorrhoeic from a pregnancy in the interval 6 < 12 months (women C and F)

- etc.

Table III

(a) Time interval elapsed since birth (months)	(b) No. of live births or end of pregnancies during the interval	(c) No of women still amenorr-hoeic after birth during the interval	(d) Proportion still amenorr-hoeic during the interval (c)/(d)	(e) Smoothing of the proportion (i.e. a moving average)
0 < 6	2	2		
6 < 12	3	2		
12 < 18	3	1		
18 < 24	3	0		

To calculate the "Proportion still amenorrhoeic during the interval", figures in Column (c) must be divided by figures in Column (b) for each "Time interval elapsed since birth". For example, to obtain the proportion still amenorrhoeic (see Column (d) in Table IV):

- for the time interval 0 < 6, divide 2 in Column (c) by 2 in Column (d) or 2/2 = 1
- for the time interval 6 < 12, divide 2 in Column (c) by 3 in Column (b) or 2/3 = 0.66
- etc.

Table IV

(a) Time interval elapsed since birth (months)	(b) No. of live births or end of pregnancies during the interval	(c) No. of women still amenorrhoeic after birth during the interval	(d) Proportion still amenorrhoeic during the interval (c)/(d)	(e) Smoothing of the proportion (i.e. a moving average)
0 < 6	2	2	2/2 = 1	
6 < 12	3	2	2/3 = 0.66	
12 < 18	3	1	1/3 = 0.33	
18 < 24	3	0	0/3 = 0	

Computation of a 3-interval moving average

The simplest way to smooth a distribution of months is to calculate a 3-interval moving average. The actual proportion is combined with the two surrounding proportions and the average is calculated. This calculation can be done for each interval except the first and last ones. The general formula is:

$$A_n = \frac{a_{n-1} + a_n + a_{n+1}}{3}$$

where: a_n = "Proportion still amenorrhoeic during the interval" (Table IV, Column (d))

A_n = "Smoothed proportion" (Column (e) in Table IV)

As an example of smoothing the data from the six cases on the pregnancy history, only two points can be calculated from these 4 months as in the example below in Table V.

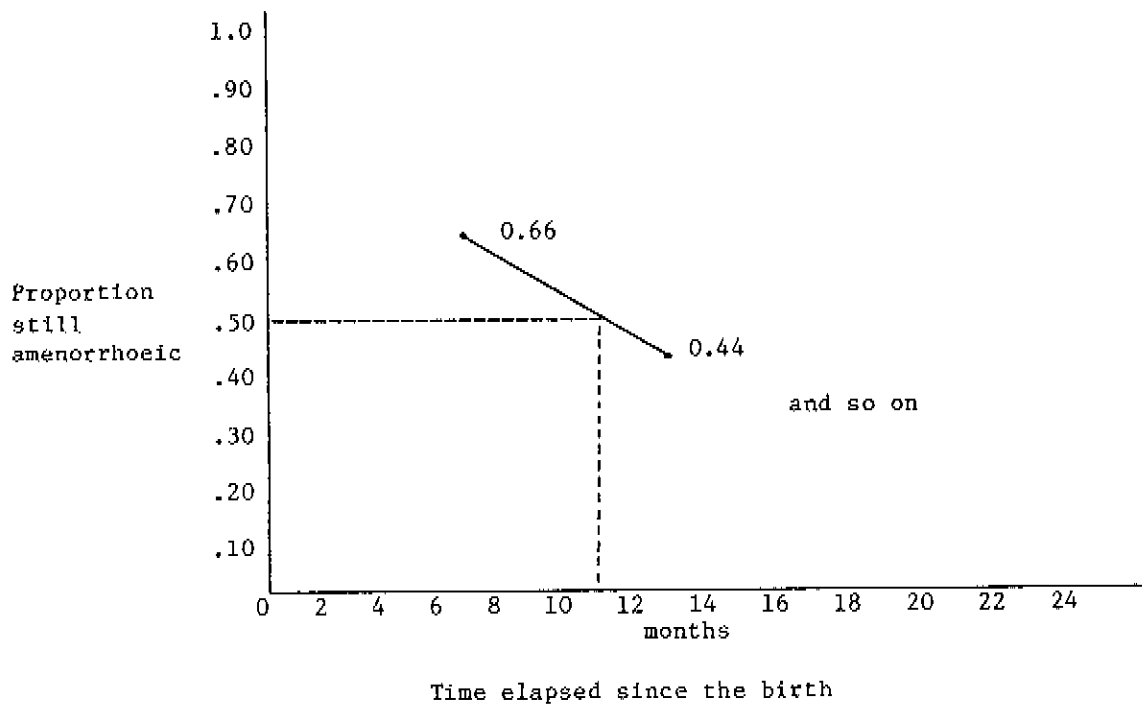
Table V

(a) Time interval elapsed since birth (months)	(b) No. of live births or end of pregnancies during the interval	(c) No of women still amenorr-hoeic after birth during the interval	(d) Proportion still amenorr-hoeic during the interval (c)/(d)	(e) Smoothing of the propor-tion (i.e. a moving average)
0 < 6	2	2	2/2 = 1	
6 < 12	3	2	2/3 = 0.66	$\frac{1 + .66 + .33}{3} = 0.66$
12 < 18	3	1	1/3 = 0.33	$\frac{.66 + .33 + 0}{3} = 0.44$
18 < 24	3	0	0/3 = 0	

The same procedure would continue to be used for the rest of the months in the reference period.

Using the data in Table V, Column (e), a graph can then be constructed in the following manner:

Figure 1



Time elapsed since the birth

If it is necessary to determine at what "month postpartum" 50% of the population of fertile women are still amenorrhoeic, a line should be drawn from the 0.50 mark on the curve representing "proportion still amenorrhoeic" to the dotted line and then from there straight down to the line representing "time elapsed since the birth". The number of months postpartum can be obtained from the point at which the broken line intersects the time line. For example, in this case the broken line intersects with the interval for the 11th month, and one can thus say that based on these data 50% of women are still amenorrhoeic at the eleventh month post partum: this will be a typical example in a group where prolonged breast-feeding is practised.

Proportion of mothers breast-feeding

Information on the proportion of the population of women breast-feeding at the time of the survey and its duration is obtained from the questionnaire via the question on breast-feeding. Only the pregnancies that ended as a live birth for each woman is included in this analysis. The data can be entered into a table similar to the one below.

Table VI

(a) Time interval elapsed since birth (months)	(b) No. of live births during the interval	(c) No. of women still breast-feeding during the interval	(d) Proportion still breast-feeding during the interval (c)/(d)	(e) Smoothing of the proportion (i.e. a moving average)

Data can be entered into Table VI from the pregnancy history example in the same way as in the calculation of the duration of lactation amenorrhoea. In this case, women A, B, C, D, F and G had a live birth during the interval; it does not matter for this analysis that women D is again pregnant. The live births are placed into the interval in which they occurred in Column (b); for example:

- the births to be assigned to interval 0 < 6 are those from mothers B and G
- the births to women C and F are thus assigned to interval 6 < 12
- etc.

Similarly, the number of women still breast-feeding (Column (c)) is placed into the interval in which the birth occurred. Proportions can be calculated and smoothed as they were for lactation amenorrhoea data and a graph similar to that used for the amenorrhoea analysis (Figure 1) can be prepared.

Notes on Data Processing

The use of microcomputers to enter and analyze the information from the survey can greatly decrease the time required to obtain an answer from these data. In this case, data entry, processing, calculating or proportions and graphing is likely to be quite rapid given the simplicity of the questionnaire and the clarity of the objective. There are also advantages in using micro-computers locally in the sense that use of micro-computers can obviate the need for information to be sent away for analysis and those involved with data collection and analysis are more likely to use the information generated if they experience rapid feedback.

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