When Fertility Seems Too High for Contraceptive Prevalence: An Analysis of Northeast Brazil

By Siân L. Curtis and Ian Diamond

Standard regression equations relating the total fertility rate to contraceptive prevalence indicate that the fertility rate of 5.5 lifetime births per woman observed for Northeast Brazil in the 1986 Brazil Demographic and Health Survey is about 1.6 births per woman higher than would be expected on the basis of contraceptive prevalence at that time. An exploratory approach for evaluating the reasons for higher-than-expected levels of fertility attributes 0.6 of the apparent excess births in Northeast Brazil to the lag effects of recent increases in contraceptive use and 0.6 to the relatively small fertility-inhibiting effect of breastfeeding. Marriage patterns play a smaller role, but appear to be responsible for 0.3 births of the remaining difference between observed and expected fertility.

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There is a strong linear relationship between the contraceptive prevalence rate among currently married women and the total fertility rate (TFR) in a population. Linear regression estimates for this relationship* are available from a number of studies; such equations explain between 72% and 91% of the variation in TFR across countries used in the estimation.[1] In general, estimates of the regression parameters are consistent across studies and suggest that an increase of 10 percentage points in the prevalence rate reduces the TFR by 0.6–0.7 births per woman. In the absence of any contraceptive use, the TFR is usually estimated to be around 7.2–7.4 lifetime births per woman.

In the majority of populations, the TFR predicted in the regression equation is within one birth of the observed TFR. There are a few populations, however, in which the observed TFR is substantially higher or lower than the rate predicted. Of course, variation around the regression line is expected, since the TFR, the contraceptive prevalence rate and the regression parameters are all subject to sampling errors. There may also be genuine reasons for large deviations from the predicted TFR, as many factors other than contraceptive use affect fertility.

Countries with a TFR that deviates substantially from the predicted value often attract particular interest and speculation as to the reason for this deviation.[2] The most common explanations that have been proposed for excess fertility (i.e., when the observed TFR is substantially greater than the predicted TFR) are lag effects from recent increases in contraceptive use, unusually low fertility-inhibiting effects of other proximate determinants (such as marriage and postpartum infecundity), and unusually low levels of contraceptive effectiveness (perhaps resulting from high levels of use of traditional methods). The main explanations proposed when observed fertility levels are substantially lower than the predicted TFR are high levels of induced abortion, high levels of natural sterility, reduced coital frequency resulting from spousal separation and unusually high fertility-inhibiting effects of other proximate determinants. However, these explanations are speculative, and very few studies have attempted to verify empirically the extent to which these factors explain excess or deficit fertility in a particular population.

In this article, we present a simple exploratory approach to evaluate the contribution of different factors to excess fertility in a population. The approach is based on adjustments and existing procedures that can be readily applied to data from the cross-sectional surveys that form the main source of demographic data for many populations. As far as possible, we utilize data that are routinely published in survey reports, although some additional calculations are required.

We illustrate the approach by means of an analysis of excess fertility in Northeast Brazil, which is based on data from the 1986 Demographic and Health Survey (DHS). We then compare our findings with observations from the 1991 Northeast Brazil DHS.

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TFR and Contraceptive Use

Since Davis and Blake produced their seminal paper on the proximate determinants of fertility,[3] many such frameworks have been proposed.[4] Of these, the most widely used is the Bongaarts framework, which relates the TFR to levels of marriage, postpartum infecundity (as determined by breastfeeding behavior), contraceptive use and induced abortion. The model was designed to isolate the causes of fertility differentials between societies, as these four proximate determinants of fertility represent factors that directly affect fertility and vary across different cultures. Other proximate determinants, such as the level of natural sterility and the rate of spontaneous abortion, tend to be fairly constant across populations, and so do not contribute toward explaining fertility differences between populations, or over time within the same population.[5]

While all of the proximate determinants affect the fertility of a population to some extent, the most important factor is the population's level of contraceptive use. As we have already discussed, several regression models of the relationship between the TFR and the contraceptive prevalence rate have been estimated; in this article, we use the model developed by Bongaarts and Kirmeyer.[6] Other models are based on more recent data (and explain a higher proportion of the variance), but Bongaarts and Kirmeyer estimated regression models for the relationships between contraceptive prevalence and the total marital fertility rate and between prevalence and the total natural marital fertility rate, both of which we use in this analysis. Hence, for consistency, we also use their model for the relationship between contraceptive use and the TFR. In fact, the parameters of their regression model are almost identical to those in the more recent models, so the predicted TFR does not vary much according to the model used. The models we use are as follows:

*By virtue of their simplicity, such regression equations are widely used to provide estimates of the level of contraceptive prevalence required to achieve a given TFR, of the TFR that could be expected for a given contraceptive prevalence rate and as a check of whether an estimated TFR for a population is consistent with the estimated prevalence rate.

- Equation 1: TFR=7.3–0.064u;
- Equation 2: Total marital fertility rate=9.5–0.048u; and
- Equation 3: Total natural marital fertility rate=15.3–0.137u.

(In each case, u is the percentage of currently married women practicing contraception.)

Many empirical studies have confirmed the reliability of Equation 1, but in a number of populations the observed TFR has been found to be much higher or lower than is predicted by this equation. Bongaarts proposed a method for adjusting the observed TFR for the difference between the observed and predicted patterns of marriage and breastfeeding,[7] thus enabling an assessment of the extent to which these factors explain the differences between observed and predicted TFRs. This adjustment is based on Equations 1–3 above, combined with the Bongaarts proximate determinants model,[8] and is given by the following equation:

- Equation 4: Adjusted TFR=TFR x $[(C_i' \times C_m')/(C_i \times C_m)]$.

In this equation, C_m and C_i are the observed indices of marriage and postpartum infecundity obtained from the Bongaarts model and C_m' and C_i' are the predicted indices of marriage and postpartum infecundity based on the observed prevalence rate. The latter values are given by the following equations:

- Equation 5: $C_m'=(7.3–0.064u)/(9.5–0.048u)$;
- Equation 6: $C_i'=(9.5–0.048u)/(15.3–0.137u)$.

Bongaarts applied these adjustments to data from Jordan, Kenya, Syria and Yemen, all of which exhibited higher fertility levels than would have been predicted from their contraceptive prevalence rates.[9] These adjustments completely eliminated excess fertility in Yemen, while they reduced it in Jordan and Syria and, to a lesser extent, in Kenya. This finding confirms that the relatively small fertility-inhibiting effects of other proximate determinants often provide a large part of the explanation for excess fertility.

Even after adjustment for the effects of other proximate determinants, however, excess fertility of just under one birth per woman remained in Jordan, Kenya and Syria. Bongaarts speculated that this could be related to measurement error, to atypical levels of frequency of intercourse or to other biological proximate determinants that could not be measured readily. No attempt was made to evaluate the contribution that each of these may have made to the remaining excess, however.

The small fertility-inhibiting effects of other proximate determinants do not always explain higher-than-predicted levels of fertility. For example, for Zimbabwe, Boohene and Dow found that the duration of postpartum infecundity actually implied greater fertility-inhibiting effects of postpartum infecundity than would be predicted from the level of contraceptive use.[10]

Boohene and Dow suggested two explanations for excess fertility in Zimbabwe: First, the equation used may not be appropriate for Africa, where fertility patterns and attitudes differ from those observed in Asia and Latin America (which provided the bulk of the data on which the regression equation was based). In particular, in Africa contraceptives tend to be used for maintaining birth intervals rather than for terminating childbearing. Second, the Zimbabwe family planning program often provided contraception postpartum, which can lead to redundant use during the period in which the woman is breastfeeding and unable to conceive.

An attempt to evaluate the latter hypothesis empirically suggested that about one-half of excess fertility in Zimbabwe could be attributed to redundant use.[11] The researchers speculated that the remaining excess was related to the effects of other proximate determinants, but they did not make any attempt to verify this hypothesis. Another potential explanation—that excess fertility is related to the lag effects of increases in contraceptive use in Zimbabwe in the early 1980s[12]—remains speculative.

In the remainder of this article, we illustrate a simple technique that can be used to evaluate the contribution of each potential factor to the observed level of excess fertility. We do this by analyzing excess fertility in Northeast Brazil.

Excess Fertility in Brazil

The data used in this article are from the 1986 Brazil DHS, which was the first national survey of fertility and family planning ever conducted in Brazil. It represents a comprehensive source of data for both the national and the regional estimation of fertility patterns. The target population was all women aged 15–44, and completed interviews were obtained from 5,892 women (out of an original sample of 6,733).

The sample was designed to allow independent estimation at the regional level and for urban and rural areas in the Northeast, and was self-weighting within each region. The study design also allowed estimates to be made at the state level for the three largest (and politically most important) states—Rio de Janeiro, São Paulo and Minas Gerais. Rural areas in the North and Central-West region, together with the population of the state of Acre and of the territories of Rondônia, Roraime and Amapá, were excluded from the sample because they are inaccessible. The final sample was representative of 95% of Brazil's population.

In recent years, Brazil has experienced a major decline in fertility. Between 1960 and the 1986 DHS, the TFR fell from 6.2 to 3.7 lifetime births per woman.[13] However, marked regional differences in demographic behavior correspond closely to regional economic prosperity. The economically disadvantaged Northeast region has experienced shallow fertility declines, with the TFR still at 5.5 births per woman for the period 0–4 years preceding the 1986 DHS.[14] In contrast, the most prosperous, Southern regions have experienced the largest declines in fertility, and by 1986 were approaching replacement level.

The primary determinant of the fertility decline appears to have been an increased reliance on modern contraceptive methods (primarily the pill and female sterilization); there is little evidence of any role of changing marriage patterns or of postpartum infecundity.[15] Regional variations in the TFR were closely linked to variations in contraceptive prevalence, which ranged from 74% in São Paulo and the rest of the South to 53% in the Northeast.[16]

To assess the impact of contraceptive use on the TFR, we applied to Brazil the Bongaarts-Kirmeyer regression equation (Equation 1). This equation predicted a TFR of 3.1 births per woman; the observed value for the period 0–4 years before the 1986 survey, however, was 3.7 births per woman, suggesting that actual levels of fertility were moderately higher than predicted. However, when we applied this model to each region of Brazil, it became clear that the majority of the excess fertility was in the Northeast, which experienced excess fertility of 1.6 births per woman (Table 1, page 60). This would suggest that the level of contraceptive use achieved in the Northeast in 1986 had not had the anticipated impact on fertility. In fact, the level of fertility experienced in Northeast Brazil would be consistent with a prevalence rate of around 28%, rather than the observed rate of 53%.

There are several possible explanations for this phenomenon. In this analysis, we adjust the model to assess the extent to which different components might account for the excess fertility in the Northeast. These are: the lag effects of recent increases in contraceptive use; lower-than-expected levels of breastfeeding and age at marriage; high contraceptive failure rates; higher-than-expected natural fertility; and redundant use of contraceptives postpartum.

Table 1. Measures of contraceptive prevalence and fertility, by region, Brazil, 1986

Measure	Rio de Janeiro	São Paulo	South	Central East	North-east	North & Central West
Prevalence	71	74	74	64	53	62
Observed TFR*	2.6	3.1	3.1	3.2	5.5	3.7
Predicted TFR†	2.7	2.6	2.6	3.2	3.9	3.3
Excess fertility‡	0.1	0.5	0.5	0.0	1.6	0.4

*Based on the period 0–4 years before the survey. †Estimated from the regression equation given in J. Bongaarts and S. Kirmeyer, 1982 (see reference 1). ‡The observed TFR minus the predicted TFR. *Sources:* **Prevalence rate**—J.M. Arruda et al., 1987 (see reference 13), Table 4.6; **observed TFR**—J.M. Arruda et al., 1987 (see reference 13), Table 3.1.

Lag Effects of Contraceptive Use

Estimates of the TFR from cross-sectional surveys such as the DHS are typically based on births in a given period before the survey—in this case, 0–4 years prior to the survey. However, when Equation 1 is used to estimate the TFR, the prevalence rate typically used is that of current contraceptive practice—i.e., at the time of the survey. If contraceptive use had increased to any extent immediately prior to the survey, this current-status estimate would not represent the actual prevalence rate during the period for which the TFR is being calculated. Consequently, the regression equation would underestimate the TFR, since current use would have been higher than the level actually experienced throughout the reference period. In effect, the predicted TFR would represent the TFR that could be expected in the future were the current level of contraceptive use maintained.

Contraceptive use in Northeast Brazil had increased in the years immediately prior to the 1986 DHS: Contraceptive prevalence surveys conducted in 1980 in Bahia, Paraíba, Pernambuco and Rio Grande do Norte estimated prevalence in those states to have been only 37%, compared to a level of 53% estimated in the 1986 DHS. These estimates are not directly comparable, since the earlier estimate was based on selected states in the Northeast. Nevertheless, there can be no doubt that contraceptive use increased markedly in the five years preceding the DHS.

Although the 1986 prevalence estimate was higher than the level of contraceptive use experienced over the entire period on which the TFR is based, it can be adjusted to refer to the midpoint of this period (i.e., 31 months prior to the survey), in order to provide a more representative estimate for use in the regression equation. The DHS survey gave information on the date of sterilization for sterilized women, which can be used to estimate directly the prevalence of sterilization. For other methods, however, we assume that the estimated prevalence rates from the 1980 state-level surveys are reasonable for the Northeast as a whole, and that the use of methods other than sterilization increased uniformly over the six-year period preceding the 1986 DHS. Under these assumptions, linear interpolation can be used to estimate the prevalence of all methods other than sterilization at the midpoint of the reference period.* Since it appears that the use of methods other than sterilization has increased much less than reliance on sterilization has over this period,[17] such an approximation should provide a reasonable estimate.

The estimated prevalence rates in the Northeast for each method (at the midpoint of the reference period) obtained using this approach are 17.1% for sterilization, 15.3% for the pill, 8.6% for natural family planning and 2.6% for other methods, yielding a total adjusted contraceptive prevalence rate of 43.6%. Substituting this value into Equation 1 gives a predicted TFR of 4.5 lifetime births per woman, compared with a TFR of 3.9 births per woman using the unadjusted prevalence rate. Consequently, adjusting for the contraceptive lag effect reduces excess fertility from 1.6 to 1.0 births per woman (see Table 2).† Thus, nearly one-half of excess fertility in Northeast Brazil is attributable to recent increases in contraceptive prevalence.

Marriage and Breastfeeding Behavior

A likely explanation for the remaining excess fertility is that the fertility-inhibiting effects of other proximate determinants are smaller than anticipated, given the level of contraceptive use. The observed TFR can be adjusted for marriage and breastfeeding behavior using Equation 4, which requires us to estimate the observed and predicted indices of marriage and postpartum infecundity. The predicted indices are based on regressions using contraceptive prevalence as the independent variable, so again it is necessary to use the adjusted prevalence rate, as this is more representative of women's experience during the entire reference period. Using the adjusted prevalence rate of 43.6% in Equations 5 and 6 produced a predicted index of marriage (C_m') of 0.61 and a predicted index of postpartum infecundity (C_i') of 0.79.

The observed indices can be calculated directly from the DHS data. The total marital fertility rate for Northeast Brazil over the period 0–4 years prior to the survey—8.6 births per married woman‡—yields an observed index (C_m) of 0.64. The mean duration of postpartum amenorrhea in Northeast Brazil (estimated to be only 3.7 months[18]) implies an infecundity index (C_i) of 0.90.§

Substituting these values into Equation 4 produces observed TFRs of 5.2 births per woman (after adjustment for marriage patterns) and 4.6 births per woman (after adjustment for marriage and breastfeeding patterns). Hence, after the effects of both variables have been taken into account, the amount of excess fertility is reduced to only 0.1 births per woman (Table 2). This reduction occurs mainly because the fertility-inhibiting effect of breastfeeding in Northeast Brazil is lower than expected, given the area's level of development (as indicated by the contraceptive prevalence rate). This, in turn, is related to the short duration of breastfeeding and high levels of supplementation that characterize infant feeding practices in this region.[19] Marriage behavior appears to be

*The use of linear interpolation to estimate the prevalence of all methods, including sterilization, would simplify the calculations, but also would require us to assume that sterilization increased linearly over the period between the two surveys. Such an assumption is likely to be adequate unless sterilization increased by a large amount during the reference period and the increase was concentrated at the start or the end of the period.

†Lag effects (and hence excess fertility) could be reduced by using a shorter period prior to the survey for the calculation of the TFR. In this analysis, we used a TFR based on the period 0–4 years prior to the survey because we wanted to use published estimates for a fixed period prior to the survey, and the published TFR was the rate for the 0–4 years prior to the survey. More recent DHS reports tend to use the period 0–2 years prior to the survey, a period preferable for these calculations that should result in reduced lag effects.

‡This estimate of the total marital fertility rate is based on the number of marital births and the marital exposure of women who were married or living in a consensual union at the time of the survey. It excludes the experience of formerly married women who may have been married for part of the reference period, but this restriction is necessary, as there was no information in the DHS on the date of dissolution of unions. Marital exposure was calculated from the reported date of first union, and only births occurring after the reported date of first union were included in the numerator. This approach may overestimate slightly the marital births and exposure of women in a second union or a higher order union at the time of the survey, since it assumes that they moved directly into a new union if their first union ended during the reference period. This effect should not be too serious, however.

§This estimate is based on current-status data, but the mean duration of postpartum amenorrhea does not appear to have changed much over the reference period; the mean duration of postpartum amenorrhea estimated for Northeast Brazil from the 1980 state contraceptive prevalence surveys was 3.8 months, almost identical to that obtained in the DHS (see reference 19). Consequently, the value of C_i can be used as a reasonable estimate for the whole period.

reasonably close to what was expected, given the prevalence rate, so it contributes less to the explanation of excess fertility.

The Bongaarts model, however, assumes no fertility outside of marriage; this is clearly not the case in Northeast Brazil. We exclude 163 births from calculation of the total marital fertility rate because they occurred prior to the reported date of first union; thus, the index of marriage is likely to have overstated the fertility-inhibiting effects of marriage. Nevertheless, it seems unlikely that marriage behavior, in its broadest sense of sexual exposure, plays a major role in explaining excess fertility in Northeast Brazil, since the majority of births occur within a cohabiting union of some form; thus, any such overstatement is likely to be relatively small.

The remaining excess fertility of 0.1 births is small and could easily be attributed to sampling variation. In addition, the adjustments described here are approximate, and are based on a number of assumptions that are likely to result in some degree of error. Consequently, the remaining explanations proposed for excess fertility are very unlikely to be important factors in Northeast Brazil. However, we examine them to confirm that they do not contribute to excess fertility in the region, and also to illustrate how such factors could be examined in populations in which controlling for lag effects of increases in contraceptive use, marriage and breastfeeding behavior does not explain the excess fertility observed.

Contraceptive Failure

The Bongaarts-Kirmeyer regression models imply that the expected contraceptive effectiveness averaged across all contraceptive users in a population is 0.83.[20] This value can be compared with the observed level of contraceptive effectiveness to investigate whether high levels of contraceptive failure play any role in explaining excess fertility.

The monthly contraceptive failure rate for the reference period can be calculated for Northeast Brazil from the DHS data using a technique developed recently by Bongaarts and Rodríguez.[21] The failure rate calculated using this technique is cross-sectional, in that it represents the average probability of failing in a month during the reference period, and therefore mixes the experience of women at different durations of method use. This approach is more appropriate for measuring the impact of failure on the TFR, however.

The monthly failure rate (f), expressed as a percentage of failures per month, is calculated from Equation 7: f=(p x b)/120ua, where p is the percentage of all marital live births occurring in the reference period that women conceived while practicing contraception, b is the period marital fertility rate (expressed in terms of the number of marital births per 1,000 woman-years of marital exposure during the reference period), u is the percentage of all person-months of exposure time spent using contraceptives (as estimated by the contraceptive prevalence rate nine months prior to the midpoint of the reference period) and a is the proportion of conceptions occurring during contraceptive use that result in a live birth.

Table 2. Measures of fertility, by adjustment for components of excess fertility in Northeast Brazil

Component	Observed TFR	Predicted TFR	Excess fertility	Excess explained
Nothing	5.5	3.9	1.6	na
Lag effects of increased contraceptive use	5.5	4.5	1.0	0.6
Marriage patterns	5.2	4.5	0.7	0.3
Breastfeeding patterns	4.6	4.5	0.1	0.6

In this instance, we have considered only marital births and marital exposure: The prevalence rate refers only to currently married women, so the population of interest is married women. For Northeast Brazil, the values of these parameters are as follows—p=11.4%; b=294.6; and u=40.5%. In the absence of reliable data on induced abortion, we set a equal to 0.83 (which represents an average risk of spontaneous abortion).[22]*

Inserting these values into Equation 7 produces an estimated monthly contraceptive failure rate of 0.83%. To convert this to an estimate of contraceptive effectiveness, we used the relationship between contraceptive effectiveness (e) and the monthly failure rate (f) given by Bongaarts and Rodríguez[23] as e = 100–(f/c), where c is the monthly probability of conceiving in the absence of contraceptive use. Bongaarts and Rodríguez suggest that values of c between 0.10 and 0.15 are probably reasonable for reproductive-age couples practicing contraception. Assuming the lower value of c (0.10) yields an estimated contraceptive effectiveness of 0.92, well above the value implied by Bongaarts and Kirmeyer's regression equation.

This high level of effectiveness is not really surprising, given the high prevalence of female sterilization in Northeast Brazil, and it confirms that high levels of contraceptive failure do not contribute to the explanation of excess fertility in Northeast Brazil; indeed, it appears that contraceptive failure rates actually act in the opposite direction, and may result in a lower level of excess fertility than would otherwise be observed.

The approach that we use here to estimate contraceptive effectiveness in Northeast Brazil requires the collection of information on the number of births in the reference period that resulted from contraceptive failure. Such information is not collected in all demographic surveys, and indeed it was not collected in many DHS surveys implemented in low-prevalence countries.

In such situations, an alternative method of estimating contraceptive effectiveness is the weighted average of the standard effectiveness of the contraceptive methods used in the population, with the weights given by the prevalence of each method.[24] Such an estimate of effectiveness will only provide information on deviations from the expected effectiveness because of the method mix of the population, though, and will not provide information on deviations related to poor quality of use. Consequently, estimates of the effectiveness of contraceptive practice in the population in question are preferred. However, low contraceptive effectiveness is most likely an important explanation of excess fertility in populations that rely heavily on traditional methods of contraception, and in such situations the weighted average of the standard effectiveness of the methods used will provide some insight into this issue if actual estimates of effectiveness in the population are unavailable.

Level of Fecundity

Another proposed explanation for excess fertility is that the population of interest is more fecund than average, and therefore experiences higher natural fertility than would be expected, especially among contraceptive nonusers. Evidence suggesting that coital frequency is relatively high in Brazil[25] would support this theory, since coital frequency is believed to be the main determinant of fecundity.

By reversing the Bongaarts-Rodríguez equation for calculating the monthly failure rate, we can estimate from the DHS

*Since some women who experience a contraceptive failure probably do resort to induced abortion, this assumption is likely to lead to an underestimate of the true contraceptive failure rate. However, contraceptive failures that result in induced abortions do not contribute to excess fertility. Consequently, underestimation of failure rates should not affect the main analysis to any great extent.

data the monthly probability of conception for nonusers in the reference period. Equation 7 represents the monthly probability of failure among contraceptive users (expressed as a percentage), but it can be redefined to represent the monthly probability of conception for nonusers, as follows: $c = (100 - p)(b)/120(100 - u)(a)$, where c is the monthly probability of conception (expressed as a percentage).

The estimate of c obtained from this procedure will undoubtedly be an underestimate of the monthly probability of conception in the population as a whole, since the fecundity of users tends to be higher than that of nonusers, as nonusers are more likely to be subfecund and infecund, as well as to have low coital frequency. Consequently, c does not represent an estimate of the fecundity of the population of Northeast Brazil. However, if fecundity is higher than average in Northeast Brazil, this estimate of c should also be relatively high when compared to similar estimates for other countries.

Substituting the values for Northeast Brazil into this equation gives an estimated probability of conception for nonusers of 4.4% per month (or 0.04). This seems very low, but when the same procedure is applied to data for Colombia, Costa Rica, the Dominican Republic, Panama and Peru,[26] estimates range from 2.9% in Peru to 3.3% in the Dominican Republic. These findings suggest that Northeast Brazil does indeed experience relatively high fecundity.

Part of this difference is likely related to the different samples covered by the surveys; for example, the Brazil sample did not include women aged 45–49, who are less fecund. There does seem to be some evidence of differences in fecundity, however, probably related to high coital frequency in Brazil. (This finding would also imply even higher levels of contraceptive effectiveness than were suggested earlier.)

Redundant Contraceptive Use

A final possible explanation for excess fertility is that some women who are practicing contraception may be doing so redundantly during the period of postpartum infecundity, and that the extent to which they do so is greater in some countries than in others. In Brazil, sterilization is often performed postpartum and in conjunction with cesarean section, so there is considerable scope for redundant use. However, this potential is offset to some extent by the very short duration of postpartum amenorrhea in Northeast Brazil; thus, redundant use tends to be short-lived.

Current-status data from the DHS support these arguments, as only 14 women who were using contraceptives at the time of the survey were also amenorrheic (2.5% of users). Ten of these women were sterilized, representing only 4% of all sterilized women. Three of the remaining users relied on traditional methods and one on the pill. Hence, redundant use of methods other than sterilization appears to be negligible in Northeast Brazil. Even if sterilization is considered, it is highly unlikely that the level of redundant use is significantly above that experienced in the countries on which the regression equation is based because of the short duration of postpartum amenorrhea in the region.

That redundant use is unlikely to contribute to the explanation of excess fertility can be confirmed by making a relatively simple adjustment to the prevalence rate. If we assume that patterns of postpartum amenorrhea and the timing of postpartum initiation of contraceptive use have not altered over the reference period, then it is reasonable to conclude that 2.5% of users practiced contraception redundantly throughout the reference period. Hence, the contraceptive prevalence rate can be adjusted to represent an "active" prevalence rate for the midpoint of the reference period. This approach leads to an active prevalence rate of 42.5%.

Substituting this value into the regression equation produces a revised estimated TFR of 4.6 births per woman, compared with one of 4.5 after adjustment for lag effects. Even this is likely to be an overcorrection for the role of redundant use (because some overlap between contraceptive use and postpartum amenorrhea is probably present in many of the countries on which the relationship between the TFR and prevalence is based), but it confirms that redundant contraceptive use does not play a major role in explaining excess fertility in Northeast Brazil.

Discussion

In this article, we have presented a detailed analysis of the reasons why Northeast Brazil experiences a higher-than-expected fertility rate, given its level of contraceptive use. A variety of techniques were used to adjust both the observed and predicted TFRs to quantify the contribution of each of several potential factors to the observed extent of excess fertility.

The main reasons for excess fertility in Northeast Brazil appear to be the lag effects of recent increases in contraceptive use (particularly sterilization) and the shorter-than-expected duration of postpartum amenorrhea, which in turn is a consequence of the short duration of breastfeeding and of early supplementary feeding patterns in the region. If this is the case, fertility rates would have been expected to decline after the 1986 survey as the increase in use took effect. The 1991 DHS-II survey in Northeast Brazil confirmed that this occurred: The observed TFR among women aged 15–44 for the period 0–2 years prior to the survey was 3.6 births per woman.[27]

In addition, if there had been no further dramatic increases in contraceptive use, excess fertility should also have declined markedly as lag effects disappeared and contraceptive prevalence increased to a level more consistent with that expected for a population with the breastfeeding patterns of Northeast Brazil. The estimated contraceptive prevalence rate among married women aged 15–44 in 1992 was 60.7%,[28] so there does appear to have been some further increase in use, but not on the scale of the increases of the early 1980s. The predicted TFR for this level of use is 3.4 births per woman, only slightly below the observed value of 3.6 per woman. Consequently, it appears that the majority of excess fertility has indeed disappeared, and that high fertility for observed levels of contraceptive use is no longer an issue in Northeast Brazil.

The techniques described in this article are relatively easy to apply, and many are based on data that can be obtained from standard DHS reports. On the other hand, these techniques are based on a number of assumptions, and as such they should be taken as providing an indication of the relative contribution of each factor to excess fertility, not an accurate estimate of each factor's absolute contribution. This in no way detracts from the utility of exploratory analyses such as this for understanding the causes and policy implications of high levels of fertility for observed levels of contraceptive use. Indeed, the analysis presented here provides useful insights into the phenomenon in Northeast Brazil, and applications of these techniques may prove equally instructive in other populations that experience similar phenomena. For example, some of the techniques have been used in an analysis of fertility decline in Botswana,[29] and they could also be adapted to investigate the opposite phenomenon—of fertility lower than that predicted from the prevalence rate.

In conclusion, policymakers initially need not be concerned if they find that the level of fertility in a population is much higher than expected, given the reported level of contraceptive use. Our results suggest that such a situation may be a temporary phenomenon caused by rapid recent increases in contraceptive use, and subsequently will resolve itself as the level of contraceptive prevalence stabilizes. However, if significant excess fertility remains even after data have been adjusted for this lag factor, simple investigations may highlight other probable factors, such as high levels of contraceptive failure, short durations of postpartum infecundity or high levels of redundant contraceptive use. An effort at addressing these issues in future policy development may then contribute to more effective and efficient contraceptive use and to further reductions in fertility.

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Resumen

Las ecuaciones de regresión estándares que relacionan la tasa global de fecundidad (TGF) a la de prevalencia de anticonceptivos indican que la tasa de fecundidad de 5,5 nacimientos por mujer, observada en la región del nordeste del Brasil en la Encuesta Demográfica y de Salud de 1986, es aproximadamente 1,6 nacimientos por mujer más elevada de lo que se podría esperar en base a la prevalencia del uso de anticonceptivos que existía en ese momento. Mediante un enfoque exploratorio para evaluar las razones por las cuales se registraron estos niveles de fecundidad más elevados de lo esperado, se le atribuye 0,6 nacimientos del exceso aparente en esa región al retraso del efecto del aumento reciente del uso de anticonceptivos y 0,6 nacimientos al efecto relativamente pequeño del amamantamiento como inhibidor de la fecundidad. Las tendencias de matrimonios desempeñan un papel más limitado, pero se le asigna el 0,3 nacimientos de la diferencia restante de la fecundidad observada y esperada.

Résumé

Les équations de régression types qui mettent en rapport l'indice synthétique de fécondité et le taux de prévalence contraceptive indiquent que le taux de 5,5 naissances par femme observé dans le Nord-est du Brésil, selon les résultats de l'Enquête démographique et de santé menée dans le pays en 1986, représente environ 1,6 naissance de plus par femme que la prévalence contraceptive de l'époque aurait donné à penser. Une approche préparatoire d'évaluation des raisons de cette différence attribue 0,6 point de la surnatalité apparente du Nord-est à l'effet tardif des gains récents de la contraception, et 0,6 point à l'effet relativement faible de l'allaitement en tant que facteur inhibiteur de fécondité. Les pratiques du mariage jouent un rôle moindre, toutefois apparemment responsable de 0,3 point du reste de la différence entre la fécondité observée et celle attendue.

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