FERTILITY CHANGE IN COSTA RICA 1960–84: ANALYSIS OF RETROSPECTIVE LIFETIME REPRODUCTIVE HISTORIES

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Summary. Lifetime reproductive histories of a 1984–85 nationally representative sample of 870 women aged 25–59 years provided data to describe the evolution of fertility, contraception, breast-feeding, and natural fecundability in Costa Rica between 1960 and 1984. The contraceptive prevalence rate increased from 23% in 1965 to 58% in 1975 and 66% in 1984. Duration of breast-feeding was stable during the 1960s, decreased in the early 1970s, and increased after about 1976. Fecundability among women who did not practise contraception was lower than expected and declined between 1960 and 1975, probably because of selection effects. Despite a high consistency between estimations from the reproductive histories and other sources of data, some suggestion of omissions of short periods of contraceptive use in the distant past was detected. The survey may have reduced recall errors by using a calendar that summarizes major life events together. The analysis demonstrated the feasibility and usefulness of asking for lifetime reproductive histories in fertility surveys in developing countries.

Introduction

A national survey of Costa Rican women in 1984–85 investigated lifetime reproductive histories, including marriages, pregnancies, breast-feeding, contraception, exposure to sexual intercourse, and sterility. This information, rarely available for a developing country, covers a period of dramatic change in Costa Rican fertility. Indeed, between 1960 and 1975 the country's total fertility rate dropped from 7·3 to 3·7 children (Rosero-Bixby, 1983). In 1986, this small Central American country had a prevalence rate of contraception of 70%, which is close to the level of contraception observed in developed countries (Asociacion Demografica Costarricense (ADC), 1987).

This article examines the validity of lifetime reproductive histories reported in the 1984–85 survey, and uses this information to describe changes in fertility, contraception, breast-feeding and natural fecundability in Costa Rica between 1960 and 1984.

By contrast with indirect methods such as that proposed by Bongaarts (Bongaarts & Potter, 1983), a reproductive history provides straightforward and precise data for studying the proximate determinants of fertility, including such poorly understood determinants as fecundability and contraceptive efficacy (Hobcraft & Little, 1984). This information is also useful in understanding patterns of family building, and how these patterns have been influenced by factors such as the introduction of family planning programmes or changes in the legal status of contraceptives.

Data and methods

The data derive from the Costa Rican Contraception and Cancer Study (CA-85), which was conducted in 1984–85 by the Costa Rican Demographic Association in collaboration with the Centers for Disease Control of the United States, Family Health International, the Costa Rican Ministry of Health, and the Costa Rican Social Security System. Detailed reviews of the methods of this population-based, case-control study of breast and cervical cancer have been previously reported (Rosero-Bixby, Oberle & Lee, 1987; Lee et al., 1987; Irwin et al., 1988).

The present analysis is based on the control series from this study. The controls consisted of a nationally representative household sample of women 25–59 years of age. The multistage cluster probability sample used the June 1984 census as a sampling frame. Sampling fractions used in selecting controls varied by age group in order to match the age distribution of the cancer subjects for the original case-control study. Table 1 records the age distribution and the weighting factors for the 870 interviewed controls. All results in this report are weighted by the factors recorded in Table 1.

Interviews were conducted between September 1984 and February 1985 by female interviewers who had undergone an intensive, week-long training course. They used a standard questionnaire modified from that developed for the Cancer and Steroid Hormone Study (Centers for Disease Control, 1983). Interviews lasted about 45

Table 1. Age distribution and weighting factors: Costa Rican CA-85 study

Age at 1 January 1985	No. of women	Weighting factors
25–29	125	2·50
30–34	158	1·33
35–39	153	1·33
40–44	105	1·33
45–49	119	1·00
50–54	113	1·00
55–59	97	1·00
Total	870	

minutes. Interviewers used a life-history calendar to assist the women in recalling their reproductive histories and, particularly, the periods of contraceptive use. The calendar included, month by month, the years 1935 to 1984. Interviewers recorded reproductive events and states in the corresponding cell-month of the calendar. The events investigated were the first and last menstrual period, first sexual intercourse, initiation and termination of marriages, and any surgery relevant to the study. The states recorded in the calendar were the periods of pregnancy, breast-feeding, use of contraceptive methods (including their brand and source), and unprotected exposure to sexual intercourse. The interview was organized so that events and states already entered on the calendar helped in the recall of other events. In particular, a final question about whether the interviewee had been exposed to the risk of conception was useful in uncovering periods of contraceptive use that had been initially overlooked. When reproductive states overlapped, only one was kept in the computer file according to the following hierarchy: pregnancy, contraceptive methods (ranked by efficacy), breast-feeding, and unprotected sexual intercourse. Unfortunately, the survey did not ask whether contraception was being used when a woman became pregnant, so direct measures of contraceptive efficacy could not be obtained.

Annual synthetic-cohort measures were computed to summarize the age-specific proportions of time the respondents spent: (1) using specific contraceptive methods, (2) breast-feeding, and (3) pregnant (Table 2). The analysis excluded periods of the history outside legal or common-law marriages. The synthetic-cohort measures were computed as the weighted average of the 5-year age-specific proportions, with weighting factors of 0·3 for the 15–19, 0·7 for the 40–44, and 1·0 for other age groups. These factors, which are not related to the sampling weights, were used in order to allow interpretation of the figures as estimates for 25 years lived continuously in marriage by a synthetic cohort of women married at completed age 18. These estimates can also be interpreted as cross-sectional proportions among women aged 15–44 years.

Because the survey included only women born between 1925 and 1960, information for the extremes of reproductive ages was missing for several years. Regression procedures were used to estimate the missing data and thereby complete the measurement for the entire reproductive age range (15–44) in every year of the period 1960–84. For the 15–19 age group, for instance, proportions were estimated in the 1978–84 period by using a regression equation with 20–24 and 25–29 age group proportions as predictor variables.

Based on the summary proportions of time spent pregnant (P) and breast-feeding (B) estimates were derived of the total marital fertility rate (F) and the mean length of breast-feeding in months (D), respectively (Table 2). The relations for these estimates were derived from the classic epidemiological proposition that prevalence is equal to incidence times duration (Lilienfeld & Lilienfeld, 1980).

$$F = 25(0{\cdot}87)(P/0{\cdot}75)$$

$$D = B \Big/ \frac{0{\cdot}87P}{9{\cdot}0}$$

where 25 is the reproductive span of the synthetic cohort, 0·87 is the observed

Table 2. The proximate determinants and the total marital fertility rate of synthetic cohorts of women married at 18 years of age: CA-85 reproductive histories, 1960–84

Year	Proportions per 1000			Months of breast-feeding	Total marital fertility rate
	Pregnant	Contraception	Breast-feeding		
1960	269	164	148	5·7	7·8
1961	284	169	143	5·2	8·2
1962	302	182	150	5·1	8·8
1963	257	198	140	5·6	7·5
1964	272	221	140	5·3	7·9
1965	231	232	143	6·4	6·7
1966	270	267	116	4·4	7·8
1967	240	305	129	5·6	7·0
1968	223	338	116	5·4	6·5
1969	228	360	110	5·0	6·6
1970	195	394	105	5·6	5·7
1971	162	446	108	6·9	4·7
1972	152	478	61	4·2	4·4
1973	157	496	56	3·7	4·6
1974	149	541	60	4·2	4·3
1975	122	576	63	5·3	3·5
1976	132	589	46	3·6	3·8
1977	140	593	51	3·8	4·1
1978	119	620	58	5·0	3·5
1979	135	620	50	3·8	3·9
1980	124	635	58	4·8	3·6
1981	137	641	58	4·4	4·0
1982	128	644	71	3·7	3·7
1983	126	672	58	3·7	3·7
1984	145	663	54	4·2	4·2

proportion of pregnancies that terminated in live births, and 0·75 and 9·0 are the observed average durations of live birth pregnancies, in years and months respectively.

The age-specific natural fecundability (N), or the monthly probability of conception among women using no contraceptive methods, was estimated using a relation that integrates the proximate determinants of fertility in the same equation. Assuming homogeneous fecundability:

$$N = \frac{\text{monthly conceptions in the year}}{\text{woman-months at risk of conceiving}}$$

$$N = \frac{(P/8·4) - (1-c)N.C - (1-b)N.B}{1 - (C+B+P+X+M)}$$

that simplifies to

$$N = (P/8·4)/(1 - cC - bB - P - X - M)$$

where 8·4 is the observed average duration of a pregnancy, P represents the proportion of time spent pregnant, C is the proportion spent using contraceptives, B is the proportion spent breast-feeding, X is the proportion spent not exposed to sexual intercourse, and M the proportion spent in post-menopausal status. The relation includes corrections for the conceptions from women using contraceptives or breast-feeding, which depend on their respective contraceptive efficacies c and b. Basing these figures on the observed changes over time in the mixture of methods (Table 4) and the efficacy for individual methods used in other studies (Bongaarts & Potter, 1983), it was assumed that the contraceptive efficacy (c) increased linearly from 0·75 in 1960 to 0·90 in 1975 and remained constant after 1975. For breast-feeding, an efficacy of 0·75 was assumed, a previously reported estimate for women in the 4th month post-partum (Hobcraft & Little, 1984). A sensitivity analysis of the effect of these assumptions on the estimated fecundability is presented later.

To validate the individual contraceptive histories the information from CA-85 was compared with separate information from the centralized national family planning data system (SIDESCO). This computerized system operated from 1974 to 1980 and recorded each visit to a physician or nurse in a public family planning clinic. These public clinics, run by the Ministry of Health and the Social Security office, are the source of contraception for about the 80% of women using modern contraceptives (Rosero-Bixby, 1981). Each subject's history of oral and injectable contraceptive use was matched with the SIDESCO records, using the unique civil identification number of each Costa Rican adult. Since the identification number was not recorded for 10% of clinic visits, SIDESCO could not be used to verify a woman's claim that she had ever used a hormonal contraceptive from a public clinic, but could be used to obtain a minimal estimate of possible false negatives: a woman's response was judged false if she claimed never to have used oral contraceptives, but her SIDESCO record indicated that she had received OCs at least once during the 7-year period covered by the computerized record system.

Results

Marital fertility

The retrospectively estimated TMFRs for Costa Rica show a sharp reduction from about eight children in 1960 to less than four in 1975, but after this year the rates remain approximately the same. These trends closely parallel those described by vital statistics (Fig. 1). The correlation coefficient between the two series is 0·97. However, estimates from pregnancy histories of CA-85 tend to be higher than those from vital statistics. This difference probably occurred because the official figure is based only on legal marriages, whereas the CA-85 estimate includes common-law unions, which represent more than 20% of all unions and usually have higher fertility than legal marriages (Rosero-Bixby, 1983).

Contraception

The sharp decline in fertility rates was consistent with the increased proportion of time spent using contraceptives indicated by the reproductive histories (Fig. 2). This
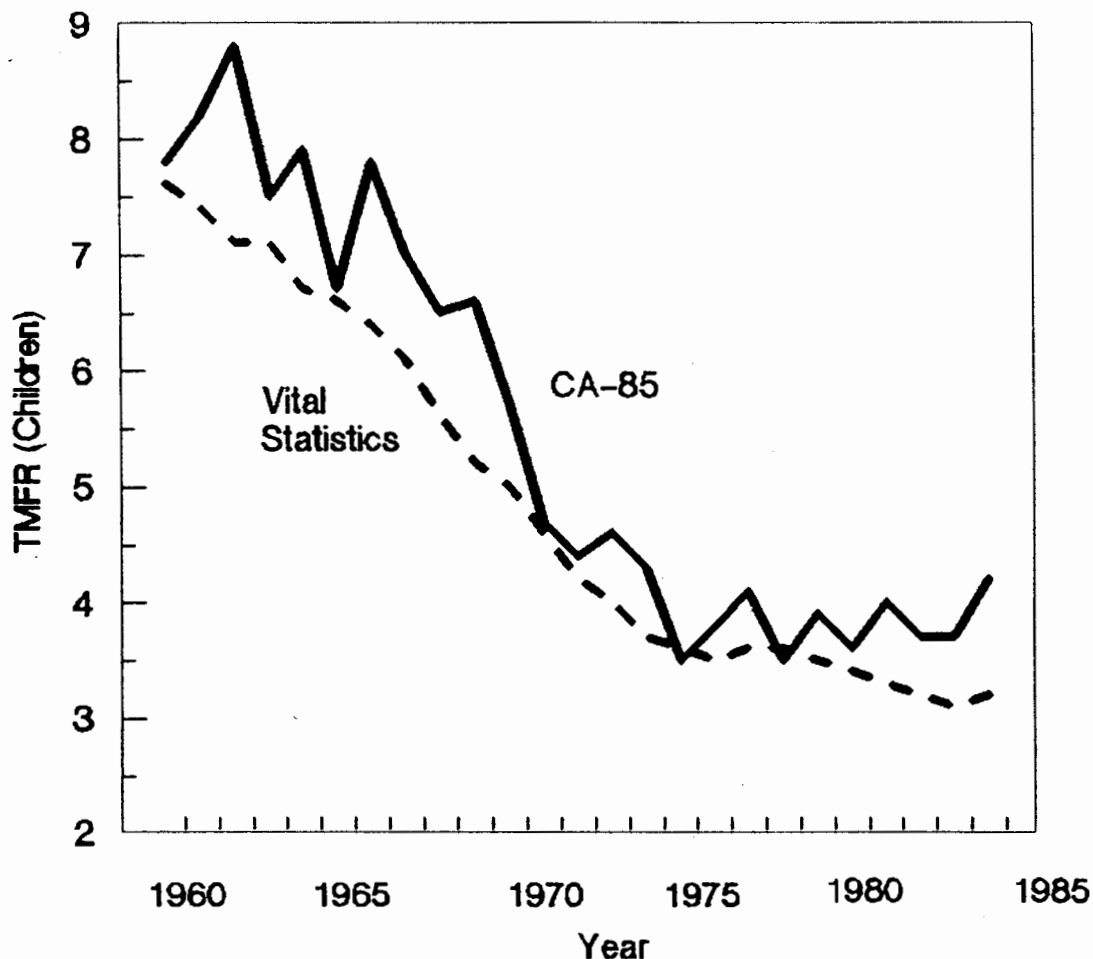
Fig. 1. Total marital fertility rate from CA-85 and vital statistics (Rosero-Bixby, 1983), 1960–84.

proportion, which is equivalent to a rate of contraceptive prevalence, grew from 16% in 1960 to 58% in 1976 and to 66% in 1984. The greatest change in both fertility and contraception was observed in the period 1965–75, coincident with the launch of private (1966) and public (1968, 1970) family planning programmes (Rosero-Bixby, Gomez & Rodriguez, 1982).

Figure 3A illustrates the close association between the TMFR from vital statistics and the contraceptive use recorded in the reproductive histories (correlation coefficient, -0.99). When the variable contraception was used as a predictor, the intercept of the regression line on TMFR was 8·6, which represents a plausible level of marital fertility with no birth control, and a slope of 0·09, which suggests that the use of contraception would have to increase 11 percentage points to reduce the TMFR by one child. Similar results were obtained by replacing the figure from vital statistics with the retrospectively estimated TMFR from the histories which yielded a correlation of -0.97, an intercept of 9·7, and a slope of 0·10 (Fig. 3B). Thus the
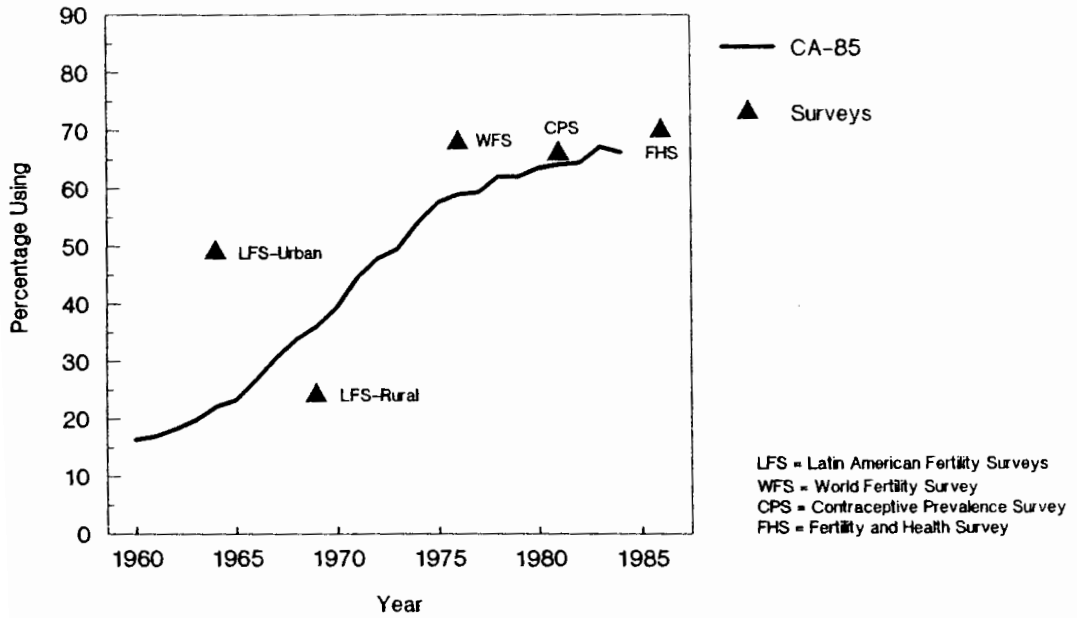
Fig. 2. Percentage using contraceptives from CA-85 and fertility surveys, 1960–84 (married women aged 15–44).
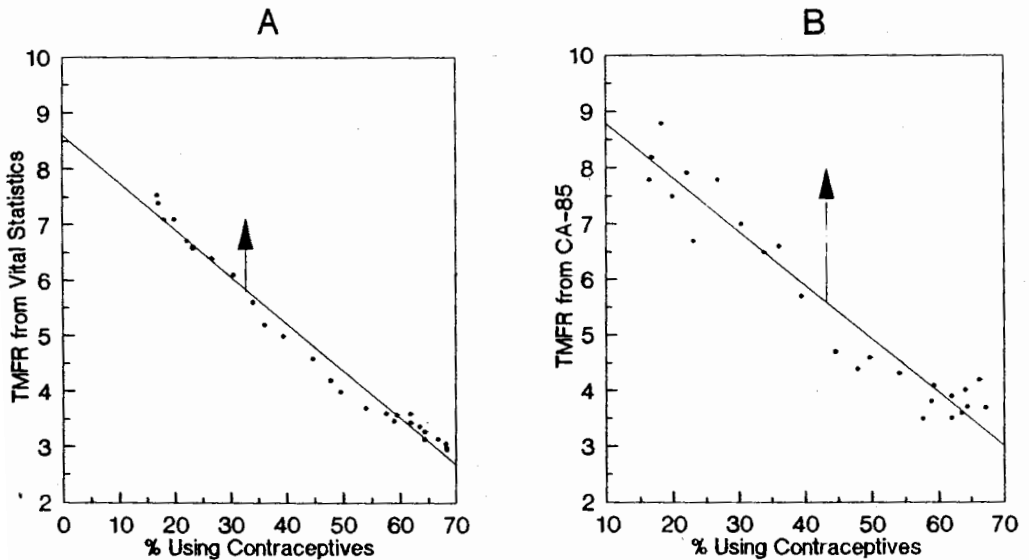

Fig. 3. Association between the percentage using contraceptives from CA-85 and the total marital fertility rate, 1960–84: A, from vital statistics (Rosero-Bixby, 1983); B, from CA-85; for explanation, see text.

reproductive histories of CA-85 showed a satisfactory internal and external consistency.

Another way to validate the estimates derived from contraceptive histories is to compare them with the prevalence rates from other surveys. Figure 2 depicts these rates from the 1964 urban and 1969 rural Latin American Fertility Surveys (LFS), the 1976 national World Fertility Survey (WFS), the 1981 Contraceptive Prevalence Survey (CPS), and the 1986 Fertility and Health Survey (FHS) (Rosero-Bixby et al., 1982; Rosero-Bixby, 1981; ADC, 1987). The retrospective rate from CA-85 for 1984 (66%) is consistent with the current figure from the 1986 FHS (70%). The retrospective result for 1981 (64%) is also quite close to the rate from the CPS for that year (66%). For 1976, however, the histories produced a substantially lower retrospective estimate of the contraceptive prevalence rate (59%) than that from the 1976 WFS (68%). The most plausible explanation for this discrepancy is the omission

Table 3. Percentage of married women aged 20–49 using contraceptives by age and method: CA-85 reproductive histories and current data from the 1976, 1981, and 1986 surveys

Age and method	CA-85 1976		WFS 1976	CA-85 1981	CPS 1981	CA-85† 1984	FHS† 1986
N	530		2684	541	2236	401	1640
Age							
20–24	43	*	64	57	58		
25–29	61		70	61	65	65	65
30–34	64		72	68	72	66	74
35–39	70		75	67	75	71	84
40–44	59	*	70	77	70	80	78
45–49	36	*	51	47	56	67	68
All	57	*	68	63	67	67	72
Method							
OCs	16	*	22	16	19	13	16
Injection	2		2	2	3	1	2
IUD	5		5	7	6	8	8
Condom	7		9	1	8	12	12
Spermicides	2		2	1	1	0	1
Tubectomy	14		16	18	20	23	21
Vasectomy	1		1	0	1	0	1
Rhythm–withdrawal	10		11	10	10	9	11

† Married women aged 25–49 years.

* Significant difference at 0·05 level (large sample statistical test for difference between two proportions).

WFS = World Fertility Survey, unpublished tabulations.

CPS = Contraceptive Prevalence Survey (Rosero-Bixby, 1981).

FHS = Fertility and Health Survey (ADC, 1987).

from contraceptive histories of short periods of use in the distant past. As expected, the retrospective estimates for 1964–69, ranging from 22% to 36%, appear low when compared with the 1964 LFS in urban areas (49%) and high when compared with the 1969 LFS in rural areas (24%); both comparisons reflect rural and urban contraceptive differentials.

The retrospective discrepancy with the 1976 WFS occurred in the entire range of ages, but mainly for one method—oral contraceptives (OCs) (Table 3). Also in 1981 and 1984, the histories apparently underestimated the use of OCs, but discrepancies in these years were not statistically significant. However, it is reassuring that the retrospective ranking of methods and ages in the histories was similar to the corresponding estimates from fertility surveys.

Table 4. Percentage of married women aged 20–39 using each contraceptive method: CA-85 reproductive histories, 1960–84

Method	1960–64	1965–69	1970–74	1975–79	1980–84
N*	270	321	358	378	331
All	18·2	30·9	48·8	60·7	64·6
OCs	2·6	6·5	18·6	20·7	18·5
Injection	0·4	0·4	1·4	1·7	1·3
IUD	0·0	2·8	4·2	6·3	8·0
Condom	5·8	6·2	6·4	8·9	12·5
Spermicides	0·5	1·3	1·6	1·4	0·3
Tubectomy	1·5	4·9	8·1	11·0	13·7
Vasectomy	0·4	0·2	0·5	0·3	0·3
Rhythm–withdrawal	7·0	8·6	8·0	10·4	10·0

* Average of woman-years in married state.

The histories from CA-85 gave a reasonable picture of the changes that occurred in the mixture of contraceptive methods during more than two decades (Table 4). In 1960–64—the period of commercial introduction of OCs, IUDs, and modern techniques of sterilization to Costa Rica—most persons who practised contraception used the condom and natural methods. The number of persons using these methods changed little between 1960 and 1974. However, the overall prevalence rate for contraceptive use rose substantially because of the increased use of OCs, tubal sterilization, and IUDs. More recently, OCs have lost popularity, whereas the use of older methods (especially the condom) has increased—a phenomenon confirmed by the most recent fertility survey (ADC, 1987).

Validity of individual contraceptive histories

Three types of possible false-negative contraceptive histories were encountered: (1) women who reported never using OCs or injectables but whose SIDESCO record

included one or more visits to a family planning clinic to obtain these contraceptives were classified as absolute false negatives; (2) women who reported using OCs or injectables only before or after 1974–80 but whose SIDESCO record contained at least one visit for these methods were classified as having date errors; (3) women who reported obtaining OCs or injectables during 1974–80 from only private providers but whose SIDESCO record contained at least one visit to a public clinic were classified as having errors in source of contraception.

Of interviewees who reported that they had not used a public clinic to obtain contraception in 1974–80, 4% had an absolute false negative history of OC use and 1% had an absolute false negative of injectable contraceptive use (Table 5). However,

Table 5. Contraceptive histories compared to SIDESCO records for women with a negative history of hormonal contraceptive use in public clinics in 1974–80

SIDESCO classification	Oral contraceptives		Injectables	
	N	%	N	%
Absolute false negative	23	3·8	9	1·2
Error in date	31	5·1	2	0·3
Error in source	4	0·7		
All false negative	58	9·6	11	1·5
True negative	548	90·4	745	98·5
Total	606	100·0	756	100·0

of the 23 women classified as having an absolute false negative history of OC use, fifteen had only one clinic visit recorded in the SIDESCO file. Similarly, of the nine women with absolute false negative histories of injectable contraceptive use, five had only one visit recorded in the SIDESCO system. These figures suggest that most absolute false negative histories may reflect women who either had used OCs only briefly, or had not taken the prescribed method. Alternatively, these single visits could represent SIDESCO errors in recording or transcribing the civil identification number needed to link the files or the method prescribed.

Of the false negative histories due to errors in reporting dates, 5% were for OCs and 0·3% were for injectables (Table 5). Only four women (0·7%) erroneously reported obtaining their OCs from a private rather than a public source.

Breast-feeding

The estimated proportion of months spent breast-feeding declined from an average of 15% of a married woman's reproductive life span in 1960 to 10% in 1972 (Fig. 4). This reduction was due to the fertility decline, rather than to a reduced duration of breast-feeding. The average duration of lactation did decline later, in the early 1970s; but after 1976, duration increased according to both the retrospective information from CA-85 and the results from fertility surveys (Fig. 4).
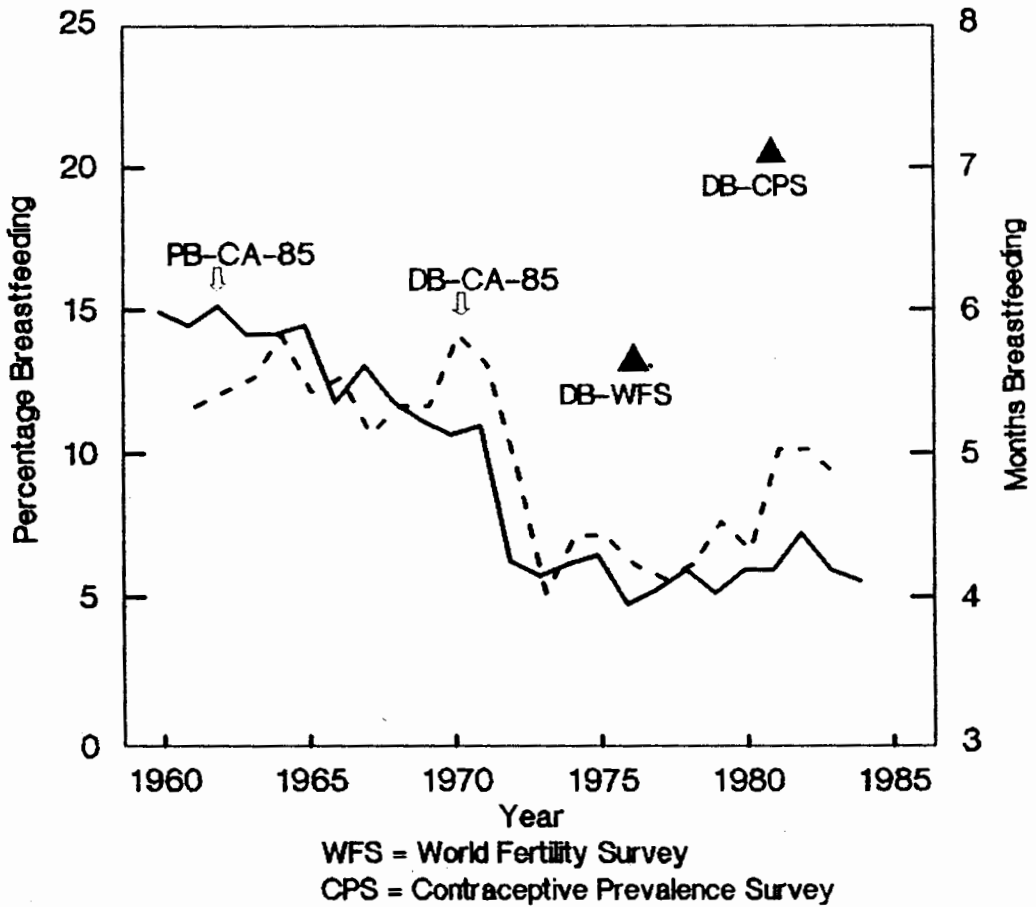
Fig. 4. Percentage breast-feeding (PB) and estimated average duration of breast-feeding (DB), CA-85 and other studies, 1960–84.

The estimates of the length of lactation from the histories were substantially lower than those from fertility surveys—3·6 versus 5·6 months in 1976, and 4·4 versus 7·2 months in 1981. This discrepancy can probably be explained by the exclusion in CA-85 of those periods of lactation that overlapped with contraceptive use. No survey information is available from the 1960s to compare with the interesting stability in lactational practices found for those years in the histories.

Natural fecundability

Despite the critical assumptions in the estimation, the fecundability of women who did not practise contraception followed reasonable patterns by age and time (Fig. 5). As expected, women aged 20–24 had the highest monthly probabilities of conception, ranging from 0·14 in the early 1960s to 0·10 in the 1970s and 1980s. These figures are lower than typical values of 0·20–0·25 found in populations with natural fertility (Bongaarts & Potter, 1983). However, low levels of fecundability can be anticipated when a high proportion of women are practising birth control, because many of the remaining women are not practising contraception precisely because of
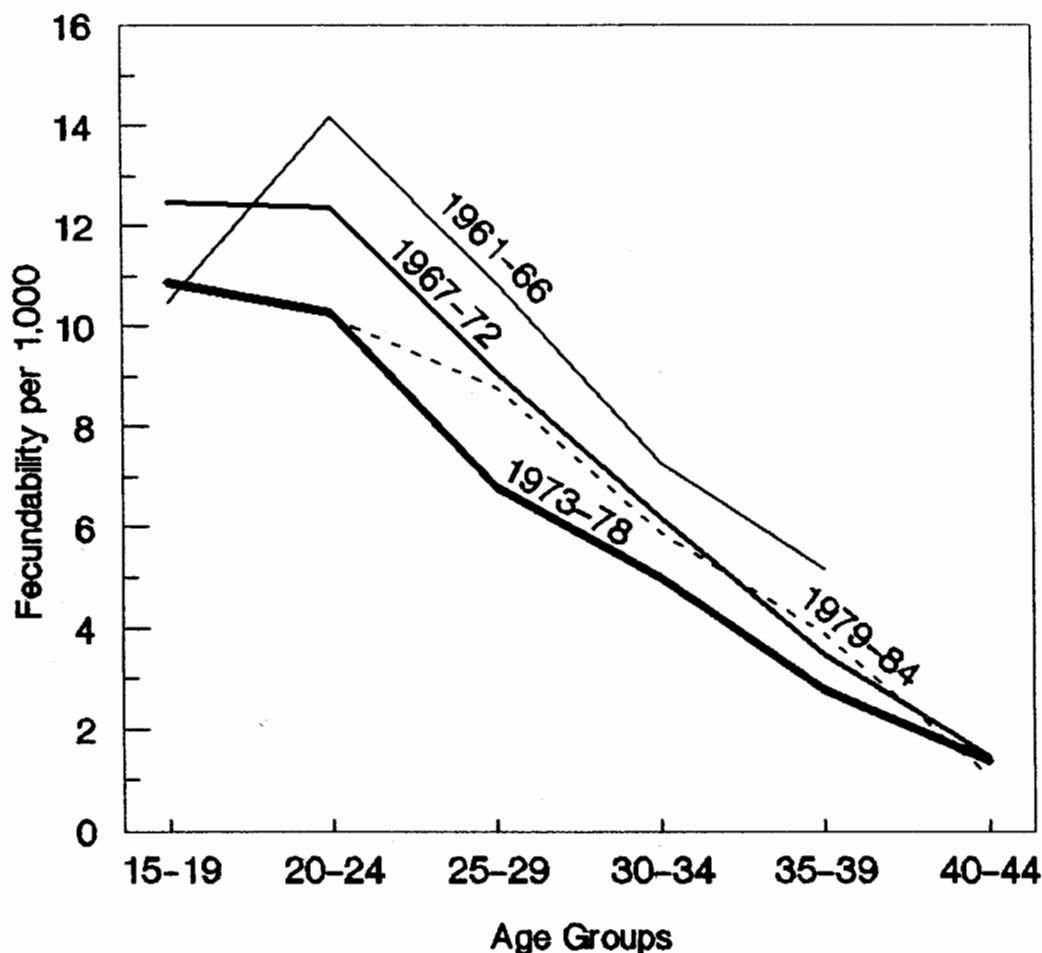
Fig. 5. Estimated fecundability from CA-85 by age, 1961–84.

their lower fecundability (Ridley *et al.*, 1969). Another source of underestimation may be unreported pregnancies that terminated in abortions. As in other fertility surveys (Rosero-Bixby, 1984), only 13% of pregnancy outcomes were reported in the histories as abortions or stillbirths.

The selection factor may also explain the declining trend in the estimated natural fecundability until approximately 1975 (Fig. 5), since the residual group of women not using contraceptives diminished over time and, consequently, became more and more selected. The unexpected, though slight, increase observed after this year may be genuine, but may also be an artifact from the increasing omission of short periods of contraceptive use in the distant past, a decline in the contraceptive efficacy in recent years, and improved reporting of abortions for recent years.

The estimate of fecundability may have been distorted by the assumptions that had to be made on the efficacy of contraceptive use and breast-feeding. A sensitivity analysis used to evaluate this possibility showed that the basic trend of estimated fecundability does not change when those assumptions are modified within reasonable margins. The largest change occurred when the breast-feeding

contraceptive efficacy was changed from 0·75 to 0·50. This modification produced reductions of up to 15% in the estimates of fecundability for the early 1960s.

Conclusion

The analysis yielded findings that have not been described by previous studies of Costa Rican Fertility: (1) contraceptive use increased rapidly from 1965 to 1975; (2) the mixture of contraceptive methods changed between 1960 and 1975 in favour of OCs, IUDs and tubal sterilization, but after 1975 the proportion using OCs declined—a trend also observed in the USA and Panama (Warren *et al.*, 1987); (3) the average duration of breast-feeding was stable during the 1960s, decreased in the early 1970s, and increased after about 1976; (4) possibly because of a selection effect, fecundability among women who did not practise contraception was low and declined from 1960 to 1975.

The recent increase in duration of breast-feeding after the sharp decline in the early 1970s is an encouraging development and may well reflect increased acceptance of the public health community's promotion of breast-feeding.

The retrospective estimates for fertility and contraceptive use from the histories were consistent with fertility trends from Costa Rican vital statistics. However, the comparison of contraceptive prevalence rates from this study with prevalence rates from several fertility surveys yielded less consistent results. Concordance was good for recent surveys, but there were suggestions of omissions of brief periods of contraceptive use in the distant past. The possibility of omissions was reinforced by an unexpected moderate increase after 1975 in the fecundability of women who did not practise contraception.

When the individual histories of contraceptive use were compared with independent data from 1974–80 visits to family planning clinics, a low proportion of false negative histories was found. In addition, the fact that about two-thirds of the women with absolute false negative histories recorded only one clinic visit suggested that errors in reported contraceptive histories would have a minimal effect on demographic analysis. The use of the life history calendar may have reduced recall errors (Coulter, Vessey & McPherson, 1986).

The results reported here demonstrated the feasibility and usefulness of asking for lifetime reproductive histories in fertility surveys in developing countries. Retrospective information gathered on less than 900 women permitted reconstruction with reasonable precision in a period of dramatic changes, 25 years of national history of fertility, contraception, breast-feeding, fecundability. However, Costa Rica may be somewhat exceptional among developing countries because of its high levels of literacy. Virtually all young adults are literate. Some of the few older, illiterate women may have found a life history calendar difficult to decipher, but others seemed to grasp the approach as easily as did the literate women.

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