

Timing and Management of Birth among the !Kung: Biocultural Interaction in Reproductive Adaptation

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The !Kung San, a band-level society of northwestern Botswana, were subsisting primarily by traditional methods of hunting and gathering into the 1970s. The basic facts of their culture, social organization, subsistence ecology, and demography have been well documented by Marshall (1976), Lee and DeVore (1976), Lee (1979), Howell (1979) and others. The purpose of this article is to consider the timing and management of birth among the !Kung as biocultural adaptation. Birth spacing and birth management are separate but interdependent aspects of the reproductive adaptation of this population. In each case it will be seen that while concepts of biological adaptation are necessary, they are not sufficient, since they enter into a complex web of factors that include cultural traditions as central.

For example, the !Kung are noncontracepting and nonabstinent, yet have low fertility, in apparent defiance of the laws of reproduction. They place little value on privacy, yet have a cultural ideal of solitary birth, in spite of grave medical risks of birth in this setting. We attempt to resolve these and other paradoxes, while demonstrating that only a biocultural approach can resolve them satisfactorily.

Since the !Kung are held by some archaeologists (e.g., Yellen 1977) to be relevant to the interpretation of some aspects of human adaptation during the paleolithic period of human evolution, these biocultural analyses may have relevance beyond the immediate interpretation of !Kung social ecology. But even if they do not, they still serve to illustrate the value of the approach in the interpretation of one society's reproductive adaptation.

Biocultural Control of !Kung Fertility

The !Kung are a noncontracepting, nonabstinent population with low natural fertility, high mortality, and a growth rate of approximately ½% per year. They have menarche at age 16½, first birth at 19½, last birth in the late 30s, and long

birth spacing, averaging 48 months in traditional bands; all these factors contribute to low fertility. Although individuals who have reached maturity can expect to live into their middle 50s, life expectancy at birth is approximately 32 years, determined mainly by high infant mortality—between 10 and 20% in the first year, almost all due to infectious disease. In the traditional situation, infanticide made a small additional contribution to mortality. The completed fertility of individual women averaged 4.7 live births, about half of whom survive to reproductive age (Howell 1979).

The late menarche and long birth spacing are probably due in part to occasionally suboptimal caloric intake and regular vigorous physical exertion (Howell 1979; Wilmsen 1978). Although they remain somewhat controversial, both of these factors, best summarized in the work of Frisch (1984), have been shown to cause primary or secondary amenorrhea in some populations. Recently it has been shown that even moderate exercise may subtly interfere with reproductive function in a manner previously unsuspected (Ellison and Lager 1986).

In addition, it has been assumed that prolonged and intensive nursing probably contributes to secondary amenorrhea and the long interbirth interval in this population (Lee 1979). Lee demonstrated a decline in the interbirth interval over a ten-year period during the 1960s and 1970s, corresponding to a trend toward increasing sedentarism and acculturation to the subsistence pattern of neighboring pastoralists. He also showed that at any given time the more sedentary bands had a shorter interbirth interval than the more traditional bands, and reasoned that the introduction of cow's milk as a supplementary infant food may have reduced the intensity and duration of nursing enough to cause the interbirth interval to decline.

Evidence for such an effect has steadily accumulated. Konner (1976) showed that the modal age of weaning in 1970 was between three and four years, with a small percentage of children, mainly boys, nursing beyond four years (Figure 1).

By 1975 the modal age of weaning was between two and three years, with no children nursing beyond four years (unpublished data). Konner and Worthman (1980) showed that the !Kung pattern of highly frequent nursing is related to amenorrhea and to low levels of the gonadal hormones estradiol and progesterone in nursing women. Figure 2 shows a day in the life of each of four infants, aged respectively four days, fifteen days, twelve months, and twenty months. Each horizontal line is an hour, the long dark bars are sleep, and the taller, open bars are nursing bouts. These can be seen to occur several times an hour.

A sample of 17 other mother-infant pairs observed for six hours each revealed an average of four nursing bouts per hour throughout the waking hours over the first two years of life. Mean duration of nursing bouts was two minutes. Frequency declined only slightly over the two years. In addition to this daytime pattern, all women reported nursing their infants at least several times during the night.

Amenorrheic nursing women up to twenty months postpartum had profoundly suppressed levels of estradiol and progesterone in serum collected at ten a.m. on two separate days, as shown in the same study (Konner and Worthman 1980). Fluctuations of the two gonadal hormones in a control sample of normally

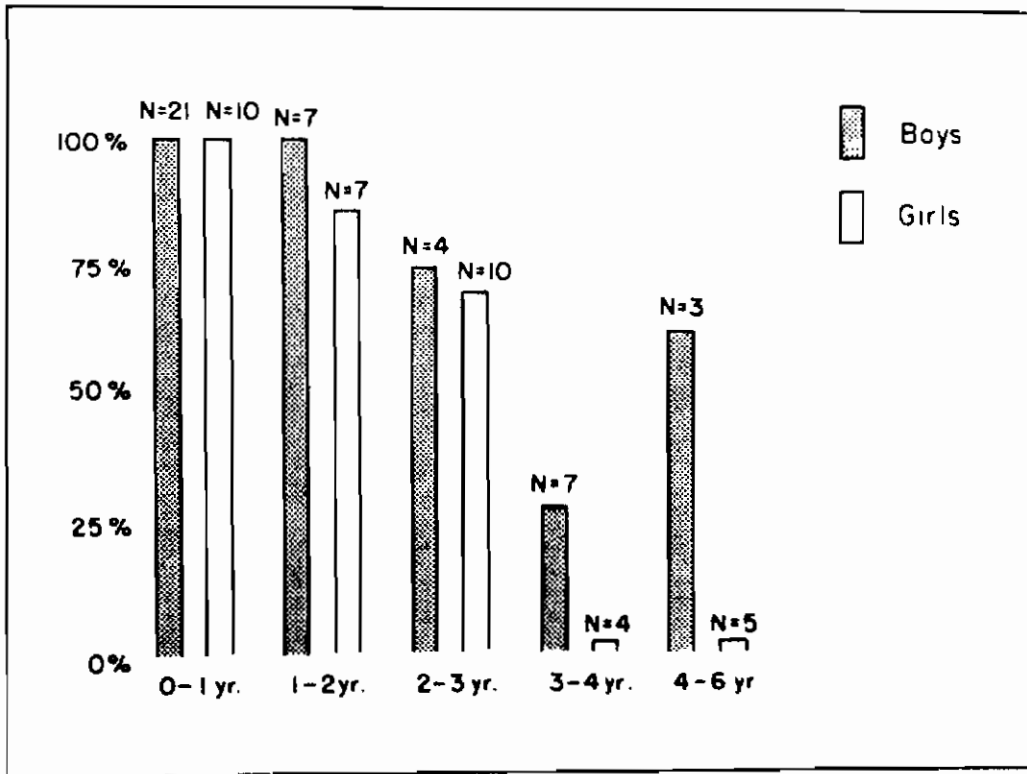


Figure 1.

Percentage of infants and children still nursing in a cross-sectional sample, by age and sex. The sex difference is significant (Fisher exact, $p < .05$) only if the children over 3 are considered separately.

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cycling !Kung women show a monthly pattern comparable to those of Western women. Values of the two hormones in amenorrheic nursing women, however, are lower than the lowest monthly values for the cycling women (Figure 3).

Perhaps the most interesting finding was that of a correlation between hormone levels and nursing frequency among the nursing women, with the mean time elapsed between nursing bouts serving as the best predictor of those levels. Based on many published studies of prolactin dynamics and its negative effect on fertility, Konner and Worthman reasoned that the release of that hormone by nipple stimulation causes amenorrhea through an antigonadal or antigonadotropic effect. Eventually, the lengthening interval between nursing bouts as the infant grows exceeds the half-life of prolactin in the mother's blood and thus disinhibits her gonadal function.

This proposed mechanism received further support several years later when prolactin levels were measured in a small sample of !Kung women (Figure 4). As hypothesized, amenorrheic nursing women among the !Kung had extremely high serum prolactin levels, much higher than nonnursing women or nursing women who had resumed cycling. These levels were also far above the range considered normal for nonnursing young women in American samples (Stern, Konner, Herman and Reichlin 1986) and are consistent with the high levels known to produce

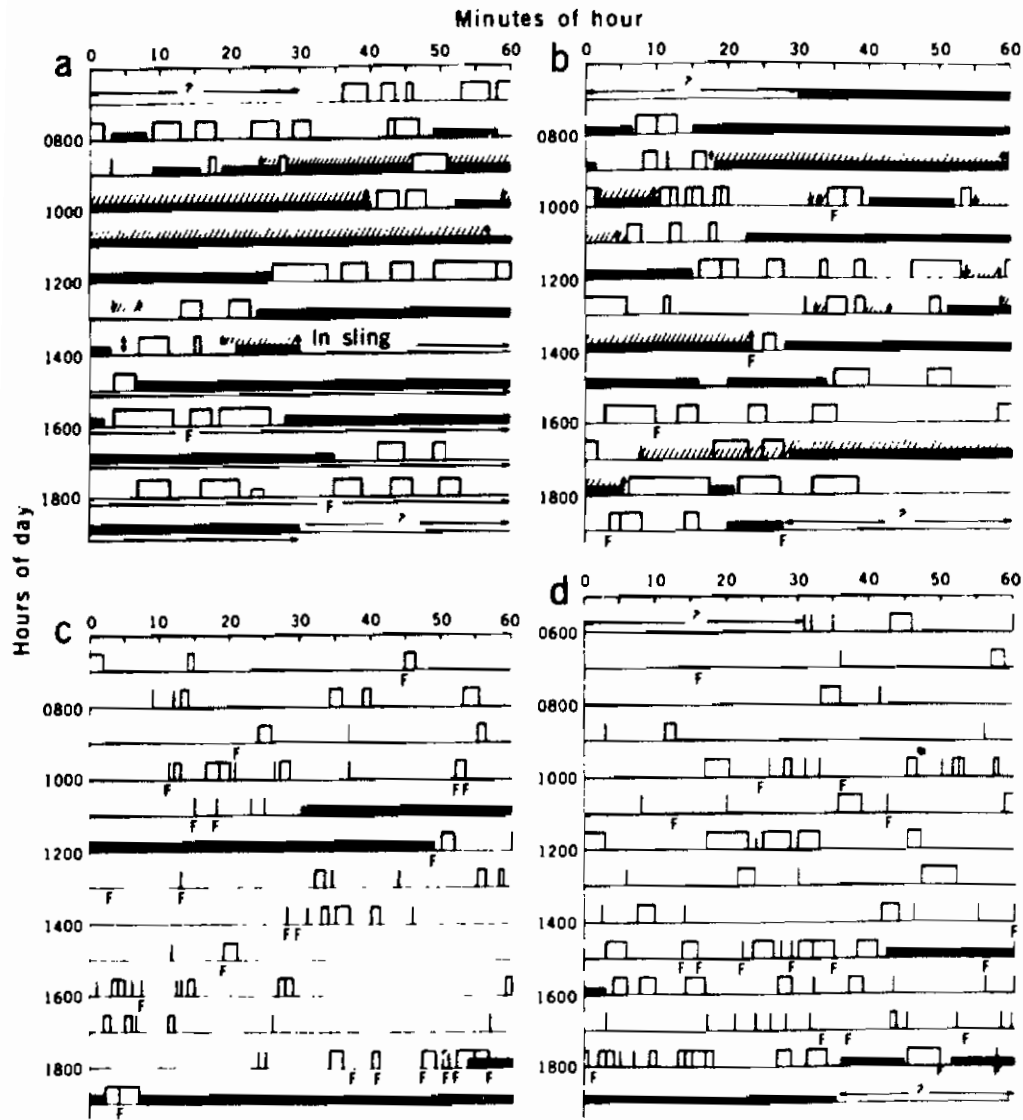


Figure 2.

A day in the life of each of four infants among the !Kung San: *a*, a 4-day-old boy; *b*, a 15-day-old boy; *c*, a 12-month-old girl; *d*, a 17-month-old boy. Each horizontal line is an hour. The long, dark bars are time asleep; the taller, open bars are nursing sessions.

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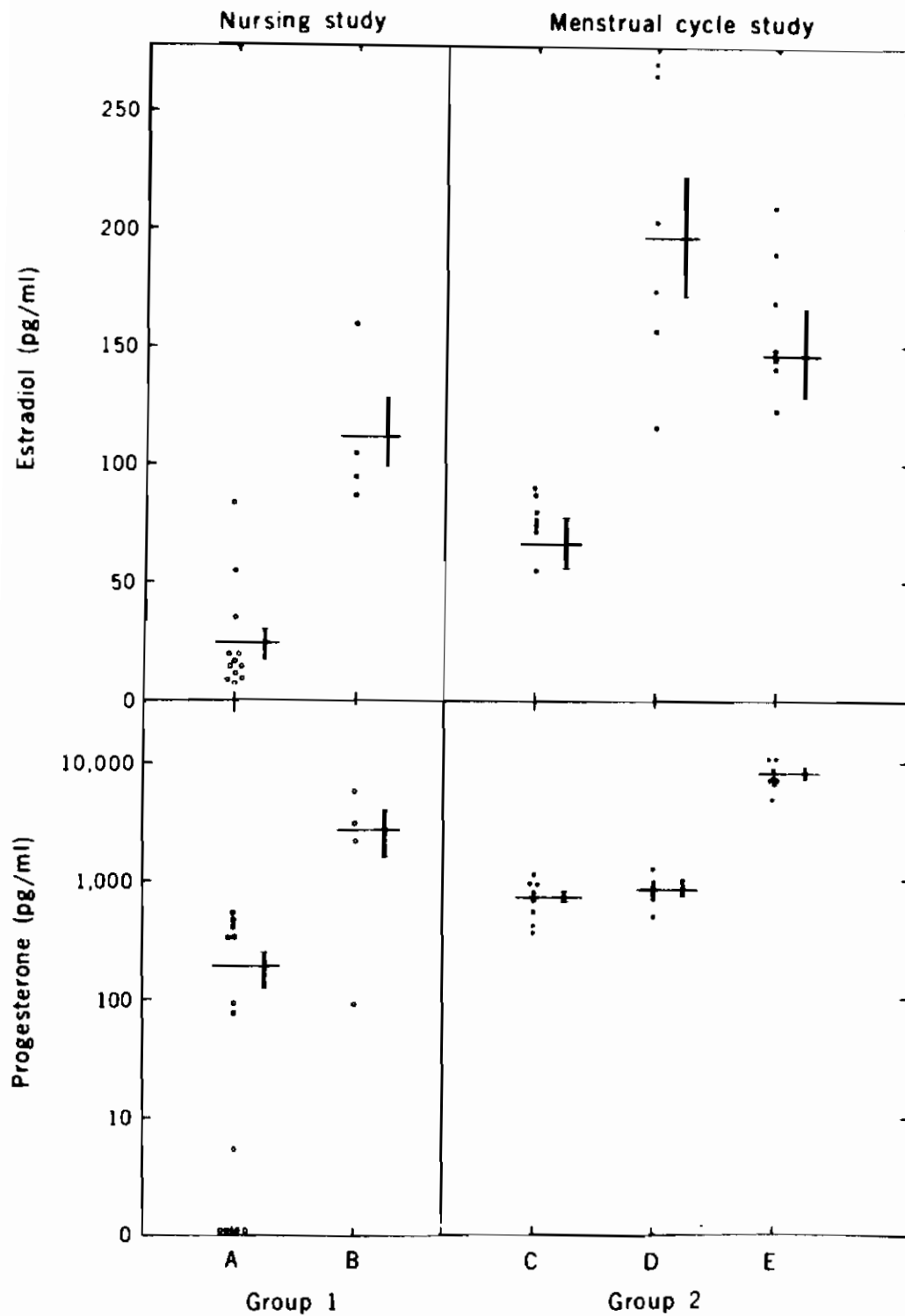


Figure 3.

Levels of estradiol and progesterone in three groups of !Kung San women. 1A, nursing and noncycling; 1B, nursing and cycling; 2, three phases of the monthly cycle in non-nursing, normally cycling women.

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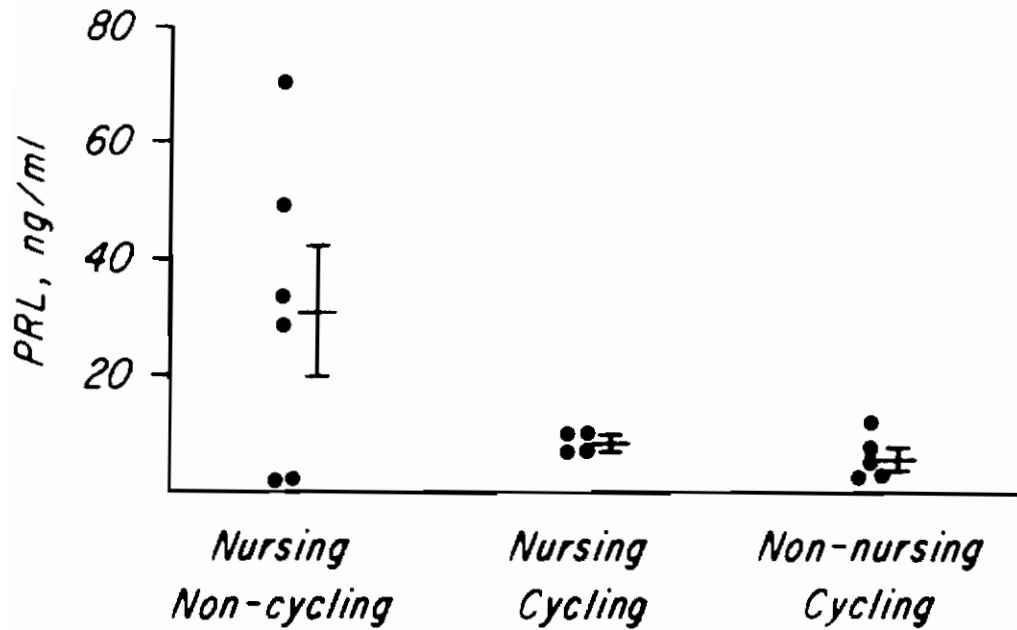


Figure 4.

Levels of prolactin in three groups of !Kung San women: nursing and noncycling; nursing and cycling; nonnursing and cycling.

amenorrhea in well-nourished, relatively sedentary American women with prolactin secreting tumors of the pituitary.

Partly to explore further the mechanism suggested by the !Kung studies, Elias, Stern, and others examined the reproductive effects of frequent nursing in American members of La Leche League, an organization devoted to the promotion of breastfeeding. Elias's group (Elias, Nicholson, and Konner 1986; Elias, Teas, Johnson, and Bora 1986) showed that frequently nursing La Leche League mothers had substantially longer postpartum amenorrhea than did a control group of standard breast feeding mothers. Stern's group (Stern, Konner, Herman, and Reichlin 1986) showed that prolactin levels in frequently nursing La Leche League mothers stayed far above the normal range during 24 hours of observation more than a year postpartum. Figure 5 shows such a 24-hour observation of prolactin measured every 20 minutes in a 28-year-old mother of 14-month-old twins. The frequent (by American standards) nursing bouts are shown on the bottom.

The La Leche League studies of Elias and Stern, as well as other investigations, including excellent studies in Edinburgh (Howie and McNeilly 1982) and among the Gainj of highland Papua New Guinea (Wood, Lai, Johnson, Campbell, and Maslar 1985) supported the proposed mechanism of birth spacing among the !Kung. The Boston and Edinburgh studies also demonstrated that neither prolonged postpartum amenorrhea nor elevated serum prolactin were dependent on nutritional or exercise stress specific to the !Kung setting.

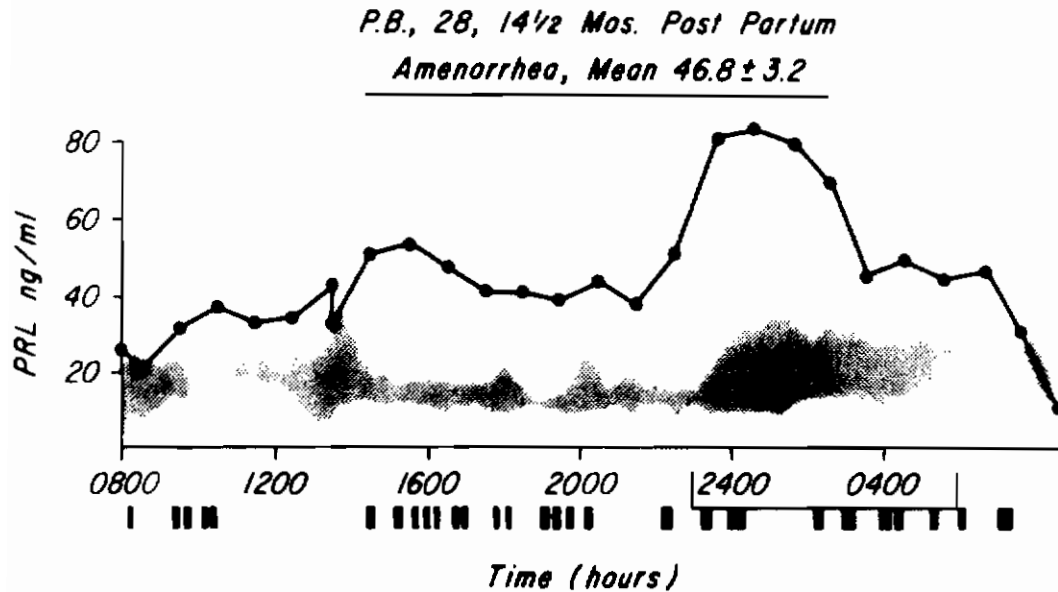


Figure 5.

Nursing and prolactin in a 24-hour period in one subject with nursing twins, from the La Leche League study of Stern, Konner, Herman, and Reichlin. Dark bars at the bottom are nursing sessions. Shaded area is normal range of prolactin from nonnursing women studied in the same laboratory.

Other possible complexities in the !Kung situation must be considered, however. Nutritional and exercise patterns could contribute to further lengthening of the interbirth interval beyond that seen in the Western samples. Furthermore, nutritional stress on the mother could compromise milk quantity or quality so as to increase nursing frequency by increasing the infant's demand for the breast. Also, there are at least two other mechanisms by which nipple stimulation may interfere with gonadal function without involving prolactin: (1) direct disruption of pulsatile secretion of gonadotropins at the level of the pituitary; or (2) effects of oxytocin, the milk-let-down hormone, on the uterine lining so as to interfere with implantation. Finally, despite the absence of a long formal postpartum sex taboo, the possibility of depression of coital frequency by the presence of a nursing infant throughout every night cannot be ruled out.

An attempt to model the biocultural regulation of fertility in this population is shown in Figure 6. Highly frequent nursing, viewed as a cultural choice, has at least three physiological consequences: release of prolactin, with antigonadal and possibly antigonadotropic effects; direct disruption of pulsatile secretion of gonadotropins; and release of oxytocin, with possible effects on implantation. These effects would be supported by periodic nutritional and exercise stress, if any, as well as by some contraceptive effect of the baby's presence on sexual inclinations. Marginally adequate infant nutrition may reinforce frequent nursing.

Kindreds maintaining this biocultural tradition should have more optimal birth spacing than those that do not, and should fare better in competition through natural selection (Lack 1966). Natural selection would thus reinforce not only the biological but also the cultural aspect of the adaptation. To the extent that this

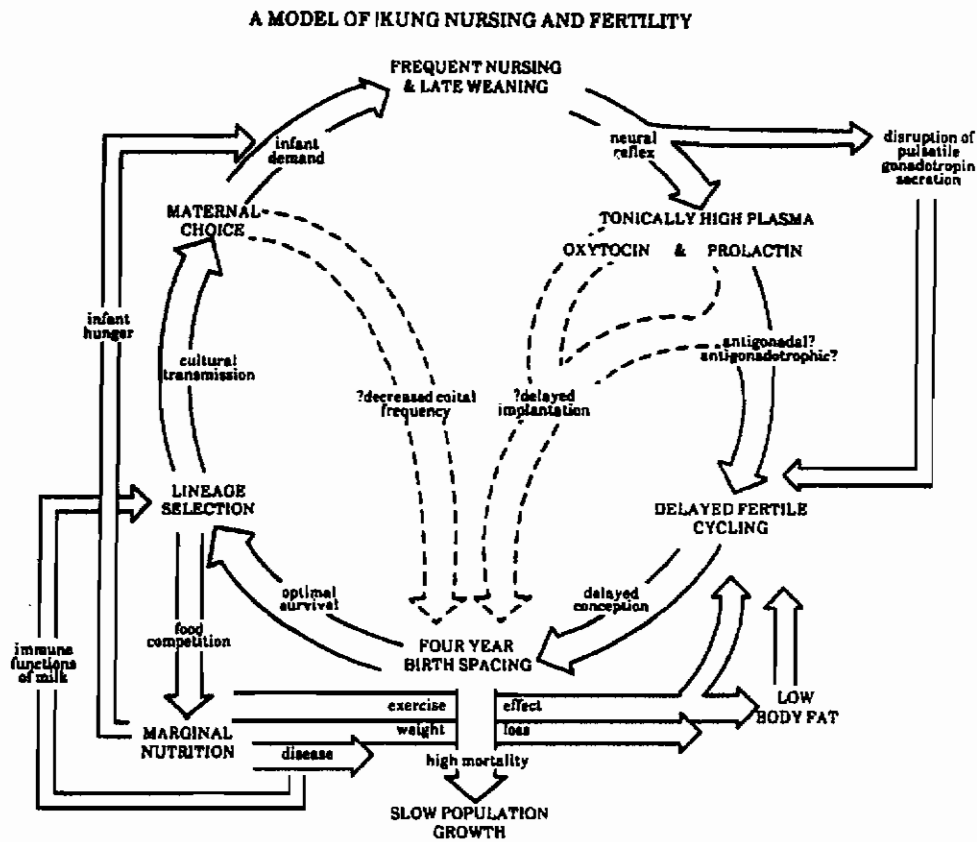


Figure 6.

A multifactorial model of the relationship of long birth spacing and slow population growth to frequent nursing and late weaning among the !Kung San. These relationships are seen in the context of other biological and cultural influences.

system might have operated in hunting and gathering populations during the paleolithic, it would have produced the extremely slow population growth believed to have been characteristic of human populations during that long epoch of pre-history. But in any case it seems a reasonable model for long birth spacing among the !Kung.

Management of Birth and the Ideal of Birth Conduct

The various birth-spacing mechanisms do eventually fail, and weaning occurs when the mother realizes she has become pregnant. According to the folk-view, continued nursing would be harmful to the fetus, the nursling, or both. (In modern terms, either competition for calories or the release of circulating oxytocin could be disadvantageous to the fetus, but it is difficult to see how the nursing

child could be adversely affected.) The !Kung place few or no restrictions on the pregnant woman, and the woman's usual round of vigorous walking and carrying involved in gathering continues virtually until labor begins. There is some expectation that a woman may be emotionally labile during pregnancy, and expressions of anger and other unusual emotional states are viewed as normal during this time.

Birth management among the !Kung takes the unusual form of what might be described as a cult of physical courage for women. They state explicitly that fear makes childbirth more difficult, and that it is a woman's responsibility to remain calm for her own safety and that of her baby. They favor the squatting position for delivery, and at least one woman identified lying down as another cause of difficulties in labor. However, reports of the pain involved in childbirth suggest an experience comparable to the one we are familiar with. Of 54 births to 14 women interviewed, only one labor was reported to have lasted more than 24 hours, although accurate estimates of length of labor were impossible to obtain. These births appeared to be distributed randomly over the day and night and over the phases of the moon.

The most noteworthy aspect of !Kung birth experience is the cultural ideal of giving birth entirely alone, which is a feature of the insistence upon courage in childbirth. The ideal !Kung woman is supposed to feel the initial labor pains, endure them without complaint and without informing anyone, go out to the bush alone at the appropriate time, deliver the baby and the afterbirth, cut the cord, and secure the baby's stability, all without assistance. Ideally, the baby's crying should be the first inkling people in the village-camp have of the delivery. Since they are well within earshot, any crying out by the mother would bring aid immediately. Often the baby's cries bring help, and this eventuality is not considered an embarrassment to the multiparous woman, as long as she has completed the birth herself.

In practice, this expectation does not apply to the first birth, and almost all primiparous laboring women have assistance, usually from female relatives. One exception to this rule was described by Shostak (1981), whose subject reported that she had been confused and in pain. By her own account she behaved ineptly and endangered the baby by leaving it in the bush, covered with leaves, while she went for help. Afterwards her husband bitterly chastised his female relatives, who had failed to help her. Interestingly, her residence in his band at the time was unusual, the more common pattern being matrilocality in the early years of marriage and patrilocality thereafter. After the labor she thought to herself in dismay, "I almost cried out in my husband's village."

Of the 54 births to 14 women mentioned above, the mother was entirely alone for the second stage of labor—that is, the delivery of the baby—in 57% of the cases. Figure 7 shows the number of women attending births and the proportion of women giving birth alone by parity in a slightly smaller sample. In the highest parities, almost all women give birth alone. For the larger sample, the cumulative percentage by parity is: primiparas, 0%; births 1 and 2, 9%; 1-3, 21%; 1-4, 31%; 1-5, 39%; 1-6, 44%; 1-7, 45%; 1-8, 52%; 1-9, 57%. Although the majority of births in the sample occurred without assistance, an individual woman

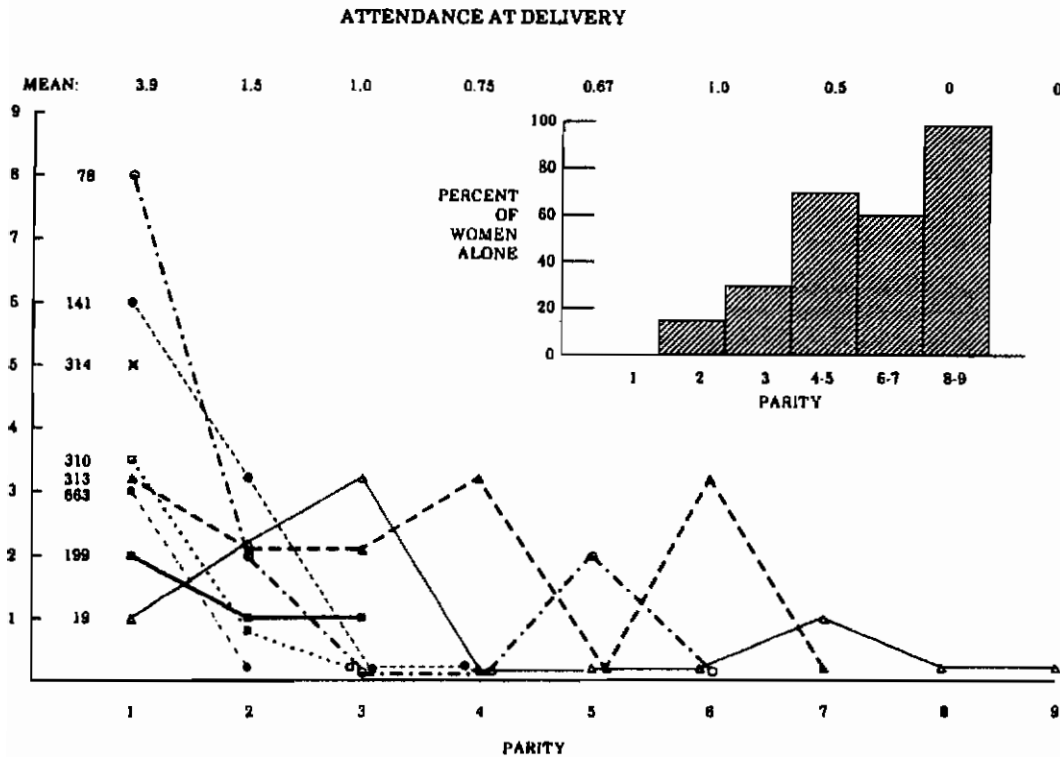


Figure 7.

Number of women attending delivery and percentage of women giving birth alone (inset) in relation to parity in !Kung women.

would not be likely to have had a majority of births alone until she reached a parity of eight. Since the mean lifetime fertility for the population is 4.7 live births, many women never achieve the ideal, and most would have the majority of their births assisted. There are no midwives or other specialized birth attendants in this society. Assistance is usually provided by one or two close older female relatives. In very difficult births the husband may be called to tie a string around the abdomen, a symbolic gesture believed to have medicinal powers and to speed delivery. Nevertheless, unassisted birth remains the conscious ideal, and it is achieved in the majority of later births.

Although !Kung women were reluctant to have us present even at attended births, one birth was attended by us during the third stage of labor, within minutes after the delivery of the baby and before the delivery of the placenta. Figure 8a shows a woman in her mid-thirties who has just delivered her seventh child with the assistance of her older sister and her mother. The sister has her arms around the waist of the laboring woman, who is in a squatting position, about to deliver the placenta. In Figure 8b the grandmother is holding the baby, cleaning him, and attempting to influence the shape of the head by a very mild form of molding. In



Figure 8a.
Events immediately following an attended birth in a multiparous !Kung woman.



Figure 8b.



Figure 8c.



Figure 8d.

Figures 8c and 8d, the mother has carried him back to the village-camp, is introducing him to his five-year-old sister, and is putting him to the breast, within two hours of the delivery. There seems to be substantial variation in the time when the infant is first put to the breast, however, with some women expressing the colostrum (believed to be harmful to the infant) and postponing nursing until true milk is being secreted. Observations of this parturient mother during and immediately after her delivery confirmed !Kung claims about the equanimity with which they react to birth and its aftermath. Although this mother had not been alone, she had been, by American standards, extraordinarily stoical.

Discussion

Highly frequent nursing and late weaning among !Kung hunter-gatherers appear to serve at least three adaptive functions: (1) nutritional stability for an infant growing in the face of high morbidity and mortality; (2) optimizing of birth spacing by suppressing fertility, so as to maximize the number of surviving offspring; and (3) frequent delivery of antibodies and macrophages to the infant's gut to combat enteric microorganisms. Constant mother-infant proximity also reduces the danger of predation, promotes the transfer of culturally stored knowledge, and insures that the mother will be exposed to, and raise antibodies against, the same microbes encountered by the infant.

The ideal of solitary birth among the !Kung is puzzling from an adaptive point of view. It appears to be dangerous more than just obstetrically. One multipara who gave birth alone in the middle of the night described herself as surrounded by barking dogs aroused by the smell of the products of labor. These were stray domesticated dogs, but were hungry enough to be dangerous, and could as easily have been wild dogs, jackals, hyenas, or lions. The obstetric risks seem obvious. Any untoward event that might require intervention becomes more dangerous if the birth is solitary. In addition, studies in our own society have shown that labor can be shortened by the presence of a supportive attendant known to the laboring woman, presumably through a psychological effect.

However, several explanations may be suggested. First, only a limited amount can be done by an untrained attendant to advance labor or avert obstetric disaster. The mother's distress cries in such a situation would be likely to bring assistance in any case. Second, one of the great sources of perinatal and puerperal maternal mortality throughout history has been infection, and the dawn of modern obstetrics in the 19th century is usually identified with the realization that these infections were introduced to their victims on the hands of birth attendants. Although this risk is much lower in a situation where an attendant sees only one laboring woman at a time, it would clearly be reduced further if the attendant were absent (Howell 1979). Third, if a birth defect or other extenuating circumstance should make infanticide a consideration, it might be advantageous for the woman to be alone in facing this decision.

Finally, the ideal of solitary birth can be viewed in the general framework of childbirth as an ideal of physical courage. The !Kung believe that fear and the

resulting tension are physically dangerous to the laboring woman and her baby. Therefore they elevate courage to the extreme of encouraging solitary birth, after an appropriate set of experiences with supportive attendants. This has the effect of minimizing fear through a combination of psychological preparedness and denial. The result appears to be a relatively successful and quite remarkable reproductive adaptation.

Conclusion

Both the timing and management of birth depend for their apparent adaptiveness on biocultural interactions. Optimal birth spacing is reached through a combination of factors, among which the nursing pattern is central. The cultural choice of close prolonged mother-infant proximity makes possible the invocation of a physiological mechanism for the suppression of ovulation through highly frequent nursing. Possibly this choice is reinforced proximally by a certain degree of hunger in the infant and ultimately by selective forces, such as disease and predation, which favor close mother-infant contact independently of the cultural tradition of child care. But undoubtedly this tradition serves to help maintain the adaptation and to reinforce it through cultural mechanisms. Finally, this bioculturally generated mechanism of prolonged mother-infant proximity also has cultural consequences that may be of great importance in !Kung psychological anthropology.

Similarly, the biological conundrum of birth without the protection of medical technology, indeed without a highly developed tradition of midwifery or expertise of any sort, cannot be solved except through the interaction of biological and cultural factors. The difficulty of birth is a biological fact, but the !Kung react to this difficulty with a unique cultural response—an ideal of physical courage for women, extending to solitary birth. They believe that the cultivation of this ideal and the conscious suppression of fear reduce the risk of unfortunate outcomes that might be precipitated by fear. This belief is not inconsistent with current knowledge of obstetrics, although this knowledge also indicates the value of a supportive person attending the laboring woman. The !Kung take advantage of this principle as well, during the generally more difficult first births, when they encourage the presence of helping individuals. Finally, the cultural ideal of solitary birth in the later parities may have the biological consequence of reducing the risk of infection, an important source of maternal and neonatal mortality.

Frequently in theoretical discussions about biological and cultural evolution we are asked to choose between these two alternatives and, in anthropology, to view the latter as a buffer against or replacement for the former. We have tried to demonstrate the inadequacy of this classic dichotomy, and to show that only a complex understanding of the way culture insinuates itself into biological adaptation, being influenced by and in turn influencing it, can suffice to explain !Kung reproductive processes. We suspect that this sort of model would also illuminate reproductive processes in other cultures. Since these processes are close to the

heart of biological adaptation for any population, it follows that biocultural analysis may be essential for the understanding of human evolution and adaptation in general.

Notes

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