

Breastfeeding, lactational infecundity, contraception and the spacing of births: implications of the Bellagio Consensus Statement*



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Abstract

While the nutritional, immunological and anti-bacterial benefits of breast milk are incontestable, the contraceptive effect of breastfeeding is more apparent in the aggregate than at the level of the individual. Nevertheless, it has recently been recommended that lactating women not consider adopting contraception until the earliest of their first post-partum menstruation, the introduction of supplementary feeding or their child's reaching six months of age. This article employs microsimulation to quantify the implications of this recommendation for the spacing of births and, in particular, for the proportion of birth intervals that are unacceptably short. The findings are not encouraging. The implementation of this protocol would not produce better birth spacing than a simpler strategy of initiating contraception early in the post-partum period and, unless implemented perfectly, the outcomes would be considerably worse. Breastfeeding should be viewed not as a method of birth control but as the best form of infant nourishment. Efficient contraception is the best way to ensure that children in modernizing societies can reap the benefits of breastfeeding, without being endangered by being weaned too early because of a new pregnancy.

Breastfeeding confers substantial health benefits on both mother and child. For the infant, the principal advantages of breast milk are nutritional, immunological and anti-bacterial. Breast milk is an excellent sole source of nutrition for the first four to six months of a child's life, and can continue to be an important part of a child's diet for many months thereafter. Immunological protection is conferred not only through colostrum, which is produced during the first few days post partum, but through ordinary breast milk thereafter, even after supplementation. Moreover, breast milk is a sterile fluid and contains powerful anti-bacterial agents (Gray 1980, Short 1984).

For the mother, breastfeeding encourages the involution of the uterus and, thus, the rapid return of uterine tone. It promotes an affectionate bond between mother and child. It is economical, an important consideration in the Third World, and it is convenient. Finally, through the prolactin-elevating effect of nipple stimulation, breastfeeding delays the return of normal ovarian function and thereby lengthens the interval between births (McNeilly 1979, Hatcher et al. 1990:470).

This latter effect also advantages the child by lessening the likelihood of displacement from the breast by a new pregnancy. Weaning foods are grossly inadequate in many developing countries, and children weaned too soon are at risk of various protein-calorie deficiencies, such as kwashiorkor¹ and marasmus, causing general debilitation, arrested development, wasting and, possibly, death (Jelliffe and

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¹ Indeed, kwashiorkor, which can be recognized by oedema, pigmentation changes, wasting, growth failure and general misery, means in the Ga language of Ghana a disease occurring in a young child deposed from his mother's breast (Jelliffe and Jelliffe 1989:276).

Jelliffe 1989:276-285). Where medical services are poor or largely absent, children who are breast-fed are more likely to survive than those who are not (McCann et al. 1981:531).

Nevertheless, breastfeeding makes considerable nutritional demands on the mother. A repeated cycle of pregnancy and lactation can become a cumulative nutritional drain and, among women who are already nutritionally vulnerable, can lead to 'maternal depletion' syndrome (Jelliffe and Jelliffe 1989:227-229); whether or not this poses a risk for her children (Haaga 1989:120), it undoubtedly represents a less than ideal situation for the mother.

The importance of maintaining the lactational period in order to protect the child at the breast has been recognized since antiquity. For centuries from the time of Galen and Soranus, the recommended length of the nursing period ranged from 18 months up to three years, and European physicians and clerics advised that nursing women should protect their milk by abstaining from sexual relations (van de Walle and van de Walle 1972, Fildes 1988:23). The major concern was the health of the child, not the mother's protection from pregnancy (McLaren 1978:67, Fildes 1986:99-100). From at least the seventeenth century, however, some physicians were aware of the relationship between breastfeeding and temporary infertility (van de Walle and van de Walle 1972), and there is considerable evidence that this knowledge was not confined to the medically-trained (Fildes 1986:108-109).

In the first half of the nineteenth century, many doctors ridiculed as an old wives' tale the notion that breastfeeding might have a contraceptive effect. Some doctors, however, were becoming more receptive to the idea of a link between lactation and fertility (McLaren 1984:67), and in France one even advocated prolonging the nursing period as a means of holding in check the fertility of the working classes (McLaren 1990:188). By the latter half of the century the medical profession generally remained opposed to artificial contraception, but in the main accepted that lactation reduces fertility. Many doctors, faced with demands from their patients for birth control, therefore advised the use of breastfeeding as one of three acceptable 'natural' methods (McLaren 1978:125)².

Nevertheless, many doctors were also opposed to lengthy breastfeeding (McLaren 1990:188), there being widespread apprehension concerning the dangers that prolonged breastfeeding posed to the health of both mothers and children. Annie Besant, a pioneer in the campaign for contraception, decried the 'foolish ... attempts made by ignorant people to limit the family [by] the prevalent habit of over-lactation, arising from the mistaken idea that conception is impossible during the nursing of a child...' (1887:24).

By the early decades of the present century, breastfeeding was advocated chiefly on nutritional grounds. The importance both of breastfeeding, and of a proper time to introduce supplementary feeding, was stressed. In England, for example, the National Birth-rate Commission considered six months to be the optimum minimum period of breastfeeding and nine months to be the upper limit for establishing weaning. In addition, the Commission declared that

Women, who for inadequate reasons refuse to suckle their offspring, and those who prolong lactation to one or even two years in the hope of preventing conception, are alike culpable (National Birth-rate Commission 1920:xciii).

² The other two natural methods were abstinence and rhythm. Unfortunately, (following Galen) the safe period was generally thought to occur in the middle of the menstrual cycle (McLaren 1978:125). Thus, Besant (1887:36) noted that 'Dr. Tyler Smith writes: "In the middle of the interval between the periods, there is little chance of impregnation taking place. The same kind of knowledge is of use by way of caution to women who menstruate during lactation, in whom there is a great aptitude to conceive; pregnancy, under such circumstances, would be injurious to the health of the foetus, the child at the breast, and the mother herself, and therefore should be avoided, if possible" '.

The practice of artificial feeding had existed for certain groups of infants for millennia but wet nursing, that is, the suckling of a child by a paid servant, is equally ancient. A fashion for hand-rearing infants started in England in the late seventeenth century among wealthy families that had previously employed wet nurses, and much later on the Continent where the practice of wet nursing was far more widespread (Fildes 1986:262-292, Fildes 1988:190-291). With the growing availability of pathogen-free milk (Dyhouse 1978) (which contributed to sharply declining infant mortality from the late nineteenth century), and with technological advances in methods of sterilization and the design of feeding vessels, the practice of bottle-feeding had become almost universal in the West by the 1930s. As breastfeeding disappeared in Western countries so did the recognition of its contraceptive effect, which remained to be 're-discovered' several decades later by demographers trying to explain why the subsequent birth interval should be shorter in historical populations if a child died than if it survived (Henripin 1954, Henry 1961, Knodel 1968).

In the 1970s, as the evidence mounted for long periods of nursing and post-partum amenorrhoea in many developing countries, there was some interest in the possibility of developing a physiologically-based birth-control method. In light of the great variability in durations of amenorrhoea among lactating women and the extent to which knowledge of the relationship between breastfeeding and birth-spacing was based on 'tenuous assumptions, biased observations, and widely divergent methodologies' (Masnick 1979:110), lactational amenorrhoea was considered far too unreliable a birth-control method for the individual woman. Moreover, lactational amenorrhoea was less effective than the oral contraceptives and IUDs then being promoted, and average periods of lactational amenorrhoea were considerably shorter than the average durations of use of these modern contraceptive methods (van Ginneken 1974, 1977). In the words of one commentator, '[this confirms] my impression that breast milk is for feeding babies, not for preventing babies' (Thomson 1977:52).

Subsequently, the physiological basis of the contraceptive effect of breastfeeding has been firmly established by clinical studies employing more refined techniques of hormonal assay. In some quarters confidence has been renewed in the use of breastfeeding as a contraceptive.

The Bellagio Consensus Statement

In 1988 an interdisciplinary group of researchers convened at the Rockefeller Foundation's conference centre in Bellagio in order to reach an agreement on the conditions under which breastfeeding can be used as a safe and effective means of regulating fertility.

The group considered lactationally-induced infecundity to be an appropriate birth-control method for many women, and recommended that it be incorporated into family planning programs and presented to potential users as one element of informed choice. The consensus was that:

the maximum birth spacing effect of breastfeeding is achieved when a mother 'fully' or nearly fully breastfeeds and remains amenorrhoeic (bleeding before the 56th postpartum day being ignored). When these two conditions are fulfilled, breastfeeding provides more than 98% protection from pregnancy in the first six months. At six months, or if menses return or if breastfeeding ceases to be full or nearly full before the sixth month, the risk of pregnancy increases. As soon as one of the events occurs, consideration must be given to adoption of other means of family planning if a high degree of protection is desired or needed (Family Health International 1988:1204).

Two strategies were proposed for exploiting the fertility-inhibiting effects of breastfeeding. For women or couples who do not wish to use other family-planning methods or to whom other methods are not readily available, breastfeeding could be used as a birth-spacing method in its own right. Alternatively, if there are additional problems with contraceptive continuation, especially during

lactation, the use of breastfeeding could serve as a means of postponing the introduction of contraception. The group felt that the latter strategy, rather than one in which contraception is initiated while most women are still protected by lactational infecundity, could help to secure an interval between successive births of at least two years.³

In a reiteration of the Bellagio statement, Kennedy, Rivera and McNeilly (1989) documented the scientific basis for the consensus and discussed key factors affecting the establishment and maintenance of breastfeeding and the duration of lactational infecundity. In addition, they suggested that in populations in which long durations of breastfeeding are common, it might be possible to extend the period during which women can rely on lactational infecundity beyond six months.

The Bellagio recommendations have not gone unchallenged. Trussell and Santow (1991) cautioned against presenting breastfeeding as an alternative to contraception. They noted that the Bellagio formula (considering contraception at the earliest of cessation of full breastfeeding, the return of the menses and the child's reaching six months of age) could prove unwieldy in the field. Moreover, of the three events signalling the need to initiate contraception, only the last (assuming, of course, that the child survives), is foreseeable with certainty. The problem with supplementation is that it may occur unexpectedly or may not be fully under the mother's control; the problem with the return of the menses is that it is sometimes preceded by ovulation. The adoption of contraception before the return of fecundity will result in some redundant protection and may even be counter-productive if contraceptive discontinuation rates are high. Nevertheless, they argued, these disadvantages must be weighed against the costs of pregnancies that occur while considering an alternative birth-control method. In their view, couples should be actively encouraged immediately after confinement to acquire contraceptives that are compatible with breastfeeding, and this should be combined with an educational message promoting their adoption sufficiently early to minimize the possibility of an unprotected period.

Responding to these criticisms, Kennedy et al. (1991) emphasized that the Bellagio guidelines should not be interpreted as promoting breastfeeding at the expense of other birth-control methods. Far from deflecting users from other family-planning methods, the informed use of lactational amenorrhoea merely adds one more item to the 'cafeteria' of birth-control methods already available. They acknowledged that identifying the beginning of supplementary feeding is the weakest aspect of the lactational amenorrhoea method (LAM), but suggested that lactational amenorrhoea provides such a high degree of protection that in some populations the full-breastfeeding requirement of the Bellagio recommendations can be relaxed. They disputed the inevitability of a delay in adopting contraception after its need is indicated. Finally, they observed that the women who are choosing LAM have hitherto been reluctant to use family planning services and that the introduction of LAM is thus increasing contraceptive coverage.

Labbok (1991) also viewed LAM as an addition to the range of birth-control methods available to users; she stressed that LAM 'may' be used in sequence with other methods since the protection afforded by breastfeeding alone is insufficient to achieve adequate birth spacing.

The issues that emerge in this debate raise a number of practical concerns.

³ A large number of studies, albeit some with questionable methodologies, have revealed a consistent pattern of higher neonatal and infant mortality among children born within two years of the previous live birth (See Gray 1980, Winikoff 1983). Hobcraft, McDonald and Rutstein (1983) found that, in all but two of 26 countries participating in the World Fertility Survey, neonatal mortality rates were at least 50 per cent higher among children born within two years of a preceding birth; and that in most of the countries such disparities persisted at least into the second year of life. This study revealed also an independent risk to an existing child when a younger sibling is born within 18 months, with mortality at age one rising by at least 50 per cent in 16 of the countries examined.

- 1) What pattern of birth spacing is implied by adopting contraception at the point indicated by the Bellagio guidelines?
- 2) How does LAM compare with adopting contraception in the immediate post-partum period?
- 3) What would be the effects on birth spacing if the adoption of birth-control were delayed beyond the earliest of the return of menses and the child's reaching six months of age?
- 4) Does LAM offer better protection than a simpler post-partum strategy if rates of premature discontinuation of contraception are high?
- 5) What would be the effects on birth spacing if the Bellagio guidelines were extended beyond six months?

To address these questions, a microsimulation model was constructed to estimate the rates of conception and the intervals between successive live births that would result from various post-partum strategies of family planning. In contrast to earlier investigations that have estimated the effects of different contraceptive strategies on average conceptive delays (Potter, Masnick and Gendell 1973, Potter, Kobrin and Langsten 1979), our focus here is on distributional measures and, in particular, on the proportions of conceptions and births that occur at extremely short durations since the last birth. To frame the problem in its simplest terms, the models make no allowance for infant deaths, induced abortion or secondary sterility. In addition, they assume that couples resume sexual relations no later than the end of the sixth week post partum. A brief account of the simulation method and the input assumptions is contained in Appendix A.

One *caveat* is in order. Supplementary feeding cannot be incorporated explicitly into the simulation models owing to a lack of sufficiently detailed information on duration-specific conditional probabilities of resuming menstruation and ovulation according to supplementation status. In the absence of such information, we can yet study the implications of the Bellagio guidelines for birth-spacing in populations in which breastfeeding is unusually long and unusually intense.

The simulation models are based on results reported for the largest single prospective study of lactational amenorrhoea and anovulation yet conducted, a clinical investigation of members of the Nursing Mothers Association of Australia (Lewis et al. 1991). In this study, most infants were given no supplementary food before five months and the mean time to supplementation was as long as 5.3 months. Only one-quarter of the women breastfed exclusively for a full six months, however, and thus most could not benefit from the maximum term specified by the Bellagio guidelines (Short et al. 1991:715). The simulations nevertheless present a best-case scenario in terms of durations of lactation and lactational amenorrhoea since few women in developing countries have the leisure to breastfeed with the dedication exhibited by the participants in the Australian study. In rural Thailand, for example, three-quarters of mothers were estimated to breastfeed for at least one year, but their median duration of full breastfeeding was only slightly longer than four weeks (Knodel, Kamnuansilpa and Chamrathirong 1985:304-305); in a prospective study in Gaza, 83 per cent of women supplemented within three months (Anderson et al. 1986:154). Similarly, median durations of breastfeeding were found to exceed nine months in 17 of 28 WFS surveys; but in those surveys which included questions about the nature of feeding, unsupplemented breastfeeding accounted for only a small proportion of the total duration. For example, in the Philippines and Lesotho the median durations of breastfeeding were, respectively, 12.3 and 21.2 months but the median duration of full breastfeeding was, in each case, only 2.9 months (Leridon and Ferry 1985).

Conceptive delays

Pregnancy is not inevitable even in the absence of both breastfeeding and contraception. A preliminary step, therefore, is to establish the maximum and minimum proportions of women who could be expected to conceive within various durations under different patterns of post-partum behaviour.

The uppermost curve in Figure 1 shows the cumulative proportions conceiving by the end of each 30-day month of a hypothetical cohort of women who neither breastfeed nor use contraception. The input for this simulation comes from a prospective study of the return of the menses and ovulation among non-lactating women. The median duration of post-partum anovulation was 56 days and the maximum duration was less than five months (Cronin 1968). In this population six per cent of women would conceive within three months of the previous confinement, 46 per cent within six months and 84 per cent within one year. The simulation also illustrates the effect of heterogeneous fecundability on the rate of conception: in each month the most fecund are the most likely to conceive, and as highly fecund women are progressively filtered from the initial population the composition of the population still at risk of conceiving shifts toward the less fecund. Thus, the longer the waiting time to conception, the smaller the conditional probability of conceiving. For example, average monthly fecundability is initially 0.25 but decreases to 0.20 at six months, to 0.17 at 12 months and to 0.15 at 24 months.

Figure 1
Cumulative proportions of women conceiving, according to months post partum and breastfeeding and contraceptive statuses

The lowest curve simulates the cumulative probability of conceiving for breastfeeding women were they to adopt perfect contraception as soon as their menses return. This simulation is based on the distribution of the time to first menstruation during lactation reported by Lewis et al. (1991) in their prospective study of members of the Nursing Mothers Association of Australia. The proportions pregnant exceed zero very early on, and rise during the second semester, because ovulation may precede the first menstruation and because the probability of such an occurrence increases with the duration since the last confinement. Nevertheless, fewer than 0.5 per cent conceive within the first three months and fewer than two per cent conceive within the first six, and the proportion conceiving while in lactational amenorrhoea reaches only seven per cent at the end of one year. These estimates accord well with the supporting scientific evidence for the Bellagio consensus statement, and with calculations presented by Short et al. (1991) to illustrate the efficacy of the lactational amenorrhoea method.⁴

⁴ The results presented by Short and his colleagues diverge, however, from the simulations shown here in other, critical ways. Their estimates of proportions pregnant among non-breastfeeding, non-contracepting women should be comparable to the uppermost curve of Figure 1. Unfortunately, by assuming that, in the absence of breastfeeding, normal ovulation and sexual relations are resumed immediately after confinement, and, to a lesser extent, by assuming homogeneous fecundability, they exaggerate the potential fertility of non-lactating women and, hence, the effect of adopting perfect contraception when the menses return. They estimate that 25 per cent of women conceive

These two curves represent extremes. The proportions pregnant at three months range from a high of six per cent (achieved in the absence of both breastfeeding and contraception) down to 0.5 per cent (achieved when women breastfeed and then adopt perfect contraception when the menses return). The proportions pregnant within six months range from 46 per cent down to two per cent, and within one year from 84 per cent down to seven per cent.

An intermediate strategy is to breastfeed but not to adopt contraception. The middle curve therefore shows the proportions conceiving among a cohort of non-contraceptors who breastfeed until they conceive. In this case, we can expect three per cent of women to conceive within the first three months post partum, 14 per cent within six months and 51 per cent within one year. Thereafter, the curve converges rapidly to its upper limit, reaching 79 per cent by the end of 18 months and 92 per cent by the end of two years. Thus, while breastfeeding on its own provides a measure of protection against the risk of pregnancy, its contraceptive benefit is most evident during the immediate post-partum period and dissipates rapidly with increasing time since the last birth. Overall, among breastfeeding women, the effect of adopting perfect contraception when the menses return is to reduce the proportions pregnant at three months from three to 0.5 per cent, at six months from 14 to two per cent and at one year from 51 to seven per cent.

Lactational amenorrhoea and time to next birth

Not every conception results in a live birth. To show the implications of different patterns of post-partum behaviour for intervals between successive live births, the simulation model was extended to incorporate a heterogeneous risk of spontaneous foetal loss and gestation intervals specific to pregnancy outcome. In addition, the model generously assumes the same distribution of durations of post-partum amenorrhoea after a miscarriage or stillbirth as experienced by non-lactating women after a live birth.

Figure 2 shows the simulated proportions of breastfeeding non-contraceptors who bear another child according to the number of months since the preceding birth and, for comparison, the birth function for women who neither breastfeed nor use contraception. The latter curve represents a theoretical maximum which has never been observed. The median duration between successive births is only 16.4 months; overall, 60 per cent of birth intervals are shorter than 18 months and 84 per cent are shorter than two years. The results for our breastfeeding women are considerably better. The median birth interval rises by more than one-third, to 22.2 months. Nevertheless, four women in five have a birth interval no longer than two-and-one-half years; three women in five could expect to bear another child within 24 months of the previous birth, and one woman in four could expect to bear another child within only 18 months of the previous birth. Thus, breastfeeding alone reduces, but does not eliminate, high-risk short birth intervals.

These intervals are short, but such patterns of birth spacing are by no means unprecedented. Among the Hutterites of North America, for example, even shorter inter-livebirth intervals have been observed: 50 per cent of women bore a second child within 17.5 months of their first, and at birth orders up to and including the ninth the median times to a subsequent live birth ranged only between 19.0 and 21.7 months (Sheps 1965:72). Among the Hutterites breastfeeding was universal. Indeed, it was not uncommon for mothers to nurse their babies for more than one year, with weaning occurring only after another pregnancy had supervened. Nursing episodes were regulated, however, according to the dictates of rigid community schedules, and supplementation occurred as early as six weeks post partum (Huntington and Hostetler 1966). The fertility achieved by the Hutterites underscores the need for

during the first month post partum (as against none in the current simulations), that 58 per cent conceive within three months (as against a more realistic six per cent) and that 82 per cent conceive within six months (as against our 46 per cent).

breastfeeding to be full and for suckling episodes to be both frequent and intense if lactation is to have a substantial effect on the length of the period of post-partum infecundity.

Figure 2
Cumulative proportions of breastfeeding women bearing another child, according to months post partum and contraceptive status

It is difficult to imagine any circumstances in which a regimen producing birth intervals as short as those of our breastfeeding women would be advocated as a means of promoting the health of mother and child. Indeed, a principal aim of the Bellagio guidelines was to minimize the incidence of dangerously short birth intervals, particularly those shorter than two years. Yet, the spacing pattern shown in Figure 2 actually reflects the consequence of following the first of the two Bellagio recommendations, namely, that couples rely solely on breastfeeding to postpone the next birth if other birth-control methods are either not available or not desired.

The Lactational Amenorrhoea Method

The second, and major, Bellagio recommendation is that couples who need or want a high degree of protection should *consider* using contraception at the earliest of the return of the menses, the cessation of full breastfeeding and the child's reaching six months of age. As we have already seen in Figure 1, the proportion conceiving within the first six months post partum when perfect contraception is adopted at the onset of menstruation is consistent with the two per cent failure rate that the Bellagio consensus statement attributes to lactational amenorrhoea. This figure, impressive though it is, could be

misleading if interpreted as a likely outcome of applying the lactational amenorrhoea method.⁵ Not all women, even if fully breastfeeding, will remain lactationally infecund during the entire six-month period⁶; and none will be privileged to adopt perfect contraception. In any group relying on the lactational amenorrhoea method, the proportion conceiving within six months post partum will reflect in part the fecundity-reducing effect of breastfeeding. Nevertheless, of equal if not greater importance for conceptive delays will be the proportion of women who are again fecund and at risk of conceiving at each duration post partum, their promptness in initiating contraception when its need is first indicated, and their contraceptive practice after fecundity has returned.

Figure 3 illustrates the effects of adopting contraception affording different levels of protection at a point indicated by the application of LAM. These simulations are based on the durations of lactational amenorrhoea reported by Lewis et al. (1991). Contraceptive use is incorporated in the models by reducing each woman's fecundability by a constant factor sufficient to induce a designated failure rate in a group of fecund, non-lactating contraceptors during twelve months of continuous use. The failure rates encompass a wide span of contraceptive efficiencies⁷, having been chosen to reflect the range of outcomes to be expected from the use of different contraceptive methods. Thus, three per cent corresponds to the pill, eight per cent to condoms, 14 per cent to withdrawal, and 25 per cent to spermicides or the diaphragm (Trussell and Kost 1987, Trussell et al. 1990, Bracher and Santow 1992).⁸

Figure 3
Cumulative proportions conceiving among women using LAM, according to months post partum and contraceptive failure rate

5 Nor should it be confused with the conditional probability of conceiving for a lactationally amenorrhoeic woman; see Lobbok (1991:113).

6 More than 75 per cent of the 'enthusiastic' breastfeeders (Lewis et al. 1991:534) on whom the simulations are based managed to maintain lactational amenorrhoea for at least six months. Their experience, however, may be atypical. In a prospective study of non-contraceptors who were relying on lactational amenorrhoea to postpone the next pregnancy, Diaz et al. (1988:60-64) found that exclusive breastfeeding on demand maintained amenorrhoea and suppressed ovulation for as long as six months in fewer than 50 per cent of women. Moreover, while fewer than one per cent of lactating women conceived during amenorrhoea within the first six months post partum, over ten per cent of all lactating women conceived within that duration (Diaz et al. 1991:339-340).

7 For example, a first-year failure rate of three per cent corresponds to a monthly contraceptive efficiency as high as 0.99, while a first-year failure rate of 25 per cent corresponds to a monthly efficiency of only 0.90.

8 Given difficulties in user-application or in access to contraceptive supplies, the failure rate associated with any particular method could vary substantially from the levels assumed here. For example, Moreno and Goldman (1991) estimated for 15 countries in Latin America, North Africa and Asia that first-year failure probabilities for the pill ranged between five and twelve per cent.

There is little variation between the curves during the immediate post-partum period. At three months the cumulative proportions conceiving are in each case less than one per cent. Even at six months the proportions conceiving range only between two and four per cent. The reason for this is that at the shortest durations virtually all women, regardless of their breastfeeding status, will be amenorrhoeic; and even at six months most are still lactationally infecund. At longer durations, as the number of women protected by lactational infecundity falls and the number protected by contraception rises, the curves become increasingly differentiated according to contraceptive efficiency: fewer than three per cent of those using the most efficient method conceive within twelve months of the birth of the reference child, and fewer than five per cent conceive within two years; comparable proportions for those using the least efficient contraception are eleven and 32 per cent.

As a basis of comparison, Figure 4 presents cumulative probabilities of conceiving for lactating women who adopt contraception at six weeks post partum, that is, before they resume sexual relations. In general, the comparable simulated conception functions in Figures 3 and 4 differ by less than one percentage point. These small differences reflect conceptions that occur within the first six months and before the return of the menses. Thus, so long as women initiate contraception when its need is first indicated by the Bellagio guidelines, they fare almost as well, as a group, as those who adopt contraception several months earlier. Indeed, since most women are protected initially by lactational amenorrhoea and all couples adopt other birth-control measures within six months post partum, the

critical factor here is not the time at which contraception is introduced but the reliability of the method adopted and the application with which it is used.

Figure 4

Cumulative proportions conceiving among women adopting contraception at six weeks post partum, according to months post partum and contraceptive failure rate

Thus far the simulations have assumed that contraception is adopted as soon as its need is first indicated by the Bellagio guidelines. Nevertheless, although Kennedy et al. (1991) dismissed the possibility of delays in adopting contraception beyond this point, such delays could come about in any one of a number of ways. A set of rules as complex as LAM is open to misinterpretation. For example, a mother might believe that within the first six months post partum the continuation of amenorrhoea indicates the continuation of reduced fecundity even though she has introduced supplementary feeding. Secondly, a mother might forget the six-month rule and continue to rely on amenorrhoea alone after that milestone had been passed. Thirdly, adhering strictly to the protocol, a couple could wait until the first sign that fecundity is returning before *considering* the acceptable alternatives; even though they ultimately adopt contraception there may be some time during which they have placed themselves at risk of an unwanted pregnancy. Overshadowing these difficulties are the supply problems so common in developing countries: a couple may appreciate the need for the timely introduction of contraception and may have chosen their method early in the post-partum period, but their forethought will benefit them little if the method they have chosen is unavailable when it is actually needed.

To test the sensitivity of LAM to even quite conservative assumptions about delays in initiating contraception, a series of simulations was run in which one-third of women adopt contraception as soon as its need is indicated by LAM, one-third delay adopting contraception for one cycle and one-third

delay for two. The resulting estimates of cumulative proportions of women conceiving within durations post partum are presented in Figure 5.

The effect of introducing short delays in initiating contraception is remarkable, even though not all women will be fecund before the first, or even the second, menstruation. In contrast to the two preceding sets of simulations, the curves initially climb rapidly, reaching seven per cent at six months and as much as eleven per cent at eight months. The cumulative proportions conceiving within the first eight months are almost undifferentiated according to contraceptive efficiency because pregnancies occur during this period more as a result of women's being completely unprotected than as a result of contraceptive failure. Thereafter, as all women are using contraception, whether or not they are again fecund, the primacy of the effect of contraceptive efficiency asserts itself and the curves come to resemble those of Figures 3 and 4, albeit at much higher levels.

The serious implications of these gaps in contraceptive protection for the proportions of births occurring after extremely short intervals are apparent in Table 1. Among breastfeeding women who adopt contraception early in the post-partum period, only one per cent of those using the most efficient contraception bear another child within 24 months of their preceding birth, and only three per cent bear another child within 30 months. For those using the least efficient method, the proportions with birth intervals no longer than 24 and 30 months leap to 12 and 22 per cent respectively, but even with such inefficient contraception only four per cent of women bear another child within 18 months. The outcomes for lactating women who initiate protection when its need is first indicated by LAM are only slightly worse. In contrast, with even modest delays in adopting contraception, eight per cent of women using the most efficient contraception have a birth interval no longer than 18 months and nine per cent have a birth interval no longer than 24 months. Among women using the least efficient contraception the picture is even gloomier: ten per cent bear a second child within 18 months, 17 per cent within 24 months and 27 per cent within 30 months.

Figure 5
Cumulative proportions conceiving among women using LAM with delays, according to months post partum and contraceptive failure rate

Up to this point we have assumed, somewhat unrealistically, that contraceptive use, once established, continues until pregnancy intervenes. Nevertheless, an important practical concern is the premature discontinuation of contraception. Fears have often been expressed that in populations with high rates of contraceptive discontinuation and traditional practices that confer some post-partum protection, the early adoption of contraception, though not necessarily detrimental to infant and maternal health, may have little impact on birth spacing because substantial proportions of women may actually abandon contraception before or shortly after the return of fecundity (see, for example, Bhatia et al. 1982). Indeed, this may have been one of the concerns that motivated the Bellagio meeting in the first place.

Table 1
Simulated percentages of women with birth intervals no longer than 18, 24 and 30 months,
according to time of adoption of contraception and 12-month contraceptive failure rate

Time of adoption of contraception

Duration	6 weeks post partum				LAM				LAM with delays ¹			
	3%	Failure rate			3%	8%	Failure rate		3%	8%	Failure rate	
		8%	14%	25%			14%	25%			14%	25%
18	<1	1	2	4	2	3	4	6	8	9	9	10
24	1	4	7	12	3	5	8	14	9	11	13	17
30	3	8	12	22	4	8	13	23	10	14	18	27

¹Equal probabilities of adopting contraception in the first, second and third cycles after its need is first indicated by LAM.

Table 2 shows the implications for birth spacing of low, medium and high levels of premature contraceptive discontinuation according to the timing of the adoption of contraception and the efficiency of the contraception adopted. In light of the paucity of information on rates of contraceptive discontinuation in developing countries, both levels and patterns of contraceptive discontinuation must be assumed. The lowest level of discontinuation incorporated in the simulations is roughly comparable to one that we might expect in a developed country (Bracher and Santow 1992). As for patterns, we might expect discontinuation rates to fall with increasing duration of use as the population of users comes increasingly to comprise the more conscientious and motivated. This selectivity is incorporated in the models by holding the monthly probability of premature discontinuation constant for several months and then allowing various patterns of linear decline thereafter (see notes to Table 2). For low, medium and high variants respectively, the implied proportions of women prematurely abandoning contraception are six, ten and 19 per cent after four months of use, 15, 23 and 39 per cent after twelve months, and 23, 33 and 51 per cent after 24 months of use.

The upper panel of the table shows the proportions of women with birth intervals no longer than 18, 24 and 30 months for the low-contraceptive discontinuation variant. For each contraceptive failure rate and at each post-partum duration the proportion of post-partum acceptors who bear a second child is virtually indistinguishable from the corresponding proportion of women who adopt contraception as soon as its need is indicated by LAM. If one-third of the women using LAM delay initiating protection for one cycle and one-third delay for two, however, the proportions of women with short birth intervals rise markedly, and particularly those critical proportions with intervals no longer than 18 months.

Table 2
Simulated percentages of women with birth intervals no longer than 18, 24 and 30 months,
according to pattern of contraceptive discontinuation, time of adoption of contraception and 12-
month contraceptive failure rate

Duration	Time of adoption of contraception											
	6 weeks post partum				LAM				LAM with delays ¹			
	3%	8%	14%	25%	3%	8%	14%	25%	3%	8%	14%	25%
Low discontinuation²												
18	2	3	4	6	3	4	5	7	9	9	9	11
24	9	11	13	18	8	11	13	18	13	15	16	22
30	16	20	23	31	16	19	22	31	19	22	25	34
Medium discontinuation³												
18	3	5	5	6	4	5	5	7	9	10	10	12
24	13	16	17	21	12	14	16	20	16	18	19	24
30	23	27	30	37	21	24	28	35	25	28	31	37
High discontinuation⁴												
18	6	7	8	9	6	7	7	8	10	10	11	12
24	23	22	25	29	18	21	22	26	21	23	24	28
30	37	38	42	47	33	36	38	44	36	38	40	46

¹Equal probabilities of adopting contraception in the first, second and third cycles after its need is first indicated by LAM.

²Monthly probability of premature discontinuation equals 0.015 during the first three months of use, declines to 0.010 at 12 months and remains constant thereafter.

³Monthly probability of premature discontinuation equals 0.025 during the first four months, declines to 0.015 at 12 months and to 0.010 at 24 months.

⁴Monthly probability of premature discontinuation equals 0.050 during the first four months, declines to 0.025 at 12 months and to 0.010 at 24 months.

Similar patterns emerge in both the medium and high variants of contraceptive discontinuation. As one might have predicted, the superiority of initiating contraceptive protection in accordance with LAM over early post-partum adoption becomes evident only with high rather than medium or low discontinuation, with more rather than less efficient contraception and at longer durations. For example, with high contraceptive discontinuation and contraception with a three per cent failure rate, the proportion of birth intervals no longer than 24 months is 18 per cent with LAM but 23 per cent if contraception is adopted at six weeks post partum. Conversely, with medium discontinuation and contraception with a 25 per cent failure rate, the proportion of birth intervals no longer than 18 months is seven per cent with LAM and six per cent with post-partum adoption. As with the low discontinuation variant, however, even a short delay in introducing contraception after its need is first indicated by LAM increases the likelihood that a birth will occur within 18 months of the previous birth. Thus, in some circumstances, initiating contraception in accordance with the Bellagio guidelines may indeed be preferable to an early post-partum strategy. Nevertheless, the superiority of LAM

appears in many cases to be at best only marginal, to depend on the timely adoption of contraception and to be most evident only when contraceptive discontinuation rates are so high that, whatever contraceptive strategy is followed, the proportion of dangerously short birth intervals is unacceptably large.

Various modifications to the Bellagio guidelines have been suggested. The second publication of the Bellagio consensus statement held out the possibility of extending the six-month limit in populations with long breastfeeding (Kennedy et al. 1989). On the basis of new evidence about the fertility-inhibiting effects of lactational amenorrhoea, Kennedy et al. (1991: 109) then proposed moving 'beyond Bellagio' to a reliance on lactational infecundity alone, without considering supplementation, for at least six months. Short et al. (1991) have moved even further by proposing the abandonment of not only the full-breastfeeding requirement but the six-month limit as well.⁹ They suggest that well-nourished women who 'merely' wish to space their births might prefer to rely exclusively on lactational infecundity until their menses return: in developing countries 'where double protection is ... particularly wasteful' (p.716), they advocate a policy of postponing contraception until the first post-partum menstruation.

The implications of such a 'post-amenorrhoeic strategy' (Potter et al. 1973) are demonstrated in Figure 6, which shows cumulative proportions conceiving according to both contraceptive efficiency and the promptness with which contraception is initiated.¹⁰ None of the outcomes resulting from this strategy is ideal. Even with the universal adoption of highly efficient contraception at the first menses, eight and eleven per cent of women conceive again within twelve and 18 months respectively. If there are short delays in adopting efficient contraception, or if less efficient contraception is used, the situation rapidly deteriorates further. Indeed, during the first 18 months post partum even a short delay in initiating protection is sufficient to cancel the inherent benefit of using highly efficient contraception, and women would actually be better served by the timely adoption of a less efficient method.

The implications of these conceptive delays for birth spacing are shown in the upper panel of Table 3. If protection is initiated at the onset of menstruation the proportions bearing another child within 18 and 24 months are comparable with the timely adoption under LAM and low contraceptive discontinuation (shown in the central block of the upper panel of Table 2). With modest delays in adopting contraception beyond the return of the menses, however, the proportions of women bearing another child within 18 and 24 months are comparable with the delayed adoption under LAM and high contraceptive discontinuation (third block of the lowest panel of Table 2). With both delays and medium discontinuation the proportions of short intervals exceed any shown in Table 2. Even with the most efficient contraception one in four women bears a second child within two years of the first; with the least efficient contraception nearly one in three does so.

9 Any proposal to extend the Bellagio guidelines beyond the original six-month limit would in any event require relaxing or modifying the full breastfeeding requirement since, in most cases, after six months breastfeeding alone would be insufficient to satisfy a child's nutritional needs.

10 In simulations incorporating delays, equal proportions of women are assumed to adopt contraception at the first, second and third menses.

Figure 6
Cumulative proportions conceiving among women following a post-amenorrhoeic contraceptive strategy, according to months post partum and contraceptive failure rate

Finally, what happens if we revert to LAM, but extend the rule beyond six to, say, nine months? The implications are shown in the lower panel of Table 3. As one would expect, the outcome in each case is more favourable than relying on the first menses alone as a guide to when to adopt contraception. Nevertheless, comparisons with the second and third blocks of Table 1 and the third block of the central panel of Table 2 show clearly that the outcomes are markedly worse than when contraception is adopted according to the original six-month rule.

Table 3
Simulated percentages of women with birth intervals no longer than 18, 24 and 30 months,
according to time of adoption of contraception and 12-month contraceptive failure rate

Duration	Time of adoption of contraception											
	Immediately				Delays ¹				Delays + Medium discontinuation ²			
	3%	8%	14%	25%	3%	8%	14%	25%	3%	8%	14%	25%
First menses												
18	4	5	6	7	10	11	11	12	12	12	12	14
24	8	10	13	18	20	22	24	27	25	26	28	31
30	10	14	19	28	24	28	31	37	35	37	40	45
LAM at 9 months												
18	4	5	5	7	10	11	11	12	11	11	13	14
24	5	8	10	15	15	17	18	22	20	22	23	26
30	7	11	15	24	16	20	22	31	28	31	33	40

¹Equal probabilities of adopting contraception in the first, second and third cycles after its need is first indicated by LAM.

²Monthly probability of premature discontinuation equals 0.025 during the first four months, declines to 0.015 at 12 months and to 0.010 at 24 months.

We are now in a position to answer our original questions.

- 1) If contraception is initiated in perfect accordance with the Bellagio guidelines, between two and six per cent of women (depending on the efficiency of the method used) bear another child within 18 months, and between three and 14 per cent bear another child within two years.
- 2) The timely adoption of contraception under LAM produces outcomes that compare favourably with the results of immediate post-partum adoption of contraception. Nevertheless, the latter strategy reduces the possibility that an early ovulation unheralded by menstruation will lead to conception, and thus does reduce the risk of very short birth intervals.
- 3) Even a modest delay in adopting contraception after its need is indicated by the LAM protocol has serious consequences for birth spacing; this is despite the fact that normal ovulation need not occur before the first or even the second menstruation. Between eight and ten per cent of women bear a subsequent child within 18 months.
- 4) With low to medium rates of premature discontinuation (15-23 per cent of users abandoning contraception within the first twelve months of use), LAM does no better than the post-partum adoption of contraception. This applies only if LAM is followed perfectly; once some women delay adopting contraception the proportions of short birth intervals rise. For high rates of premature discontinuation (39 per cent of users abandoning contraception within the first twelve months), LAM performs better than the post-partum strategy, but the incidence of short intervals reaches an unacceptable level.

- 5) Extending the six-month limit of LAM to nine months raises appreciably the proportion of short birth intervals. Delays in adopting contraception thereafter would negate any benefits that might be conferred by relaxing the six-month rule. Abandoning the upper limit altogether and moving to a post-amenorrhoeic strategy of adoption would have unfortunate, and potentially disastrous, effects on birth spacing.

To sum up, when the duration of lactational amenorrhoea is typically long, the birth spacing achieved by initiating contraception at the point at which the Bellagio guidelines say its adoption should be *considered* is similar to that achieved by post-partum adoption of contraception, although a slightly greater proportion of birth intervals will be no longer than 18 months unless discontinuation rates are exceedingly high. In fact, had it been possible to introduce the timing of supplementary feeding explicitly into the simulation model, the outcomes implied by the two strategies would have been even closer since adding an extra criterion can serve only to shorten the post-partum duration at which the adoption of contraception is indicated under LAM. To realize this near equivalence, protection must be initiated as soon as the need for contraception is indicated by the original Bellagio guidelines: the six-month rule can be neither abandoned nor extended with safety, nor is it safe to delay adopting contraception for even one or two months. Finally, as long as contraception is adopted at the earlier of the cessation of full breastfeeding and the return of menstruation, and in any event no later than six months post partum, the major determinant of patterns of early birth spacing is not the rule used to determine when contraception should be adopted, but the inherent efficiency of the method, and the conscientiousness with which it is used.

Discussion

The simulations demonstrate that, in ideal circumstances, initiating contraceptive protection according to the Bellagio guidelines produces outcomes only slightly worse than those resulting from a simpler strategy of adopting contraception in the immediate post-partum period. The simulations additionally demonstrate, however, that the Bellagio guidelines do not obviate the need for good contraceptive practice. Even short delays in initiating protection after its need is indicated by LAM produce much poorer outcomes than the simpler strategy. Moreover, any gain in overall contraceptive coverage achieved by postponing the introduction of contraception is generally insufficient to offset the negative effects of premature contraceptive discontinuation. In the worst-case scenario, where 'there are no alternatives available or if a couple chooses not to use other family planning methods' (Family Health International 1988:1204), the contraceptive benefit of the lactational amenorrhoea method would be the same as relying on breastfeeding alone. Since the contraceptive benefits of breastfeeding are available to all lactating women regardless of whether they employ the lactational amenorrhoea method, and since the implementation of the Bellagio guidelines would place additional burdens on family-planning users and workers alike, it is natural to question why LAM should be advocated at all.

One reason might be related to double protection. Virtually all women will be anovulatory at six weeks post partum; and many, if still breastfeeding, will still be anovulatory at six months. The early post-partum adoption of contraception means that some women will be 'protected' by contraception even before they are again fecund. For women who adopt contraception at six weeks post partum rather than according to the Bellagio guidelines, the additional period of redundant protection (that is, over any redundant protection associated with LAM itself) could be as long as four and a half months. On

average, however, the period will be considerably shorter, since some women will have started supplementing or have experienced the first menstruation before their babies reach six months of age.¹¹

The use of mechanical or hormonal contraceptives during the period of double protection involves a financial cost that must be borne either by the individual couple or, if contraceptives are provided free of charge, by the State. This financial cost cannot be ignored even though the period during which it will be incurred is very short. On the other hand, since the early return of ovulation cannot be predicted for an individual woman, this double protection reduces the risk of conceiving very early in the post-partum period. Any accounting exercise would therefore also have to consider the financial, and emotional, costs of a mistimed pregnancy and the danger that it poses to the well-being of the mother and to the health, and even survival, of both the existing child and the new one.

A second cause for concern might be a fear that contraception may undermine the establishment and maintenance of breastfeeding. The most obvious target of concern is hormonal contraception.¹² It has often been recommended that oral contraceptives not be prescribed until six weeks post partum in order to allow breastfeeding to be successfully established beforehand (Hatcher et al. 1990:465-466); further, in light of the findings of studies conducted during the 1960s and 1970s that hormonal contraceptives can have deleterious effects on both the volume and composition of breast milk (GellŽn 1977, Hull 1981), it has sometimes been recommended that the use of hormonal contraceptives be delayed during lactational amenorrhoea until six months or more post partum.¹³ The latter recommendation pertains to combined oral contraceptives and, particularly, to high-dose oestrogen formulations. A recent World Health Organization study of the effects of hormonal contraceptives confirmed the findings of earlier studies (McCann et al. 1981) that, in the absence of infant or maternal malnutrition, there is no evidence of important adverse effects from progestogen-only contraceptives¹⁴; and concluded that such contraceptives may actually prove to be beneficial to lactation (WHO Task Force on Oral Contraceptives 1988).

In some cases, adopting contraception that does not interfere with lactation during the period of double protection could actually be advantageous for contraceptive continuation, by giving women time to establish successful use of their chosen method before the need for it becomes acute. Mini-pills, for example, must be taken at the same time each day, and the user may require time to establish a pill-taking routine (Hatcher et al. 1990:319). The risk of discontinuation of the IUD because of side effects, the most common cause of premature discontinuation of that method, is highest during the first few months and then diminishes over time, even within the first year of use (Bracher and Santow 1992).

11 For example, Kennedy et al. (1989:482) anticipated that supplementation will usually take place between the fourth and sixth months, as long as delaying supplementary feeding does not jeopardize infant health and development.

12 Non-appliance and barrier methods are clearly not a problem; neither is the IUD, medicated varieties of which release amounts of progestin too small to affect either the infant or the quantity of breastmilk (Hatcher et al. 1990:469).

13 See for example Gray and Huber (1983). In contrast, some authors have suggested that any potential hazard associated with hormonal contraceptives would be outweighed by their positive effect on birth spacing (McCann et al. 1981:555). Short (1984:29), in advocating the use of Depo-provera to protect the nursing period, pointed out that when a lactating woman becomes pregnant her milk also contains progestogen and oestrogen, a condition which the contraceptive was designed to prevent.

14 This is not to say that progestogen-only contraceptives pose a risk in malnourished populations; the WHO trials excluded from consideration mothers and babies with any sign of malnutrition, so there is simply no evidence either way.

Early adoption of these methods would allow women who are identified early on as unsuccessful users to switch to more compatible methods while the risk of conception is still low.

Many studies have observed an inverse relationship between breastfeeding and the use of contraception, and Millman (1985) has advanced several explanations for why this should be so. One is that the negative association reflects the adverse effects of contraceptives, and in particular high-dose pills, on lactation, but she does not put particular weight on this explanation since the negative association between breastfeeding and contraception has also been observed among women using non-hormonal methods.

Another explanation is that women substitute contraception for breastfeeding as a means of controlling their fertility. This substitution could be conscious, or unconscious. In the first case, Millman argues, women in the past may have been motivated to breastfeed, at least in part, by a desire to postpone conception.¹⁵ Recognizing greater surety in modern contraception (and, possibly, an incompatibility between contraception and breastfeeding), they choose the more efficient method.¹⁶ In the second case, women may simply take for granted the pattern of birth spacing associated with extended breastfeeding; yet breastfeeding durations have been shrinking, and with the menses returning more rapidly than previously, women may be prompted to adopt contraception in order to maintain the customary spacing between births.

A final explanation offered by Millman is that the relationship reflects the influence of a third factor that is associated negatively with breastfeeding and positively with contraceptive use. Attempts to identify a social or economic factor with these properties have been unrewarding. Yet this explanation holds considerable promise if one looks beyond socio-economic variables.

A promising candidate is sexual activity. Permeating the Bellagio recommendations, and many of the studies on which they draw, is the assumption that exposure to the risk of conception begins with the first normal ovulation. This ignores three critical, and interrelated facts. First, many women are not sexually active again by the time of first ovulation even if it occurs at six months post partum. Secondly, a very common precipitant of weaning in developing countries is a new pregnancy¹⁷, and many women live in anxiety that such a pregnancy will occur too soon. Thirdly, in many societies, steps are taken to prevent this by protecting at least some, if not all, of the period of lactation by post-partum sexual abstinence (Caldwell and Caldwell 1977, Page and Lesthaeghe 1980, Bracher and Santow 1982, van de Walle and TraorŽ 1986).

Women may see breastfeeding as incompatible with contraception simply because breastfeeding was traditionally seen as being incompatible with sex. Many women who are breastfeeding may not use contraception because they feel they do not need to: either they are not sexually active, in which case their decision is entirely correct; or, with their attention being focused on the new baby, who

15 Beliefs in the contraceptive effect of breastfeeding are well documented for both historical populations (McLaren 1990) and in contemporary societies (van Ginneken 1974). Nevertheless, the widespread recognition that conception can occur in the absence of menstruation, and the commonness with which weaning takes place after a subsequent conception, provide clear evidence that even completely traditional women were aware that not just breastfeeding, but lactational amenorrhoea, offer imperfect protection.

16 See also Gomez de Leon and Potter (1989). There is indeed some evidence that women, if faced with a choice between breastfeeding and oral contraception, may choose contraception; and fears have been expressed about the consequences for infant health in areas where there is no adequate substitute for breast milk (McCann et al. 1981).

17 Areas where this has been documented include Bangladesh, South India, North India, Punjab, Java, the Philippines, Taiwan, Yemen, Iran, Lebanon, Nigeria, Zaire, Uganda, Botswana, Kenya, Burkina Faso, Guatemala and Mexico; and, in North America, in the Alaskan Eskimo and Hutterite communities (Whiting 1963, McCann et al. 1981, Santow 1987, Trussell et al. 1989).

occupies them greatly during the day and with whom they sleep at night, their sexual activity is greatly reduced. Other breastfeeding women may feel uneasy that they are sexually active, and certainly may be embarrassed to admit that they are sexually active by seeking contraceptive advice. These are the women who need assistance to adopt contraception. They need to be reassured that breastfeeding and contraception are entirely compatible and, indeed, that the proper use of contraception can, by protecting the period of lactation, be positively beneficial to their babies' health.

For women who still live and bear their children according to traditional proscriptions and prescriptions, a recommendation that they adopt contraception either according to the Bellagio guidelines, or in the immediate post-partum period, is irrelevant. It is not these women, however, who are the primary target of concern. Our concern must lie, rather, with the women who are already in the process of abandoning the traditional birth-spacing practices that bind them to traditional roles and patterns of behaviour (Mosley et al. 1977) but who are not yet confident, and competent, users of modern contraception.

It would be unfair to criticize the Bellagio signatories for failing to consider this problem since they met to reach a consensus about the conditions under which breastfeeding can be used as a safe and effective method of contraception (Kennedy et al. 1989:478), not to consider the use of contraception by breastfeeding women (Kennedy et al. 1991:108). Yet, in choosing to address neither the problem of the use of contraception to protect the period of lactation, nor the confounding factor of the presence or absence of sexual activity, the Bellagio signatories have ignored an enormous area of need, and one in which a significant contribution remains to be made.

A major criticism of family-planning services is that women are seen just once, close to the time of delivery, and that there is no adequate follow-up (Winikoff and Mensch 1991). In contrast, LAM would require clinic staff and out-workers to teach the method to their clients, to follow them up at frequent intervals, to question them about their breastfeeding and menstrual statuses and to counsel them about their options once the point identified by the Bellagio guidelines had been reached.

Yet, this would not come without a cost and there would no guarantee of increased contraceptive coverage; indeed, contraceptive coverage could be considerably worse. Few would dispute the advantages of including LAM in family-planning programs if, in addition to teaching the Bellagio guidelines, health workers were occupied in promoting breastfeeding for its nutritional, immunological and anti-bacterial benefits, in monitoring infant development and maternal nutrition and intervening where necessary, in assisting women to find the contraceptive best suited to them and in coaching them in its use, in distributing contraceptives and ensuring contraceptive supplies, in assisting women to overcome problems that could otherwise lead to their discontinuing contraception and, in programs providing abortion, in offering this back-up should it be needed. It is possible, however, that the advocacy of LAM could serve to confuse women about the separate and complementary advantages of breastfeeding and contraception, and divert scarce resources from already inadequate health services. In this event, the Bellagio signatories, by broadcasting the message that it is safe to delay initiating contraception, and by failing to broadcast the message that it is unsafe to use no contraception at all, will have done, however unintentionally, a grave disservice to both their clients and their clients' children.

Appendix

The computer microsimulation model on which the analyses are based takes the members of hypothetical cohorts of 10,000 parturient women from the birth of one child to the conception and birth of the next.

Each woman is initially amenorrhoeic after the birth of a child. The model first takes her through a period of post-partum infecundity to the return of menstruation and first normal ovulation. Her duration

in the amenorrhoeic state is simulated by comparing a random probability with an input distribution of durations of post-partum amenorrhoea, the menses being said to return in the first month in which the random probability exceeds the input cumulative proportion still amenorrhoeic. The actual day of first menstruation is estimated using linear interpolation. The times to first menstruation are those reported for 101 well-nourished members of the Nursing Mothers' Association of Australia (Lewis et al. 1991:532-533). In this group, the mean time of introduction of supplementary foods was 161 days, and most women breastfed exclusively at least into the fifth month. Fewer than 25 per cent of the study population menstruated during lactation within six months post partum and only 70 per cent did so within twelve months; and the duration of lactational amenorrhoea ranged from a low of 35 days to a high of almost two years.

The overall durations of post-partum amenorrhoea and post-partum anovulation tend to be very similar, but the resumption of ovulation does not coincide exactly with the return of the menses. It has long been established that both the timing and the sequence of the first post-partum menstruation and ovulation are closely linked to the intensity and length of lactation (Perez et al. 1971, 1972). More recent studies have determined that even if ovulation precedes the first menstruation, a sizeable proportion of first ovulations are followed by an inadequate luteal phase, and therefore cannot lead to a pregnancy (Eslami et al. 1990, Gray et al. 1990).

Based on the findings of Lewis et al. (1991:532), the simulations assume, first, that the proportion of first menstruations preceded by ovulation increases linearly from 0.3 in the first three months post partum to 0.9 at twelve months and then remains constant thereafter; and, secondly, that the proportion of ovulations followed by a normal luteal phase is constant at 0.6. The simulations allow some variability between women in the lengths of menstrual cycles and, for individual women, in the lengths of cycles until normal ovarian function is resumed, with the average length declining from 32 days for the first cycle, to 30 days for the second and to 28 days for the third and succeeding cycles. These distributions are based also on results reported by Lewis et al. (1991:534). With these parameters, and assuming further that ovulation occurs randomly between 11 and 15 days before menstruation (Santow 1978:69-71), the timing of the first normal ovulation relative to the first post-partum menses ranges between -15 days to more than three months. The simulations assume that a woman's fecundability returns to its fixed value at the first normal ovulation.¹⁸

In a variant of the model that did not include breastfeeding, the timing of ovulation was simulated by direct reference to the durations of post-partum anovulation reported by Cronin (1968) for non-lactating women. In that case, the mean and median times from a live birth to the first ovulation are 74 and 56 days respectively, with a maximum duration of just 140 days.

Sexual relations are assumed to begin at six weeks post partum and, therefore, once normal ovulation has resumed a woman is again at risk of conceiving. To determine the timing of conception, the simulations incorporate heterogeneous fecundability, whereby the innate risk of a *recognized* pregnancy occurring varies between women but remains constant for each woman from one cycle to the next. Fecundability is represented by a beta function with mean and variance of 0.250 and 0.010

¹⁸ Some demographic studies have found that waiting times from first menses to conception are extended by maternal breastfeeding, and have inferred that breastfeeding depresses fecundability even beyond the return of the menses 'presumably as a result of a higher proportion of anovulatory cycles or a decreased probability that a fertilized ovum will implant' (VanLandingham, Trussell and Grummer-Strawn 1991:152). This inference, however, is open to question since the same effect would be observed if sexual activity were reduced during breastfeeding, if sleeping arrangements of mother and child precluded frequent sexual contact, or if fathers practised techniques of incomplete intercourse, such as coitus interruptus, during this period (Santow 1987). Only a clinical study can resolve this issue; and the simulations take a conservative approach to the question.

respectively (Leridon 1975:105-107). Conceptive delays are simulated by generating a series of random probabilities, with conception being said to take place in the first cycle at which the random probability is smaller than or equal to a woman's characteristic fecundability. The time from a live birth to the next conception is thus a function of the time a woman spends in the post-partum infecundable state, the number of fecund cycles until she conceives and the lengths of her menstrual cycles.

Once a woman has conceived, it remains to estimate the time to the next live birth. Since conception does not lead invariably to a live birth, it is necessary to allow first for the possibility of foetal loss. The risk of foetal loss is represented by a beta function with a mean of 0.144 and a variance of 0.014 (Santow and Bracher 1989), with an associated distribution of gestation periods ending in spontaneous foetal death with a mean of 3.2 lunar months (French and Bierman 1962). After a foetal loss, the woman experiences an additional period of post-partum infecundity, the distribution of which is assumed to be the same as that reported by Cronin (1968) for non-lactating women after a live birth.

The final input to the model is the live-birth gestation interval. This distribution is also taken from French and Bierman (1962), and has a mean of 10.5 lunar months. The simulation terminates at the earlier of 30 months post partum and the occurrence of a live birth, and the process is then repeated for the next member of the cohort.

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