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EFFECTS OF FERTILITY CHANGE ON MATERNAL AND CHILD SURVIVAL: PROSPECTS FOR SUB-SAHARAN AFRICA

by

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A B S T R A C T

In this paper, the potential effects of fertility change on maternal and child mortality in sub-Saharan Africa are estimated. Three aspects of both maternal and child mortality are examined: the current level of mortality; relative risks associated with family formation patterns; and exposure to risk factors.

Information on maternal mortality in sub-Saharan Africa is woefully sparse. Nevertheless, there is enough information to make the following statements. Maternal mortality in sub-Saharan Africa is still very high—probably well above 200 deaths per 100,000 live births in most areas. Using World Fertility Survey (WFS) data on child-bearing patterns and desires, and existing information on relative risk associated with maternal age, we estimate that if women who say they want no more children (and are not using effective contraceptives) had no more children, from 5 to 18 percent of maternal deaths in sub-Saharan Africa would be prevented (depending on the country).

While mortality rates among children younger than five have declined substantially during the last several decades, they are still the highest in the world. Published studies of WFS data, and our own analyses of WFS data tapes from Cameroon, Ghana and Kenya, show the following:

- Short birth intervals are associated with substantial excesses of mortality among children born either at the start or the end of such an interval. The excess in risk is strongest and most consistent during the first two years of life.

- The excess in deaths associated with short intervals is not explained by socio-economic status (as indicated by maternal education), maternal age, or birth order. In fact, birth interval is always a stronger predictor of death under age two than these other factors. Furthermore, control for these factors and for survival of the older child of the pair hardly reduced the relative risks of short interval.

- A number of possible explanations of the birth spacing effect were explored, including concentration of short-interval births among disadvantaged groups, competition for family resources among closely-spaced children, and maternal depletion. None of these theories appears to explain the powerful and persistent effect of birth spacing on child survival.

If all children were preceded by a birth interval of at least 24 months, infant mortality rates in sub-Saharan Africa would be reduced by an estimated 5-22 percent. Longer intervals would produce even greater reductions.

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TABLE OF CONTENTS

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INTRODUCTION

The effects of family formation patterns on the health of women and children have been explored in scores of studies carried out over the last fifty years. In spite of differences in time, place and methodology, strong patterns are apparent. For women, several factors are associated with increased morbidity and mortality during pregnancy: bearing children when younger than 18 or older than 35; having four or more children. For children, unfavorable maternal age, high birth order, and short birth intervals have been associated with increased morbidity and mortality, and decreased physical growth and intelligence test scores [Wray, 1971; Nortman, 1974; Maine, 1981].

Since only a few of the early studies of family formation patterns and maternal/child health were done in developing countries, it was recognized that better data from such countries were needed. In 1970 the World Health Organization (WHO) initiated an international collaborative study of family formation patterns and infant health. The results obtained in Colombia, Egypt, India, Iran, Lebanon, Pakistan, Philippines, Syria and Turkey, confirmed that unfavorable family formation patterns have negative effects in developing as well as affluent countries [Omran and Standley, 1976, 1981].

In the last few years, the World Fertility Survey (WFS) has provided researchers with an unprecedented wealth of information on infant mortality. The advantages of WFS data are both in scope and detail. In terms of scope, it has provided comparable data from large, systematic samples in more than 40 developing countries, including nine in SubSaharan Africa (SSA). In terms of detail, it permits us to study, in ways never before possible, the prevalence and relationship to child survival of such factors as short birth intervals.

The health situation in Africa today is complex. On one hand, using almost every available indicator of health status -- crude death rates, infant mortality rates, proportion of deaths under 5, life expectancy at birth -- health status in Africa is the worst in the world. Indicators of socioeconomic and environmental factors that affect health are consistent with this. On the other hand, for at least the last several decades, mortality rates (both crude and infant) have declined substantially.

Gwatkin, in a review of demographic change around the globe, observed that although life expectancy in Africa has increased rapidly since World War II, the overall level in SubSaharan Africa is still below 50 years [Gwatkin, 1981]. Furthermore, the rate of increase in life expectancy is beginning to slow at an appreciably lower level than in other regions. Gwatkin speculates that the initial declines in mortality were due to relatively simple Western medical technology that became available in the 1950s, such as antibiotics, immunizations and malaria control. Further decreases in mortality, especially among infants and young children, may require significant improvement in the standard of living. This is happening extremely slowly, if at all, in much of SubSaharan Africa.

Mortality and fertility are related in dynamic and complex ways. In Africa, the decline in mortality has not been offset by decreased fertility. Birth rates have declined minimally, if at all [World Bank, 1984]. The result, of course, is rapid population growth -- three percent per year for the continent as a whole [Kent, 1983].

In this paper, we will concentrate on one particular aspect of the relationship between mortality and fertility -- the direct or short-term effect of fertility on family health. "Direct" and "short-term" are relative terms. An example of a short-term effect is the increased likelihood of maternal death with increasing birth order. An example of an indirect or long-term effect might be that high birth order spurs population growth, thereby increasing the load on the medical system and perhaps lowering the quality of obstetric care, resulting in more maternal deaths.

Before we proceed, several qualifications are necessary. First, we will be dealing almost exclusively with the health of women and young children because these, so far as we know, are the family members whose health is directly affected by family formation patterns. Secondly, we will often be discussing survival, rather than health <u>per se</u>. This is because even in developed countries morbidity data are sparse. In Africa, more than any place else in the world, we must rely on mortality data since so many people have little or no contact with the modern medical system, and special health surveys are rare.

MATERNAL HEALTH

Life expectancy can be considered the "bottom line" in discussions of health. Table 1 shows that life expectancy in Africa as a whole is estimated to be 50 years -- 10-14 years less than in other parts of the Third World, 24 years less than in North America [Kent, 1983]. In most of SubSaharan Africa, life expectancy is less than 50 years.

Pregnancy and childbirth are major determinants of women's health. In developing countries, complications of pregnancy and delivery make up about one-quarter of all deaths among women of reproductive age [Chen, et al, 1974; Williams, 1979; Fortney, 1982]. By comparison, in the United States, maternal deaths comprise less than one percent of total deaths among women 15-49 [National Center for Health Statistics, 1984].

The second tier of Table 1 gives WHO ranges for maternal mortality rates (MMP). Again, the disadvantage faced by African women is clear. The minimum estimate for Africa is 160 deaths per 100,000 live births -- 10 times higher than the maximum in North America [WHO, 1983]. Only in South Asia do rates approach those in Africa.

The bottom tier of Table 1 shows the proportion of deliveries attended by trained medical personnel [WHO, 1983]. This is far lower in Africa (28 percent) than in Asia or Latin America (51 and 62 percent, respectively).

These data tell us something about the risks faced by women giving birth in Africa. From an epidemiologic viewpoint, the effect of fertility on the mortality among women can be measured in several ways. One is the overall risk of maternal mortality, i.e., the average risk of death associated with becoming pregnant in a given country. A second measure is the relative risk associated with pregnancy among various groups of women, e.g., maternal mortality among women of different ages. The public health importance of relative risk depends, in part, on the proportion of women in the population who fall into high risk groups -- i.e., the level of exposure to risk. Using data on risk and exposure, we can estimate the impact of family formation patterns on maternal mortality.

The Overall Risk of Maternal Death

While the WFS has provided a tremendous amount of information on child survival in Africa, very little has been learned about maternal mortality in the past decade. What information we do have comes from three sources: hospital studies, official records, and community surveys.

By far the most common form of information on maternal mortality in Africa is the hospital series -- i.e., a report on the number of deaths in a hospital compared to the number of deliveries there during a specified period of time. The major problem with such reports is that we cannot identify the population from which the patients are drawn, since most women in Africa deliver at home. In other words, we do not have appropriate denominators with which to derive rates. Doubts about the representativeness of hospital series data are substantiated by the common complaint of clinicians in Africa -- that many of the women who die under their care arrive in the hospital already moribund [Bullough, 1981; Aggarwal, 1980].

Despite these drawbacks, we need not disregard all hospital data. Some researchers provide separate MMRs for women who received prenatal care at the hospital ("booked" cases). The advantage of information on booked cases is that women who come for prenatal care can be considered to be a population within which some deaths occur. This reduces the bias that results from a heavy concentration of complicated deliveries.

Of the dozens of African hospital studies examined, only nine provide separate mortality rates for booked patients.* In these, the MMR among booked women ranged from 59 to 530 deaths per 100,000 deliveries, as Table 2 shows. The median MMR is 150. We do not know the reasons for the variation, but it is likely that patterns of "selection" into medical care are as important as true difference in the MMRs. For example, in countries where most women have no prenatal care, it is likely that booked women are more advantaged than average. While these data may still be flawed, they are more meaningful than are statistics that include unbooked patients as well. The MMR among unbooked patients is of~~ten 10 or more tim~~es that among booked cases in the same facility [Akingba, 1977].

Another source of data is studies of official records. By this we do not mean routine government reports of maternal mortality (which are notorious for underreporting), but special studies of official records. Typically, in such studies the numerator is derived from surveys of death records in as many

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* Throughout this paper, all relevant studies that we could find are included in text or tables.

sources as possible in a given area, and the denominator is the estimated number of births in the area during the same period of time. Four such studies were found, yielding MMRs of 103 to 172, with the median being 130.

A basic assumption in these special studies is that a large majority of maternal deaths (unlike births) either take place in health facilities or eventually come to the attention of the medical personnel. This is a questionable assumption. For example, one of the lower MMRs reported in Table 2 (103 deaths per 100,000 births) is from a study of official records in Malawi in 1977 [Bullough, 1981]. In this study, questionnaires were sent to hospitals and large maternity units, as well as any of the 92 smaller maternity centers that had noted a maternal death in its monthly reports. The reported deaths were divided by the expected number of births in the region during the study period. In this population, more than 60 percent of all births take place at home. However, all but six of the 118 reported deaths took place in medical facilities. Since a large proportion of maternal deaths in developing countries are caused by hemorrhage and eclampsia (which often lead to rapid death) it seems most unlikely that so few women died before they reached medical care. Thus, underestimation of the MMR seems certain, but its magnitude cannot be known. Suffice it to note that a study by the Centers for Disease Control found that during 1974-1978, maternal deaths in the United States were underreported by 20-30 percent [Smith, et al, 1984]. Assuming no greater underreporting of deaths in Malawi, the true death rate would be 124-134.

By far the best evidence on maternal deaths comes from community studies, but these are rare. The findings of recent community studies in SubSaharan Africa are shown in Table 2. The MMR ranges from 400 in Ghana to 700 in Senegal. (Another study, in rural South Africa, produced a MMR of 550, but this was based on a sample of only two deaths [Larsen, 1983].) These figures fall around the middle of the range of MMRs in Africa provided by the WHO: 160-1,100 (see Table 1). For comparison, a community study in Egypt found a MMR of 190 [Fortney and Rodgers, 1984]. Considering that the average life expectancy in Egypt is 56 years, compared to less than 50 years in SSA, this difference in MMRs does not seem unreasonable [Kent, 1983].

What can we deduce from this relatively meager collection of data? Most of the studies shown in Table 2 present conservative estimates, avoiding the wildly inflated rates found in hopital studies that include unbooked patients. Among the studies of booked patients and official records, the median MMR is 138. The recent community studies (the preferred source of data) produce a range of 400-700 deaths per 100,000. It is credible that maternal deaths in SubSaharan Africa are this common? Quite possibly, considering that in 1920, when the life expectancy for women in the United States was 55, the MMR was a staggering 800 for the total population, and even higher among minorities [New York, 1933].

When discussing the risks of childbearing to women's health, it is necessary to consider the risks of avoiding pregnancy. Over the two decades since oral contraceptives reached the market, probably more information has been gathered on their effects than on those of any other substance in human history. Hundreds of studies have been done on IUDs and other methods as well. To the best of our knowledge, use of any one of these methods by women in developed countries is far safer than pregnancy and childbirth, with the exception of use of the pill by older women who smoke [Ory, et al, 1980; Ory, 1984].

Not surprisingly, data from developing countries on the side effects of modern methods of contraception are virtually nonexistent, and the issues are complex. On one hand, it might be that common health problems in poor countries interact with contraceptives to produce side effects that are either not seen or not common in industrialized countries. However, this possibility has not been substantiated. On the other hand, it may be that use of effective contraception is even more beneficial to women in poor countries whose health is more fragile to begin with. There is some support for this view. For example, preliminary results of the Menoufia study found that "in spite of less than optimal medical supervision, the practice of contraception in a developing country is safer than the alternative," i.e., pregnancy [Fortney, 1982].

Finally, the above remarks refer to the use of modern methods of contraception. Women who resort to illicit abortion in order to avoid having a child are at very high risk of serious complications and death in most developing countries. Tens of thousands of Third World women die from illegal abortions every year [Rochat, 1980; Liskin, 1980]. While deaths from illicit abortion are less common in SSA than in other parts of the world, they are certainly not unknown [Ojo and Savage, 1974]. Furthermore, clinicians in SSA report an increase in young women suffering the effects of illegal abortions [Akingba, 1977]. Only if birth planning is accomplished by safe methods do the health benefits to women discussed below apply.

Relative Risks of Maternal Mortality

Maternal Age

The overall risk of maternal death is largely determined by factors that affect the standard of living, such as era (e.g., before or after the invention of antibiotics), country, socioeconomic status and access to medical care. Unfortunately, there is usually little an individual or family can do to change these factors. There are a number of factors, however, that also affect the risk of maternal mortality and are, to some extent, under women's control: the age at which they give birth, and the number and spacing of births. It is these factors we will consider under relative risks.

Numerous studies spanning continents and decades have shown that adolescents and women 35 or older are much more likely than are women in their 20s to die as a result of pregnancy [Nortman, 1974; Maine, 1981]. This relationship is not dependent on socioeconomic status. In fact, in her landmark review and analysis of the literature, Nortman observed that the effect of age on maternal mortality is stronger in countries that have low rates of maternal deaths (e.g., European countries) than in those with high rates [Nortman, 1974].

Regardless of the level of maternal mortality, the effect of age is impressive. Figure 1 shows the relative risk of maternal death by age in Nortman's "high mortality" group of countries. In this group of countries (as in the low- and medium-mortality groups) women in their early 20s had the lowest rates of maternal death. In Figure 1, women younger than 20 are half again as likely to die of complications of pregnancy or childbirth as are women aged 20-24. At age 25 the rate starts to rise again, until women 40-44 have a MMR nearly five times that of women 20-24.

The shortcomings of African data on maternal mortality are especially pronounced when one tries to specify rates for subgroups, such as age groups. Consequently, most analyses of this type use Asian and Latin American data. For example, none of the high mortality countries in Nortman's study were African. To what extent, then, does age affect maternal mortality in Africa?

Figure 2 shows maternal mortality by age in Zaria Hospital in Nigeria during 1976-1979 [Harrison and Rossiter, 1980]. These data are drawn from a series of 22,000 deliveries among both booked and unbooked patients -- as is usually the case, there were not enough booked patients to derive MMRs for different age groups. The excess of deaths among women in their early teens is clear. Fifteen-year-olds had almost seven times the risk of death of women aged 20-24. Women on either side of the "ideal" age group -- those aged 17-19 or 25-29 -- had MMRs elevated by 30 percent. Among 16-year-olds and women 30 and older, the risk of dying was 2.5 times that of women aged 20-24. (The available data did not permit creation of more conventional age groups.) These data indicate that maternal mortality in Africa is affected by age in much the same way as in other areas.

Parity

For decades, studies have consistently shown that maternal mortality varies with parity as well as with maternal age. In general, maternal mortality is slightly elevated among women having their first birth, lowest among women having their second or third child, and increases sharply thereafter [Nortman, 1974; Maine, 1981]. As is the case with age and mortality, this relationship has been documented in a wide variety of settings, and has held up as maternal mortality rates declined dramatically during this century.

The relationship between parity and maternal mortality in Africa is even less well documented than that between mortality and age. Even so, the few fragments of information we do have indicate that Africa is no different than the rest of the world in this respect. Figure 3 shows the relative risk of maternal death by parity in a hospital in Senegal during 1971-1975 [Correa, 1978]. As usual, the curve is J-shaped, although there are several notable features. First, the relative risk of death among women having their first birth is higher than in some other studies. This might be due to the young age at first birth in Senegal. Secondly, the relative risk is slightly higher among women having their second birth than among those having their third. This might be because approximately one-fifth of women younger than 20 were having their second or later birth.

This brings up the issue of interaction between age and parity as they affect maternal mortality. Of necessity, as women have more children they are also getting older. Consequently, when one looks at either age or parity, some of the observed effect is probably due to the other. There have, however, been large studies in industrialized countries where the effects of age were controlled while those of parity were examined [Nortman, 1974]. These showed that both age and parity influence maternal mortality independently.

Birth Interval

Over the years, as evidence of an effect of birth spacing on infant mortality has accumulated, people have speculated about a similar effect on maternal mortality. Having children very close together must be hard on women, especially poor women, the reasoning goes. It was hypothesized that this strain on the mother's body (named the "maternal depletion syndrome" by Jelliffe), might be one of the ways in which birth spacing affects infant health [Jelliffe, 1966]. As sensible as this seems, no direct evidence of the maternal depletion syndrome has been found, but there is indirect evidence. Nortman observed that the optimal age for maternal survival increases with parity [Nortman, 1974]. Since this cannot be either an age or a parity effect, it seems to be a spacing effect. Thus, while we can infer that closely spaced births are harmful to women's health, the effect is not nearly as strong as on infant and child health.

Exposure to Risk of Maternal Mortality

The importance of the relative risks discussed above depends, to a large extent, on the proportion of pregnancies that carry high risk. For example, the high risk to maternal health associated with giving birth after age 40 is of little consequence in the United States because it has become an uncommon event. In SubSaharan Africa, on the other hand, women generally marry early, have their first birth soon afterwards, and continue to have children until they are in their late 30s or early 40s. (There is, of course, considerable variation within and among countries.)

Maternal Age

Table 3 shows the proportion of all births that are to women in high-risk age groups in nine SubSaharan and two North African countries. The proportion of total births that are to women 15-19 ranged from six percent in Tunisia to 23 percent in Cameroon. There was less variation in births to older women: 8-15 percent among those aged 35-39; 3-13 percent among women 40-49. The last column of Table 3 shows the proportion of all births that take place in unfavorable age groups. This is lowest in Benin (25 percent) and highest in Kenya (38 percent). In general, about one-third of all births occured at ages when the woman is at increased risk of serious complications and death.

Parity

Unless pregnancies are very widely spaced, continuing childbearing into their late 30s and early 40s is a sign that women are attaining very high parity. This is the case in Africa where fertility is higher than in other parts of the world. The the Total Fertility Rates (TFRs)* are 4.1 and 4.3 in Asia and

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* The Total Fertility Rate (TFR) is a synthetic rate, representing childbearing in an imaginary cohort. It is the number of children an average woman would have during her lifetime if she conformed to the age-specific fertility rates current at the time of the survey.

Latin America, respectively, compared to 6.5 in Africa [Kent, 1983]. Kenya has the highest TFR in the world -- 8.0.

Actually, the TFR (being a kind of 'average') doesn't express what large families many African women have. As Table 4 shows, among women who have, for the most part, completed their childbearing (i.e., aged 45-49), at least one-third of women in the African countries for which we have data have borne seven or more children. In most of these countries, the proportion is more than one-half. In some societies, family size in one's grandparents' generation seems large when compared to current standards. However, it is important to remember that the large families cited above are not relics of the past. We have no evidence that fertility rates are declining substantially in these countries.

The Potential for Averting Maternal Deaths

A number of researchers have made estimates of the proportions of maternal deaths that might be averted with a given change in childbearing patterns [Nortman, 1974; Trussel and Pebley, 1984]. However, they either did not have or did not take advantage of the kinds of information that the WFS provides. They assumed that, for example, women 35 or older no longer gave birth. But they did not take into account whether or not such births were wanted.

The WFS provides data on the number of women in each age group who say they want no more children. Therefore, we can use women's own fertility desires to estimate the proportion of births that might be averted in the future through the use of contraception.* Although these data have shortcomings, using women's stated desires definitely seems preferable to the alternatives.

In addition, using WFS data we can determine the proportions of women who want no more children that are already using effective methods of contraception. If we didn't have this information, we would be doublecounting -- i.e., counting among the deaths that could be averted some that already are being averted.

The proportion of women who say they want no more children is much higher in North Africa (47-53 percent) than in SSA (4-17 percent), as Table 5 shows. Table 5 also shows the proportion of women who want no more children that were using an efficient method of contraception at the time of the WFS survey. This proportion is 4-17 percent in the seven SSA countries, compared to 46 percent in Egypt, and 48 percent in Tunisia.

Table 6 show estimates of the proportion of deaths that could be prevented if all unwanted births were averted through use of effective methods of contraception if women in all age groups who say they want no more children (and are not currently using an efficient method of contraception) realized their desires and had no more births. (The methodology used is

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* This is not to say that these data are necessarily predictive. Some women who say they want no more children, and are exposed to the risk of pregnancy, do not use effective methods of contraception even when there is no apparent physical or financial barrier to access. On the other hand, it is quite likely that there are a good many women (perhaps especially in Africa) who will not say to a stranger that they want no more children, even though that is the truth.

presented in Appendix 1.) In Egypt, where half of currently married, fecund women say they want no more children, the reduction would be largest (28 percent), followed closely by Tunisia (26 percent). In the six SSA countries for which we have the necessary data, an estimated 5-18 percent of maternal deaths would be averted. While lower than in Egypt, these are still substantial reductions, especially when one remembers how common maternal deaths are in these countries.

Another way to conceptualize the reduction in maternal deaths possible with the use of family planning is to focus on the risk to an individual woman. While infant death is a one-time risk, women face the risk of maternal death repeatedly. Consequently, even if we ignore the increasing risk per pregnancy with age and birth order, a woman's chances of dying are multiplied by the number of births she has. Thus, reducing the average completed family size Kenya from eight to six children would reduce the number of maternal deaths by at least one-quarter.

INFANT AND CHILD HEALTH

The Overall Risk of Infant and Child Death

In 1982, infant mortality in SSA ranged from 77 deaths per 1,000 live births in Kenya, to 190 in Sierra Leone, with most countries having rates between 100 and 140 [World Bank, 1984]. (See Table 7.) (These figures are estimates based on census and survey data since vital registration in most African countries is far from complete.) Child mortality rates (deaths at 1 to 5 years) ranged from 13 deaths per 1,000 children per year in Kenya, to 39 in Angola, with most countries having rates of 20 to 30. These rates mean that in many SSA countries, one-fifth to one-quarter of children die before their fifth birthday.

Although these rates are among the highest in the world, they are considerably lower than they were two decades ago. As Table 7 shows, in about half of the 32 SSA countries, infant mortality declined by 20-30 percent during 1960-1982. Child mortality declined by at least 40 percent in two-thirds of the countries shown.

~~A thorough~~ discussion of the determinants of child mortality is beyond the scope of this paper. As is the case with maternal mortality, the national level of infant and child mortality reflects many of the factors that comprise standard of living. The focus of this paper is risks associated with certain aspects of family formation -- i.e., birth interval, birth order, and maternal age, but it is important to remember that socioeconomic status has a strong influence on mortality even when these factors are controlled [Hobcraft, et al., 1984; McNamara, 1985].

Relative Risks of Infant and Child Death

Birth Order and Maternal Age

Traditionally, studies examining the relationship of birth order to infant mortality have shown U-shaped or J-shaped curves. That is, mortality is lowest among second and third children [Nortman, 1974; Wray, 1971; Maine, 1981]. The relationship between infant/child mortality and family formation patterns in SubSaharan Africa has been explored with WFS data for nine countries [Rutstein, 1984]. The familiar pattern emerges, as Figure 4 shows [Rutstein, 1984]. In these countries, infant mortality is generally lowest among second and third order children, while seventh and higher order children generally have the highest mortality rates. In Mauritania and Kenya, infants of birth order 4-6 have the lowest rates of death. In the Sudan, infant mortality appears to decline steadily with birth order -- a very unusual pattern. After the first year of life, birth order has no consistent effect on mortality.

Figure 5 shows the relationship of maternal age to infant mortality. The relationship is roughly what would be expected from the findings of previous studies -- i.e., mortality is lowest among infants born to women in their 20s.

Until a few years ago, birth order and maternal age were the main family formation factors studied for effects on infant wellbeing. A number of practical considerations contributed to this. Information on birth order and maternal age is easier to collect, often being available from birth certificates. Furthermore, without computers, simultaneous examination of a number of variables in large groups was exceedingly difficult.

Now that computer analysis is standard, and the WFS provides data from large and varied populations, that has changed. And, at the moment, the trend seems to be to discount the importance of birth order and age. The reason for this is that when, for example, the effects of maternal education, and infants' sex, birth order and interval are controlled, the effect of maternal age on infant mortality is often reduced and, in some countries, disappears [Hobcraft, et al, 1984]. Similarly, when education, sex, interval and maternal age are controlled, the effect of birth order is diminished and inconsistent. In our analysis of the WFS data from Cameroon, Ghana and Kenya, we found that adjustment for birth interval tends to slightly increase the effect of older maternal age and weaken that of high birth order. (See Appendix Table 6.)

We believe that it is a mistake to discount maternal age and birth order on the strength of such analyses. The reason for this is that there is a difference between research conducted to discover etiology and research done to shape policy and programs. In this case, controlling for various other factors while examining the effect of, for example, birth order allows us to search for the root "cause." Having done that, we can see that there is no simple cause. What then? In reality, maternal age and birth order are not separable. For example, it is unusual for old women to be having their first child, especially in developing countries. On the other hand, to individual women or the program personnel who have contact with them, age and birth order are still extremely useful markers, indicating the need for special counselling and care.

The same argument, we believe can be made in terms of the recent attention to the idea that completed family size, rather than birth order, is an important influence on infant mortality [Gray, 1984]. Midwives, physicians and health educators, when faced with an individual woman, have no way of knowing what her completed family size will be (as, indeed, she herself does not). They can only know that she is 35 years old and has already given birth to five children. If statistical analyses are to be helpful to policymakers, it is imperative that the models from which "findings" are derived are relevant to the programs where they will be applied.

Length of Birth Interval

Scientific interest in birth spacing is recent compared to interest in birth order and maternal age. Early studies that included birth interval as a variable were conducted by the U.S. Children's Bureau in the 1920s, and there were a few other studies over the following decades [Hughes,1923; Woodbury, 1925; Eastman, 1944; Morris and Heady, 1955]. But it wasn't until the 1970s that a concerted effort was made to gather data on this factor. Only in the last ten years did researchers begin to discern that birth interval can be a more powerful influence on infant mortality than either birth order or maternal age [Swenson, 1976, 1977]. The World Fertility Survey, by providing quantities and kinds of data never before available, has lead to confirmation of this finding.

Preceding Birth Interval

The WFS data confirm that a short birth interval adversely affects both the child born at the start of the interval and the one born at its end. Figure 6 shows the relationship between infant mortality in nine countries and the length of the preceding birth interval. This relationship is expressed as the relative risk of death among infants born at the end of a short birth interval (less than 24 months). Infants born at the end of a medium-length interval (24-47 months) serve as the baseline group. The countries are placed in order of their overall infant and child mortality levels. During the decade 5-14 years before the survey, in Senegal there were 271 deaths per 1,000 among children younger than five, compared to 129 in Ghana.

An increase in infant mortality is associated with short birth interval in each of the nine countries. The relative risk ranges from 1.30 in Senegal (i.e., an excess of 30 percent) to 2.10 in Ghana, as Figure 6 shows.[1] Thus, among these African countries there is a rough inverse relationship between the excess in infant deaths and overall infant mortality. However, it is not clear what meaning, if any, this observation may have, since no such relationship was found in an analysis of WFS data from 40 countries [Rutstein, 1984]. Furthermore, and perhaps more

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[1] The WFS data tape for Nigeria is not yet generaly available, but Shea Rutstein kindly provided the results of some preliminary analyses (personal communication, June 1985). These show that in Nigeria, which contains one-fifth of the population of SubSaharan Africa, short birth intervals carry substantial excess risk of childhood mortality. Relative risk of infant mortality at intervals less than 24 months, compared with 24-47 months, was 1.6. When the interval was longer than 47 months, the relative risk fell to .7.

important, while infant mortality has declined in all of these countries in recent decades, the relative risk associated with short intervals has not changed in any systematic way over the 30 years of birth histories covered by the WFS surveys.

Figure 6 also shows that being born at the end of a long interval (48 or more months) confers substantially more protection against infant mortality than does being born at the end of a medium interval in all nine countries.

Working with WFS data on births 0-15 years before the survey in Cameroon, Ghana and Kenya, we broke down birth intervals into finer categories. This analysis shows that infants with preceding birth intervals of three years (36-47 months) have substantially lower death rates than infants with preceding intervals of two years (24-35 months). (See Figure 7.) Taken together, Figures 6 and 7 indicate no "threshold" in birth intervals above which risk of death stabilizes. On the contrary, the beneficial effect of lengthening birth interval is incremental, at least up to six years.

Figure 8 shows deaths among "toddlers" (children 12-23 months old) in the nine SSA countries. In Senegal, Mauritania and Ivory Coast, short preceding birth interval was not associated with increased toddler mortality. In the other six countries, toddlers born at the end of short intervals were 24-58 percent more likely to die than those born at the end of a medium interval.

The meaning of the inconsistencies that appear among these nine SSA countries is not clear. Three community studies of child spacing in SSA have not found evidence of excess mortality associated with short intervals [Cantrelle and Leridon, 1971; Doyle et. al., 1978; Boerma and van Vienen, 1984]. The different study designs and absence of controls for potentially confounding factors make comparison impossible, but these anomalous findings strongly suggest the need for more community-level studies with common methods and definitions of intervals and other variables.

The additional benefit of a long interval (48 or more months) is more pronounced among toddlers than among infants, as Figure 8 shows. In eight of the nine African countries, intervals of at least four years were associated with the lowest mortality. In a number of countries, mortality among toddlers born after such long intervals was about half that among those born after a medium interval; in Nigeria, it was about one-third (see footnote p. 22).

As for deaths at 2 to 5 years, there is no consistent excess of deaths among children born after short intervals (not shown).

Subsequent Birth Interval

The widespread and strong traditions of child spacing in Africa generally have, as their stated purpose, the survival and development of the child already born -- i.e., the first born of the pair [Williams, 1938]. Becoming pregnant again before that child is on its feet (literally and figuratively) is a reason for shame in many parts of SSA [Lesthaeghe, et al, 1981]. Premature weaning is obviously hazardous to children's health [Cantrelle and Leridon, 1971]. After the birth of the second child, the first may receive much less maternal attention, and is commonly given into the care of an older child.

In spite of the recognition of these hazards in many African cultures, there has been little information on the effects of the subsequent interval on child health. Only WFS data permit quantification of the effects of birth spacing on both children of a pair of adjacent siblings in many countries.

Using WFS data, Hobcraft et. al., analyzed the effect of subsequent birth interval on deaths from ages 1-5 in Lesotho, Kenya, Sudan and Ghana [Hobcraft, et al, 1983]. The results are shown in Figure 9, where the baseline group is children for whom both the preceding and subsequent birth intervals were short (Group A). These children are compared to children who had a short preceding birth interval (B), or a short subsequent interval (C or D). This allows us to compare the relative importance of preceding and subsequent intervals. (Note that the WFS researchers made the cutoff point for "short" succeeding intervals at less than 18 months for toddlers, and less than 30 months for children 2-5 years old. This may account for some of the apparent differences shown in Figure 9.)

The first three columns of Figure 9 show that, for toddler mortality, a short subsequent interval is more harmful than a short preceding interval. This seems to confirm folk wisdom about the importance of subsequent interval to the wellbeing of the weanling. The relative risks for short preceding interval are 1.23-1.46, while those for short subsequent interval are 1.49-2.72. We examined the WFS data for Cameroon, Ghana and Kenya for the effects on toddler mortality of 18-30 month intervals compared to longer and found no elevation of risk.

In a later analysis, Hobcraft et al. analysed the risks of toddler death associated with very short subsequent birth intervals - i.e, less than 12 months [Hobcraft, et al, 1984]. Relative risks following such short intervals were extremely high, even after the effects of birth order and maternal age and education were controlled.

As for mortality in the second to the fifth year, Figure 9 shows weaker and more varied results, with relative risks of 1.01 to 1.48 associated with short preceding intervals, and of 0.95-1.46 associated with short subsequent intervals. Furthermore, when multivariate analysis was used to control the effects of birth order, maternal age and education, the effects of subsequent interval on mortality at 2 to 5 years disappeared in most of these African countries [Hobcraft, et. al., 1984].

To summarize, it appears that in SubSaharan Africa, as in other parts of the world, the longer the birth interval, the greater are the child's chances of survival. This is true at least for the first five years of life, although the effect diminishes with age. Comparison of the effects of preceding and subsequent intervals indicates that (at least among toddlers) subsequent interval is the more powerful.

While there is considerable variation among countries in relative risks associated with birth spacing, this variation does not invalidate the general conclusions stated above. Further research may produce some insight into the reasons for these differences among countries.

Possible Confounding Factors and Explanations

Ever since studies of the relationship between birth interval and child mortality have been published, questions about its validity have been raised, and theories about mechanisms of action have been proposed. The wealth of new data and recent studies allows us to address some of these issues.

In discussing the risks associated with short birth interval, some investigators have raised the possibility that in many cases the birth interval may be short because the first child of the pair died. Death of a young child may hasten the next conception by interrupting lactation amenorrhea, postpartum abstinence or use of contraceptives. It is likely that children born in such circumstances are at higher risk because of conditions particular to the family, either biological or environmental.

We tested this hypothesis using the WFS data for Cameroon, Ghana and Kenya. As expected, mortality rates are much higher for siblings of non-survivors, and in the multivariate analysis the death of an immediately adjacent sibling is a powerful predictor of mortality. However, the relative risk of mortality associated with birth spacing is quite similar whether the older sibling survives or dies.

The following table shows the relative risk of death associated with a preceding interval less than 24 months, with and without control for survival of the child born at the beginning of the interval (at least until age two). Differences in relative risk are apparent only during the first year of life, and they are not large. When we adjust for the survival of the older child of the pair, the relative risk of death in the first month of life is reduced from 3.5 to 3.0 in Cameroon. In the other countries, differences due to this adjustment are smaller.

Relative risk of death associated with preceding birth interval less than 2 years compared with 3-4 years: Unadjusted and adjusted for survival of the older sibling of the pair.

Age at Death	Cameroon	Ghana	Kenya
1st Month			
Unadjusted	3.5	2.6	2.3
Adjusted	3.0	2.2	2.1
1-11 Months			
Unadjusted	2.3	3.1	2.1
Adjusted	2.0	2.7	1.9
12-23 Months			
Unadjusted	1.8	2.2	2.3
Adjusted	1.8	2.2	2.3
24-59 Months			
Unadjusted	1.3	1.0	1.4
Adjusted	1.3	1.0	1.4

Other factors that might confound the relationship between birth interval and mortality are maternal age, birth order and socioeconomic status. The reason is that short-interval births might be concentrated among high-risk women -- i.e., poor women, women at either extreme of their reproductive years, and high parity women. In this case, the apparent excess of deaths among children with short birth intervals might be due to these other factors.

As will be shown below in the section on "Exposure to Risk," concentration of short-interval births among disadvantaged women does not explain the association of birth interval and child mortality. Secondly, by using logistic regression we can discern the relative contribution of these various factors to mortality.

The effects of birth interval on mortality are clearly independent of maternal education (an indicator of socioeconomic status), maternal age and birth order. When these three factors are introduced into a logistic regression, relative risks of death are virtually unaffected, as the following table shows:

Relative risk of death associated with preceding birth intervals less than 2 years compared to 3-4 years: Unadjusted and adjusted for maternal education, maternal age and birth order.

Age at Death	Cameroon	Ghana	Kenya
0-11 Months			
Unadjusted	2.8	3.0	2.2
Adjusted	2.8	2.9	2.2
12-23 Months			
Unadjusted	1.8	2.2	2.3
Adjusted	1.8	2.2	2.3
24-48 Months			
Unadjusted	1.4	1.1	1.5
Adjusted	1.3	1.0	1.4

One popular theory about the reason for the birth spacing effect (both in folk wisdom and among researchers) is that when children in a family are born too close together, they compete for the family's resources, such as food and parental attention. Despite the common-sense appeal of this theory, the WFS data indicate that competition within the family is not a major factor in the birth spacing effect. First of all, it would seem that families of higher socioeconomic status would be able to provide enough food and care for several young children. But, as we have seen, controlling for maternal education does not materially change the relative risks of death associated with short birth interval. Secondly, if the older child of a closely-spaced pair dies in infancy, and the competition is thus ended, the risk of death for the younger child associated with short interval should be reduced. Again, this is not the case.

Another theory about the hazards of short birth intervals is that they are a characteristic of "high-risk" families, and that this intra-familial risk (rather than short interval) is the real reason for the apparent effect of birth spacing on child survival. But the death of an older sibling seems a reasonable marker for high-risk families, and yet the effects of birth spacing are not appreciably greater in such families than in those where the older sibling survived.

Finally, there is the "maternal depletion" theory, in which it is the physical strain on the mother exerted by closely-spaced pregnancies that adversely affects the children. While this might explain some of the effect on newborns, it is a less likely explanation for risk to older children.

In truth, each of the theories discussed above may play a part in the effect of birth spacing. However, even when taken together, they do not appear to account for the entire effect -- from birth through the first five years of life, on both children in the pair. Furthermore, the persistence of the birth spacing effect after adjustment for maternal education, maternal age and birth order, and across countries and decades, indicates that we have much to learn about its causes.

Exposure to Risk of Infant and Child Death

Birth Order and Maternal Age

As was noted in the section on maternal mortality, very large families (e.g., seven or more children) are common in SSA. Even in SSA, many women do not want such large families.

Births at unfavorably young and old ages are also common. Among the women aged 20-34 at time of interview, 39 percent had their first birth before they were 18 in Kenya, and 29 percent in Ghana. As Table 3 has shown, childbearing among women in their 40s is still relatively frequent in SSA.

Factors Affecting Birth Spacing

Anthropological studies show that people in traditional societies all over the world have long perceived the advantages of long birth intervals. This was certainly the case in scores of African societies, where prolonged postpartum sexual abstinence and breastfeeding were the rule.

In a recent review of anthropologic data from SubSaharan Africa, 167 societies were reported to have traditions of postpartum abstinence. (Schoenmaeckers, et al., 1981) The duration of abstinence varied, being less than 40 days in 17 percent of cultures, 40 days to one year in 28 percent, and longer than one year (often 2-3 years) in 55 percent. Generally, the justifications for abstinence referred directly or indirectly to child health. Often the duration was linked to developmental landmarks for the child, i.e., abstinence was continued until the child could walk or was completely weaned.

This review also indicated that patterns of postpartum abstinence are changing and, in fact, probably have been for many years. The authors observed, for example, that since Islam imposes abstinence only during the first 40 days postpartum, this standard has been adopted in a number of SubSaharan societies where it was probably much longer in the past.

Urbanization and education of women beyond the primary level will also probably shorten breastfeeding and postpartum abstinence. Unless these traditional practices are replaced by use of modern contraceptives, the result will be shorter birth intervals. This expectation is based on experience in other countries, and on differences that are now appearing between urban and rural residents and among women of different educational levels. In Nigeria, for example, the ideal birth interval in rural areas is three years, compared to two years in urban areas [Acsadi and Johnson-Acsadi, 1984].

The Caldwells' work in Nigeria also produced evidence of change [Caldwell and Caldwell, 1981]. Women with no schooling continued breastfeeding for an average of 24 months and abstinence for 30 months. Among women with at least secondary schooling the average period of breastfeeding was 10 months and that for abstinence was 11 months. The duration of abstinence and lactation in the intermediate eduational levels was between these two extremes.

These findings of shorter periods of lactation and abstinence at higher educational levels are confirmed by WFS data from Ghana, Kenya, Lesotho, and Sudan. [Acsadi and Johnson-Acsadi, 1984]. Table 8 shows differences by educational level in duration of breastfeeding and postpartum abstinence. From the lowest educational level to the highest, mean duration of breastfeeding declined by 5-7 months, while abstinence declined by 0-4 months. (Note: Because these are national data, they do not reflect regional and ethnic differences.)

Birth Interval

Table 9 shows the proportion of births preceded by intervals of less than two years in 26 developing countries [Hobcraft, et al, 1983]. The five African countries for which this information is available fall into two distinct groups. Among the 26 countries, there are only four countries in which less than 20 percent of births follow short intervals. Three of these are African -- Ghana, Lesotho, and Senegal. In Kenya and Sudan, on the other hand, at least 35 percent of the births are preceded by short intervals.

Given the importance to child survival of birth spacing, it is of interest to know what groups of women are most likely to have closely spaced births. Of perhaps even more interest is any evidence of trends in birth spacing. With the WFS data for three SSA countries -- Cameroon, Ghana and Kenya -- we were able to address these issues.

The declines in breastfeeding and postpartum abstinence in SSA has been noted by a number of researchers. Such trends, it is feared, may increase the frequency of short-interval births. We were surprised to find that in these three countries short birth intervals seem to be getting less common, rather than more so. When the fertility histories reported by women are divided into births that took place 10-14 years and 0-5 years before the survey, the proportion of births with short preceding intervals decreased: from 34 to 29 percent in Cameroon; 25 to 20 percent in Ghana; and 44 to 38 percent in Kenya. These declines were apparent in each maternal age group. One possible explanation is that, since infant deaths have become less common, lactation amenorrhea is less often interrupted. This is, however, pure conjecture. More research is needed on trends in birth spacing and the reasons for such trends.

Examination of the WFS data clearly shows that women younger than 20 are particularly likely to have short birth intervals. As Figure 10 shows, in Ghana short birth intervals were almost twice as common among adolescents as among older women. There is no clear pattern in the relationship of birth spacing in these countries to either maternal education or area of residence, as Figures 11 and 12 show.

Detailed local studies contribute to our understanding of birth spacing patterns and trends in SSA, and some of the evidence is hopeful. For example, the Caldwells found that the upper educational groups in Nigeria have begun to substitute modern contraceptives for postpartum abstinence. Data from Ghana on recent births indicate longer intervals among younger women and among those with secondary education, and especially long intervals among women in the largest urban centers. [Gaisie, 1984]. This is probably evidence of effective use of contraception. Differences were also apparent in the age at stopping reproduction. In Ghana, women with some education stopped, on the average, about one year before those with no education. Women in large urban areas stopped having children about two years earlier than did rural women.

The Potential for Averting Infant and Child Deaths

The information presented above allows us to estimate the effect on infant mortality of various changes in fertility patterns in Africa.

Using WFS country-specific data on the proportions of births that follow short intervals, and on the risks associated with such intervals, we estimate that if all preceding intervals less than 24 months long were extended to 24-47 months, the proportion of infant deaths averted would be 12 percent in Lesotho, 19 percent in the Sudan, 5 percent in Senegal, 17 percent in Ghana, 22 percent in Cameroon, and 20 percent in Kenya. (See Appendix 1 for methodology.) If intervals were extended to four or more years, the reductions would be even greater. A number of points should be made about the above estimates. First of all, they refer only to infant mortality, whereas the WFS data clearly indicate that the deleterious effects of short birth interval persist for at least the first five years of life. Second, they represent only the effects of the preceding birth interval, whereas it seems that in the second year of life the subsequent interval is more important. Third, in Africa, where women generally bear children as long as they are able, extension of birth intervals would undoubtedly result in a decline in fertility. This would, in turn, reduce the number of high-order births, further reducing infant mortality. Unfortunately, we have no way of knowing how big this reduction would be. In short, there are a number of ways in which our estimates of infant deaths prevented by improved birth spacing are probably too low.

The proportion of women who say they want no more children is smaller in SSA than in other parts of the world. Even so, if such women had no more births, we estimate that there would be smaller, but still substantial, reductions in infant deaths: 8-11 percent in Ghana, Kenya, Lesotho and the Sudan. These estimates are based on the proportion of women of various parities who say they want no more children, and on country-specific relative risks of infant death by birth order.

DISCUSSION

The previous sections have delineated the risks to maternal and child health posed by unfavorable family formation patterns in SubSaharan Africa. In addition, we have constructed rough estimates of maternal and infant deaths which might be averted if more favorable patterns were adopted. For example, even though the proportion of women who say they want no more children is relatively small, if only these women had no more births, about one-sixth of maternal deaths would be averted.

Improvement of birth spacing patterns, according to our estimates, would dramatically reduce infant deaths. If all birth intervals were at least two years long, we estimate that at least 12-20 percent of infant deaths in SubSaharan Africa would be averted. This is a truly remarkable prospect, and an attractive one also, given the favorable cultural background for birth spacing. The above estimate does not take into account the fact that fertility would almost certainly decline if birth spacing were increased, which would avert even more infant deaths.

Discussions of health and population policy in developing countries often get bogged down in arguments about the reciprocity of fertility and mortality. The ostensible object of these arguments is to establish priorities among various kinds of programs. We believe that consideration of family planning as a health intervention obviates most of these arguments. For example, one such argument is that reducing mortality without first reducing fertility will, in the long run, aggravate health problems through uncontrolled population growth. This argument simply does not apply to family planning, which reduces mortality and fertility at the same time.

According to the available evidence, there are few initiatives that have the potential to decrease both fertility and mortality. Increases in urbanization, income, education and employment of women are all associated with reductions in infant mortality. Studies in various parts of the world have associated these same factors with declines in fertility, but (at least so far) the data from Africa are conflicting. For example, while urbanization is generally associated with smaller family size, in Africa it is also linked to the deterioration of traditional birth spacing practices, resulting in shorter birth intervals. It may be that this is a temporary effect. But even if this transitional phase lasts only a generation, any rise in the already high levels of fertility in Africa has serious implications for health.

Thus, it is our opinion that whether the objective is prompt improvement of family health or long-term balancing of fertility and mortality in order to bolster development efforts, an essential component of development efforts in SubSaharan Africa should be programs that: a) educate families about the health risks associated with unfavorable reproductive patterns; and b) provide them with access to modern methods of contraception so that they can put into practice their knowledge and desires.

Table 1. Indices of Women's Health.

Index	Africa	Asia	Latin America	North America
Life Expectancy (years)	50	60	64	74
Maternal Deaths per 100,000 Live Births (range)	160-1,100	7-1,000	16-458	7-15
Deliveries Attended by Trained Personnel (%)	28	51	62	100

Sources: Kent, 1983; WHO, 1983.

Table 2. Maternal Mortality Rates* in SubSaharan Africa, by Country and Type of Study.

	Country	Period	MMR per 100,000 Births
Hospital (Booked Patients)			
	Kenya	1977	280
	Nigeria	1966-1972	225
		1966-1975	98
		1970	159
		1970-1971	530
		1971-1972	88
		1970-1974	142
			230
		1976-1979	130
	Zimbabwe	1976	59
Official Record			
	Malawi	1977	103
	Niger	1980	135
	Nigeria	1961-1969	172
	Uganda	1967	126
Community			
	Ethiopia	1981-1983	566
	Ghana	1972	400
	Senegal	1962-1982	700

* Rates are usually per 100,000 total births, rather than live births.

Sources: Hospital Series: Kenya, 1977 -- Aggarwal, 1980; Nigeria, 1966-1972 -- Akingba, 1977; Nigeria, 1966-1975, Ayangade, 1981; Nigeria, 1970 -- Hartfield, 1980; Nigeria, 1970-1971, Waboso, 1973; Nigeria, 1971-1972 -- Megafu, 1975; Nigeria, 1970-1974 -- Okoisor, 1978; Nigeria, 1976-1979 -- Harrison and Rossiter, 1980; Zimbabwe, 1976 -- Brown, 1981. Official Records: Malawi, 1977 -- Bullough, 1981; Niger, 1980 -- Thuriaux and Lamotte, 1984; Nigeria, 1961-1969 -- Hartfield and Woodland, 1980; Uganda, 1967 -- Grech, Galea and Trussell, 1969. Community Studies: Ethiopia, 1981-1983 -- Kwast, et al, 1985; Ghana, 1972 -- Department of Community Health, 1979; Senegal, 1962-1982 -- Family Health International, 1983.

Table 3. Percent of All Births to Women in Various Age Groups, WFS.

Country	15-19	20-24	25-29	30-34	35-39	40-49	15-19 + 35-49
Benin	10	28	29	18	10	5	25
Cameroon	23	28	21	14	8	6	37
Egypt	14	31	27	16	9	3	26
Ghana	15	27	23	16	11	9	34
Ivory Coast	19	30	23	13	8	6	34
Kenya	10	21	22	18	15	13	38
Lesotho	14	30	23	16	10	7	31
Nigeria	18	25	25	18	8	6	33
Senegal	19	25	24	15	11	6	36
Sudan	11	24	32	16	11	5	27
Tunisia	6	29	27	17	13	9	28

Source: WFS First Country Reports

Table 4. Women Aged 45-49 Who Have Borne a Given Number of Children, WFS.

Country	Number of Children 7-8	9+	7+
Cameroon +	17	20	37
Egypt *	25	33	58
Ghana *	28	29	57
Ivory Coast +	20	37	57
Kenya +	26	47	73
Lesotho +	19	18	37
Sudan *	23	26	49
Tunisia +	26	34	60

* Percent of ever-married women. + Percent of all women.

Source: WFS First Country Reports

Table 5. Percent of Women Who Want No More Children, and Percent of Those Who Want No More Currently Using an Efficient Method of Contraception, WFS.

Country	Want No More Children *	Using Efficient Contraceptive +
Cameroon	10	6
Egypt	53	46
Ghana	12	17
Ivory Coast	4	4
Kenya	17	17
Lesotho	15	16
Nigeria	5	4
Sudan	17	16
Tunisia	47	48

* Currently married, fecund women
+ "Exposed" women who want no more children.

Source: WFS First Country Reports

Table 6. Estimated Proportion of Maternal Deaths that Would be Averted If Women 15-49 Who Want No More Children Had No More *

Country	%
Egypt	28
Ghana	15
Ivory Coast	5
Kenya	15
Lesotho	18
Nigeria	6
Sudan	18
Tunisia	26

* Corrected for women who are already using an efficient method of contraception.

Note: See Appendix A for methodology.

Table 7. Estimated infant and child mortality rates in 1982, and percent decrease since 1960, SubSaharan Africa.

Region & Country	Infant Mortality		Child Mortality	
	Rate	% Decrease	Rate	% Decrease
Western Africa				
Benin	117	32	23	45
Ghana	86	35	15	44
Ivory Coast	119	29	23	42
Liberia	91	47	16	62
Mali	132	26	27	40
Mauritania	132	26	27	40
Niger	132	26	27	40
Nigeria	109	43	20	60
Senegal	155	13	34	24
Sierra Leone	190	39	50	30
Togo	122	39	25	54
Upper Volta (Bourkina Fasso)	157	33	36	49
Middle Africa				
Angola	165	24	39	38
Cameroon	92	31	16	43
Central African Republic	119	30	23	44
Chad	161	23	37	38
Congo	68	42	10	56
Zaire	106	29	20	38

Southern Africa				
Lesotho	94	29	23	42
Sudan	119	29	23	42
Eastern Africa				
Burundi	123	14	24	22
Ethiopia	122	29	25	40
Kenya	77	31	13	38
Madagascar	116	34	23	49
Malawi	137	33	29	52
Mozambique	105	32	20	41
Rwanda	126	24	25	38
Somalia	184	14	47	23
Tanzania	98	32	18	45
Uganda	120	14	22	21
Zambia	105	36	20	47
Zimbabwe	83	17	14	26

Note: Infant mortality rate is deaths under one year of age per 1,000 live births. Child mortality is deaths at ages 2-5 per 1,000 children of these ages, per year.

Source: World Bank, 1984

Table 8. Mean duration (in months) of breastfeeding and postpartum abstinence in last closed pregnancy interval, by educational level, WFS.

	Lesotho	Sudan	Kenya	Ghana
Breastfeeding				
No Schooling	21	17	14	16
Lower Primary	20	14	14	14
Upper Primary	20	11	12	13
Secondary or Higher	15	na	9	9
Difference	-6	-6	-5	-7
Abstinence				
No Schooling	14	6	4	10
Lower Primary	14	5	4	7
Upper Primary	14	4	3	7
Secondary or Higher	11	na	4	6
Difference	-3	-2	0	-4

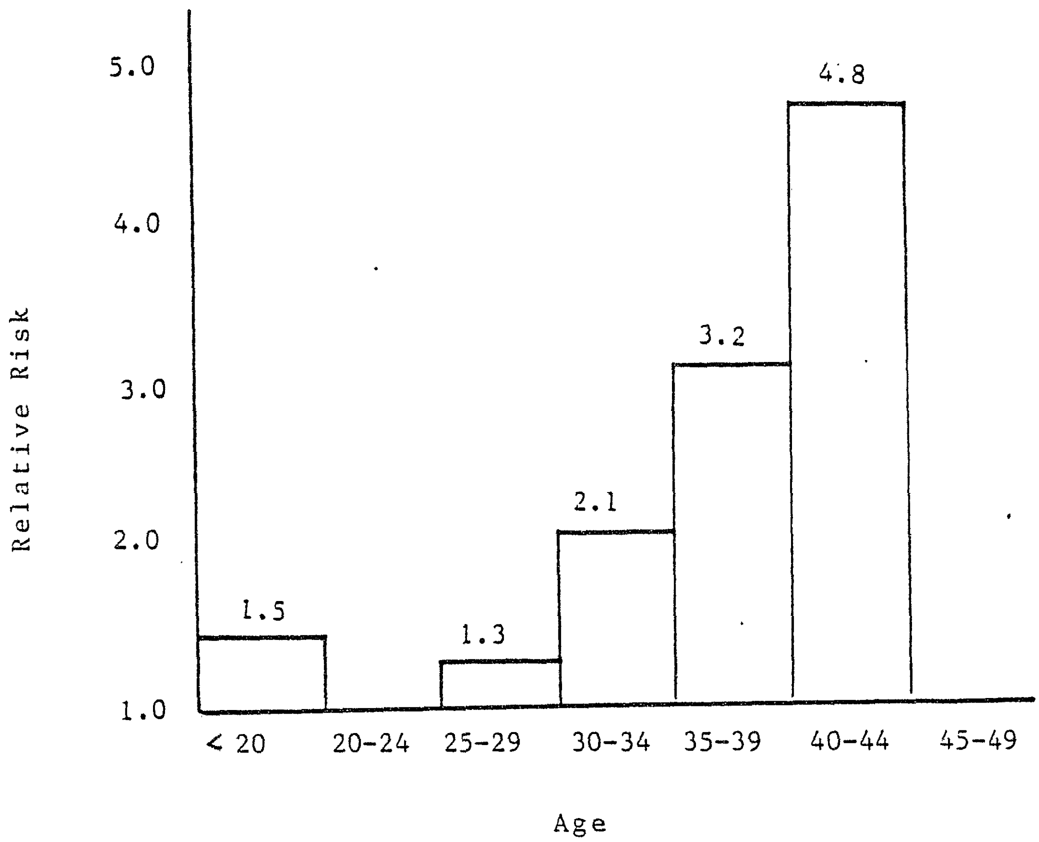
Source: Acsadi and Johnson-Acsadi, 1984

Table 9. Percent of All Births Following an Interval of Less than 24 Months, WFS.

Region	16-19	20-24	25-29	30-34	35-39	40+
Africa	Ghana Lesotho Senegal			Cameroon	Kenya Sudan	
Asia	Korea	Nepal	Indonesia Pakistan	Bangladesh Sri Lanka Thailand	Malaysia Philippines	Jordan Syria
Latin America			Haiti		Ecuador Peru	Costa Rica Colombia Guyana Jamaica Mexico Panama

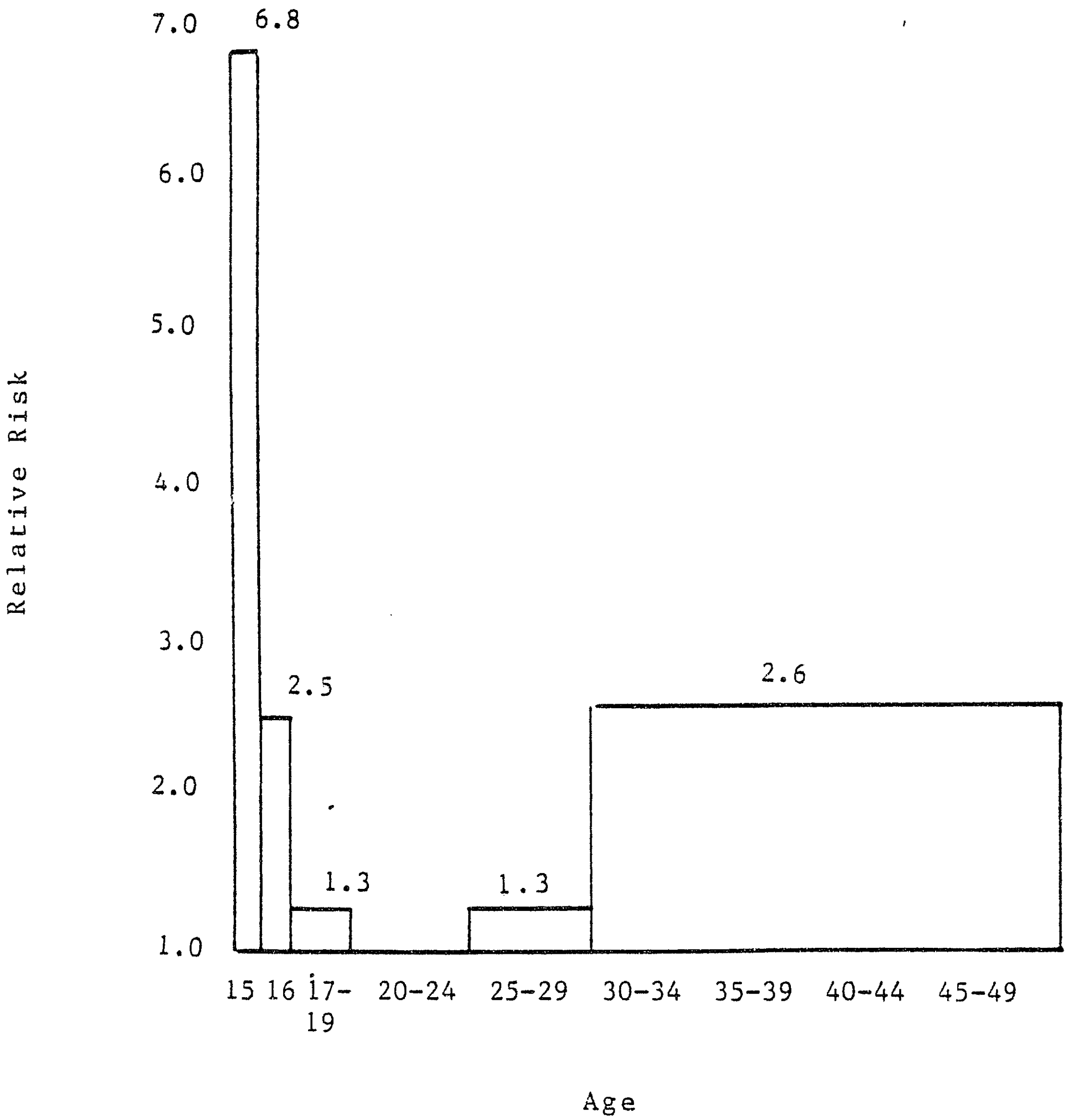
Source: Hobcraft et. al., 1983; Cameroon WFS Tape

Figure 1. Maternal Mortality, by Age, "High Mortality" Countries



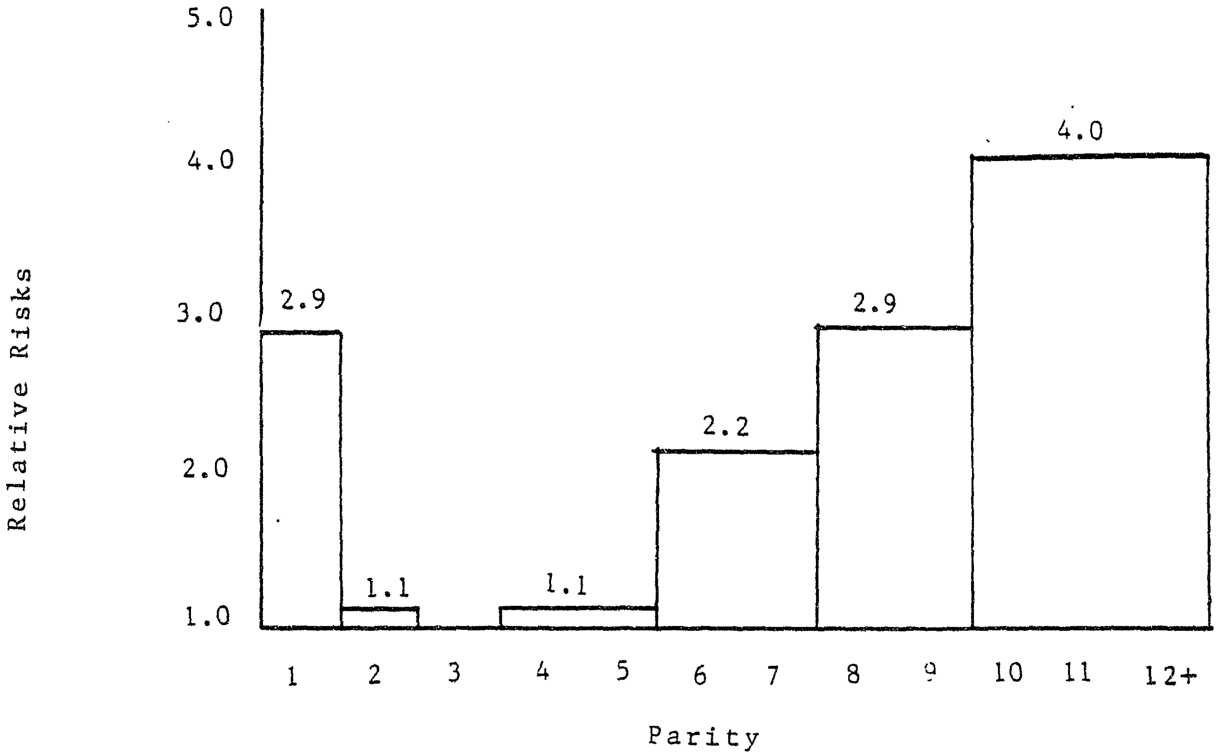
Source: Nortman, 1974

Figure 2. Maternal Mortality, by Age, Zaria Hospital, Nigeria, 1976-1979



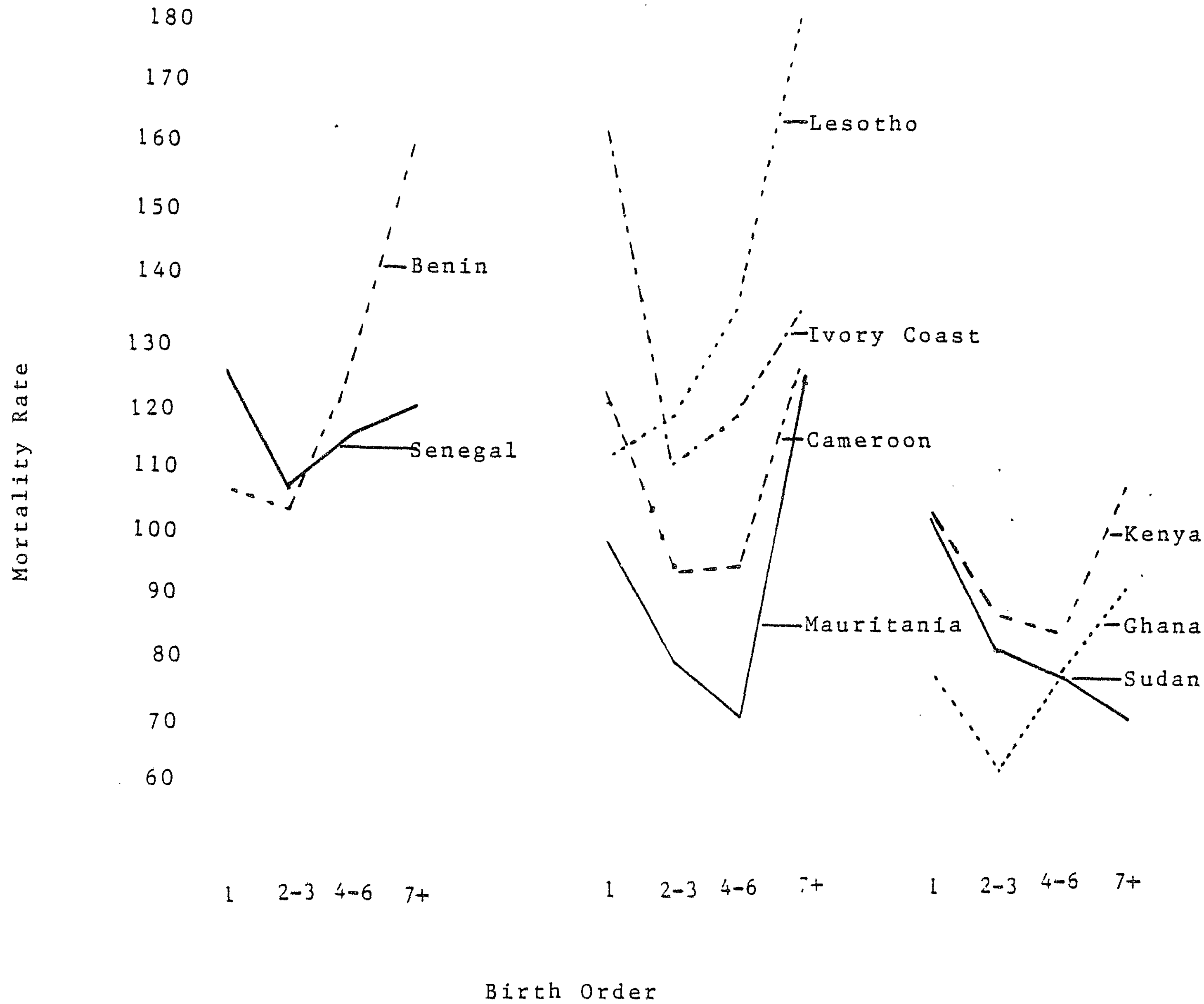
Sources: Harrison and Rossiter, 1980.

Figure 3. Maternal Mortality, by Parity, Dakar, Senegal, 1971-1975



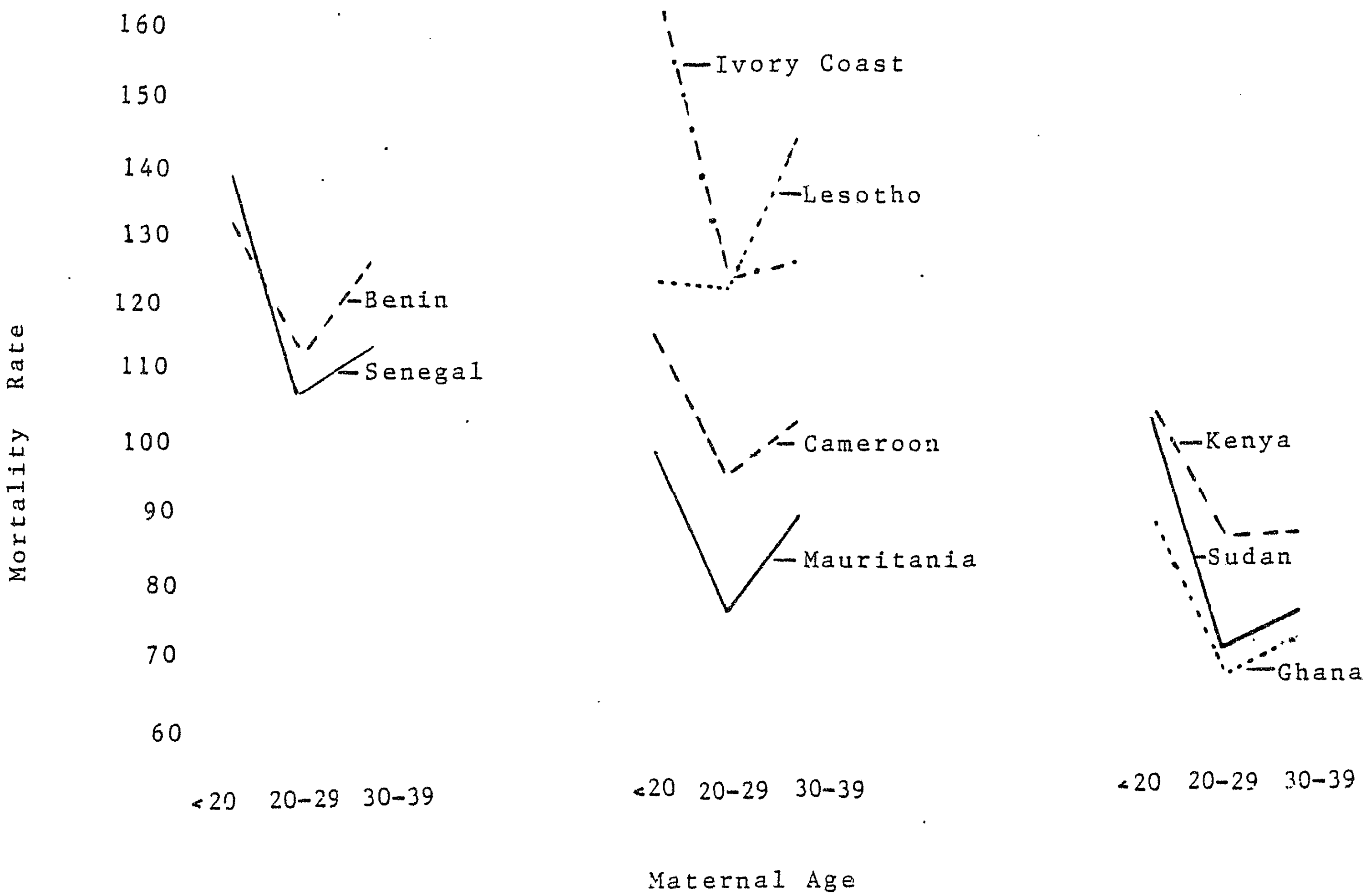
Source: Correa, 1978.

Figure 4 . Infant Mortality by Birth Order, 9 Sub-Saharan Countries



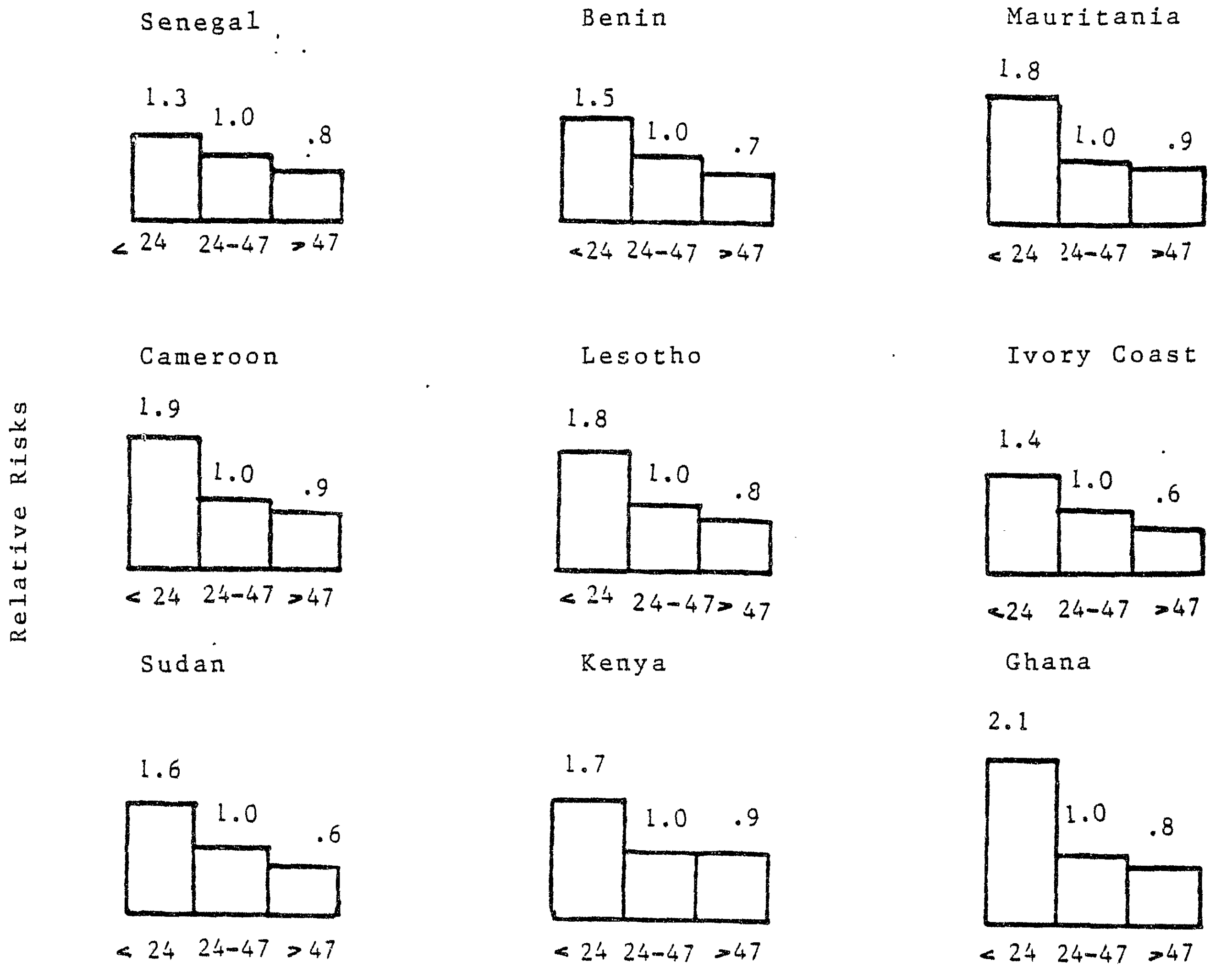
Source: Rutstein, 1984.

Figure 5 . Infant Mortality by Maternal Age, 9 Sub-Saharan Countries



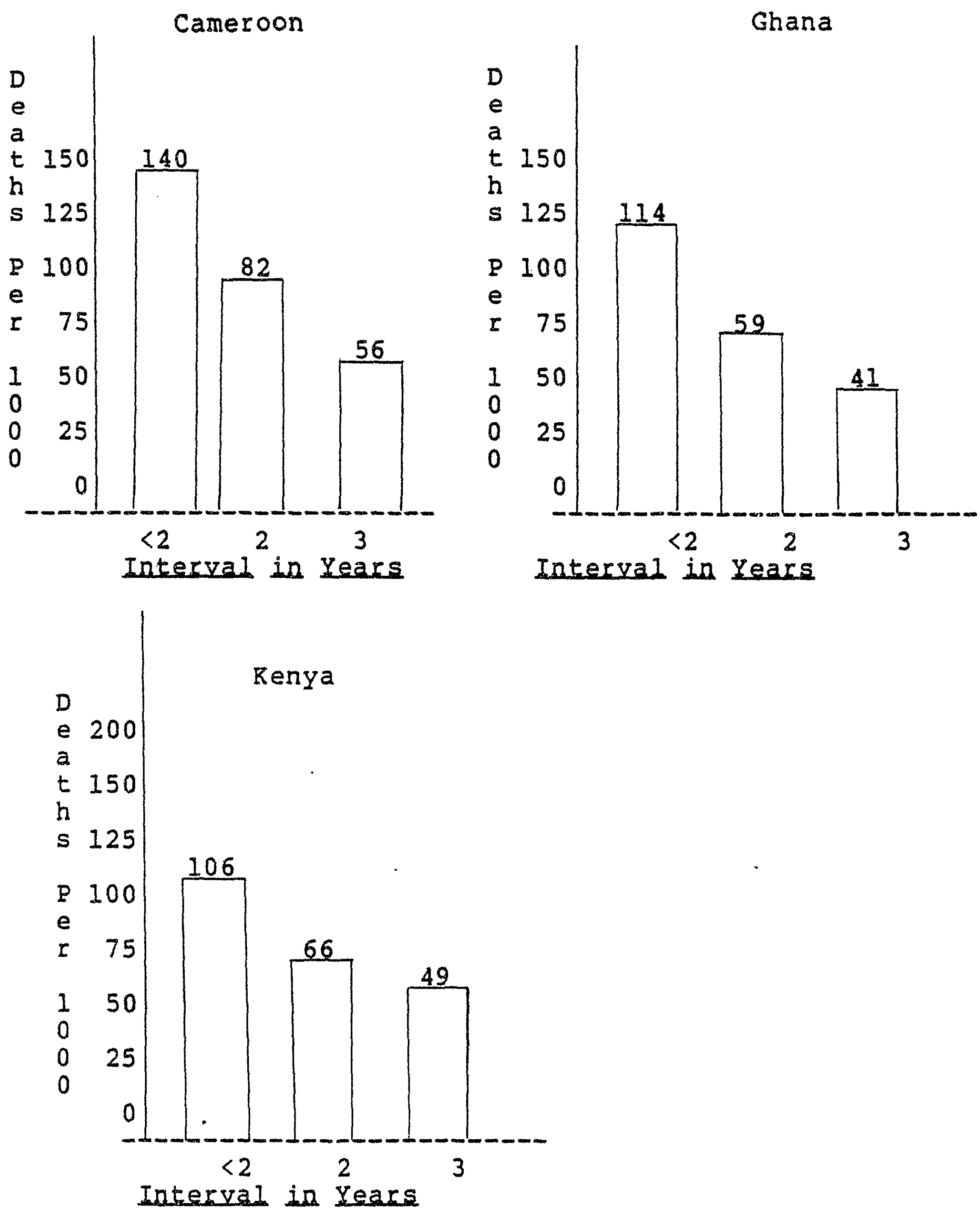
Source: Rutstein, 1984.

Figure 6. Infant Mortality by Preceding Birth Interval (in Months)



Source: Derived from Rutstein, 1984.

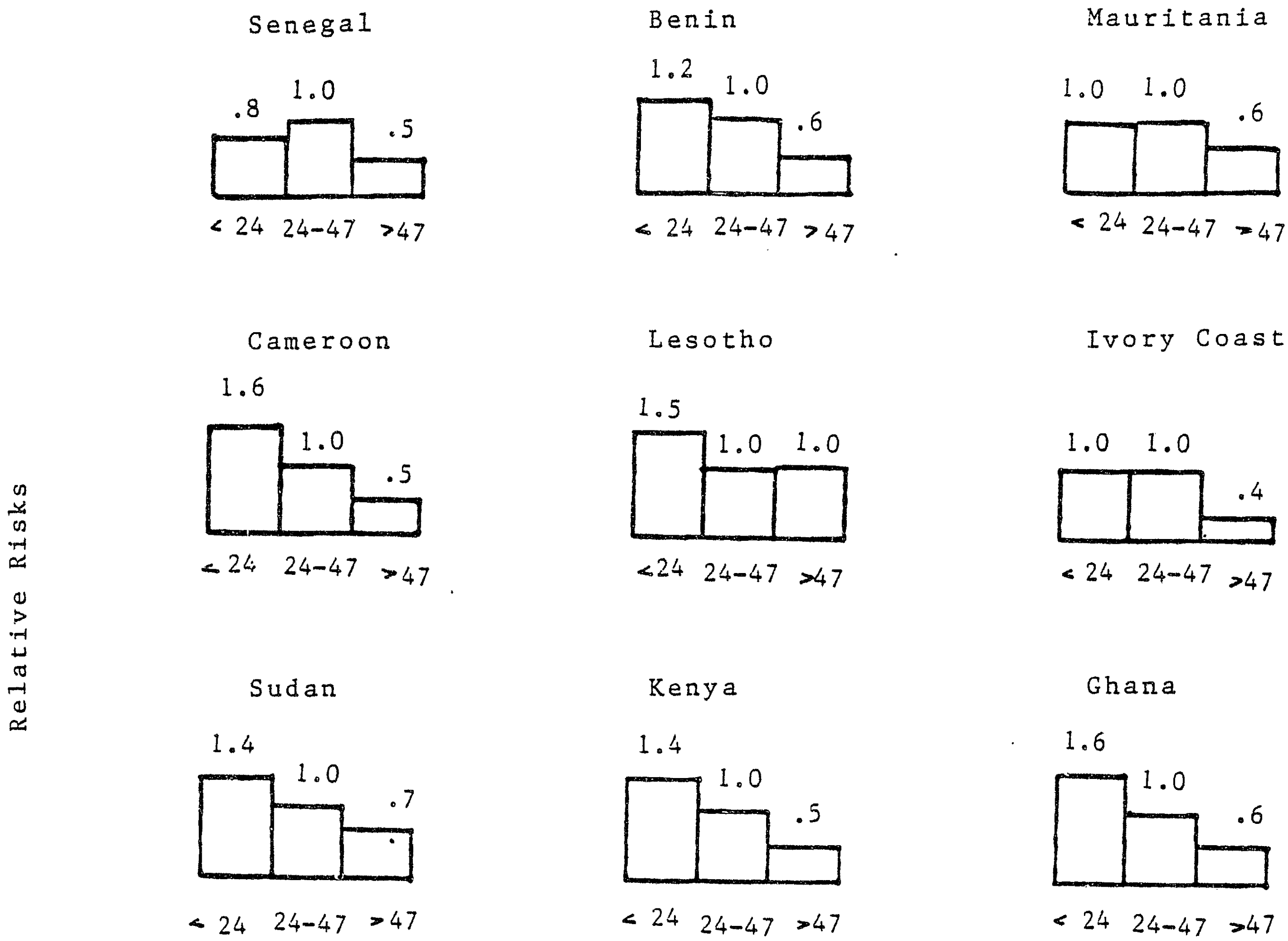
Figure 7. Infant Mortality rates among children with preceding birth intervals of less than 2 years, 2 years, and 3 years*



* Probability of death during the first year of life per 1,000 live births. Interval categories are <24, 24-35, and 36-47 months.

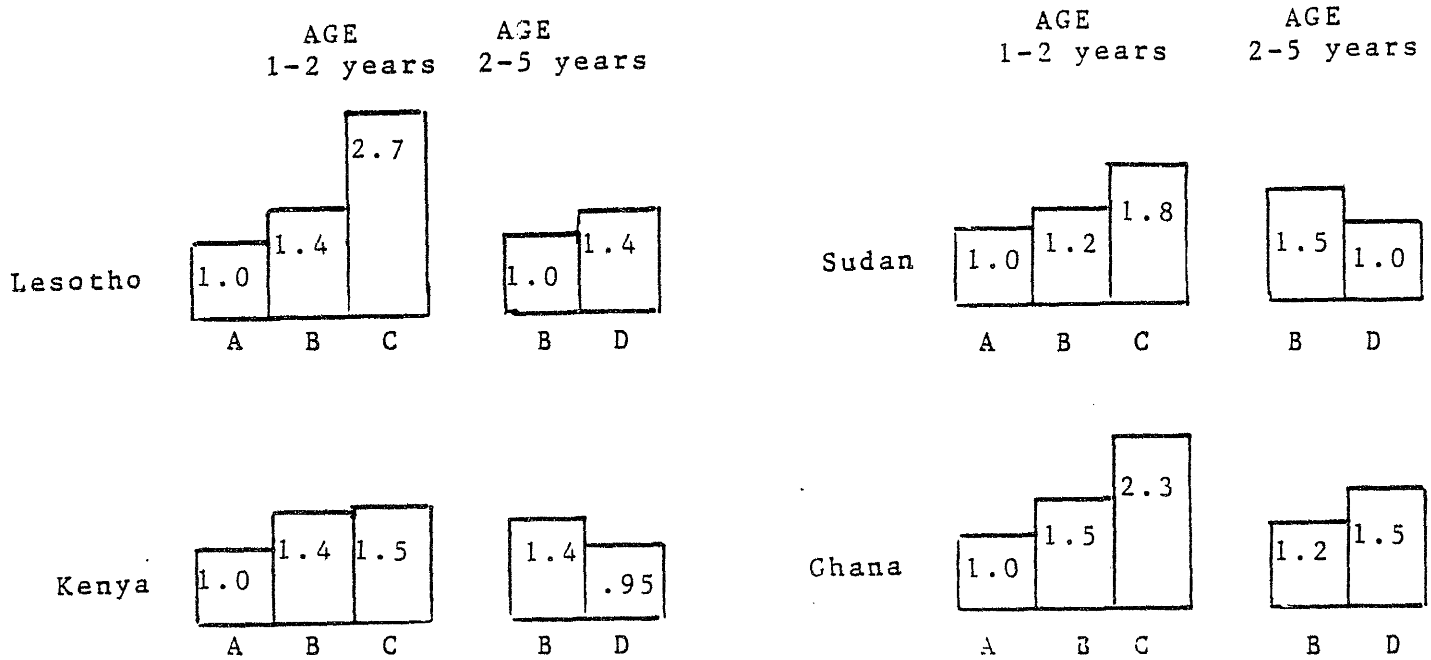
Source: WFS data tapes

Figure 8. Toddler Mortality by Preceding Birth Interval (in Months)



Source: Derived from Rutstein, 1984.

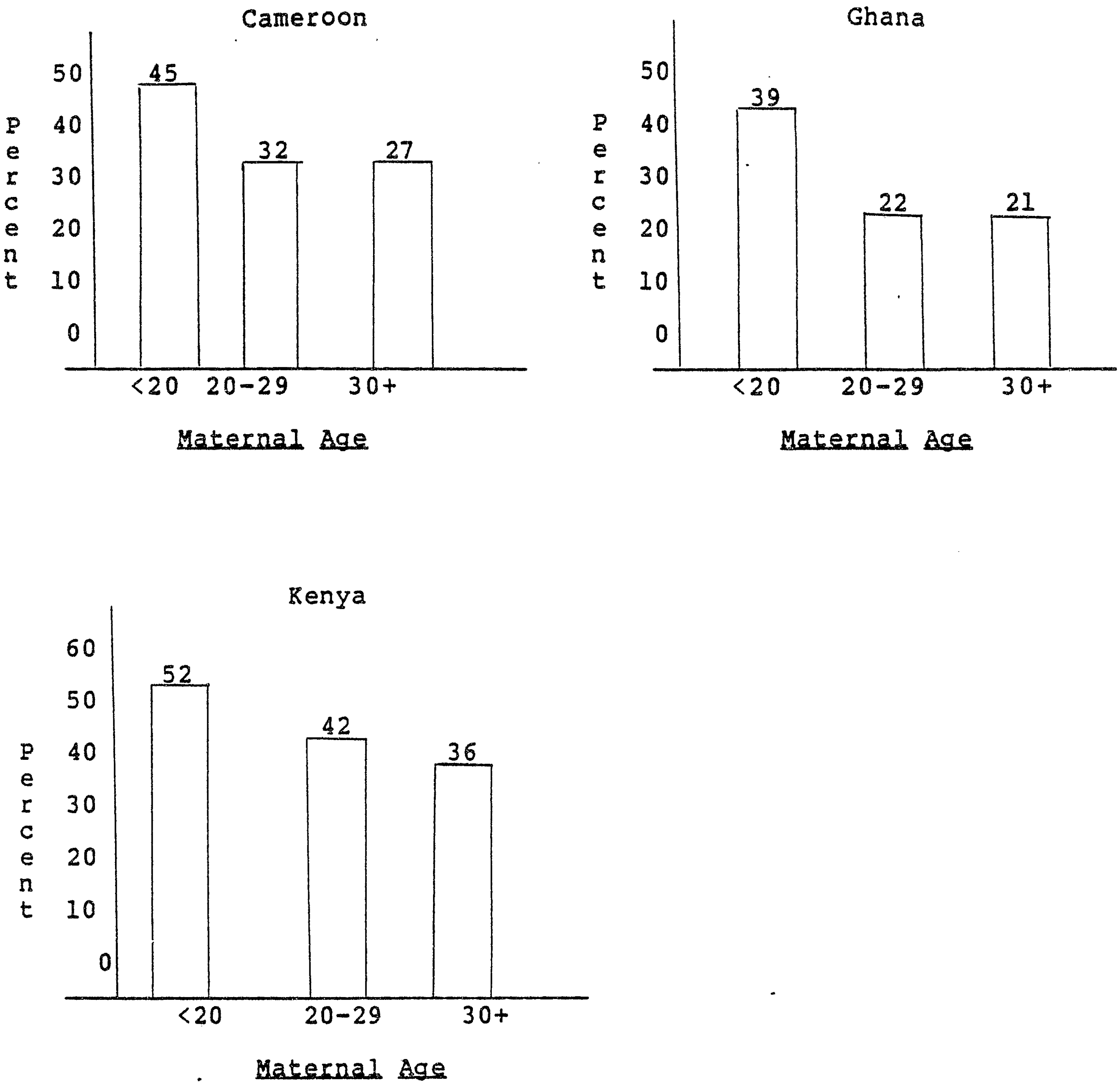
Figure 9. Relative Risk of Mortality by Preceding and Subsequent Birth Interval, ages 1-2 and 2-5



A - Base, no close births
B - Preceding birth within 24 months
C - Subsequent birth within 18 months
D - Subsequent birth within 30 months

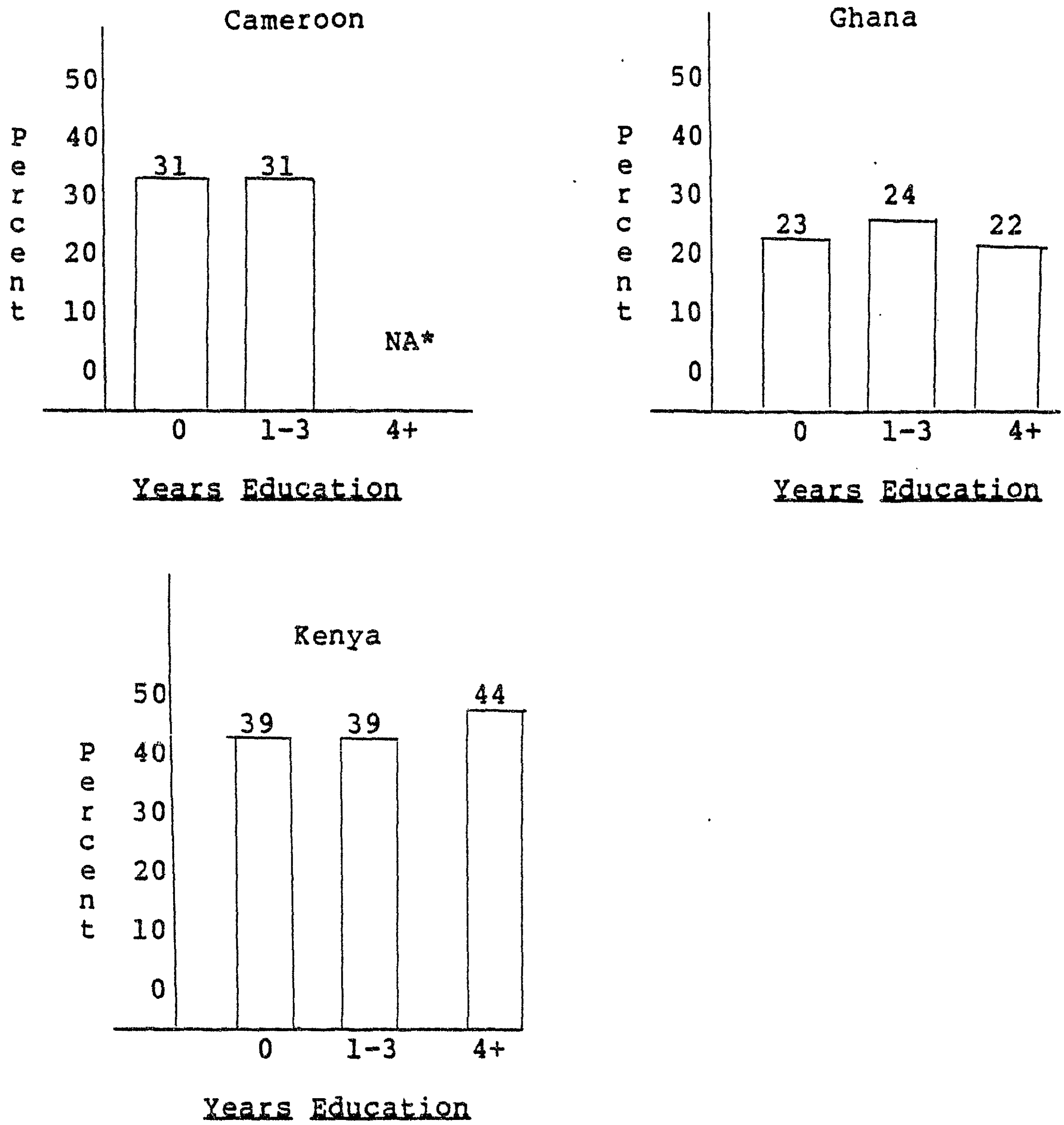
Source: Derived from Hobcraft, McDonald and Rutstein, 1983, Tables 5 and 6.

Figure 10. Percent of children with preceding birth intervals less than 2 years long, by maternal age



Source: WFS data tapes

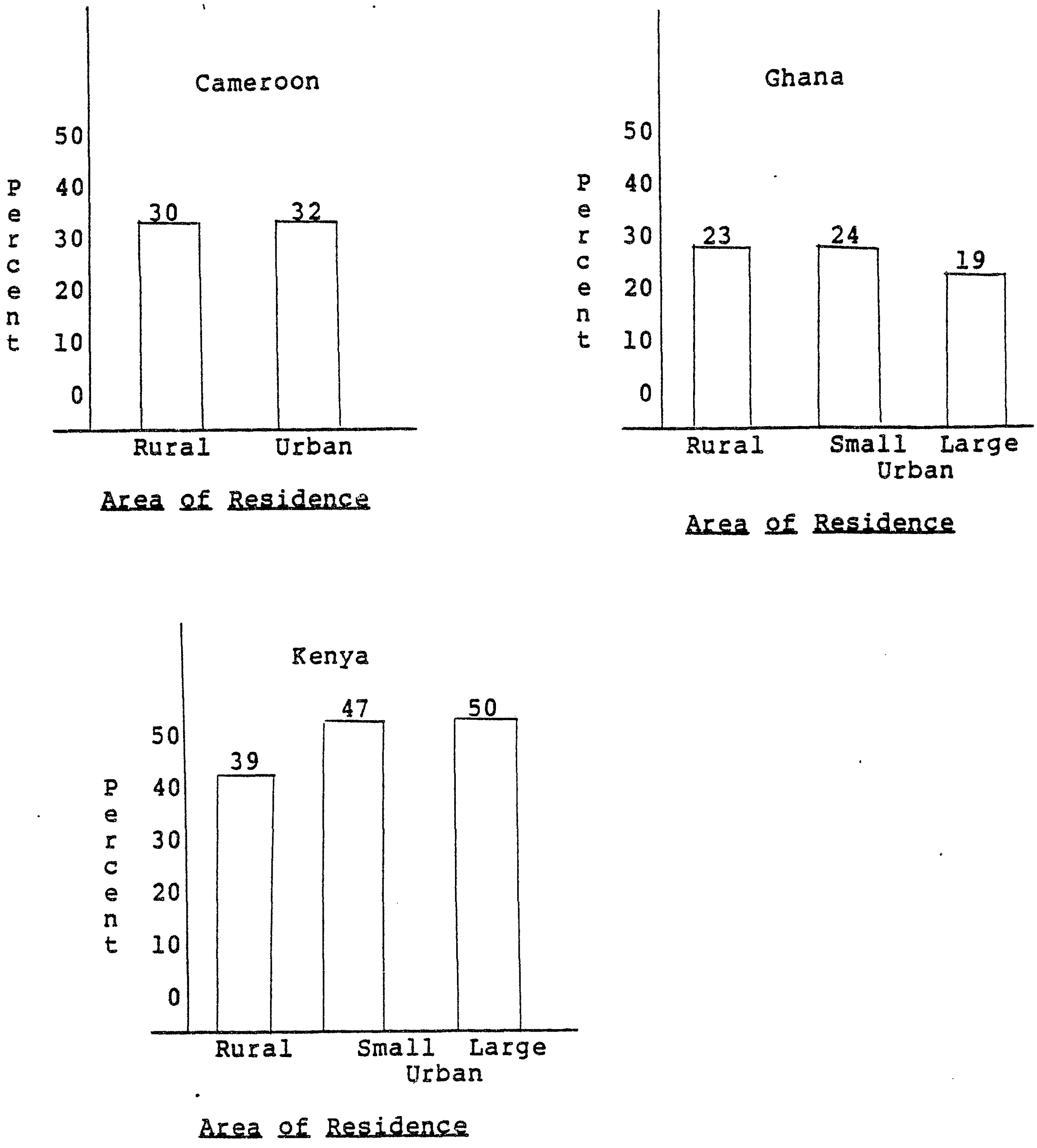
Figure 11. Percent of children with preceding birth intervals of less than 2 years, by maternal education



* Not applicable

Source: WFS data tapes

Figure 12. Percent of children with preceding birth intervals of less than 2 years, by area of residence



Source: WFS data tapes

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APPENDIX I: METHODOLOGY

Proportion of Births to Women of Various Ages

1. For each country, the number of women in each age group was multiplied by the age specific fertility rate for that group, which yields the number of births to women in each age group. Added together these produce the total births. WFS First Country Reports were used.

2. The number of births to women in each age group were divided by the total number of births, giving the proportion of births to women in that age group.

Potential for Averting Maternal Deaths

1. We constructed a synthetic cohort of childbearing women, using country-specific data from WFS First Country Reports. First we ascertained the distribution of all women by five-year age group. For women of reproductive age (15-49), we multiplied this proportion by the age-specific fertility rate (ASFR) for the appropriate age-group. In order to work with sufficient numbers, the product was multiplied by one million. This gives us the number of births per year in each age group for a cohort of women conforming to the age and fertility patterns of the country.

2. The number of births to women in each age group were then multiplied by an arbitrary maternal mortality rate (.002). Note that the rate of maternal mortality used here does not affect the results, as we are determining the proportion of deaths averted, not the number. The product is multiplied by the relative risk of maternal mortality in that age group, derived from Nortman's data for "high mortality" countries [Nortman, 1974, Table 2]. This produces the number of maternal deaths expected, given current fertility patterns.

3. To estimate deaths averted, we began with the proportion of women in each age group who said that they want no more children [Table 3.1.1.]. This we discounted by the proportion of such women who were already using an efficient method of contraception. To do this, we multiplied the percent of women who want no more children by 1-(percent of these women using efficient contraceptives) [Table 5.2.3.A]. The product is the percent of women who want no more children and are not using efficient contraceptives. This is multiplied by the number of maternal deaths expected in that age group in our synthetic cohort, producing the number of deaths averted under these conditions and assumptions. This process is repeated for each age group and the deaths averted summed. The total is simply divided by the total number of expected deaths to derive the proportion

4. If women in an age group are assumed to have no more children (i.e., tiers 2 and 3 of Table 6) then all deaths occuring in the age group (rather than just those among unprotected women who want no more children) are added to the numerator.

Example: Women aged 35-39 in Lesotho

.048 = proportion of all women 35-39 at time of survey
.169 = their age-specific fertility rate

.048 x .169 x 1,000,000 = 8,112 births per year

.002 = arbitrary overall maternal mortality rate
3.17 = relative risk of maternal death at 35-39

8,112 x .002 x 3.17 = 51 maternal deaths

.275 = proportion of women 35-39 in Lesotho who want no more children
.203 = proportion of these women currently using an efficient method of contraception

.275 x 1 - (.203) = .219 = proportion of women 35-39 who want no more children and are not using an efficient method of contraception

.219 x 51 = 11.2 = deaths averted if these women had no more births.

This process is repeated for each age group, the deaths averted summed and divided by the total deaths, to give the proportion of deaths averted.

Multivariate Analysis of Factors Affecting Infant Mortality

Logistic regression (SAS: Proc Logist) was selected as an appropriate method for analysis of mortality as a binary dependent variable. The procedure employs maximum likelihood estimation to calculate the log of the ratio of the odds of the probability of dying and the probability of not dying, in the presence of selected conditions. It approximates the relative mortality risk associated with a particular value of some factor (e.g., relative risk of death at a specific birth interval or birth order).

The multiple regression equation takes the form:

$$\ln \frac{P(Y=1)}{P(Y=0)} = B_0 + B_1X_1 + B_2X_2 + \ldots + B_kX_k,$$

where B_0 = constant

B_i = regression coefficients

X_i = predictors

In the multivariate analysis, the odds of dying when the birth interval is less than 24 months and 24-35 months was compared to those odds when it is 36-47 months. This permitted observation of relative risk associated with both short and medium length intervals. Reference categories for the other variables were a) birth orders 2 and 3, b) maternal age 20-29, c) some maternal education, and d) survival of the preceding sibling to age two.

Potential for Averting Infant Deaths

Deaths Averted By Birth Spacing

We assume that no woman really wants to have a short interval birth, or that, conversely, no woman would mind waiting a few extra months to become pregnant again. Consequently, our calculations in this case assume that no more short-interval births take place. This simplifies calculations considerably.

1. For each country, we determined the proportion of all births that followed short intervals (less than 24 months) [Hobcraft, et al, 1983].

2. We determined the infant mortality rates among infants born after short and long intervals [Rutstein, 1983, 1984].

3. Then we calculated the percent attributable risk, using the following formula:

$$\frac{Io - In}{Io}$$

Where:
Io = infant mortality rate in the total population
= WnIn + WsIs
In = infant mortality rate after long interval (24-48 months)
Is = infant mortality rate after short intervals (<24 months)
Wn = proportion of births at long intervals
Ws = proportion of births at short intervals

Example: Kenya

Wn = .65 Ws = .35
In = 68 Is = 117

$$Io = .65(68) + .35(117) = 85.15$$

$$\% \text{ deaths averted} = \frac{85 - 68}{85} = 20\ \%$$

Deaths Averted By Reducing Birth Order

To estimate the proportion of infant deaths that would be averted by reducing birth order, we constructed a synthetic cohort similar to that used to estimate maternal mortality, except that women are grouped by parity, not age. Unfortunately, the published WFS data are not arranged to make this a simple process.

1. The distribution of ever-married women by number of children ever born was used to determine the order of their last birth. From a cross-tabulation of age by parity, we derived the parity distribution of (last) births in each age group [Table 2.2.1]. This was multiplied by the total number of births to women in that age group in our synthetic cohort (see step 1 of maternal mortality), which yielded the number of births by age and parity. When summed across parity, we had the parity distribution in our synthetic cohort, having taken into account the age distribution and ASFR of the country.

2. The number of births in each parity group are then multiplied by the overall infant mortality rate and the relative risk associated with parity in that country [Kent, 1983; Rutstein, 1983, 1984]. This gives us the number of infant deaths by birth order.

3. The remaining steps are similar to steps 3 and 4 of the maternal mortality calculations. The proportion of women at various parities who want no more children (Table 3.1.2) was multiplied by 1-(the proportions of those women already using efficient methods of contraception) (Table 5.2.3.A). One slight difference is that the proportion of women who want no more children was figured using the parity at last birth minus one. For example, we multiplied the proportion of women whose last birth was their seventh by the proportion of women who, at parity 6, said they did not want another child. The product was then multiplied by the number of infant deaths in that parity group, derived above.

APPENDIX 2

Notes to Appendix Tables 1-4:

In the logistic regression analysis, four models were used:

Model I included preceding interval only,
Model II included the interval and maternal age,
Model III included interval and birth order,
Model IV, the "full model," included interval, maternal age, birth order, and maternal education.

The relative risks associated with any one variable in Model IV are therefore controlled for the influence of the other variables.

Risks are relative to those in the following reference categories:

Preceding birth interval 36-47 months.
Maternal age 20-29.
Birth order 2-3
Maternal education 1+ years (i.e., any formal education)

* indicates .05 significance
** indicates .01 significance

Appendix Table 1. Relative risk of **neonatal** mortality

	Model I	Model II	Model III	Model IV
CAMEROON				
Preceding interval				
< 24 mo	3.3 **			3.5 **
24-35 mo	1.7 **			1.8 **
48+ mo	1.4			1.4
Maternal age				
< 20		1.0		1.0
35-39		1.4 **		1.3
Birth order				
7-8			1.1	1.2
9+			1.5 **	1.1
Maternal education				
none				1.8 **
GHANA				
Preceding interval				
< 24 mo	2.7 **			2.6 **
24-35 mo	1.5 *			1.4
48+ mo	.9			.9
Maternal age				
< 20		1.0		1.2
35-39		1.1		.9
Birth order				
7-8			1.3	1.2
9+			2.3 **	2.0 **
Maternal education				
none				1.0
KENYA				
Preceding interval				
< 24 mo	2.1 **			2.3 **
24-35 mo	1.2			1.4
48+	1.1			1.1
Maternal age				
< 20		.9		1.0
35-39		1.0		.6 **
Birth order				
7-8			1.2	1.4 **
9+			1.9 **	2.3 **
Maternal education				
none				1.2 **

Appendix Table 2. Relative risk of **postneonatal** mortality

	Model I	Model II	Model III	Model IV
CAMEROON				
Preceding interval				
< 24 mo	2.3 **			2.3 **
24-35 mo	1.4 *			1.4 *
48+	.9			.8
Maternal age				
< 20		1.1		1.1
35-39		1.1		1.1
Birth order				
7-8			1.1	1.0
9+			1.4 *	1.2
Maternal education				
none				1.8 **
GHANA				
Preceding interval				
< 24 mo	3.2 **			3.1 **
24-35 mo	1.5 *			1.5 *
48+	1.0			.9
Maternal age				
< 20		1.0		1.1
35-39		1.0		.9
Birth order				
7-8			.9	.8
9+			1.5	1.4
Maternal education				
none				1.6 **
KENYA				
Preceding interval				
< 24 mo	2.2 **			2.1 **
24-35 mo	1.3			1.3 *
48+	1.0			1.0
Maternal age				
< 20		1.6 **		1.6 **
35-39		1.0		.8
Birth order				
7-8			1.1	1.2
9+			1.0	1.1
Maternal education				
none				1.4 **

Appendix Table 3. Relative risk of **toddler** mortality

	Model I	Model II	Model III	Model IV
CAMEROON				
Preceding interval				
< 24 mo	1.8 **			1.8 **
24-35 mo	1.3			1.3
48+	.6 *			.6 *
Maternal age				
< 20		1.5 **		1.4 *
35-39		.7		.8
Birth order				
7-8			.5 **	.6 **
9+			.7	.8
Maternal education				
none				1.6 **
GHANA				
Preceding interval				
< 24 mo	2.2 **			2.2 **
24-35 mo	1.6 *			1.6 *
48+	.8			.7
Maternal age				
< 20		.8		.9
35-39		.7		.6
Birth order				
7-8			1.2	1.3
9+			.6	.6
Maternal education				
none				1.6 **
KENYA				
Preceding interval				
< 24 mo	2.3 **			2.3 **
24-35 mo	1.8 **			1.8 **
48+	.9			.8
Maternal age				
< 20		1.3		1.3
35-39		1.2		1.1
Birth order				
7-8			.8	.8
9+			1.1	1.1
Maternal education				
none				1.8 **

Appendix Table 4. Relative risk of child mortality

	Model I	Model II	Model III	Model IV
CAMEROON				
Preceding interval				
< 24 mo	1.4 *			1.3
24-35 mo	1.0			1.0
48+	.7			.7
Maternal age				
< 20		1.0		1.1
35-39		1.1		.8
Birth order				
7-8			1.4 *	1.5 *
9+			1.6 **	1.9 **
Maternal education				
none				1.7 **
GHANA				
Preceding interval				
< 24 mo	1.1			1.0
24-35 mo	.9			1.0
48+	.4 **			.3 **
Maternal age				
< 20		2.1 **		2.2 **
35-39		1.2		1.0
Birth order				
7-8			.8	.9
9+			1.6	1.7
Maternal education				
none				4.2 **
KENYA				
Preceding interval				
< 24 mo	1.5 *			1.4
24-35 mo	1.4			1.4
48+	.7			.7
Maternal age				
< 20		1.4 *		1.5 *
35-39		2.0 **		1.6 **
Birth order				
7-8			1.4 *	1.3
9+			1.8 **	1.6
Maternal education				
none				1.8 **

Appendix Table 5. Relative risk of **toddler** mortality when births are closely spaced, demographic and socioeconomic factors controlled

	CAMEROON	GHANA	KENYA
Relative risk*			
Preceding int.	1.7	2.1	2.2
Subsequent int.	2.2	2.3	1.6
Combined	3.7	4.8	3.5

*Preceding interval <24 months
Subsequent interval <18 months

Note: These relative risks differ slightly from those shown in other tables because the estimates are based on the mortality rates of those children who have both preceding and succeeding intervals, i.e., it excludes first born and last born children. Subsequent intervals of this very short length characterize 12 percent of these births in Cameroon, 6 percent in Ghana, and 16 percent in Kenya.

Appendix Table 6. Relative risk of **neonatal, postneonatal, and toddler** mortality by maternal age and birth order, unadjusted and adjusted for birth interval and maternal education

A: CAMEROON

	Unadjusted[a]	Adjusted
Neonatal		
Maternal age		
<20	1.1	1.0
30-34	1.0	1.1
35-39	1.1	1.3
40+	1.1	1.3
Birth order		
4-6	1.0	.9
7-8	1.0	1.2
9+	1.5 *	1.1
Postneonatal		
Maternal age		
<20	1.2	1.1
30-34	.8	.9
35-39	.8	1.1
40+	1.3	1.3
Birth order		
4-6	1.1	1.0
7-8	1.3 *	1.0
9+	1.6 **	1.2
Toddler		
Maternal age		
<20	1.3 *	1.4 *
30-34	.9	1.0
35-39	.7	.8
40+	.9	.9
Birth order		
4-6	.9	.8
7-8	.7	.6 **
9+	1.0	.8

[a] Age controlled for order, order controlled for age

Appendix Table 6 (continued). Relative risk of **neonatal, post-neonatal and toddler** mortality by maternal age and birth order, unadjusted and adjusted for birth interval and maternal education

B: GHANA

	Unadjusted[a]	Adjusted
Neonatal		
Maternal age		
<20	1.2	1.2
30-34	1.2	1.4 *
35-39	.6 *	.9
40+	1.0	1.6
Birth order		
4-6	1.4 **	1.2
7-8	1.6 *	1.2
9+	2.5 **	2.0 **
Postneonatal		
Maternal age		
<20	1.4 *	1.1
30-34	.7 *	.8
35-39	.8	.9
40+	1.3	1.4
Birth order		
4-6	1.1	1.0
7-8	1.1	.8
9+	2.0 **	1.4
Toddler		
Maternal age		
<20	1.4	.9
30-34	.9	.9
35-39	.6	.6
40+	1.0	1.1
Birth order		
4-6	1.3	1.1
7-8	1.6	1.3
9+	.8	.6

Appendix Table 6 (continued). Relative risk of **neonatal, post-neonatal and toddler** mortality by maternal age and birth order, unadjusted and adjusted for birth interval and maternal education

C: KENYA

	Unadjusted[a]	Adjusted
Neonatal		
Maternal age		
<20	1.1	1.0
30-34	.7 **	.8 *
35-39	.6 **	.6 **
40+	.8	1.1
Birth order		
4-6	1.2	1.2
7-8	1.7 **	1.4 **
9+	2.7 **	2.3 **
Postneonatal		
Maternal age		
<20	1.7 **	1.6 **
30-34	1.0	1.0
35-39	.8	.8
40+	1.2	1.4 *
Birth order		
4-6	1.1	1.0
7-8	1.3 *	1.2
9+	1.4 *	1.1
Toddler		
Maternal age		
<20	1.5 **	1.3
30-34	.9	1.0
35-39	1.0	1.1
40+	.6	.8
Birth order		
4-6	1.1	1.0
7-8	1.0	.8
9+	1.4	1.1

* .05 significance
** .01 significance

Note: Reference group: maternal age 20-29, birth order 2-3, some maternal education

Appendix Table 7. Summary table of **infant (1-11 months) and child (12-59 months)** survival by preceding birth interval (3 categories), 0-15 years before survey

	Preceding interval (in months) <24	24-47	48+
CAMEROON			
Infant*			
Survived	3,449	6,601	1,392
Died	598	564	89
Total	4,047	7,165	1,481
Child**			
Survived	1,981	3,775	827
Died	285	367	42
Total	2,266	4,142	869
GHANA			
Infant*			
Survived	1,919	5,426	1,502
Died	256	323	57
Total	2,175	5,749	1,559
Child**			
Survived	1,220	3,314	907
Died	100	229	28
Total	1,320	3,543	935
KENYA			
Infant*			
Survived	6,332	7,896	1,554
Died	792	546	92
Total	7,124	8,442	1,646
Child**			
Survived	3,864	4,759	923
Died	326	323	30
Total	4,190	5,082	953

* Born at least one year before survey date
** Born at least five years before survey date

Appendix Table 8. Proportion of births following intervals less than 24 months, by demographic and socioeconomic characteristics

	CAMEROON	GHANA	KENYA
	%	%	%
Total	31.4	22.4	40.6
Maternal age			
<20	45.4	38.6	52.5
20-29	32.2	21.6	42.2
30-34	28.1	21.8	38.7
35-39	24.8	21.1	35.3
40+	28.0	18.1	27.6
Birth order			
2-3	30.9	20.8	41.7
4-6	31.3	22.7	39.9
7-8	31.0	25.1	40.1
9+	36.7	28.8	40.5
Cohort*			
1	33.6	25.0	44.3
2	32.5	23.5	41.0
3	29.3	19.9	38.0
Residence			
Large urban		19.4	50.4
Urban	30.5	24.2	46.8
Rural	31.7	22.6	39.3
Maternal education			
none	31.5	22.6	39.3
1-3 years	31.0**	24.1	39.4
4-6 years		24.3	39.2
7+ years		20.6	49.5

*1 = 10-15 years before survey
2 = 5-10 years before survey
3 = <5 years before survey

** primary+