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Contraceptive use and breast-feeding duration in rural Bangladesh

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The association between contraceptive use and breast-feeding duration was investigated in 2380 women in rural Bangladesh where women usually stop breast-feeding once pregnant. Life table analysis showed that women receiving regular injections of depo medroxy progesterone acetate (DMPA) and those using non-hormonal contraception breast-fed significantly longer than women using no contraception. In contrast, women using oral contraceptives (combination of 0.5 mg norgestrel and 0.05 mg ethinyl oestradiol) did not breast-feed longer than women using no contraception. It is suspected that prolongation of breast-feeding obtained by delaying the next pregnancy with this oral contraceptive was offset by the depressing effect of oestradiol on lactation. Thus, in communities where prolonged breast-feeding is associated with improved child survival, non-hormonal contraceptive methods, or injectable DMPA, should be preferred for lactating women to oestrogen-containing oral contraceptives.

Introduction

In communities with a high prevalence of malnutrition, breast-feeding is associated with improved child survival up to three years of age (Lepage, Munyakazi & Hennart, 1981; Briend, Wojtyniak & Rowland, 1988; Briend & Bari, 1989). In rural Bangladesh, most women stop breast-feeding once pregnant and pregnancy seems to be the most important cause of breast-feeding cessation (Huffman *et al.*, 1980). Hence, promotion of family planning, by delay of the next pregnancy, should in principle result in increased duration of breast-feeding and in better child survival. The relationship between contraceptive use and breast-feeding duration is not straightforward, however, and an inverse association has frequently been reported (Hull, 1983; Millman, 1985). In Bangladesh it has been reported, based on subjective evidence, that breast-feeding could be reduced by injectable contraceptives (Parveen, Chowdhury & Chowdhury, 1977). Biologically, it seems plausible that some hormonal contraceptives, especially those containing oestrogens, may inhibit lactation (Rosa, 1976; Laukaran, 1981; WHO Task Force on Oral Contraceptives, 1988). It has also been suggested that women who breast-feed to delay a new pregnancy do not see the need to continue breast-feeding once they are using safer contraceptive methods (Millman, 1985).

Contraceptive use during lactation is becoming more and more frequent in developing countries. Its effects on lactation, especially in communities with prolonged breast-feeding, should be explored (Hull, 1983; Pebley, Goldberg & Menken, 1985). In this study, we examined this relation in a community of rural Bangladesh where breast-feeding beyond one year seems to

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play a key role for survival of malnourished children (Briend *et al.*, 1988; Briend & Bari, 1989).

Methods

Since 1966 the International Centre for Diarrhoeal Diseases Research in Bangladesh (formerly the Cholera Research Laboratory) has maintained a demographic surveillance system that continuously records births, deaths, marriages and migrations in a total population of about 180,000 in the Matlab area, 40 km south-east of Dhaka, the capital. This area is typical of rural Bangladesh, with a subsistence farming economy and poor infrastructures and communications. It has a high population density (700 per km^2), high infant mortality (100 per 1000 live births), and a low literacy rate (30 per cent among adults).

In 1978 a community-based Family Planning and Health Services Project was initiated in half of the study area with a total population of about 95,000. In each village, a female community health worker (CHW) visits every household with under-five children fortnightly to provide basic health and family planning services.

In this project, contraceptive methods are not proposed to women exclusively breast-feeding their child, on the assumption that the contraceptive effect of full breast-feeding is sufficient to prevent a new pregnancy. Contraceptives are offered when the child is at least six months old, at a time when food supplements have already been started and represent a substantial portion of the child's diet. The CHWs explain the main advantages and disadvantages of each contraceptive method and the women choose with them the method best adapted in their case. Only high parity women are proposed tubectomy, whereas oral contraceptives are more readily recommended to young, primiparous, better educated women.

Every year each of the 80 CHWs is provided with a service record book with a computer-generated list of all women eligible for family planning in their working area. In this book, CHWs record information about maternal and child health, including breast-feeding, pregnancy and family planning use. At the end of each year, these books are taken back from the field and become available in the project office for service evaluation and research.

Data used in this study were collected from 20 randomly selected books used from April 1987 to March 1988. Records of 2380 women who had at least one under-five child alive in March 1988 were included in this study. For all these women, it was noted whether they were still lactating, either fully or partially, in March 1988 and, if not, it was determined when they stopped breast-feeding by means of record books of previous years, if necessary. It was noted also whether the mother was using contraception and whether she was pregnant when she stopped breast-feeding. All information regarding pregnancy was confirmed by checking the occurrence of a birth in the months after breast-feeding cessation. For all these women, parity, the number of years of formal education and the dwelling floor area, an indicator of socio-economic level, were also noted.

The comparison of duration of lactation for women using different contraceptive methods was made by lifetime data analysis methods (Peto *et al.*, 1976, 1977). An observation was considered complete if it ended up with breast-feeding cessation, and censored if the woman was still lactating in March 1988. The probability of a child continuing to be breast-fed at different ages was calculated with the use of both censored and complete observations by the product-limit estimator (also called Kaplan Meier estimate). Expected duration of lactation was estimated by summing the cumulative chance of breast-feeding for each month. Curves of breast-feeding frequences in relation to age were compared by the logrank test. Risk factors related to cessation of breast-feeding were determined by means of Cox's proportional hazard regression model (Cox, 1972).

Results

Three-monthly intramuscular injections of 150 mg depo medroxy progesterone acetate (DMPA) was the most widely used contraceptive method, followed by oral contraceptives containing a combination of 0.5 mg norgestrel and 0.05 mg ethinyl oestradiol. Most popular non-hormonal methods were the intra-uterine device and tubectomy. Use of other methods, such as condom, vasectomy or vaginal foam, was rare (Table 1).

Among women using no contraception, pregnancy was a frequent cause of breast-feeding cessation: the expected duration of lactation was 31 months for women who were pregnant at the end of the follow-up compared to 44 months for those who were not pregnant (logrank chi-square = 95.8, $P < 0.001$). Almost half of women (47.8 per cent) who did not use contraception were pregnant when they stopped breast-feeding, against only 5.5 per cent among contraceptive users (chi-square = 101.3, $P < 0.001$).

Expected duration of lactation was 43 months for contraceptive users compared to 40 months for women who did not use contraceptives (logrank = 12.6, $P < 0.001$). The effect of contraception on lactation varied according to the method used: women using oral contraceptives did not breast-feed significantly longer than women not using contraceptives, whereas women using non-hormonal methods or those receiving DMPA had an expected duration of lactation of 43 and 45 months respectively (Table 1, Fig. 1), which was quite similar to the 44 weeks of lactation observed among women not using any contraception who were not pregnant at the end of the follow-up.

Parity and level of education were among the factors considered when a contraceptive method was chosen. These factors are also related to breast-feeding duration (Huffman *et al.*, 1980) and could confound the relationship between contraceptive use and lactation. For that reason, in this investigation of the relationship between contraceptive use and duration of lactation adjustment was made for these variables by means of Cox's proportional hazards model (Cox, 1972). Dwelling floor area, which is considered a good indicator of socio-economic level in this community, was not related to breast-feeding duration once education and parity were taken into account, and was not kept in the final models.

Non-hormonal methods and DMPA were associated with a lower risk of breast-feeding cessation compared to that for

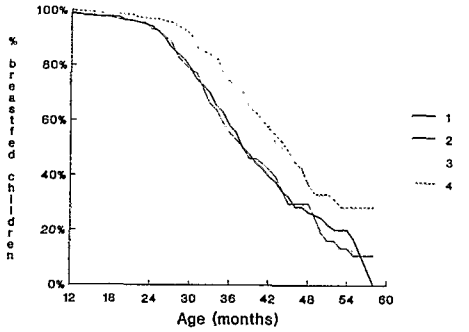

Fig. 1. Probability of being breast-fed in relation to age when the mother (1) does not use contraceptives, (2) uses oral contraception, (3) uses non-hormonal methods, or (4) uses DMPA.

Table 1 Frequency of contraceptive use and estimated mean duration of breast-feeding for different contraceptives ($n = 2380$).

Type of contraceptive	*Number of women under follow-up*	*% of women using the method*[a]	*Estimated duration of breast-feeding (mean months)*	*Logrank chi-square compared to non-contraceptive users*
No contraceptive	1292	–	40	–
Oral contraceptive	258	23.7	40[+]	0.03[ns]
DMPA	562	51.6	45[+]	18.3**
Non-hormonal methods	268	24.6	43[+]	7.6*

[a] Among contraceptive users.
[+] The last observation is censored. The mean duration of breast-feeding may be greater than its estimated value.
[ns] Non-significant.
* 1 degree of freedom, $P < 0.01$.
** 1 degree of freedom, $P < 0.001$.

women using no contraception even after adjustment was made for parity and maternal education (Table 2). In contrast, oral contraceptive use was not associated with a lower risk of breast-feeding cessation. When pregnancy was added to the possible risk factors, oral contraceptive use was found to be associated with an increased risk of breast-feeding cessation (Table 3). An increased risk of breast-feeding cessation for oral contraceptive users was also observed when women who were pregnant at the end of follow-up were removed from the analysis (Table 4).

Table 2 Estimation of risk factors for breast-feeding cessation by a Cox proportional hazards regression model.

Risk factor	*Hazard ratio*	*95% confidence interval*	*P*
Non-hormonal contraceptive	0.72	0.54–0.96	0.024
Oral contraceptive	1.08	0.82–1.43	ns
DMPA	0.62	0.48–0.80	< 0.001
2–4 children[a]	0.70	0.53–0.91	0.008
5 children or more[a]	0.60	0.45–0.80	< 0.001
1–4 years of formal education[b]	1.53	0.62–3.82	ns
5 years of formal education or more[b]	4.90	2.91–8.27	< 0.001

[a] Compared to women with one child.
[b] Compared to women with no formal education.
ns = non-significant.

Table 3 Estimation of risk factors for breast-feeding cessation by a Cox proportional hazards model including pregnancy among the predictors.

Risk factor	*Hazard ratio*	*95% confidence interval*	*P*
Pregnancy	3.75	2.84–4.95	< 0.001
Non-hormonal contraceptive	1.01	0.74–1.37	ns
Oral contraceptive	1.42	1.06–1.90	0.017
DMPA	0.87	0.66–1.16	ns
2–4 children[a]	0.75	0.57–0.98	0.036
5 children or more[a]	0.63	0.47–0.84	0.002
1–4 years of formal education[b]	1.08	0.43–2.74	ns
5 years of formal education or more[b]	5.15	3.06–8.67	< 0.001

[a] Compared to women with one child.
[b] Compared to women with no formal education.
ns = non-significant.

Table 4 Estimation of risk factors for breast-feeding cessation among non-pregnent women by the Cox proportional hazards model.

Risk factor	*Hazard ratio*	*95% confidence interval*	*P*
Non-hormonal contraceptive	1.00	0.72–1.37	ns
Oral contraceptive	1.49	1.09–2.04	0.012
DMPA	0.87	0.65–1.17	ns
2–4 children[a]	0.66	0.48–0.91	0.010
5 children or more[a]	0.58	0.42–0.91	0.001
1–4 years of formal education[b]	0.58	0.08–4.27	ns
5 years of formal education or more[b]	5.02	2.72–9.26	< 0.001

[a] Compared to women with one child.
[b] Compared to women with no formal education.
ns = non-significant.

Discussion

This study confirms that a new pregnancy is a frequent cause of breast-feeding cessation in rural Bangladesh. It also shows that women using non-oestrogenic contraceptives tend to breast-feed longer than those who do not use any contraception, and breast-feed, on average, as long as women who do not use any contraception and do not become pregnant. This is consistent with the hypothesis that contraceptive use, by delaying the next pregnancy, protects breast-feeding and hence may improve child survival.

Mean duration of lactation in this study has been estimated with a long follow-up: some women were actually followed-up until their child reached the age of five years, and censoring of observations with long durations of breast-feeding was minimal. Moreover, the mean duration of breast-feeding was estimated on a sample of women who had a child alive when the follow-up was completed. Hence, breast-feeding cessation due to the death of the child, a frequent cause of breast-feeding cessation in poor communities, was not taken into account in this study. These two factors may explain why the mean duration of breast-feeding reported here is one of the highest ever reported in the literature. Our results, however, are consistent with Huffman *et al.*'s (1980) observation in the same community that over 75 per cent of the women who had their last child alive at 30 months of age were still breast-feeding.

Our findings regarding the prolonged lactation of women using injectable contraception compared to women using no contraceptives are at odds with the observations of Parveen *et al.* (1977). They reported that, among 1020 women who were breast-feeding at the time of the first injection of DMPA, 147 reported a decrease in lactation and 37 an increase. In 20 cases, milk production declined sharply after the first dose of DMPA. These observations, however, were based on the subjective impression of the mother regarding her milk production, which may be less reliable than reports on presence or absence of breast-feeding used in our study for the life table analysis. Parveen *et al.*'s study (1977) was not designed to assess the effect of DMPA on lactation, and duration of breast-feeding of women receiving contraception was not compared with that of women using no contraception. Finally, some of the women receiving injectable contraception in their study were given a capsule of long-acting oestrogen (quinoestradiol 0.4 mg) which may also have affected breast-milk production.

It is quite possible that the different durations of lactation observed in our study among women receiving DMPA or the oral pill or using non-hormonal contraceptive methods could be due to the confounding effect of some unknown factor related both to breast-feeding duration and to contraception use. Maternal education, compliance with taking daily doses of oral contraceptives, support from the husband, and knowledge regarding benefits of breast-feeding are all factors related to contraceptive use. Their respective effects on breast-feeding are difficult to assess from this study.

Our study suggests, however, that injectable and non-hormonal contraceptives led to an increased duration of breast-feeding. Adjusting duration of breast-feeding for parity and maternal education, which are the most likely potential confounding factors, did not markedly affect the relationship between contraceptive use and duration of breast-feeding.

For women using oral oestrogenic contraceptives, duration of breast-feeding was similar to that for women using no contraceptives. When adjustment was made for pregnancy at the end of follow-up or when women who were pregnant at the end of follow-up were excluded from the analysis, oral contraceptive use was associated with an increased risk of breast-feeding cessation. This suggests that the higher risk of breast-feeding cessation observed for oral contraceptive users compared to other methods may not be related to contraceptive failure but rather to a depressing effect of oestradiol on lactation, which offsets the prolongation of breast-feeding obtained by delay of the next pregnancy. The depressing effect of oestrogenic contraceptives on milk production at this stage of lactation should be

confirmed by direct measure of milk output to validate this hypothesis. Unknown confounding factors may also explain this association. However, an increased risk of breast-feeding cessation among women using oestrogenic contraceptives in early stages of lactation has also been reported in several other studies (Hull, 1983; WHO Task Force on Oral Cotnraceptives, 1988; Martines, Ashworth & Kirkwood, 1989).

In most circumstances, acceptance of medically approved contraceptive procedures must certainly outweigh any adverse effects these methods may have on lactation. In Bangladesh, and presumably in other communities with a high prevalence of severe malnutrition, absence of breast-feeding is associated with a higher risk of dying in malnourished children at least up to three years of age. In this case, and until further evidence is at hand, it may be wiser to prefer other methods to oestrogenic contraceptives, at least among lactating mothers of severely malnourished children.

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Variation in measures of urea kinetics over four years in a single adult

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Urea kinetics was measured in a single woman on five occasions over four years by the prime/intermittent oral-dose method with [$^{15}N^{15}N$]-urea. On a nitrogen intake of 231 ± 24 mg/kg/day, urea production was 198 ± 22 mg/kg/day, with the urinary excretion of urea being 143 ± 25 mg/kg/day. Urea hydrolysis and salvaging in the bowel was 55 ± 6 mgN/kg/day. The coefficients of variation for production, 11 per cent, excretion, 18 per cent, and hydrolysis, 11 per cent, were similar to that for intake, 10 per cent, and substantially less than reported inter-individual variations from other studies. It is concluded that the method employed for measuring urea kinetics gives reproducible results and that the intra-individual variation in urea kinetics is much less than the inter-individual variation.

Introduction

In normal people, nitrogen balance can be maintained over a wide range of protein intakes by modification in the rates at which urea is produced in the liver and excreted in the urine (Schmike, 1962a, b; Allison & Bird, 1964; Stephen, 1968; Stephen & Waterlow, 1968). On an adequate diet about three-quarters of the urea produced is excreted in the urine (Walser & Bodenlos, 1959; Jones *et al.*, 1969; Varcoe *et al.*, 1975; Gibson *et al.*, 1976; Long, Jeevanandam & Kinney, 1978; Jackson, Picou & Landman, 1984). The other quarter undergoes hydrolysis by the microflora of the lower bowel (Levenson *et al.*, 1959) with the nitrogen being made available for further metabolic interaction (Moran & Jackson, 1990).

The approaches adopted for the measurement of urea kinetics have varied from group to group and the total number of studies is still small. However, as with most aspects of protein metabolism, it has been found that there is wide interindividual variation in the results obtained for all aspects of urea kinetics, with an overall coefficient of variation (CV per cent) of around 35 per cent for urea production and excretion. This variability may in part be explained by the different experimental approaches that have been used, but might also reflect a true inherent variability in aspects of urea metabolism.

In the early studies (Walser & Bodenlos, 1959; Jones *et al.*, 1969; Varcoe *et al.*, 1975; Gibson *et al.*, 1976; Long *et al.*, 1978); a single dose of isotopically labelled urea was given intravenously and samples of blood or urine were collected at intervals to measure the change in isotopic labelling with time. This method requires precise knowledge of the size of the urea pool, which has been presumed to remain constant (Charlwood, 1965). Picou & Phillips (1972) introduced a non-invasive approach with a constant infusion of isotope until an isotopic steady state had been achieved with the application of

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