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PREFACE

The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) is an autonomous, international, philanthropic and non-profit centre for research, education and training as well as clinical service. The Centre is derived from the Cholera Research Laboratory (CRL). The activities of the institution are to undertake and promote study, research and dissemination of knowledge in diarrhoeal diseases and directly related subjects of nutrition and fertility with a view to develop improved methods of health care and for the prevention and control of diarrhoeal diseases and improvement of public health programmes with special relevance to developing countries. ICDDR,B issues two types of papers: scientific reports and working papers which demonstrate the type of research activity currently in progress at ICDDR,B. The views expressed in these papers are those of authors and do not necessarily represent views of International Centre for Diarrhoeal Disease Research, Bangladesh. They should not be quoted without the permission of the authors.

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ABSTRACT

Two studies have been conducted in Matlab Thana of Rural Bangladesh over the 1975 to 1981 period to test the hypothesis that contraceptive services can reduce fertility in rural Bangladesh. This paper reviews the designs of the two studies and analyzes their demographic effects.

The first study tested a pill and condom household contraceptive distribution approach; the second augmented that strategy with better training of workers, a wider battery of methods, more intensive follow-up and referral services, and ancillary health care. Both projects had an impact on fertility. Contraceptive distribution had a modest impact in its first year and no effect subsequently. The initial impact of the comprehensive health and contraceptive care approach was at least double the intial impact of the contraceptive distribution approach. Moreover, effects of the second study were sustained over time.

Policy implications of the findings of the studies are reviewed.

INTRODUCTION[1]

The decline of fertility in settings where there has been concomitant proliferation of contraceptive use has suggested to many observers that organized contraceptive service programmes have contributed to the observed trends.[2] Yet the causal role of contraceptive service programmes in inducing and sustaining fertility reduction in developing countries continues to be the subject of discussion and debate principally because establishing causality requires rigorous experimental designs. Field experiments appropriate for a test of service programme effects require large-scale field operations, treatment and control areas, and accurate longitudinal demographic data - conditions that can rarely be met in practice. This report analyses the demographic effects of two studies in Matlab Thana of Bangladesh which meet these conditions.

The Matlab Contraceptive Services Experiments: Hypotheses and Designs

The Matlab family planning studies were conducted by the Cholera Research Laboratory (CRL);[3] the first from October 1975 to October 1977, and the second from October 1977 to the present.

The first of the CRL experiments, known as the Contraceptive Distribution Project (CDP), was designed to test the hypothesis that ubiquitous availability of contraceptive supplies would increase the prevalence of contraceptive practice and reduce fertility. The CDP approach was based on the observation, reported in the 1968 Bangladesh National Impact Survey, that while 55 percent of married women expressed a desire to cease child-bearing and 13 percent were willing to consider contraceptive use only 1.9 percent and 3.7 percent of the rural and urban population respectively were actually using a modern method of contraception (Sirageldin *et al.*, 1975). Similar findings noted in subsequent studies suggested that a lack of information about, and availability of, modern contraceptive methods impair programme success (see, for example, Ministry of Health, 1978). This led to the hypothesis of a latent demand for contraceptives which could be met by distribution of supplies alone.

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1 This report elaborates on an earlier draft prepared for the United Nations Economic and Social Commission for Asia and the Pacific (Phillips *et al.*, 1981).

2 See for example, Mauldin and Berelson, 1978.

3 In 1979, the CRL became the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B).

To test this hypothesis non-clinical methods of contraception (oral pills and condoms) were distributed in 150 villages with a population of 135,000 while 83 villages were serviced by the regular Government programmes and designated the comparison area.[1] In all 154 lady village workers (LVWs) were recruited and instructed in the distribution of oral contraceptives. Most LVWs were illiterate, elderly, and widowed women. Each LVW was responsible for maintaining lists of women eligible for contraception and conducting household visits to all women to offer six months of pill supplies and to replenish stocks when needed. The project was launched in October of 1975 with a minimal amount of LVW training about motivation and follow-up, in accordance with the hypothesis that distribution alone would increase contraceptive usage and reduce fertility.

A baseline survey of eligible women showed that about 33 percent of the respondents were either current users of contraception or expressed a desire to cease child-bearing and an interest to use contraception in future. This finding supported the latent demand hypothesis. In a survey conducted three months after the start of contraceptive distribution, however, only 16.9 percent of the respondents reported using oral pills. By the end of 18 months, moreover, the prevalence of pill use had declined to 8.6 percent. Overall prevalence was correspondingly low: 17.8 percent at 3 months and 12.8 percent at 18 months.[2]

The declining prevalence was due to declines in both acceptance and continuation rates. Oral pill failure rates were high owing to irregular and improper use. Side-effects, such as irregular menstrual bleeding and dizziness were common, and concerns about risks discouraged acceptance and continuation. Although knowledge of condoms increased with time, the method never became popular.

These findings suggested that a residual unfulfilled demand for contraception persisted in 1977 despite two years of CDP services -- a demand that could be better served by a wider battery of methods and more intensive follow-up and care of users. Certain operational problems of the CDP approach underscored this conclusion. Although LVWs were knowledgeable about their villages, they were too old to have practiced contraception, and they were not trained to deal with side-effects. Thus they lacked credibility as family planning workers and were

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1 Both studies were originally designed to test the effects of adding strategies to existing Government services. However, since Government village based services have not yet been fully implemented, the studies represent a defacto test of the effects of services vis-a-vis no services at all. Matlab was selected for the studies because a decade of accurate vital data were available, a resource which greatly facilitates evaluation (See Appendix A).

2 Overall use prevalence in comparison area villages remained at 3.9 percent throughout the study (Rahman *et al.*, 1980).

only infrequently relied upon for contraceptive advice. This was exacerbated by their relatively low social status among villagers, who accorded them too little prestige for them to be effective agents of social change.

The limitations of the CDP led to a restructuring of contraceptive research in Matlab in the form of a project known as the Family Planning Health Services Project (FPHSP).[1] CDP treatments were partitioned into cells of the FPHSP and subsequently collapsed into new treatments. The village groups of the new design are shown in Table I.[2]

TABLE I--VILLAGE GROUPS OF THE CDP-FPHSP DESIGN

		CDP Treatments	
		Treatment	Comparison
FPHSP Treatments	Treatment	1	2
	Comparison	3	4

Although the FPHSP work began in October, 1977, CDP household distribution activity continued through March, 1978 when LVWs provided acceptors a six month supply and advised them to contact local Government family planning workers for their future supplies. In the remaining half of the distribution area and half of the CDP comparison area, the new FPHSP field structure was developed.

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1 A comprehensive review of the FPHSP is in Bhatia *et al.*, 1980. Although the project has included maternal and child health services, only tetanus immunization and oral therapy for diarrhoeal disease components have been fully implemented. Workers were trained to advise pregnant women on delivery practices, to provide nutritional information, and to train households on hygiene and sanitation. Since health work is mainly oriented to the treatment and care of contraceptive users, however, the approach is more one of comprehensive family planning service delivery than an integrated health service approach.

2 In the CDP analysis below we combine villages of cells 1 and 3 for comparison with cells 2 and 4. For the FPHSP analysis we compare fertility in villages of cells 1 and 2 with cells 3 and 4. For our time series analysis of the relative impact of treatments our regression model utilizes all four cells. Village groups and census populations are reported in Appendix A. The DSS area was reduced in 1978 to 149 villages with a population of 160,000. The cells of the FPHSP are thus comprised of 80,000 each.

Both the administrative structure[1] and the staffing of the FPHSP differ from the CDP. This structure continues to date. A new cadre of literate young married village workers was recruited. Most are members of influential families and all were recruited from the villages in which they work. These female village workers (FVWs) were given 6 weeks of intensive training in contraception, field visitation methods, and basic reproductive physiology. In the first 6 months of the project weekly meetings were convened to train FVWs in the treatment of minor ailments, basic nutrition, tetanus toxoid injection methods, and other MCH work.

The administrative system was strengthened to include two forms of supervision: technical supervision for treatment and referral of MCH-FP problems, and administrative supervision to insure that work was being done on schedule at all levels. This system involved recruitment of lady family planning visitors (LFPV's) who are Government certified paramedics with 18 months of formal training, and male supervisors, senior health assistants (SHA). One SHA and one LFPV was assigned to districts of 20 villages, each encompassing 20,000 population. SHA's serve as male motivators and community organizers. One medical officer works full time on the project, supervising tubectomies in Matlab,[2] conducting medical rounds in the field, and conducting continuous paramedical training.

Day to day management of the FPHSP is conducted by an administrator paramedic and two assistants. Field staff are accountable to them both for both service and research activities.

The overall goal of the FPHSP service system was to shift from the emphasis of the CDP on contraceptive technology to an emphasis on comprehensive contraceptive care, to include frequent and regular visits to all women whether contracepting or not, a wide choice of methods conveniently available, and ancillary health services. The initial emphasis was on comprehensive family planning services rather than MCH.[3] The most important change was the addition of depot-medroxy-progresterone acetate (DMPA) to the battery of methods available in the village. At the subcentres paramedics insert Copper T intrauterine devices and perform menstrual regulation.[4] The principal link between health

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1 See Bhatia *et al.*, 1980 and Phillips *et al.*, 1981.

2 All tubectomies are performed by paramedics in Matlab with a physician attending.

3 In mid-1979 development of MCH services lapsed owing to departure of the principal investigator, a physician, from the project. For this reason, the FPHSP is more characteristically a family planning project than an integrated health services scheme.

4 Menstrual regulation (MR) is not actively promoted in the field. Rather, it has served primarily as a backup method for contraceptive failures. Accordingly, only 250 MRs were performed in 3 years.

and family planning services has been a three-tiered referral system for the detection and treatment of side-effects. All FVW's treat minor side-effects and refer more serious problems to subcentres for treatment or further referral to the physician.

Introduction of this new service FPHSP system was followed by an immediate rise in contraceptive prevalence from 10 percent in October of 1977 to 31 percent by the end of 1978. This level of use prevalence continues to date.

The two experiments, in summary, shared a common underlying hypothesis; namely, that convenient and low cost village-based contraceptive services can initiate widespread usage of contraception thereby reducing fertility. The studies thus addressed the central question of the international population debate; namely, whether contraceptive services can reduce birth rates in the absence of changes in reproductive motives wrought by social change and economic development.

The studies differed principally in the contraceptive service strategy employed: the first was a method-oriented programme designed to serve the villagers' perceived need for contraceptive supplies. The second was a more user-oriented programme designed to serve the villagers' continuing need for counselling, paramedical care, and convenient supplies.

The Study Population

A potentially difficult issue in testing the effects of contraceptive services arises from the confounding effects of secular social and demographic trends. Secular trends could arise from one of two possible characteristics of a study population: (1) A population could be experiencing socioeconomic changes which affect fertility limitation motives in treatment and comparison areas differently. In a society that is experiencing rapid socioeconomic change the net effects of services would thus be difficult to ascertain. (2) The demographic history of treatment and comparison areas could differ in ways that produce periodic secular fertility differentials. Across-treatment differentials in age structure, marital patterns, or long term fertility cycles could confound the assessment of contraceptive services effects. These issues have not been the subject of systematic investigation. To the extent to which our results are conditional on a detailed analysis of social and economic trends in Matlab, they must be viewed as preliminary and subject to qualification. We nevertheless present our findings because we have reason to believe that these potentially confounding characteristics of the study population do not apply in this instance.[1]

A review of the socio-demographic situation in rural Bangladesh is beyond the scope of this brief report, but reviews of the economic circumstances of rural Bangladesh indicate a gradual worsening of conditions: landlessness has grown

1 Tabulation of Matlab census data has shown that no pronounced socio-economic differentials across treatments existed in the pre-experimental period.

markedly in recent years (Alamgir 1975), illiteracy, though high, has not declined (Bangladesh Bureau of Statistics 1977), and health conditions, while improved in this century owing to control of infectious diseases, may have deteriorated over the past decade from the combined effects of political crises and famine (see, for example, Curlin *et al.*, 1976). Dramatic social, political, and economic changes have thus affected rural life, but the changes that have occurred are not of a sort that demographers regard as pre-requisites or co-requisites of demographic transition.[1]

The Matlab area was originally selected as a research station in the early 1960s because it is a low-lying deltaic area with endemic cholera. While it is in certain respects atypical of the country as a whole, it is nevertheless in many respects representative of rural Bangladesh. The 1974 Matlab CRL census population was 88 percent Muslim and 12 percent Hindu. The area is entirely rural with economic activity dominated by farming and fishing. Educational attainment is higher than the national average, but low by international standards: only 30 percent of the over 5 population is literate, and among the female population only 16 percent is literate. In 1974, 18 percent was landless - a proportion that is growing with time. Annual fluctuations in rainfall and river beds subject the population to periodic risks of famine and epidemics. There were 780 persons per square mile as of 1974, although land area varies markedly by season owing to monsoon floods that typically cover as much as 80 percent of the arable land.

While anecdotal evidence suggests that the agricultural economy of Matlab has improved throughout the study period, the changes that have occurred were wrought more by the vagaries of climate than by systematic economic development and social change. Thus changes have occurred which may have had social and economic implications, but we argue that such changes were sufficiently uniform across treatment as to permit comparative analysis. Nevertheless, the issue of social and economic change in Matlab bears further investigation.

Quite apart from changes and socioeconomic conditions, there could be demographic differentials in Matlab which would confound an analysis of contraceptive service effects. Age differentials, for example, can have pronounced effects on fertility levels. The similarity of age structures for the treatments attests to the comparability of the data (Table I). Because fertility in Matlab has been high for generations, the population is young. The age structure is not stable, however. As an artifact of fluctuations in past mortality and fertility the 1974 proportion of women aged 15 and 19 is higher and the proportion aged 25-29 is lower than would be expected in a stable population. The median age fell by nearly 15 months between 1974 and 1980 as a

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1 A useful review of the development situation in Bangladesh and its demographic consequences appears in Arthur and McNicoll (1978). Recent research in Indonesia has shown that areas with the greatest economic adversity are areas most receptive to contraception (Freedman *et al.*, 1981). Clearly the social and economic context of the Matlab study bears further investigation.

consequence--a trend that contributed to a secular increase in overall fertility during the study period. However, we have not reported age standardized general fertility rates in the tables below, because, as Table I shows, the effects of changing age composition impinge upon treatments similarly so that age-standardized rates typically vary from unstandardized rates by less than 1 percent.

TABLE II--AGE COMPOSITIONS FOR TREATMENT AND COMPARISON AREAS OF THE CDP AND FPHSP, 1974 CRL MATLAB CENSUS

Age Group	Percentage Age Distribution					
	CDP Areas			FPHSP Areas		
	Treatment	Comparison	All Areas[a]	Treatment	Comparison	All Areas[b]
15-19	25.5	26.6	26.0	26.1	27.2	26.6
20-24	17.9	16.9	17.5	16.3	18.0	17.1
25-29	15.1	15.8	15.5	13.5	16.2	14.8
30-34	16.9	16.5	16.6	17.8	17.8	17.8
35-39	13.3	12.6	13.0	13.0	10.6	11.9
40-44	11.3	11.6	11.4	13.3	10.2	11.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Total Population	15,047	14,831	29,878	10,727	10.099	20,826
Median	27.19	27.04	27.11	27.82	26.49	27.12

a Includes women from the 233 villages of the CDP (excluding 24 villages receiving services 18 months postpartum and 6 DMPA villages).

b Includes women from the 149 villages of the FPHSP treatment and comparison areas.

We address our discussion therefore to studies conducted in an area with ample research resources for field experimentation, comparable experimental and comparison areas, and no known social economic or demographic trend that would confound or judgment of programme effects. While it is possible that conditions have changed in Matlab during the study period, it seems implausible that changes could have had a differential impact on our treatment and comparison areas.[1]

METHODOLOGY

The most salient feature of the methodology that follows is its simplicity: direct unadjusted fertility measures can be used owing to the availability of accurate and complete census and vital data for the period from 1968 to the present.[2] The DSS system has included birth, death, and migration registration since 1966 and marriage registration since 1975. Although intervillage migration is recorded in the field, only migration into and out of the surveillance areas is computerized. Thus information is not available on local migration, most notably among younger women who migrate for marriage. Resulting biases, if any, accumulate with time but they are likely to be concentrated among women under 20 or 25. A critical assumption of the research reported below is that net migration across treatment boundaries was sufficiently inconsequential as to permit reliable birth rate comparisons.

This study presents quarterly and annual births for various village groups[3] for the period between mid-1974 and mid-1980.[4] The number of births was obtained from the vital registration data, although it should be noted that 1980 figures are only preliminary as of this writing.[5] The denominator was estimated for each period after mid-1974 by the lexis method of advancing a portion (in this case

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1 This assertion is based mainly on the observation that across treatment socio-economic status differentials were inconsequential prior to the projects. See Phillips and Chowdhury, 1981.

2 This census and vital data system is known as the Demographic Surveillance System (DSS). A useful review of the DSS system appears in the Cholera Research Laboratory Scientific Report Number 9 on the DSS methods and procedures (Cholera Research Laboratory, 1978) and in Aziz (1977). A brief discussion of data quality is in Appendix A.

3 Births to women under 15 or over 44 were added into the adjacent age groups.

4 In mid-1978 villages were dropped from surveillance. All villages are included in the CDP tables and time series below. Only the included villages are used FPHSP tabulations. Thus FPHSP analyses of 1974-78 data use the reduced DSS area villages to insure comparability with tabulations of post 1978 data.

5 Mortality and migration data for 1980 are incomplete. Incomplete mortality data introduced only minor spurious reductions in 1980 rates, however, because mortality among women in the child bearing ages is low. The 1980 data presented below are nevertheless tentative and subject to revision.

one-tenth) of each age group for each semester[1] adjusting for deaths and net migration.[2] Because project impact assessment begins at mid-years, all annual rates are expressed in July to June project years (PY). Denominators for annual birth rates of each PY use the estimated December 31st population, while mid-quarter denominators were interpolated for quarterly rates.

Three fertility measures are emphasized in this analysis. The first is the GFR, which is calculated by dividing total births during a particular time period by the estimated number of women aged 15 to 44. Quarterly rates were annualised by multiplication. Since younger women typically have higher fertility rates than older ones, this measure is only appropriate if the areas and time periods being compared have approximately the same age distribution -- as they do in this study.[3] Since project effects seemed to vary by age, we also calculate age-specific rates for women aged 15 to 29 and for women over 30. Five-year age-specific rates are calculated by year but not by quarter owing to marked random fluctuation in quarterly rates for small populations. The total fertility rate (TFR) is not used extensively because the computational assumption of equal numbers of women in each five year age group spuriously accentuates fertility impact if effects are pronounced in the older age groups.

Natural fertility in rural Bangladesh is subject to marked seasonal variation that can obfuscate the short term effects of fertility control. We therefore present seasonally adjusted fertility time series in order to elucidate trends. Our adjustment procedure and seasonality is discussed in Appendix B.

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1 Denominators for five year age groups are somewhat distorted by age heaping and by discontinuities in the size of individual age groups. We advanced a constant one-tenth of each five year age group per semester, although a graduated method using a parabolic curve would have been more valid. Most analyses in this paper are based on 15-year age groups or on the general fertility rate, and it is doubtful that results would have been significantly affected by this refinement.

2 Migration is not registered until six months after it occurs. Therefore data are unreliable after January 1978 for villages dropped from the DSS in July. Preliminary estimates for 1980 are compromised by the same problem as the 1979 census was not available for lexis computations. Annual rates are not affected because they are based on the estimated population as of December 31st.

3 Age differentials do not affect our areal comparisons, but the fall in the median age by approximately 15 months from 1974 to 1979 has a slight impact on chronological comparisons.

THE DEMOGRAPHIC IMPACT OF THE CONTRACEPTIVE DISTRIBUTION PROJECT

The CDP commenced in October of 1975 and continued until September of 1977, at which time half of the CDP treatment area was shifted into the experimental area of the FPHSP and half was placed in the FPHSP comparison group. Since the CDP continued to function in FPHSP comparison area villages through February of 1978, and since CDP services were terminated with a final six month supply of pills, the final termination date for CDP services was July of 1978. The period of possible impact of the CDP thus began in July of 1976 and extended through April of 1979.[1]

Adjustment of the Sample for Possible Contamination Effects

Two features of the CDP represent possible contaminants of the study -- in one area services were available prior to the CDP, in two other areas services were delivered which were not representative of the CDP strategy.

The commercial and administrative centre of the DSS area, Matlab Bazar, has had contraceptive services since the Johns Hopkins Fertility Research Project was established in 1974 in order to test the feasibility of delivering contraceptive services in rural Bangladesh. While the project was limited to clinical services in Matlab Bazar itself, and no extension services were offered in the surrounding villages, we view Matlab Bazar and the nearby villages as contaminated by the Johns Hopkins Project and atypical of other Matlab villages. We therefore excluded this area from the analysis and tested its effect on results. As effects were inconsequential these villages have been included in the analysis.

Two CDP service areas were atypical of the project as a whole. Women in one fifth of the CDP service villages were instructed to begin pill use no earlier than 18 months post-partum, while the remaining villages were instructed to adopt 6 months post-partum.[2] Rahman *et al.* (1980) have shown that contraceptive use prevalence rates were substantially lower in the "18 month" villages than in the "six month" villages. There is consequently reason to believe that "18 month" fertility does not represent a test of the CDP. We therefore exclude the "18 month" villages from the analysis.

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1 The timing of initial effects of the project can be unambiguously assigned to nine months after initiation of services. The timing of its final effects are considerably more complex to estimate, however, because it is impossible to know the precise timing of births that would have occurred in the absence of contraceptive practice. If effects accrued from the CDP it is likely that they extended beyond April of 1979 and gradually dissipated with time.

2 This was intended to provide a basis for testing the hypothesis that early adoption of the pill in the post-partum period can truncate lactation and amenorrhea. If continuation rates are low, early post-partum adoption can result in higher fertility than would prevail in the absence of pill use. An analysis, reported in Appendix C, fails to support this hypothesis. Further research on this hypothesis is forthcoming.

The second atypical service area of the CDP was a cluster of villages used in a field test of DMPA. Six villages of the CDP trial area were provided with house-to-house DMPA services in addition to the regular CDP services. Since this approach departed somewhat from the overall CDP strategy, we exclude the six DMPA villages from the analysis.

Comparability of Treatments

Table III reports fertility rates in the two CDP areas for project years (PY)[1] after the project began. The pre-project comparability of areas is shown by columns for the period before mid-1976. Fertility in the pre-project year 1974-75 differed by treatment. Rates in the treatment area were 7.5 percent below those in the comparison in PY 1974 while in PY 1975 rates were 6.0 percent higher -- differences which were consistent across age groups. Since 1974 and 1975 was a famine period, the unusually low fertility in PY 1975 reflects its fertility effects. The results may thus suggest that the comparison area was more severely affected by the famine than the CDP treatment area. While this conjecture bears further investigation, it is clear that we cannot uncritically assume that the treatment area would have had the same fertility as the comparison group in the post project period. It is nevertheless appropriate to note that there is no consistent age pattern in the pre-project differences between the two groups, and that most differences were small and insignificant.[2]

We conclude that treatment differences in pre-project fertility warrant cautious interpretation of results, but that CDP population groups were sufficiently similar prior to mid-1976 as to allow post-project comparisons.

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1 In Table III and in Table V below annual fertility rates are reported in project years (July to June) so that pre-programme and post-programme rates are based on the same time metric.

2 In theory, statistical inference does not apply to the comparisons in Table III. Tests of significance use a z test for the difference between two proportions. This test is not strictly appropriate because the rates are the true rates for populations. Moreover, successive observations are not independent and the "sample" population (Matlab) was not randomly selected. In theory, therefore, these results cannot be generalized beyond Matlab thana. We nevertheless report z tests owing to the similarity of this area with others in Bangladesh and elsewhere with the view that findings are broadly relevant to the developing world and that tests are, in a general sense, helpful in interpreting results.

TABLE III--AGE SPECIFIC FERTILITY RATES, TOTAL FERTILITY RATES (TFR) AND GENERAL FERTILITY RATES (GFR) FOR THE COMPARISON AND TREATMENT AREAS OF THE CDP PRE-PROJECT AND POST-PROJECT PERIODS

Age Group	Pre-project Period						Post-project Period					
	1974[a]			1975[a]			1976[a]			1977[a]		
	A[b]	B[c]	Percent[d]	A	B	Percent[d]	A	B	Percent[d]	A	B	Percent[d]
15-19	154.8	167.4	- 7.5	134.5	119.5	12.6*	187.4	177.5	5.6	166.1	149.1	11.4*
20-24	253.8	266.5	- 4.8	189.9	176.8	7.4	303.5	331.5	- 8.4**	254.8	235.0	8.4
25-29	267.4	269.7	- 0.9	225.3	205.6	9.6	321.4	346.6	- 7.3*	276.9	270.4	2.4
30-34	210.9	218.3	- 3.4	178.1	158.9	12.1*	285.5	359.2	-20.5**	250.5	242.0	3.5
35-39	118.6	129.6	- 8.5	93.0	96.4	- 3.5	139.1	189.8	-26.7**	147.4	163.7	-10.0
40-44	34.3	53.6	-36.0	32.1	41.3	-22.3	46.7	68.5	-31.8**	55.2	70.5	-21.7*
TFR	5.2	5.5	- 6.0	4.3	4.0	6.8	6.4	7.4	-12.9	5.8	5.6	1.8
GFR	179.0	193.5	- 7.5**	147.3	139.0	6.0	221.4	251.1	-11.8**	197.3	192.4	2.5

a All years are project years (July to June) of the specified year.

b A: CDP Treatment Area.

c B: CDP Comparison Area.

d The difference between the two areas, divided by the rate for the comparison area. In this and in subsequent tables a negative sign indicates that the treatment area had a lower rate than the comparison area. Pre-project tests are two tailed and post-project tests are one tailed in this and in subsequent tables. A single asterisk indicates $p<0.05$, a double asterisk indicates $p<0.01$.

Fertility Levels and Trends During the CDP

In PY 1976, the general fertility rate was 11.8 percent lower in the treatment area than in the comparison group, a difference that was significant for all age groups above age 20, and in general larger than pre-project differences. The 11.8 percent differential is markedly different from the positive differential of 6.0 percent in PY 1975.

There is also a distinct age pattern of the differentials: percent differences fall steadily from a positive 5.6 percent among women ages 15 to 19 to a negative 31.8 percent among women aged 40 to 44. These age differentials accord well with February, 1976 contraceptive prevalence differentials: among women under 20 only 6.5 percent were contracepting whereas among 35 to 39 year olds 29.7 percent were contracepting (Huber and Khan, 1979). The magnitude and consistency of these results thus provide evidence that the CDP had fertility effects during the first year of its operation.

We have noted above that surveys showed that the project functioned best in its first two quarters: recorded prevalence rates peaked at 17.8 percent in February 1976, and declined subsequently (Rahman *et al.*, 1980). Across treatment fertility differences were thus expected to be greatest in the third and fourth quarter of 1977 and to diminish with time. The data suggest that effects not only diminished with time -- they disappeared: differentials in PY 1977 were inconsequential. The CDP was thus a qualified success. It demonstrated that fertility reduction could be induced by distributing contraceptives, but that effects were transitory.

The seasonal pattern and magnitude of the treatment and comparison area fertility differentials over the 1976 and 1977 period further support the conclusion that the CDP affected on fertility (Figures 1 and 2).

Figure 1[1] shows that the across treatment fertility differentials reversed in the first quarter of the period when CDP impact was possible.[2] Treatment area fertility was 11 percent below comparison area fertility by the third quarter of 1976, a differential that increased to 17 percent in the fourth quarter and declined to 12 percent in the first quarter of 1977. At the trough in the 1977 seasonal cycle, fertility levels converged. Effects were thus confined to

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1 All raw data for Figures 1-9 appear in Appendix D. Detailed age specific fertility rates appear in Appendix E.

2 It is appropriate to note that over the 1968 to 1974 period low seasonal troughs were often followed by pronounced peaks. The crossing of the curves is therefore not altogether unexpected. The implications of a natural reversal in the differential are explored in the section below on the range and magnitude of effects.

Fig. I QUARTERLY GENERAL FERTILITY RATES IN CDP TREATMENT AND COMPARISON AREAS, 1974-1978

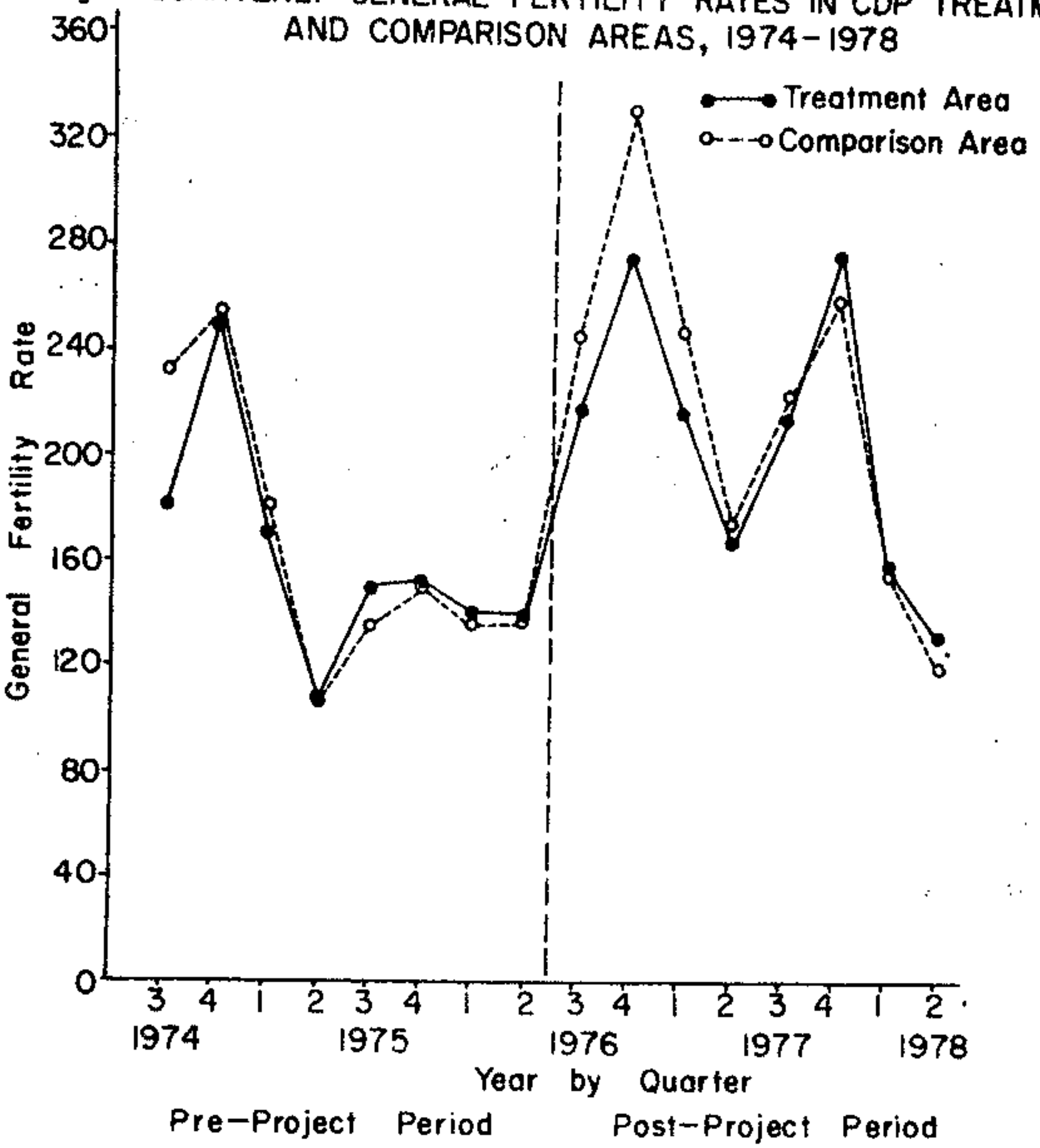
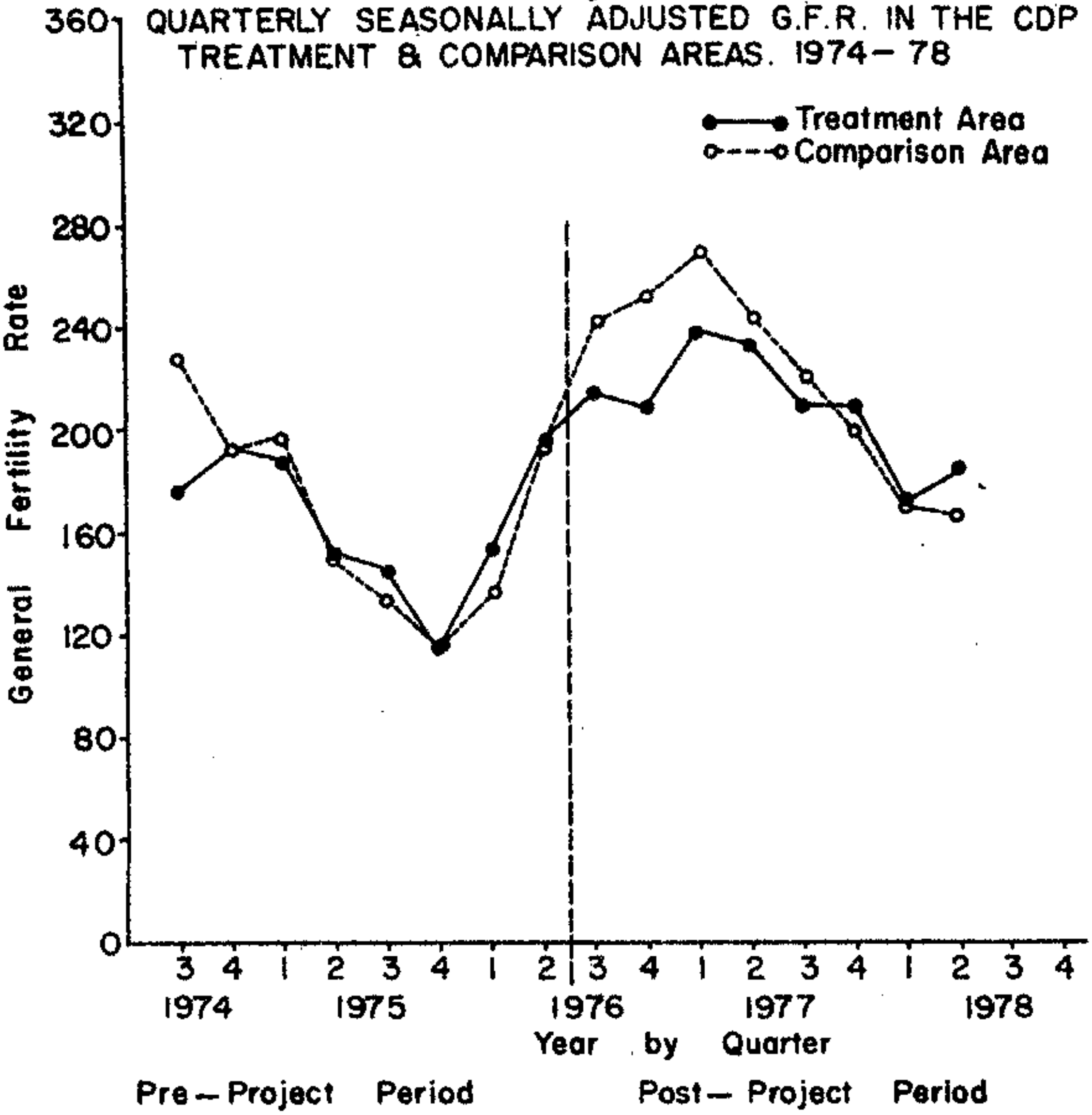


Fig. 2

QUARTERLY SEASONALLY ADJUSTED G.F.R. IN THE CDP TREATMENT & COMPARISON AREAS. 1974-78



3 quarters of a year, most prominently in the quarter when fertility is naturally high. Figure 1 also depicts the diminishing differential in the course of 1977.

Figure 1 shows that fertility was unusually low throughout 1975 and unusually high in 1976. In order to examine CDP effects in this context of changing natural fertility we have adjusted the Figure 1 time series for seasonality and presented the results in Figure 2. The adjusted time series elucidates the magnitude of the impact of the CDP, as well as its diminishing efficacy during 1977.

Figures 3 and 4 are age-specific fertility rate time series which further refine the presentation of results. We observe in Figures 1 and 2 that the CDP had only a moderate impact. By decomposing fertility into age specific rates, it is possible to observe the treatment differences for age groups in which effects were likely to have been concentrated. As Figure 3 shows, the CDP had no apparent effect among women under age 30 except possibly at the peak fertility season. In the second project year fertility differentials reversed so that treatment area fertility among young women was higher than comparison area fertility. Thus effects of the programme were conditional on season and confined to the first year of the project.

Among women age 30 and over effects were also seasonal and confined to the first project year. Although effects dissipated in the second project year, there was no reversal. Thus contraceptive distribution had pronounced effects among women likely to have attained their desired family size, and therefore likely to have adopted out of strong motivation to terminate their fertility. Despite its initial success, however, the CDP failed to maintain effects over time, even among the older and presumably more motivated women.

The Probable Range in the Magnitude of CDP Project Impact

We have noted above that fertility differentials in the CDP experiment were 11.8 percent in the first year, but that we cannot precisely quantify the magnitude of the effects of the CDP because pre-project comparison area fertility rates were different from pre-project treatment rates. Although these pre-project differences were not pronounced, they complicate interpretation because post-project differences were also not pronounced. Thus natural fertility cycles could confound observed trends and lead to spurious conclusions. We therefore examine some alternative assumptions in order to identify a probable range within which the true magnitude of effects occurred.

Three assumptions can be made about what fertility would have been in the absence of the CDP (Table IV). The first is that post 1976 fertility differences would have been the same as they were in 1975 and 1976; that is, that treatment area fertility would have averaged 6.0 percent higher than in the comparison area. Under this assumption, one concludes that the 1976-77 GFR in the treatment area would have been 266.2 and that the project had an overall impact of 16.8 percent.

Fig.3 FERTILITY RATES AMONG WOMEN AGED 15-29 FOR TREATMENT & COMPARISON AREAS OF THE CDP.

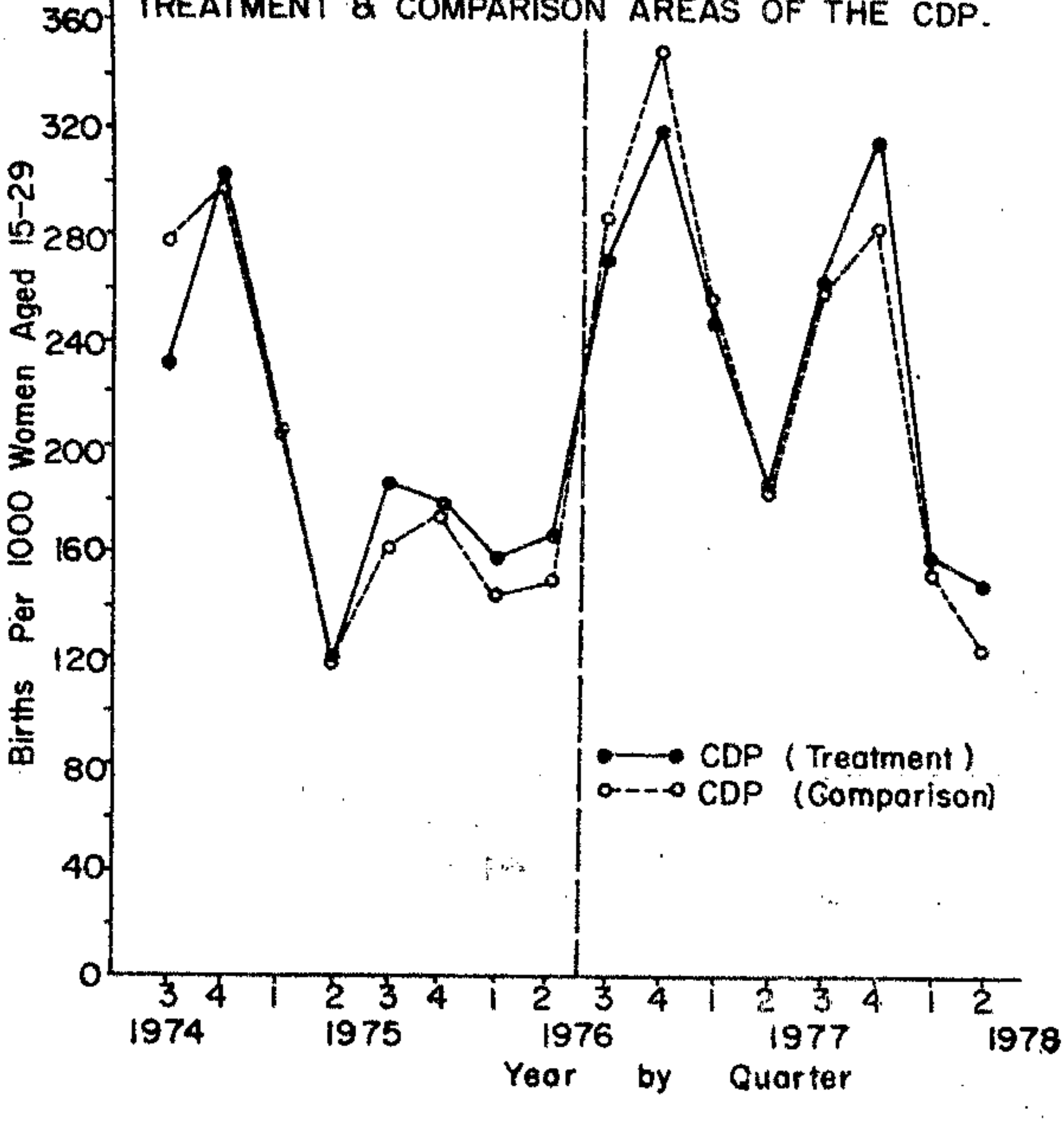


Fig. 4

FERTILITY RATES AMONG WOMEN AGED 30-44 FOR TREATMENT AND COMPARISON AREAS OF THE CDP.

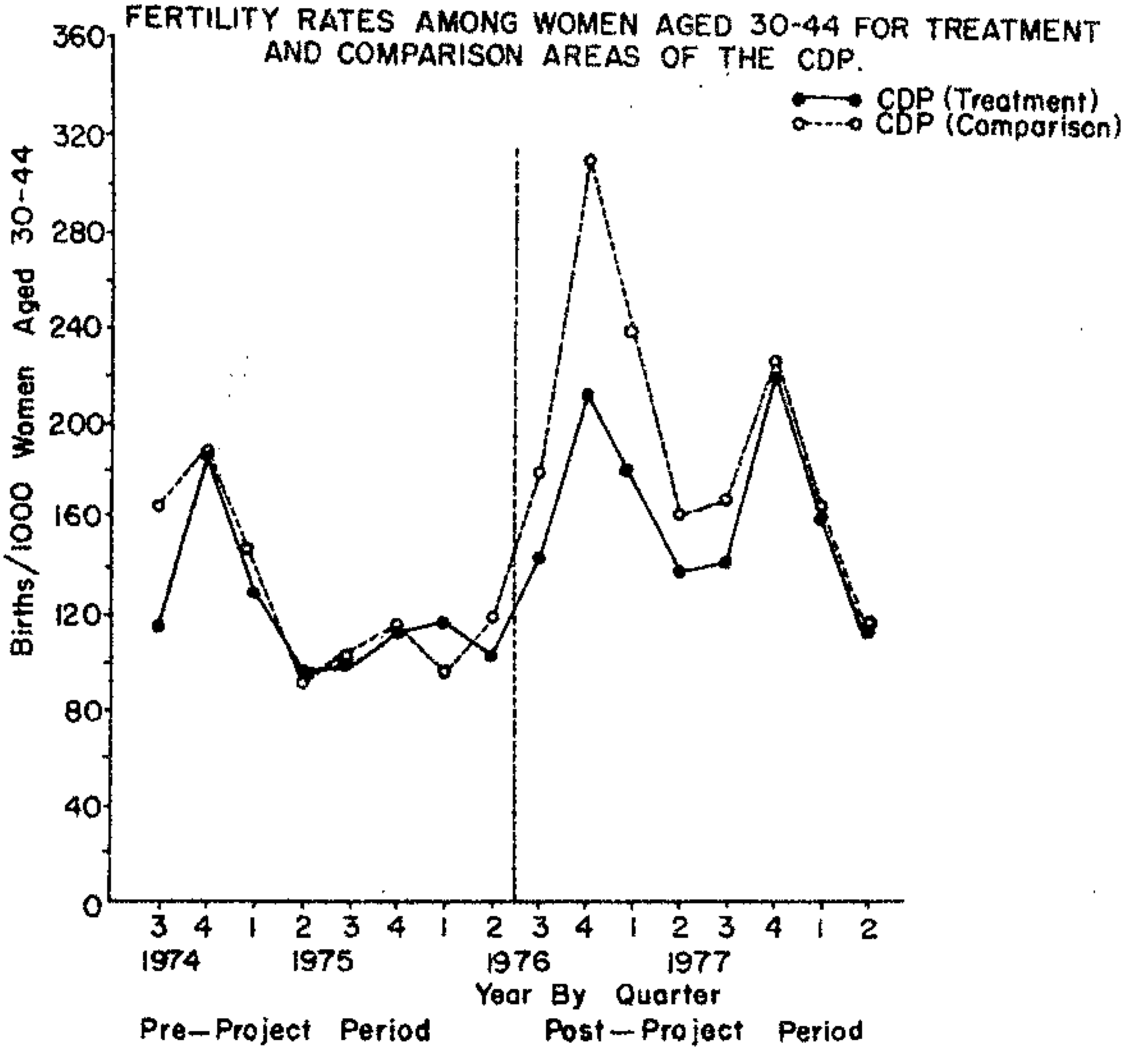


TABLE IV--THREE ALTERNATIVE ESTIMATES OF THE IMPACT OF THE CDP[a]

Project Years	Observed Treatment Area GFR	Comparison Area Expected GFR			Percent Differences[b]		
		Assumption: A	B	C	Assumption: A	B	C
			All Ages				
1976	221.4	266.2	232.3	251.1	-16.8	- 4.7	-11.8
1977	197.3	203.9	178.0	192.4	- 3.2	10.8	2.5
			Ages 15-29				
1976	256.2	292.7	254.6	266.6	-12.5	0.6	- 3.9
1977	221.6	226.2	196.7	206.0	- 2.0	12.7	7.6
			Ages 30-34				
1976	167.0	226.8	201.2	224.8	-26.4	-17.0	-25.7
1977	158.1	170.2	151.0	168.7	- 7.1	4.7	- 6.3

a Assumptions:

A) Expected GFRs equal observed treatment GFRs plus the PY 1975 proportional difference.

B) Expected GFRs equal observed treatment GFRs plus the PY 1974 proportional difference.

C) Expected GFRs equal observed treatment GFRs.

b Negative differential indicates possible CDP impact.

A second assumption is that the treatment and comparison areas would have been in the same relative position as they were in 1974-75; that is, that treatment area fertility in the absence of CDP would have been 7.5 percent below the comparison. This assumption implies a CDP impact of 4.7 percent. The third alternative is to assume that the two areas would have had identical fertility levels in 1976-77. This is the implicit assumption of the 11.8 percent differential in Table 3.[1] It is therefore likely that the overall impact of CDP during its first year was in the range between 4.7 and 16.8 percent. Though modest, the CDP had an effect on fertility in Matlab in its first impact year.

In the second CDP project year the programme had no effect irrespective of the assumptions employed. Interestingly, one could argue that the CDP increased fertility slightly in the second year. Although this is seemingly implausible, this possibility has been advanced by some authors who note that lactational amenorrhea in Bangladesh is long, and that early adoption of oral contraception regularizes menstruation prematurely. This effect of oral contraception would not occur if pill use were sustained on the average beyond the period of amenorrhea experienced in the absence of use. Since continuation rates were low in the second calendar year of the CDP, however, such truncation effects are possible (see, for example, Minkin, 1979). This aspect of the effects of the CDP is investigated in Appendix C in a comparison of fertility in villages receiving pills 18 months post-partum with 6 month post-partum villages. The analysis fails to support the hypothesis that early pill adoption increases fertility. The second year reversal in treatment-comparison area fertility differentials is thus unexplained and will bear further investigation.

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1 In this preliminary report we are not testing a fourth assumption; namely, that a positive difference for the seasonal trough implies a negative differential at the seasonal peak. Testing this hypothesis with 1968-74 Matlab data is important because differentials between treatments reversed in the first quarter of the first CDP project year. If such a reversal is to be expected under a natural fertility model, then the CDP effects are arguably nil.

THE DEMOGRAPHIC IMPACT OF THE FPHSP

Table V presents fertility measures for the FPHSP for four years prior to the programme and for two years in which programme effects are possible. Since services were launched in the fourth quarter of 1977, July of 1978 was the earliest date at which effects were possible.

The data in Table V demonstrate that fertility patterns and levels were similar prior to PY 1976. By PY 1976 and PY 1977 experimental area fertility was approximately 8 percent lower than treatment area fertility, although age-specific rates evince no consistent trend over time. We thus conclude from the table that fertility levels were essentially similar before the experiment although minor differences arose in 1976 and 1977. We will analyze the differences below.

The PY 1978 data contrasts markedly with the level and pattern of fertility in the pre-experimental period. Overall fertility in the experimental area was 25 percent lower than comparison area rates, a difference that accrued principally from marked reductions in fertility among women aged 30 and over. Among women aged 30-34 in Table V the birth rate is 27 percent lower in the treatment area than in the comparison area. Among women over 35 the experimental area fertility level is 50 percent lower -- a differential that was unprecedented in recent years. The data thus suggest that fertility effects were significant, substantially so among women aged 30 and over. The data, moreover, evince a direct relationship between age and programme impact: between treatment differentials range over all age groups and increase monotonically with age.

The time series ploted in Figures 5 to 8 further elucidate the impact of the programme. Figure 5 depicts the GFR time series for the FPHSP areas. Fertility levels were closely comparable across the FPHSP treatments prior to the time of CDP impact. The timing of the onset of lower FPHSP treatment area fertility suggests that a differential impact of the CDP across the areas apportioned to treatments of the FPHSP may have contaminated the FPHSP. Thus FPHSP fertility may have been lower at the outset of the FPHSP than it would have been in the absence of the CDP because areas where the CDP was most effective were assigned to treatment areas of the FPHSP. The trajectory of the GFR over time nevertheless suggests that a more pronounced differential emerged during the FPHSP and that the magnitude of the differential was unprecedented in recent years.

Figure 6 is a plot of seasonally adjusted GFRs. It shows more clearly than Figure 5 the hypothesized contaminating effect of the CDP and the pronounced effect of the FPHSP in the post-project period. Viewed in terms of the long range cycles in fertility, the FPHSP impact period commenced at a time when fertility was unusually low owing to the "ripple effect" of the 1974 famine. An unusually large proportion of women were at risk of conception in 1975 owing to the low fertility in that year. Birth rates were therefore high in 1976, which,

TABLE V--AGE SPECIFIC FERTILITY RATES, TOTAL FERTILITY RATES (TFR) AND GENERAL FERTILITY RATES (GFR) FOR THE COMPARISON AND TREATMENT AREAS OF THE FPHSP, PRE-EXPERIMENT AND EXPERIMENT PERIODS

	Pre-project Period												Post-project Period					
	1974[a]			1975[a]			1976[a]			1977[a]			1978[a]			1979[a]		
Age Group	A[b]	B[c]	%Diff.	A	B	%Diff.	A	B	%Diff.	A	B	%Diff.	A	B	%Diff.	A	B	%Diff.
15-19	152.1	155.1	- 1.9	114.7	122.8	- 6.6	171.9	181.3	- 5.2	135.6	161.0	-15.8**	125.5	146.1	-14.1**	148.3	156.1	- 5.0
20-24	259.8	260.4	- 0.2	186.1	185.4	+ 0.4	303.0	337.6	-10.2*	232.2	248.6	- 6.6	216.1	269.0	-19.7**	235.6	308.6	-23.7**
25-29	275.4	267.9	+ 2.6	188.1	207.8	- 9.5	294.7	331.6	-11.1**	241.9	259.6	- 6.8	185.3	236.1	-21.5**	215.7	281.7	-23.4**
30-34	213.9	231.2	- 7.5	181.1	184.8	- 2.0	315.6	328.2	- 3.8	236.4	274.4	-13.8**	184.5	253.7	-27.3**	168.7	260.5	-35.2**
35-39	122.4	122.1	+ 0.2	91.2	100.5	- 9.2	170.2	156.8	+ 8.5	150.8	154.6	- 2.5	95.6	186.3	-48.7**	114.1	199.9	-42.9**
40-44	46.1	53.9	-14.5	41.9	47.9	-12.5	64.7	72.7	-11.0	69.9	70.2	- 0.4	29.4	66.3	-55.6**	41.0	66.1	-37.9**
TFR	5.35	5.45	- 1.8	4.02	4.25	- 5.4	6.60	7.04	- 6.2	5.33	5.84	- 8.7	4.18	5.79	-27.8	4.6	6.4	-28.1
GFR	185.42	186.6	- 0.6	138.54	145.8	- 4.5	225.06	239.9	- 6.2*	180.21	198.65	- 9.3*	147.3	196.5	-25.0**	164.1	217.8	-24.7**

a All years are project years (July to June) of the specified year.

b A[b] FPHSP Treatment Area.

c B[c] FPHSP Control Area.

* Statistically significant at p<.05. TFR differences were not tested.

** Statistically significant at p<.01.

Fig. 5
QUARTERLY GENERAL FERTILITY RATES IN FPHSP TREATMENT AND COMPARISON AREAS, 1974-1980, MATLAB

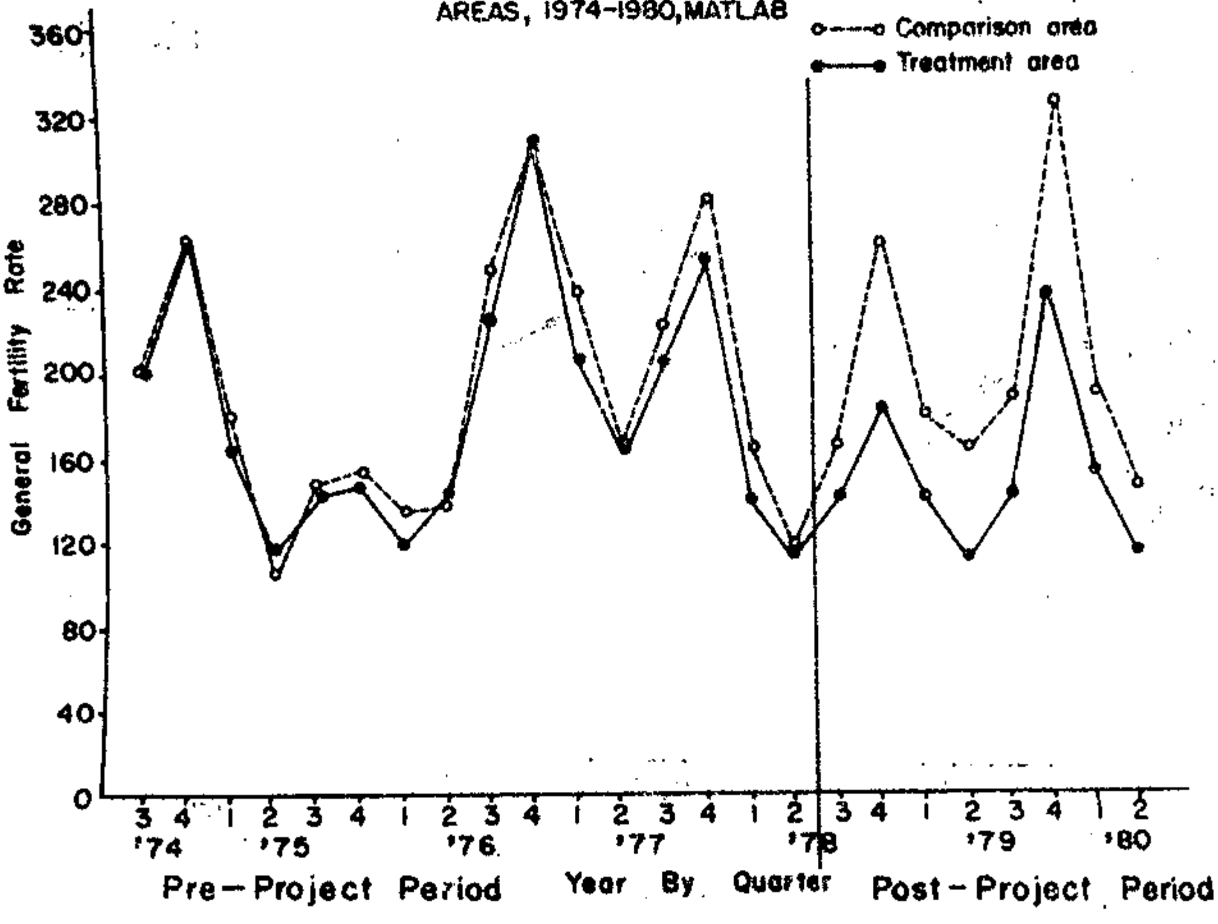


Fig. 6
QUARTERLY SEASONALLY ADJUSTED G.F.R. IN THE FPHSP TREATMENT AND COMPARISON AREAS, 1974-80

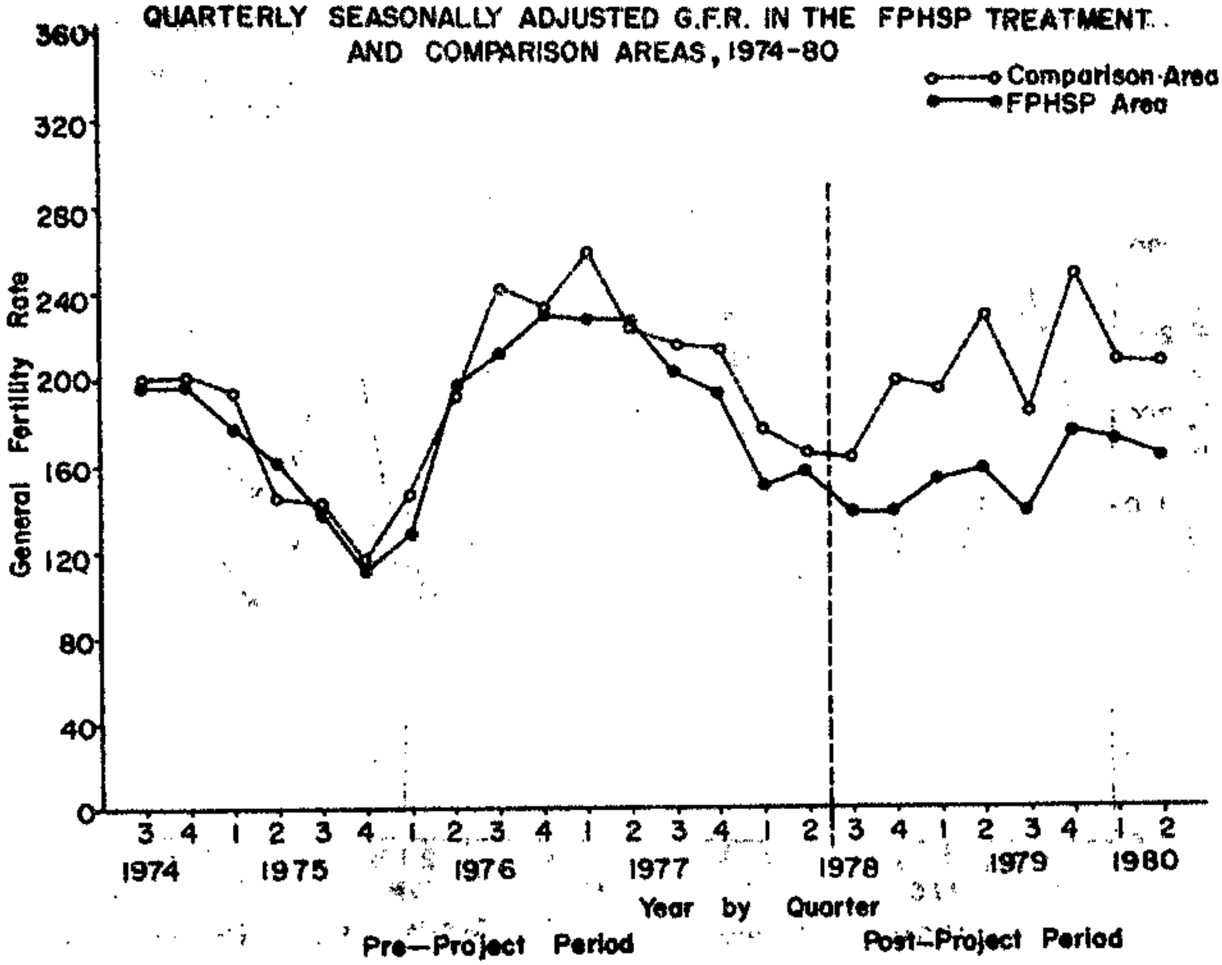


Fig. 7
QUARTERLY FERTILITY RATES AMONG WOMEN AGED 15-29 IN TREATMENT AND COMPARISON AREAS OF THE FPHSP, 1974-1980

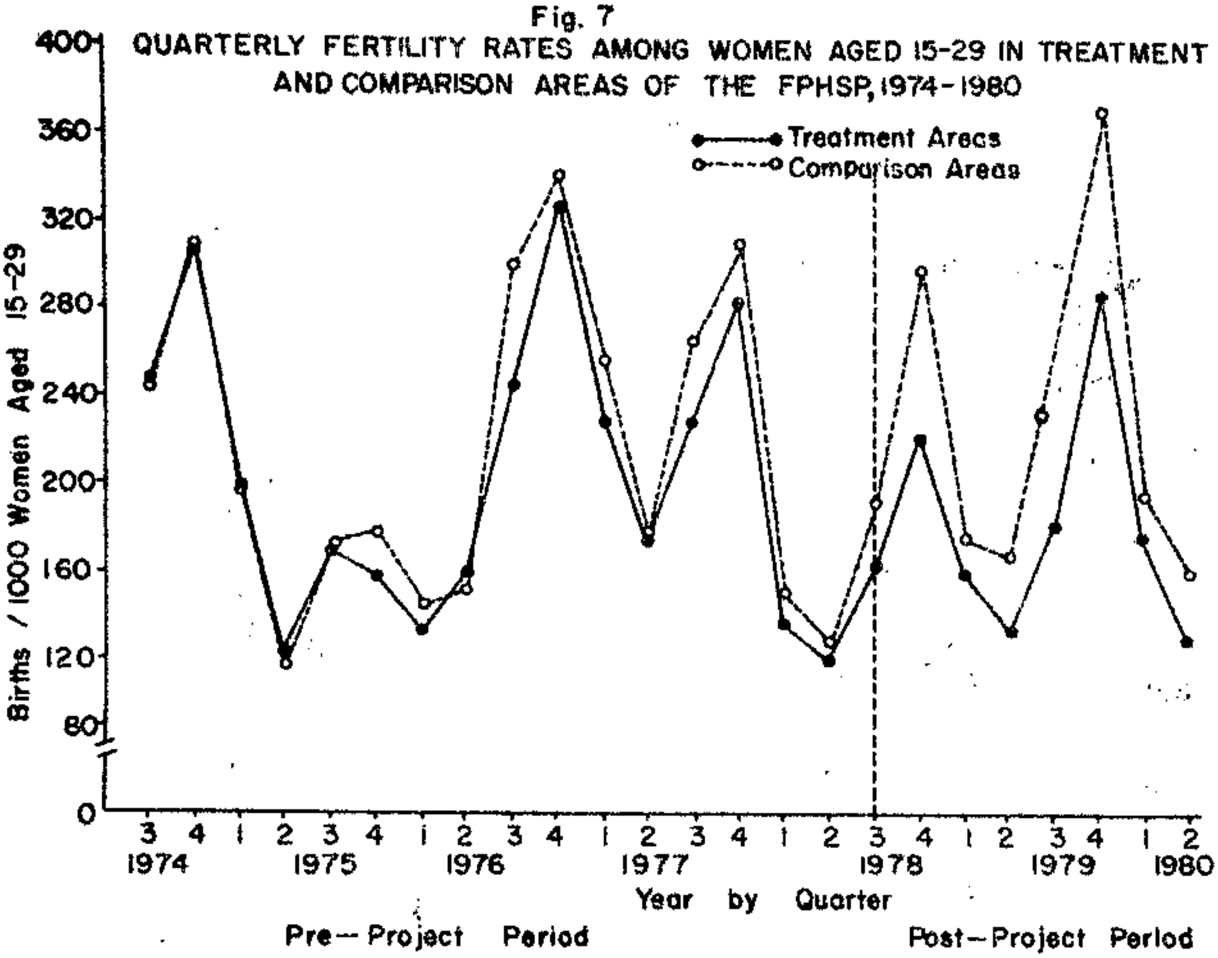
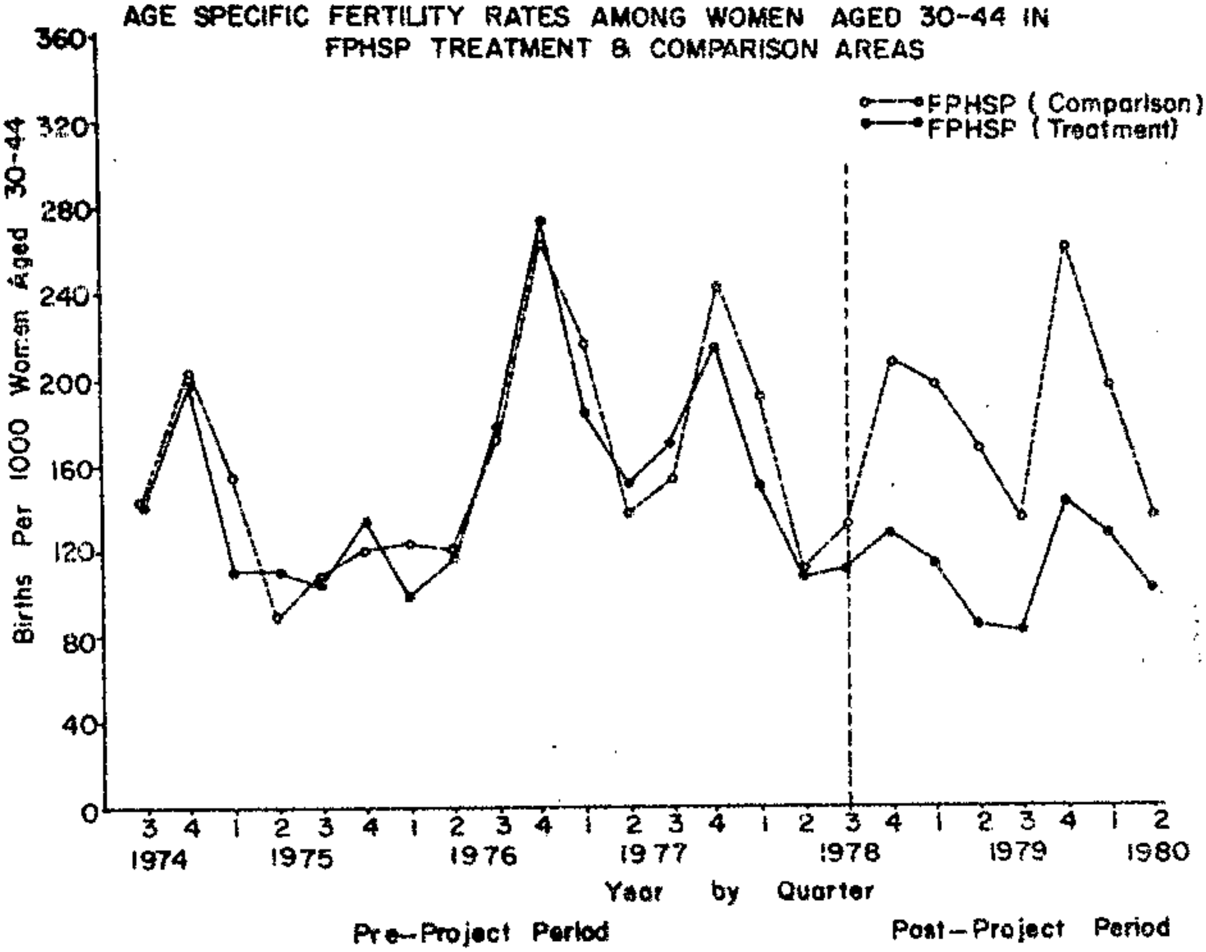


Fig. 8
AGE SPECIFIC FERTILITY RATES AMONG WOMEN AGED 30-44 IN
FPHSP TREATMENT & COMPARISON AREAS



in turn reduced the proportion of the population at risk of conception in the subsequent year. Although the FPHSP did not reduce fertility below the already low 1978 levels, it averted a rise treatment area fertility that would have occurred in the absence of FPHSP services. This is illustrated in Figure 6 by the sustained increase in comparison area fertility over the 1978 to 1980 period.

Figure 7 shows that the FPHSP, unlike the CDP, had a sustained effect on fertility among women under age 30 and that this effect was not restricted to the peak fertility season.

Figure 8 shows the pronounced impact of the programme among women 30 and over and the tendency of the programme to dampen seasonal swings. This is hardly surprising as seasonality is a natural fertility[1] phenomenon.

The Probable Range in the Magnitude of the FPHSP Impact

The differentials reported in Table V are based on an implicit assumption that expected treatment area fertility rates are equal to observed fertility rates in comparison areas. The 25 percent differential thus represents FPHSP impact. At least two alternative assumptions can be made: 1) FPHSP effects are the additive effects of the project less pre-experimental effects of the CDP in FPHSP treatment areas. 2) FPHSP effects are the difference between observed treatment area rates for the post experimental period and comparison rates adjusted for residual effects of the CDP services in FPHSP. Both assumptions derive from the fact that the two experiments were conducted in the same area, and that effects must be disentangled.

The notion that effects must be disentangled is consistent with the premature onset of treatment differentials in Figures 7 and 8. This premature onset of differentials coincides with the CDP impact period. While it is possible that the CDP could have contaminated the FPHSP, it seems unlikely that this could have occurred among women under age 30 whose fertility was largely unaffected by the CDP. Among women aged 30 and over, however, the contamination hypothesis is plausible. Contamination would occur if CDP effects were more pronounced in some areas than in others, and if areas with atypically high CDP efficacy were allocated to treatment areas of the FPHSP.

To investigate this hypothesis we have decomposed the time series from Figure 8 into the four cells of Table I and presented the results in Figure 9. In the absence of contamination, one expects cell 1 fertility levels to conform to cell 3 fertility levels during the CDP period, but for cell 1 fertility to conform more closely to cell 2 levels during the FPHSP. That is, the crossover design of the experiments should manifest itself in the coincidence and crossing of fertility curves. Contamination would be reflected by a cell 1 versus cell 3 differential in the CDP period.

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1 Contraceptive use prevalence is not seasonal in Matlab. See Figure 3 in Phillips *et al.*, (1981). The dampening of fertility seasonality is more pronounced as age increases. See Figures E2.1 - E2.5 in Appendix E.

Fig. 9 FERTILITY RATES AMONG WOMEN AGED 30 AND OVER FOR THE FOUR CELLS OF THE CDP AND THE FPHSP, 1974-1980

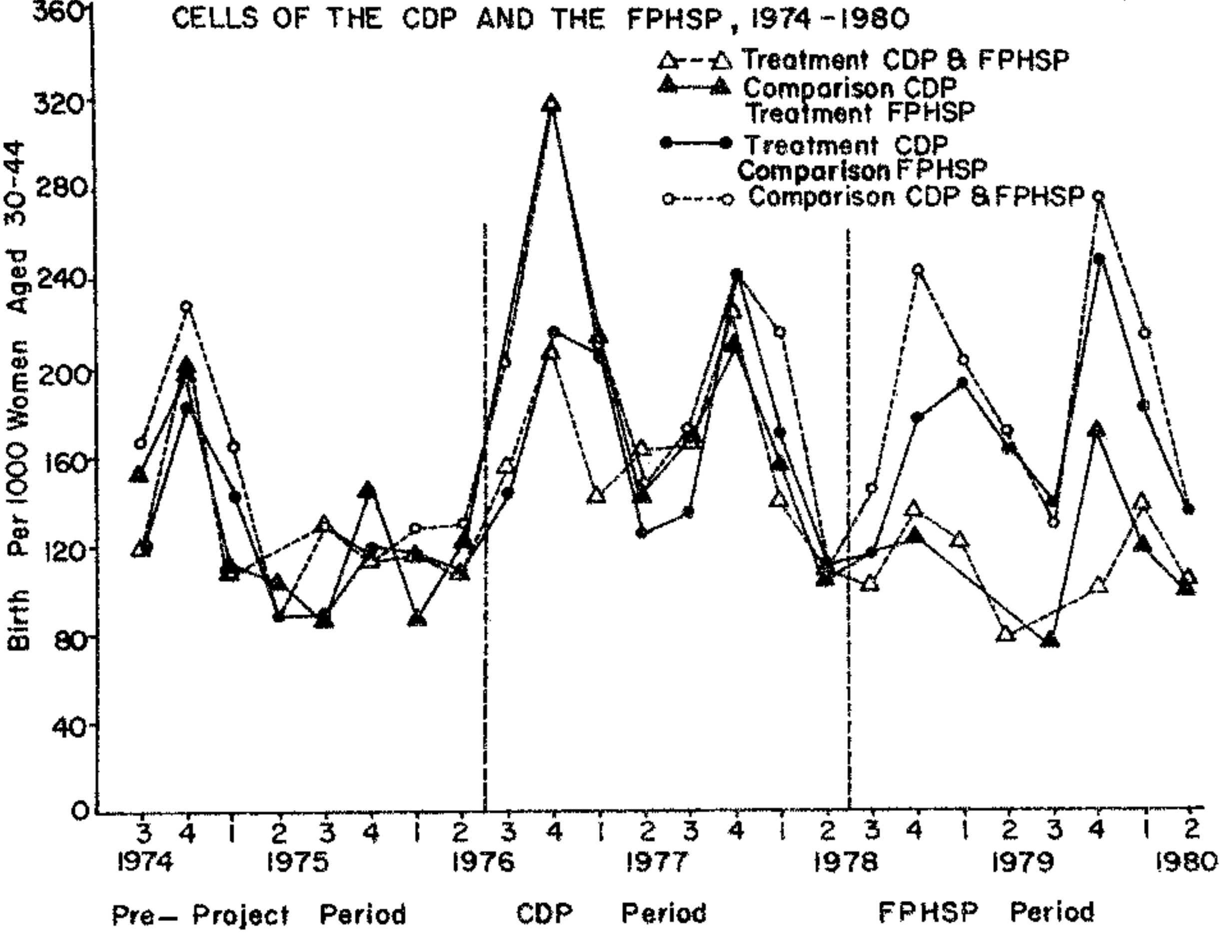

Figure 9 lends support to the contamination hypothesis: cell 1, the area receiving services in both projects, had lower fertility than cell 3 in all but two quarters of the CDP period. Moreover CDP effects may have lingered into 1979 in those FPHSP comparison villages that were treatment areas of the CDP. This may be attributable to the fact that CDP activities were discontinued in January of 1978 with a six-month pill supply -- a policy that could have continued to have effects in 1979. As Figure 9 shows, where services were withdrawn, CDP treatment area fertility only gradually converges to the control area level -- a pattern which suggests that lasting CDP effects may have contaminated the FPHSP comparison area.[1] Figure 9 thus suggests that both FPHSP treatment and comparison area fertility rates were affected by the CDP in 1979 and that lingering effects of the CDP may have depressed the magnitude of the between treatment fertility differential that is reported in Table V. It is therefore important to examine the implications of assumptions 1 and 2.

Assumption 1: The FPHSP was contaminated by pre-experimental CDP effects. Figure 10 illustrates the contamination hypothesis. In the diagram the cumulative discrepancy between treatments is plotted against time. As the figure shows, there is a noticeable disjuncture in the curve at the time of CDP impact. The extent of contamination can be estimated by fitting regressions to the segments of the curve and taking the difference in the slopes. Two simple regressions were fitted to the Figure 10 data by ordinary least squares:[2]

$$Y_i = \alpha + \beta X_i \qquad (1)$$

where X_i indexes the ith ordinal quarter elapsed since the first quarter of CDP impact, Y_i is the cumulative between treatment discrepancy in the GFRs, and α and β are unknown coefficients. The two regressions correspond to the two disjunctures in the Figure 10 curve: the first is the period in which the CDP may have contaminated the FPHSP, the second is the period of FPHSP impact. The slope of the first curve gives the trajectory of the contamination effect, the second slope gives the effect of the FPHSP unadjusted for contamination. Thus the difference between the two slopes is the net FPHSP effect on the GFR. The estimated parameters are as follows:

$$Y = 44.75 + 17.54\ (X) \quad \text{for } X = 1,2.......10$$

and

$$Y = -357.8 + 58.10\ (X) \quad \text{for } X = 10,11......16$$

respectively. Therefore the adjusted between treatment differential in the GFR is 50.10 - 17.54 = 40.56. Assuming an expected annual fertility rate of 197 (Table V), the contamination adjusted effect of the FPHSP was 21 percent.

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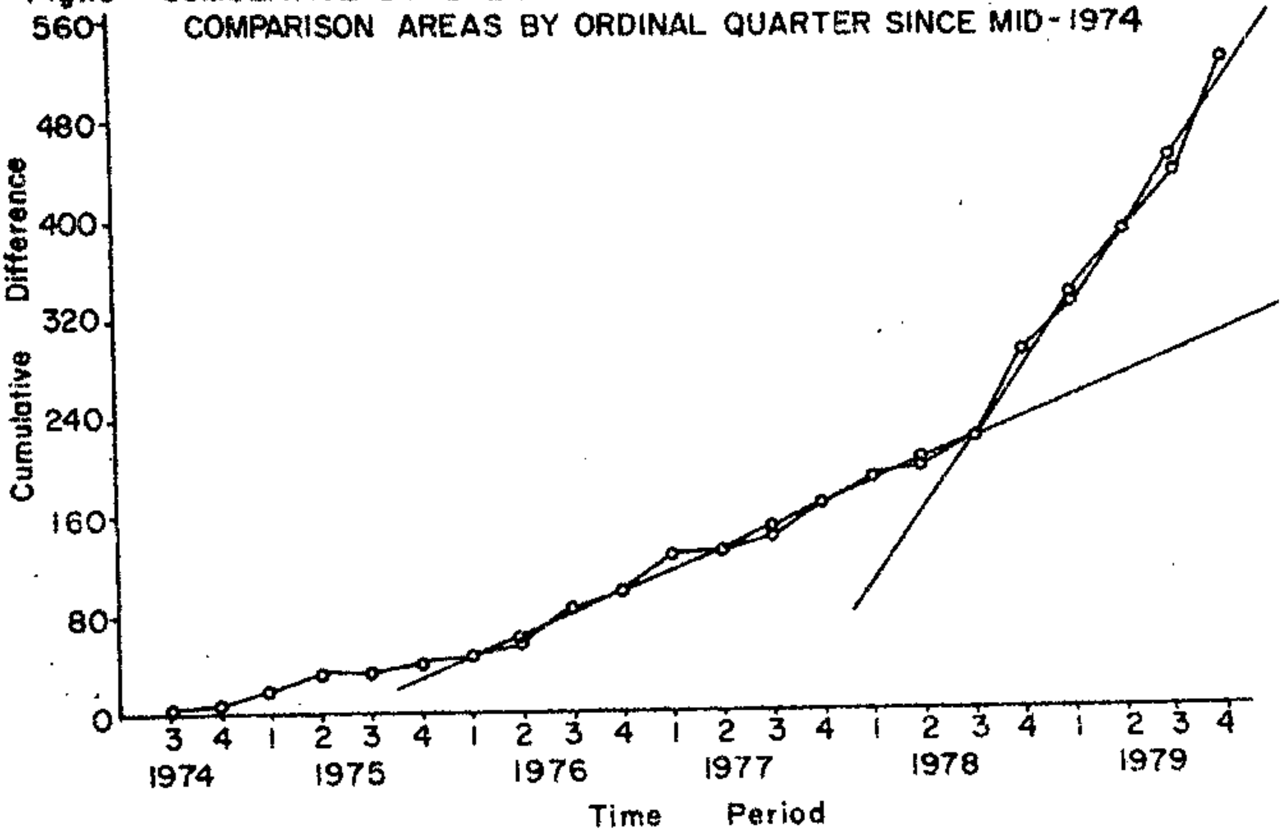
1 Note that curves cross in 1978 in a manner consistent with the hypothesis that withdrawing contraceptive services will increase fertility.

2 The Figure 10 data are autocorrelated over successive estimates of Y. In this instance, the assumptions of OLS are violated in the process, as regression errors are correlated. This will be corrected in subsequent versions of this report.

Fig.10 CUMULATIVE DIFFERENCE OF THE GFR'S IN TREATMENT AND COMPARISON AREAS BY ORDINAL QUARTER SINCE MID-1974



Assumption 2: Residual effects of the CDP fertility levels in FPHSP areas confound the comparison of treatments. To examine the implications of this assumption we estimate a regression which assesses net effects of the two strategies partialling out overlapping periods and controlling for seasonality.

GFRs were computed for the villages of the four cells of the CDP-FPHSP design by quarter and regressed on dummies scored for each data point. Ignoring, for the moment, autocorrelation, the model is specified as follows:

Let X denote season and V and W the CDP and FPHSP such that:

X_1 = 1 in quarter 1 of each year and O otherwise,

X_2 = 1 in quarter 2 of each year and O otherwise,

X_3 = 1 in quarter 3 of each year and O otherwise,

V = 1 for time periods and treatments in which CDP effects were possible and O otherwise,

W = 1 for time periods and treatments in which FPHSP effects were possible and O otherwise.

An ordinary least square regression of GFRs on X,V, and W is given by

$$Y_{ijk} = a + \sum_{i=1}^{3} b_i + g_j + h_k \qquad (2)$$

where a is an intercept equal to the mean GFR for the omitted season of X.

b_i represents the effects of season, X_i

g represents the effects of the CDP, V

h represents the effects of the FPHSP, W and

Y_i is the predicted GFR for season i. of the CDP or FPHSP.

Since successive fertility rates are serially correlated, (2) must be expanded to include lagged values of the dependent variable and estimation must incorporate a computational algorithm that allows for autocorrelated error. Such a model for p lags is given by

$$Y_t = \phi_1 Y_{t-1} + \ldots\ldots + \phi_p Y_{t-p} + \alpha + \sum^{3} \beta_i + \gamma_j + \delta_k \qquad (3)$$

where each ϕ is an unknown lag coefficient, and α, β, γ, and δ replace a, b, g, and h in (2), respectively. Estimation uses the Box and Jenkens (1976) method.

By experimenting with alternative lag specifications in (3) it was found that only ϕ_1 was significant. The estimated parameters of this model are reported in Table VI.

Coefficients in Table VI attest to the predominant independent effects of seasonal variation. This suggests that variation in natural fertility determinants such as the timing of marriage, coital frequency, spouse separation, and the like account for substantially more of the variation in Matlab fertility than treatments defining the accessibility of contraceptive services. Tests on coefficients nevertheless suggest that both service strategies had fertility effects, substantially so among couples in the FPHSP areas. Over 80 percent of the variance is explained by the regression, the unexplained portion being secular trends or "famine ripple" effects discussed in the introduction above.

The expected GFR in Table VI show the predicted Y under different conditions. The intercept row (202.8) is the predicted GFR when all independent variables are set at their means -- the sample grand mean of the GFR's. The GFR for the seasons is the predicted GFR when all seasonal effects are set at their means and CDP and FPHSP effects are 0. Thus the expected GFR and FPHSP express the additive effect of services adjusting for seasonality. The predicted CDP GFR (203.0) represents an 8.3 impact on fertility, on the average. The FPHSP GFR, 172.7 represents a net decline of 22 percent. Thus, the coefficients suggest an effect of the FPHSP that is nearly three times the effect of the CDP.

Additional regressions were estimated to test the hypothesis that programme effects are subject to seasonal variation. Interaction terms were insignificant which fails to support the hypothesis that treatment effects interact with fertility seasonality.[1] Effects of programmes are thus additive: contraceptive services have altered the level of fertility but not the seasonal variation in fertility.

We conclude, in summary, that both projects had a net effect on fertility. Seasonality has more pronounced effects than contraceptive services -- effects which are dampened in absolute, but not relative terms by widespread fertility control. The FPHSP, under the assumptions employed, reduced fertility by an amount ranging between 21 and 25 percent in its first two project years.

IMPLICATIONS

Much of the international literature on population policy in the past decade has been addressed to a debate on the efficacy of contraceptive service programmes.[2] Two positions have achieved prominence in this debate, although it could be argued that a third has emerged in recent years.

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1 Second order interactions with age were not tested. It is possible that programme effects are seasonal among women over 30.

2 A useful review of positions in this debate can be found in Freedman and Berelson (1976). Positions in the debate are well represented by Bogue and Tsui (1979) and a critical review of that paper by Demeny (1979).

TABLE VI--A FIRST ORDER AUTOREGRESSIVE ANALYSIS OF THE RELATIVE IMPACT OF THE CDP AND THE FPHSP

Coefficient Name	Coefficient	Standard Error	t Ratio	Predicted GFR
ϕ	- 0.485	0.109	- 4.4**	-
Intercept[a]	290.5	9.3	31.1**	202.8[b]
Quarter 1 effect	- 87.7	7.4	-11.8**	
Quarter 2 effect	-129.8	8.2	-15.8**	221.4[c]
Quarter 3 effect	- 80.8	6.8	-11.9**	
CDP effect	- 18.4	11.0	- 1.7*	203.0[d]
FPHSP effect	- 48.7	11.8	- 4.5**	172.7[e]

Multiple R_2 = 0.910 N = 64

R = 0.828

F = 55.92** d.f. = K/N-K-1=5/58

* p<.05 (one tail)

** p<.001 (one tail)

a Since quarter 4 is omitted, the intercept is the quarter 4 mean

b GFR = $\bar{Y}$ = the grand mean

c GFR = $Y = \alpha + \Sigma\beta_i\bar{\bar{X}}_i$

d GFR = $Y = \alpha + \Sigma\beta_i\bar{\bar{X}}_i + \gamma$

e GFR = $Y = \alpha + \Sigma\beta\bar{X}_i + \delta$

The first position holds that the effects of contraceptive services are a consequence of prior changes in reproductive motives. In this view contraceptive service effects are an outcome of social and demogrpahic changes that influence reproductive motives. Once motives have been affected by social change, then fertility limitation behaviour will change, because traditional alternatives to contraception exist wherein some measure of fertility control can be exercised. Modern contraception can substitute for traditional birth planning behaviour, but it can never induce demographic change (Blake and Das Gupta, 1975; Davis, 1969).

The second position holds that contraceptive services have effects because a latent demand exists for efficient birth planning methods. In this view there are gradations in reproductive motives such that convenient, inexpensive, and effective services can to some extent obviate the need for strong fertility control motives. In the absence of widespread birth limitation behaviour, service programmes can initiate fertility change (Bogue, 1967).

A third view emerges from the study of contemporary demographic trends: namely, that contraceptive service programmes do not initiate fertility change, but can nevertheless satiate a growing demand for fertility control more efficiently than traditional means and can stimulate diffusion of contraceptive innovation in traditional societies. Thus as demogrpahic changes occur, fertility declines are more pronounced in the period following the introduction of services than in the prior period (Mauldin and Berelson, 1978).

The data from the Matlab contraceptive services studies support the second position. The findings appear to show that vigorous contraceptive services can initiate a fertility change in a poor rural traditional population. Thus it appears that an unmet demand for contraception exists in rural areas of Bangladesh which can be served by an intensive field programme.

Six policy implications emerge from this research with specific relevance to Bangladesh:

1. Fertility can be significantly reduced in Bangladesh by making contraceptives readily available to households. Effects are likely to be temporary, however, unless distribution involves trained workers who systematically follow-up users and attend to their needs. Since poverty and chronic ill-health is widespread in rural Bangladesh, users are incapable of distinguishing side effects from other illnesses and cannot afford treatment for minor ailments. Although rural couples will experiment with new contraceptive technology, they will not sustain its use unless both real and perceived contraceptive and health problems are attended to by trained and sympathetic village based paramedics.

2. A user oriented programme with a wide choice of methods, skilled counselling, rigorous follow-up and care of side-effects, and ancillary health services will be substantially more effective than

one based on one or two methods distributed by unskilled workers. Moreover, effects can be sustained over time. It is difficult, in an analysis of the FPHSP, to determine the extent to which the project's success relates to family planning strategies (home administered DMPA, follow-up, improved training, etc.) or to ancillary health services (treatment and referral of side effects, MCH care, etc.). It is useful to note however that dramatic increases in prevalence were attained prior to development of MCH services. Thus integration seems to have improved programme performance through its direct effects on family planning care. A health service approach has enabled ICDDR,B workers to provide couples with a wider choice of methods and better contraceptive care than would be possible in a vertical family planning campaign.

The question of whether comprehensive MCH services aimed at reducing morbidity and mortality can indirectly affect fertility is a question to be addressed in future research.

3. Seasonality of fertility is pronounced even in areas served by our project. This feature of fertility needs investigation and recognition in policy planning. Intensive campaigns, for example, will be much more effective if launched in the months from December to March than in April to December. Intensive education and promotional campaings should coincide with seasons when conception rates are high. More research should be addressed to developing our understanding of natural fertility dynamics and its policy implications.

4. Trends in reproductive motives requires further research. We have no evidence that reproductive motives have been affected by our projects. We have observed that use prevalence in Matlab has remained constant at 34 percent for three years. This prevalence of use agrees well with the pre-project prevalence of women who said they were either using a method or would use one in future if contraceptive were provided. While this may suggest that we have met the demand for contraception that exists in Matlab and that by doing so our project has had substantial fertility effects, we must research this question formally to determine if motives change after reproductive behaviour has changed. We recognize that further increases in the impact of the FPHSP may require changes in reproductive motives. Whether reproductive motives can be influenced by health service interventions or other policies is thus a critical question to be investigated in Matlab in the next three years.

5. More research is needed on the determinants of programme success. Several villages in Matlab have use prevalence rates exceeding 50 percent; others have rates of less than 10 percent. The question of why we succeed in some villages but fail in others is an important research issue.

6. The success of the Matlab experiment presents a challenge to researchers and administrators to discover ways in which results can be translated into action. In particular, it must be recognized that the capability of the CRL to train, field, supervise, and support a comprehensive contraceptive service programme is the principal difference between the programme in the FPHSP service and comparison areas. This operational capability needs careful scrutiny, with a view towards implementation of its elements elsewhere in Bangladesh. Future research should test implementation in the context of the Government service system, and focus on identifying and understanding the critical barriers to replicating the Matlab experience.

The Matlab contraceptive service experiments demonstrate that rural Bangladesh holds considerable promise for achieving demographic development and that effective services can produce substantial fertility declines. The paucity of evidence of demographic effects of the national programme may thus relate more strongly to incomplete programme implementation than to an absence of motivation to limit or space births among rural Bangladeshi couples.

APPENDIX A

THE DEMOGRAPHIC SURVEILLANCE SYSTEM: A SYNOPSIS WITH 1974 AND 1978 CENSUS POPULATIONS OF TREATMENT AND COMPARISON AREA VILLAGES

The CDP and the FPHSP were fielded in Matlab because of the remarkable demographic resources of the CRL. In 1963, the CRL was established to conduct health research in rural Bangladesh. An early priority of the CRL was the field trial of cholera vaccines, a research focus that required periodic censuses and careful demographic surveillance. A system was developed that is known as the Matlab Demographic Surveillance System (DSS). In 1963, 23 DSS villages were enumerated with approximately 28,000 people. A second census of 132 villages was conducted in 1966 and surveillance of the 112,000 enumerated at the time continues to date. The surveillance area was expanded in 1968 to an additional 101 villages with a population of 109,000. Those 233 villages comprise the study areas of the first experiment, the Contraceptive Distribution Project (CDP). In July of 1978 the surveillance area was contracted to 149 villages, encompassing 160,000 population. The reduced DSS area was used in the second experiment, FPHSP.

The quality of DSS data is maintained by continuous field checking and supervision. Vital events are first observed and reported by designated village residents,[1] and they are then recorded by trained field workers. Both the field workers and their supervisors make regular checks to verify reported information and to search for unreported events. Curlin *et al.*, (1976) in an investigation of early DSS data found less than a one percent undercount of vital events, Aziz (1977) using somewhat later data found an undercount of 1.1 percent and lexis updating of the 1974 census to the 1978 census (adjusting it for births, deaths and net migration) suggests an overall undercount of less than one percent per year for the study period (M.K. Chowdhury, forthcoming).[2] Clearly, the excellent coverage of the DSS obviates the need for data adjustment and correction.

A map of the study area is shown in Figure A1. Matlab is approximately thirty miles south of Dacca, although the area is largely inaccessible by road, it is intersected by tributaries of the Megna and Gumati rivers. Area delineated on the Figure A1 map correspond to village populations tabulated in detail in Tables A1 - A6 and summarized in Table A7.

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1 These same village residents served as field workers for the two family planning projects, and there is some possibility that this reduced vital event reporting. Supervisors were aware of this possibility but report no evidence of missed events. Furthermore, there is no evidence of under-reporting of either birth or death data.

2 Census data for 1978 are not yet available and could not be used for this study. Data in Tables A1 - A7 are preliminary and subject to minor revision.

Fig. A I

MATLAB SURVEILLANCE AREA, 1975–1981

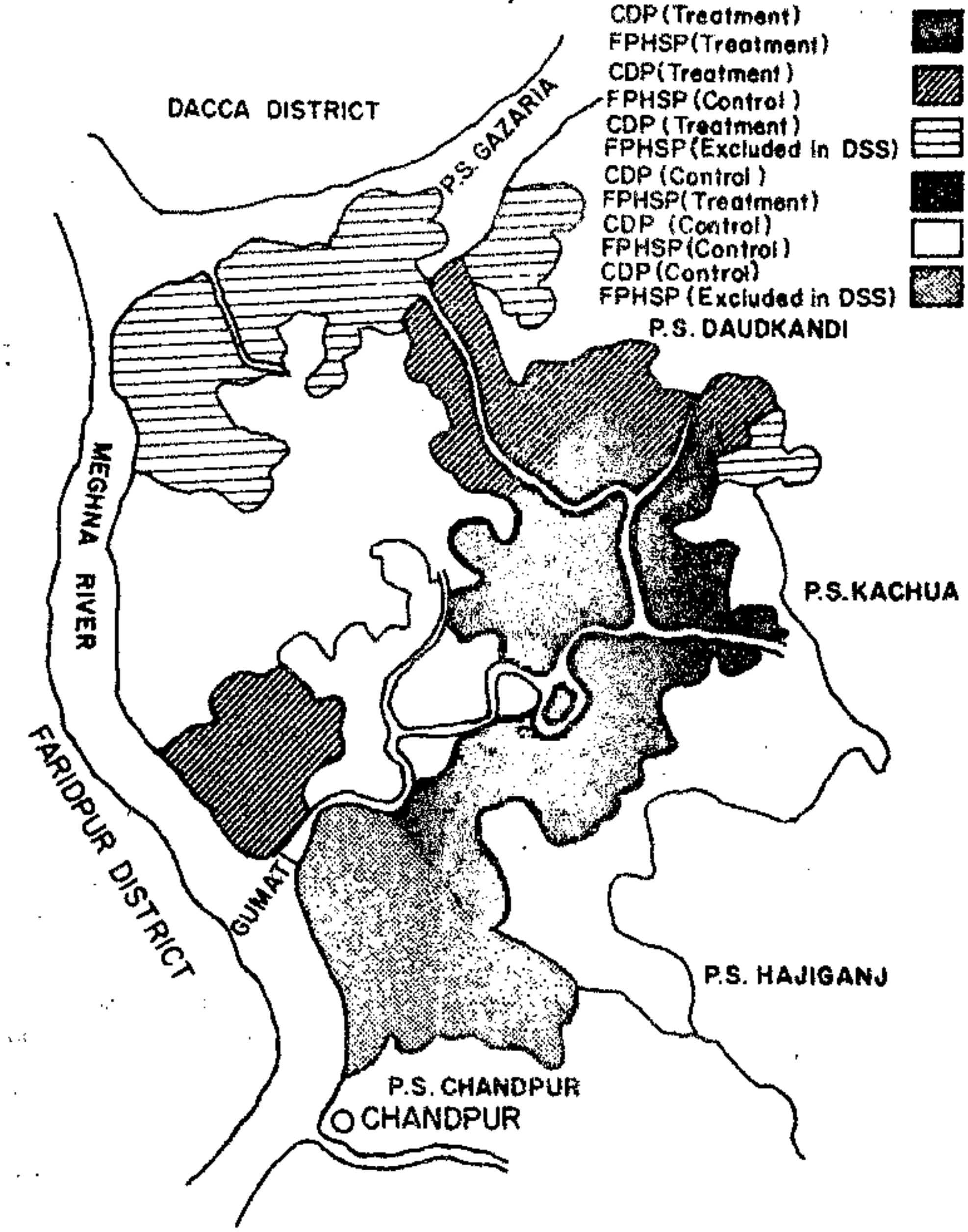

Table A1: Villages in the CDP Treatment Area that became FPSHP Treatment Villages

Matlab Identification Numbers		Census Populations	
Village VTS Number	Hopkins Number	1974 Census Population	1978 Census Population
H[1]	110	1159	1173
K[1]	112	743	781
L	113	355	342
M	114	100	127
N	115	1694	1763
O	116	959	1055
P	117	1527	1669
Q	118	293	316
R	119	1171	1199
V20	143	862	878
V21	144	382	409
V22	145	540	568
V23	146	513	528
V24[1]	147	2035	2212
V26[1]	149	2031	2207
V27[1]	150	725	785
V28[1]	151	961	1095
V30	153	442	459
V33	156	726	700
V34	157	679	705
V39	162	286	323
V40	163	548	629
V41	164	1103	1185
V42	165	556	602
V43	166	787	812
V44	167	467	486
V57	180	849	935

[1]Villages receiving DMPA services and eliminated from the analysis.

contd..../

Table A1 continued.../..

Matlab Identification Numbers		Census Populations	
Village VTS Number	Hopkins Number	1974 Census Population	1978 Census Population
V64	187	3841	4105
V82	205	1071	1164
V83	206	387	415
V85	208	328	368
V86	209	616	648
V87	210	507	503
V88	211	340	378
D100 = DX0	105	2618	2819
D101 = DX1	106	1095	1102
VB11 = VBA	237	1933	2131
VB12 = VBB	238	3229	3320
VB13 = VBC	239	3585	3786
Total	(39)	42043	44682

Table A2: CDP Treatment Villages that became Comparison Villages in the FHSP

Matlab Identification Numbers		Census Populations	
Village VTS Number	Hopkins Number	1974 Census Population	1978 Census Population
V35	158	2899	2982
V37	160	296	323
V38	161	1262	1352
V45	168	685	731
V46	169	248	276
V47	170	1462	1558
V48	171	537	559
V49	172	974	994
V50	173	725	760
V51	174	1386	1378
V58	181	1039	1113
V65	188	512	547
V66	189	715	735
V68	191	655	681
V69	192	1139	1042
V70	193	605	620
V71	194	283	319
V73	196	650	671
V74	197	957	1036
V75	198	277	333
V76	199	1162	1286
V78	201	173	199
V79	202	256	293
V80	203	733	837
V90	213	860	936
V96	219	467	435
V97	220	422	403
V98	221	177	184
V99	222	582	635

contd...../

Table A2 continued.../..

Matlab Identification Numbers		Census Popualtions	
Village VTS Number	Hopkins Number	1974 Census Population	1978 Census Populations
VB1	223	1097	1085
VB2	224	674	730
VB3[1]	225	2100	2316
VB4	226	2376	2343
VB5	227	724	659
VB6	228	319	304
VB7	229	161	161
VB8	230	878	868
VB9	231	322	163
D28	033	1010	1045
D29	034	142	155
D30	035	599	632
D31	036	856	938
D32	037	476	486
D33	038	751	833
D34[1]	039	1066	1193
D35[1]	040	599	613
D88	093	1666	1730
D89	094	505	549
D90	095	2362	2315
D91	096	1263	977
D92	097	603	654
D95	100	342	343
D96	101	185	180
D97	102	528	530
Total	(54)	43742	45020

[1]Villages receiving services 18 months post-partum and excluded from the analysis.

Table A3: Villages in the CDP Treatment Area that became Excluded from Demographic Surveillance System

Matlab Identification Numbers		Census Populations	
Village VTS Number	Hopkins Number	1974 Census Population	1978 Census Population
V77	200	276	
V91	214	398	
V92	215	146	
V93	216	2051	
V94	217	492	
D36[2]	041	391	
D37[1]	042	1082	
D38[1]	043	521	
D39[1]	044	597	
D40[1]	045	523	
D41[1]	046	1926	
D42[1]	047	1311	
D43[1]	048	1657	
D44[1]	049	623	
D45[1]	050	1589	
D46[1]	051	704	
D47[1]	052	1126	
D48[1]	053	950	
D49[1]	054	1754	
D50[1]	055	975	
D51[1]	056	989	
D52[1]	057	223	
D53[1]	058	902	
D54	059	2229	
D55[1]	060	871	
D56[1]	061	737	
D57	062	1240	
D58	063	583	

contd....../

[1] Villages receiving services 18 months post-partum and excluded from the analysis.

Table A3 continued..../..

Matlab Identification Numbers		Census Populations	
Village VTS Number	Hopkins Number	1974 Census Population	1978 Census Population
D59	064	570	
D60	065	402	
D61	066	1155	
D62	067	957	
D63	068	737	
D64	069	663	
D65[1]	070	1061	
D66	071	1131	
D67	072	287	
D68	073	513	
D69	074	915	
D70	075	1374	
D71	076	1143	
D72	077	1041	
D73	078	1039	
D74	079	580	
D75	080	4448	
D76	081	916	
D77	082	817	
D78	083	794	
D79	084	270	
D80	085	310	
D81	086	885	
D82	087	1602	
D83	088	1031	
D84	089	519	
D85	090	1144	
D86	091	681	
D87	092	717	
Total Villages	(57)	54568	

[1]Villages receiving services 18 months post-partum and excluded from the analysis.

Table A4: Villages in the CDP Comparison Area that became FPHSP Treatment Villages

Matlab Identification Numbers		Census Populations	
Villages VTS Number	Hopkins Number	1974 Census Population	1978 Census Population
DO	005	1359	1354
S	120	942	1024
T	121	1185	1315
W	236	1938	2115
V10	133	1169	1261
V11	134	1014	1149
V12	135	394	398
V13	136	628	669
V15	138	559	522
V16	139	714	705
V17	140	1018	1026
V18	141	2108	3182
V19	142	2800	2907
V25	148	1181	1218
V29	152	590	624
V31	154	7018	7310
V32	155	2037	2106
V52	175	227	225
V54	177	466	496
V55	178	445	482
V56	179	1093	1197
V59	182	744	791
V60	183	769	772
V61	184	587	582
V62	185	660	684
V63	186	1798	1896
V67	190	492	512
V72	195	4443	4626
V81	204	480	511
V84	207	1777	1806
V89	212	1096	1203
Total	(31)	42731	44668

Table A5: Continuous Surveillance DSS Villages that have not received Contraceptive Serivces 1975-1981.

Matlab Identification Numbers		Census Populations	
Village VTS Number	Hopkins Number	1974 Census Population	1978 Census Population
A	001	2095	2185
B	003	1496	1595
C	004	2731	2773
F	108	1271	1143
G	109	1880	2042
J	111	318	321
U	122	5820	6342
V1	123	691	670
V2	124	375	400
V3	125	576	593
V4	126	195	202
V5	127	2663	2703
V6	129	2154	2033
V7	130	328	351
V8	131	967	1033
V9	132	794	873
V14	137	909	901
V36	159	3863	4170
V53	176	2451	2543
V95	218	773	807
VB10	232	1312	1429
D93	098	694	646
D94	099	832	822
D98	103	2329	2353
D99	104	1617	1646
Total	(25)	39134	40576

Table A6: Villages in the CDP Comparison Area that became Excluded from Demographic Surveillance System.

Matlab Identification Numbers		Census Populations	
Village VTS Number	Hopkins Number	1974 Census Population	Census Population
D1	006	1773	
D2	007	6507	
D3	008	4329	
D4	009	77	
D5	010	1056	
D6	011	2203	
D7	012	653	
D8	013	508	
D9	014	723	
D10	015	1291	
D11	016	429	
D12	017	746	
D13	018	2835	
D14	019	401	
D15	020	2770	
D16	021	3060	
D17	022	2993	
D18	023	1341	
D19	024	2958	
D20	025	1770	
D21	026	1518	
D22	027	3382	
D23	028	2670	
D24	029	3939	
D25	030	3248	
D26	031	1252	
D27	032	320	
Total Villages	(27)	54761	

Table A7: Village Groups in the CDP-FPHSP Design with 1974 and 1978 Matlab CRL Census Population

	Contraceptive Distribution Project					
	Treatment			Comparison		
Village Type	Number of Villages	1974[a] Population	1978[b] Population	Number of Villages	1974 Population	1978 Population
Villages included in the DSS after 1978	93	85785	89702	56	81865	85244
Villages excluded in the DSS after 1978	57	54568	-	27	54761	-
Total CDP	150	140353	-	83	136626	-

	FPHSP					
	Treatment			Comparison		
Village Type	Number of Villages	1974[a] Population	1978[b] Population	Number of Villages	1974 Population	1978 Population
Former CDP Treatment	39	42043	44682	54	43742	45020
Former CDP Comparison	31	42731	44668	25	39134	40576
Total FPHSP	70	84774	89350	79	82876	85596

a Midyear population, 1974.

b Year end population.

APPENDIX B

SEASONALITY OF NATURAL FERTILITY IN MATLAB: IMPLICATIONS FOR ASSESSING DEMOGRAPHIC EFFECTS

Matlab data have been used for a variety of studies of fertility and birth interval dynamics.[1] Research on data collected before the studies has consistently shown that couples do not alter birth spacing or limitation behaviour upon achieving some desired parity. Thus the Matlab experiments were introduced into a natural fertility population with essentially no prior exposure to contraceptive services that could confound the analysis.

The analysis of fertility impact of contraceptive service is nevertheless complicated by two aspects of natural fertility in Matlab: (1) the marked seasonality of fertility within years,[2] and (2) the pronounced decline of fertility following the 1974 famine and a compensatory surge in 1976. These aspects of the recent demographic history of Matlab accentuate the importance of maintaining comparison areas, and complicate analysis because seasonality and famine effects can differ by village thereby confounding the interpretation of programme effects.

The seasonality of fertility is illustrated in Figure B1 which shows the time series in general fertility rates (GFR) for the villages in Matlab which have never received contraceptive services. The diagram shows that the GFR typically doubles between troughs and peaks, ranging between 120 and 240 in the second and fourth quarter, respectively. Becker (1981) has analysed and modelled seasonal variation for the 1968 to 1974 period and found a corroborating pattern in which peaks and troughs varied 40 percent from the mean, a level of variation that is "more pronounced than social, economic, or geographic differentials that have been observed in the Bangladesh population (Becker, 1979)." Seasonality of coital behaviour is the most frequently cited explanation of this pattern (c.f. Gupta, 1975; and Aziz, 1980) although seasonality in spouse separation (Chen *et al.*, 1978) contribute to the observed pattern. The harvest season, which precedes the peak conception period, reduces nutritional adversity thereby increasing fecundability at a time when coital frequency is relatively high owing to the cool weather at that time of year (Huffman *et al.*, 1978).

A further complication in the assessment of project effects is the marked fertility effects of the famine of 1974 and 1975.[3] This is illustrated by the missing surge in fertility in the fourth quarter of 1975. Figure B2 depicts a

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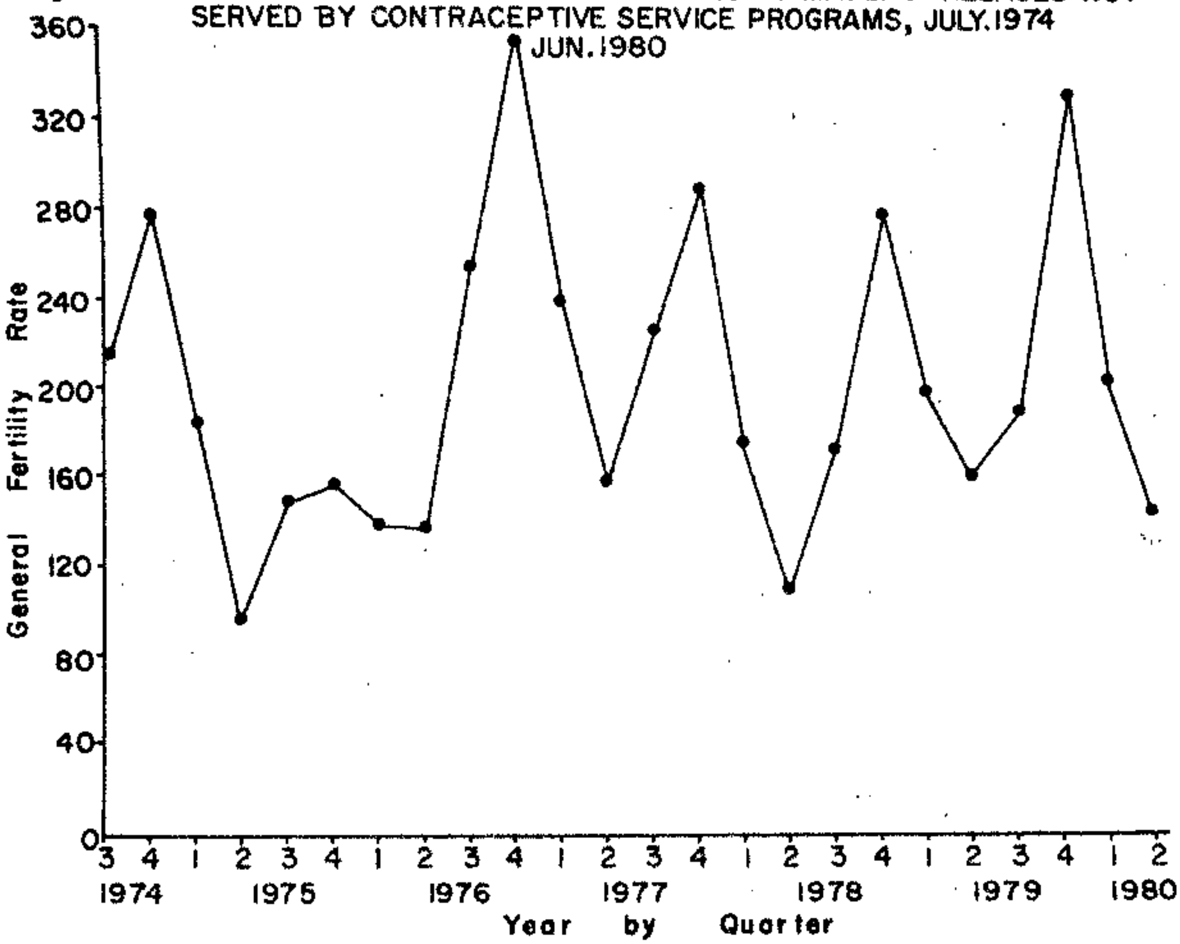
1 See, for example, Chen *et al.*, 1974.

2 Seasonality was first documented by Stoeckel and Chowdhury (1972) and has been observed in other areas of Bangladesh. See, for example, the reports of fertility dynamics in Companigonj (Alam *et al.*, 1980).

3 An analysis of the effects of the famine appears in Curlin *et al.*, 1976.

Fig.B1: QUARTERLY GENERAL FERTILITY RATES IN MATLAB VILLAGES NOT SERVED BY CONTRACEPTIVE SERVICE PROGRAMS, JULY.1974 JUN.1980



seasonality adjusted version of the Figure B1 data.[1] The seasonally adjusted GFRs show a marked decline in the fourth quarter of 1975, a compensating bulge in fertility that persisted until 1977, and a trough in 1978 that achieves a minimum at the quarter following the famine trough corresponding to the mean closed birth interval of Matlab women (see Chen *et al.*, 1974). The fertility surge in 1976 removed women from the fecundable population in 1978, because of lactational amenorrhea.

Thus the launching of an experimental programme in 1975 and its successor in 1978 coincided with marked temporal cycles in natural fertility comprised of two components -- one short term and seasonal, another long term and anomalous.

---

1 Seasonality was adjusted by the following procedures:

Let F define an adjustment factor for quarter i of age group m. Then

$$F_{im} = \frac{\sum_{i=1}^{4} \sum_{j=2}^{6} B_{ijm}}{\left[\sum_{j=2}^{6} B_{ijm}\right]} \qquad (B1)$$

Where:

B_{ijm} = the number of births to mothers aged m in quarter i of year j.
Note that this seasonality factor annualizes quarterly rates by multiplying by four.

The adjusted GFR was calculated using factors for each age group:

$$GFR_{ij} = \frac{\left(\sum_{m=4}^{9} F_{jm} \cdot B_{ijm}\right) \cdot 100}{P_{ij}} \qquad (B2)$$

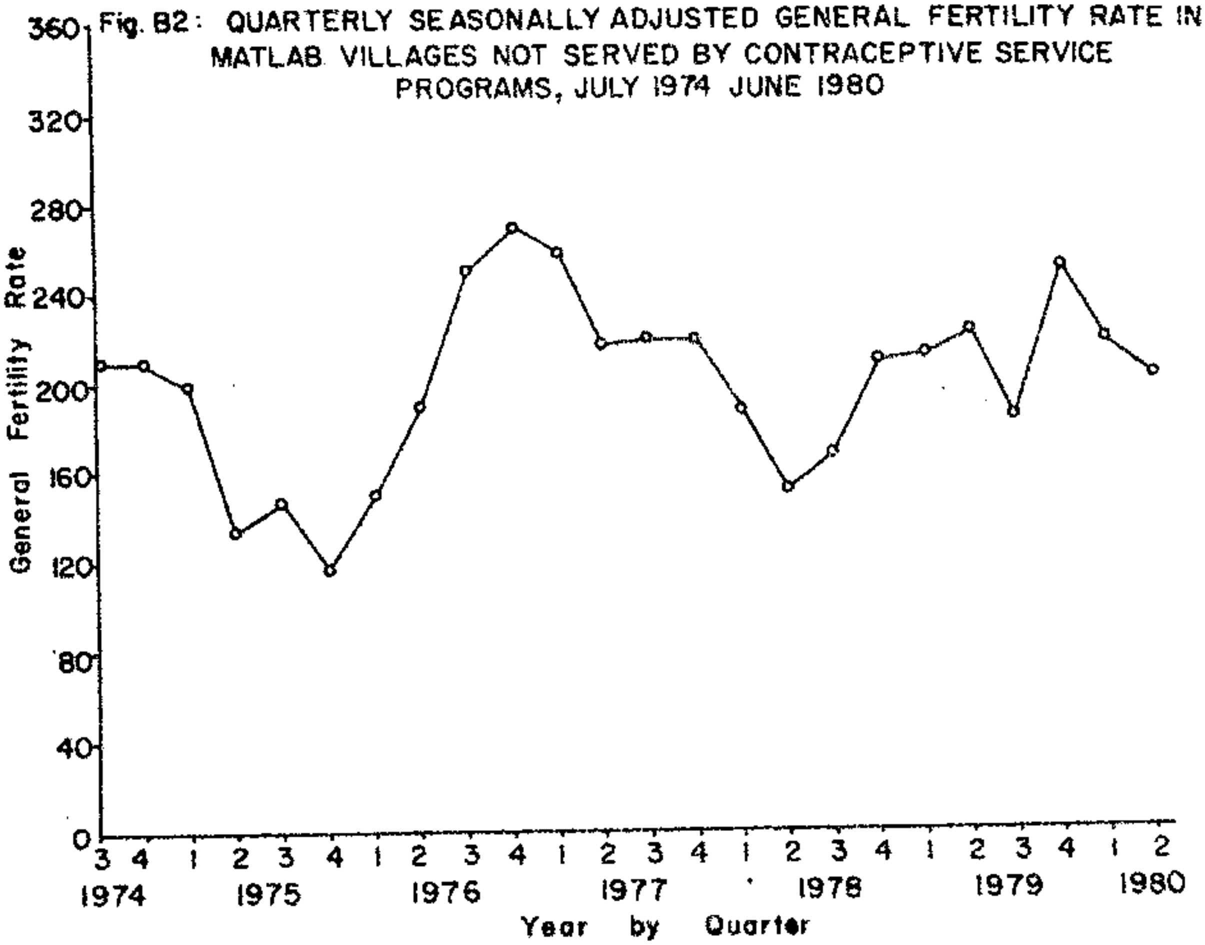
Where:

GFR_{ij} = the adjusted general fertility rate for quarter i of year j

and, P_{ij} = the estimated numbers of women 15-44 at the middle of quarter i of year j.

An implicit assumption of this approach is that seasonality is multiplicative: high fertility generates high seasonality. A useful discussion of alternative factors is in Chatfield (1980).
For calculations throughout the main text we initially calculated separate adjustment factors for each village group but found that specific factors varied only slightly from one group to another. A single set was then calculated and used for all village groups. The adjustment factors are used only to simplify graphic presentations and not for precise calculations of project impact.

Fig. B2: QUARTERLY SEASONALLY ADJUSTED GENERAL FERTILITY RATE IN MATLAB VILLAGES NOT SERVED BY CONTRACEPTIVE SERVICE PROGRAMS, JULY 1974 JUNE 1980



APPENDIX C

A PRELIMINARY STUDY OF THE FERTILITY EFFECTS OF TWO ALTERNATIVE FIELD STRATEGIES FOR THE TIMING OF PILL ADOPTION

One of the ancillary questions regarding the Matlab contraceptive distribution project concerned the best time for women to initiate pill use after their most recent pregnancy termination. Women in Bangladesh experience unusually prolonged post-partum amenorrhea, which depresses rates of natural fertility. Birth rates in Bangladesh are, nevertheless, high. Some researchers and programme planners have hypothesized that the timing health and demographic effects of starting pill use during lactational amenorrhea determines whether or not pill adoption affects fertility (Minkin, 1979). According to this hypothesis early adoption can truncate lactation. If continuation rates are low, the truncation of lactation and consequent shortening of amenorrhea can result in an earlier return to fertility than would have occurred in the absence of pill use.

While demographic effectiveness is only one consideration in timing pill use its importance can be evaluated in Matlab.[1] The original CDP design specified that women 75 percent of the treatment villages were advised to start pill use 6 months post-partum, and that the remaining women (numbering about 5,000) were advised to wait an additional year. While there are serious limitations to this test,[2] it should be possible to determine whether adoption at 6 months increases fertility relative to 18 month adoption.

Table C1 compares general and age specific fertility rates for the 6 and 18 month post-partum adoption groups for the pre-project and the post-project period. Differences between the areas were generally small, although the 1976 project year comparison is statistically significant. This difference was confined, however, women under age 30.

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1 This issue is explored in a more technical study now under preparation by one of the FPHSP investigators, S. Bhatia, in collaboration with S. Becker, formerly of the ICDDR,B.

2 The instructions to workers may or may not have been carried out with precision and the intensity of follow-up may have been variable. Moreover, the particular rationale for 6 or 18 months is unclear. Huffman *et al.*, (1978) reports mean durations of amenorrhea of 18 months. Thus adoption was timed roughly at the point at which half of the women resume menses. The six months post-partum instruction has no comparable rationale. While the study could show the effects of late versus relatively early adoption, it does not permit analysis of the optimum timing of adoption.

Table C1: General and Age Specific Fertility Rates for CDP Treatment Areas: Comparison of the Six and Eighteen Month Post-partum Groups

Project Year[a]	Villages with 6 Months Post-partum Services	Villages with 18 Months Post-partum Services	Absolute Difference	Percentage Difference
		General Fertility Rates		
1974	179.0	183.0	- 4.0	- 2.2
1975	147.3	149.2	- 1.9	- 1.3
1976	221.4	243.2	-21.8	- 9.8*
1977	197.3	206.4	- 9.1	- 4.6
		Age Specific Rates		
		15 to 29		
1974	212.9	229.1	-16.2	- 7.6
1975	173.7	173.6	+ 0.1	- 0.0
1976	256.2	294.2	-38.0	-14.8*
1977	221.6	235.1	-13.5	- 6.1
		30 to 44		
1974	131.7	120.7	+11.0	+ 8.4
1975	108.2	113.4	- 5.2	- 4.8
1976	167.0	162.7	- 4.3	+ 2.6
1977	158.1	159.6	+ 1.5	+ 0.9

a July of the specified year through June of the next year.

* P<.05.

Thus the women whose fertility we have shown to be most strongly affected by the CDP are unaffected by whether or not adoption is early in the post-partum period. This suggests that early adoption confers no protection among such women because of concomitant lactational amenorrhea. Among women under age 30, an early adoption policy confers more contraceptive protection probably because lactation is shorter among such women and amenorrhea confers a substantially shorter period of protection from conception than it does among older women.

An implication of these findings is that it is important to ascertain the appropriate timing of adoption so as to minimize the period of risk between resumption of menstruation and onset of use. Achieving some degree of overlap with amenorrhea is better than delaying use to a point of time that subjects the population to the risks of unwanted pregnancy.

A second implication of findings is the failure of the data to support the hypothesis that a service programme will increase fertility if it promotes early pill adoption. This conclusion, although consistent with the data in Table C1, bears further investigation.

APPENDIX D

Tables of Fertility Rates with Statistical
Tests for Figures in the Main Text.

Table D1: CDP Quarterly Seasonally Unadjusted General Fertility Rates July 1974 to June 1978[a]

Year	Quarter	Treatment Area	Comparison Area	Absolute Difference	Percent Difference
1974	3	182.0	233.5	-51.5	-22.1%**
	4	255.6	256.3	- 0.7	- 0.2
1975	1	172.1	180.5	- 8.4	- 4.7
	2	110.2	108.5	1.7	1.6
	3	151.4	137.6	13.8	10.0
	4	153.5	152.1	1.4	0.9
1976	1	142.0	127.3	14.7	11.5*
	2	141.8	139.0	2.8	2.0
	3	221.9	248.5	-26.6	-10.7**
	4	277.7	334.5	-56.6	-16.9**
1977	1	219.5	250.1	-30.6	-12.2**
	2	169.1	176.2	- 7.1	- 4.0
	3	217.2	226.8	- 9.6	- 4.2
	4	279.3	264.5	14.8	5.6
1978	1	160.5	158.4	2.1	1.3
	2	134.6	121.2	13.4	11.1

[a]Raw data for Figure 1, main text.

* p<.05

** p<.01

Table D2: CDP Quarterly Seasonally Adjusted Generally Fertility Rates July 1974 to June 1978[a]

Year	Quarter	Treatment Area	Comparison Area	Absolute Difference	Percent Difference
1974	3	176.1	227.3	51.2	-22.5**
	4	192.6	193.0	0.4	- 0.2
1975	1	186.6	197.1	10.5	- 5.3
	2	152.1	149.6	2.5	+ 1.7
	3	146.5	133.6	12.9	+ 9.6
	4	115.6	114.6	1.0	+ 0.9
1976	1	154.2	138.3	15.9	+11.5*
	2	197.0	192.5	4.5	+ 2.3
	3	215.1	242.1	27.0	-11.2**
	4	209.0	252.2	43.2	-17.1**
1977	1	238.9	269.3	30.4	-11.3**
	2	233.8	243.6	9.8	- 4.0
	3	209.8	220.8	11.0	- 5.0
	4	210.5	199.5	11.0	+ 5.5
1978	1	172.5	170.1	2.4	+ 1.4
	2	185.8	167.3	18.5	+11.1

[a]Raw data for Figure 2, main text.

* $p<.05$

** $p<.01$

Table D3: Age Specific Quarterly Birth Rates Among Women Aged 15 to 29 and 30 to 44 for CDP Treatment and Comparison Areas July, 1974 to June 1978[a]

Year	Quarter	Age Group							
		15-29				30-44			
		Treatment	Comparision	Absolute	Percent	Treatment	Comparision	Absolute	Percent
1974	3	231.6	278.6	-47.0	-16.9**	114.3	164.1	-19.8	-12.1**
	4	303.8	298.8	5.0	1.7	188.7	189.8	1.1	- 0.6
1975	1	202.8	203.3	- 0.5	- 0.2	129.0	144.3	-15.3	-10.6
	2	119.9	118.7	1.2	1.0	96.4	92.0	4.4	4.8
	3	188.7	162.6	26.1	16.1**	97.3	97.0	0.3	0.3
	4	180.3	174.3	6.0	3.4	114.0	115.7	- 1.7	1.5
1976	1	158.6	146.1	12.5	8.6	117.2	96.1	21.1	22.0*
	2	167.0	150.6	16.4	10.9	108.6	119.8	-16.2	-18.5
	3	272.4	286.6	-14.2	- 5.0	144.2	184.3	-40.1	-21.8**
	4	319.9	349.4	-29.5	- 8.4*	212.0	308.6	-96.6	-31.3**
1977	1	248.8	252.7	- 3.9	- 1.5	173.5	245.6	-72.1	-29.4**
	2	188.3	184.1	4.2	2.3	138.7	162.5	-23.8	-14.6*
	3	264.3	260.3	4.0	1.5	142.2	169.1	-26.9	-15.9*
	4	316.3	285.7	30.6	10.7**	219.7	227.7	- 8.0	- 3.5
1978	1	160.8	154.3	6.5	4.2	160.0	165.6	- 5.6	- 3.5
	2	149.2	126.1	23.1	18.8	111.0	112.7	- 1.7	- 1.5

[a] Raw data for Figure 3 and 4, main text.

* p<.05
**p<.01

Table D4: FPHSP Quarterly Seasonally Unadjusted General Fertility Rates July 1974 to June 1980[a]

Year	Quarter	Treatment Area	Comparison Area	Absolute Difference	Percent Difference
1974[b]	3	203.2	201.2	2.0	+ 1.0
	4	261.5	265.4	3.9	- 1.5
1975	1	163.7	180.4	16.7	- 9.3
	2	117.7	104.6	13.1	+12.5
	3	143.7	147.4	3.7	- 2.5
	4	148.3	155.8	7.5	- 4.8
1976	1	119.1	136.5	17.4	-12.7
	2	142.7	139.9	2.8	+ 2.0
	3[c]	219.2	249.9	30.7	-12.3*
	4	306.1	311.0	4.9	- 1.6
1977	1	211.5	241.0	29.5	-12.2*
	2	166.0	162.4	3.6	+ 2.2
	3	208.2	223.9	15.7	- 7.0
	4	258.2	285.3	27.1	- 9.5*
1978	1	142.1	166.8	24.7	-14.8*
	2	115.6	121.4	5.8	- 4.8
	3	144.1	169.9	25.8	-15.2*
	4	187.3	265.0	77.7	-29.3**
1979	1	143.3	184.5	41.2	-22.3**
	2	114.9	167.9	53.0	-31.6**
	3	144.8	192.1	47.3	-24.6**
	4	234.4	331.1	96.7	-29.2**
1980	1	158.4	197.1	38.7	-19.6**
	2	119.3	151.9	32.6	-21.5**

[a]Raw data for Figure 5, main text

[b]Statistical tests use: H_o: $P_1=P_2$, Two tailed test for the preproject period.

[c]Statistical tests use H_o: $P_1<P_2$ for the project impact period.

* $p<.05$ ** $p<.01$

Table D5: Quarterly Seasonally Adjusted GFR in the FPHSP Treatment and Comparison Areas July 1974 to June 1980[a]

Year	Quarter	Treatment Area	Comparison Area	Absolute Difference	Percent Difference
1974	3	197.9	196.0	1.9	+ 1.0
	4	197.1	200.1	3.0	- 1.5
1975	1	177.8	194.6	16.8	- 8.6
	2	162.3	144.5	17.8	+12.3
	3	139.3	143.4	4.1	- 2.0
	4	111.9	117.4	5.5	- 4.7
1976	1	129.4	147.5	18.1	-12.3*
	2	197.8	193.4	4.4	+ 2.3
	3	213.5	243.0	29.5	-12.1*
	4	230.9	234.5	3.6	- 1.5
1977	1	229.5	260.1	30.6	-11.8**
	2	228.9	224.2	4.7	+ 2.1
	3	203.7	217.1	13.4	- 6.2
	4	194.8	215.2	20.4	- 9.5*
1978	1	151.7	178.2	26.5	-14.9**
	2	159.6	167.5	7.9	- 4.7
	3	139.4	165.1	25.7	-15.6**
	4	140.8	199.8	59.0	-29.5**
1979	1	155.5	196.5	41.0	-20.9**
	2	159.7	231.5	71.8	-31.0**
	3	139.0	186.0	47.0	-25.3**
	4	176.2	249.6	73.4	-29.4**
1980	1	172.4	209.8	37.4	-17.8**
	2	164.8	209.8	45.0	-21.4**

[a] Raw data for Figure 6, main text.

* $p<.05$

** $p<.01$

Table D6: Age Specific Quarterly Birth Rates Among Women Aged 15-29 and 30 to 44 for FPHSP Treatment and Comparison Areas, July 1974 to June, 1980[a]

Year	Quarter	Age Group: 15-29[a] Treatment	15-29[a] Comparison	15-29[a] Difference Absolute	15-29[a] Difference Percent	30-44[b] Treatment	30-44[b] Comparision	30-44[b] Difference Absolute	30-44[b] Difference Percent
		Preproject Period							
1974	3	246.9	243.6	3.3	- 1.4	139.3	140.8	1.5	- 1.1
	4	304.3	308.2	3.9	- 1.3	198.0	203.6	5.6	- 2.8
1975	1	199.6	198.5	1.1	+ 0.6	109.6	153.9	44.3	-28.8**
	2	123.1	115.8	7.3	+ 6.3	109.5	88.1	21.4	+24.3*
	3	169.7	173.3	3.6	- 2.1	103.5	108.2	4.7	- 4.3
	4	158.1	179.5	21.4	-11.9*	133.1	119.5	13.6	+11.4
1976	1	132.4	145.5	13.1	- 9.0	98.1	122.6	24.5	-20.0**
	2	159.9	152.4	7.5	+ 4.9	115.3	120.2	4.9	- 4.1
	3	244.8	299.5	54.7	-18.3**	177.7	170.9	6.8	+ 4.0
	4	326.0	340.3	14.3	- 4.2	273.6	263.6	10.0	+ 3.8
1977	1	228.0	256.1	28.1	-11.0*	184.3	216.5	32.2	-14.9**
	2	175.6	178.4	2.8	- 1.6	150.0	136.2	13.8	+10.1
	3	231.3	266.8	35.5	-13.3**	169.5	153.5	16.0	+10.4
	4	283.9	310.9	27.0	- 8.7	214.8	242.8	28.0	-11.5*
1978	1	137.4	152.0	14.6	- 9.6	150.0	191.5	41.5	-21.7**
	2	120.8	127.9	7.1	- 5.6	106.6	110.5	3.9	- 3.5
		Post-project Period							
	3	163.4	193.4	30.0	-15.5*	111.2	130.5	19.2	-14.7*
	4	221.9	298.7	76.8	-25.7*	128.3	208.1	79.8	-38.3**
1979	1	160.5	176.5	16.0	- 9.1	113.9	198.0	84.1	-42.5**
	2	132.4	168.1	35.7	-21.2**	85.2	167.6	82.4	-49.2**
	3	181.6	225.3	43.7	-19.4**	81.9	135.5	53.6	-39.6**
	4	287.9	371.5	83.6	-22.5**	142.9	262.0	119.1	-45.5**
1980	1	176.6	196.6	20.0	-10.2**	127.1	198.0	70.9	-35.8**
	2	129.9	161.2	31.3	-19.4**	100.9	135.9	35.0	-25.8**

[a] Raw data for Figure 7, main text.

[b] Raw data for Figure 8, main text.

* $p \leq .05$ ** $p < .01$

Table D7: Fertility Rates Among Women Aged 30 and Over for the Four Cells of the CDP and the FPHSP, 1974-1980

Year	Quarter	Treatment CDP Comparison FPHSP	Comparison CDP & FPHSP	Treatment CDP & FPHSP	Comparison CDP Treatment FPHSP
1974	3	118.2	167.0	118.7	152.6
	4	182.8	227.9	200.4	196.6
1975	1	143.5	166.1	107.3	111.2
	2	88.3	88.1	117.7	104.4
	3	90.0	129.5	127.8	87.9
	4	121.1	117.9	114.1	145.7
1976	1	117.2	129.1	115.7	87.0
	2	110.8	131.3	109.4	119.4
	3	144.0	202.5	155.4	192.7
	4	216.5	319.0	207.0	317.5
1977	1	205.7	229.6	142.5	211.9
	2	126.3	148.0	163.3	142.1
	3	135.7	174.7	166.5	172.1
	4	243.1	243.7	223.3	210.2
1978	1	171.0	216.3	140.8	156.7
	2	112.6	108.8	111.7	103.9
	3	117.1	146.5	101.9	117.8
	4	178.2	243.9	137.5	123.2
1979	1	194.3	203.6	122.0	109.4
	2	163.6	173.4	78.5	89.9
	3	140.0	131.1	91.2	76.4
	4	250.4	277.5	100.0	170.6
1980	1	182.7	217.0	140.0	119.6
	2	135.7	137.1	104.4	99.3

APPENDIX E

Age Specific Fertility Rates for Five Year Age Groups of the CDP Treatment and Comparison Areas (1974-1978) and FPSHP Treatment and Comparison Areas (1974-1980).

Table E1: Age Specific Quarterly Unadjusted Birth Rates CDP Treatment and Comparison Areas, July, 1974 to June, 1978

Quarter	Age Group											
	15-19		20-24		25-29		30-34		35-39		40-44	
	T	C	T	C	T	C	T	C	T	C	T	C
3	192.1	214.7	271.4	337.5	254.3	320.4	187.8	258.9	99.9	118.5	24.1	62.0
4	228.7	224.2	346.2	360.8	387.0	356.6	301.0	294.1	172.9	155.1	46.4	62.3
1	122.3	147.2	261.3	243.1	276.3	255.5	208.2	205.9	114.4	146.2	34.4	45.0
2	81.8	91.5	145.9	134.1	156.9	149.0	147.6	114.8	90.2	102.1	32.8	45.2
3	161.8	138.7	211.6	160.5	209.3	207.9	150.9	133.8	83.9	102.8	39.7	33.4
4	146.0	132.0	185.7	209.8	237.1	207.7	185.2	175.5	101.5	91.2	32.6	52.7
1	111.3	94.8	171.5	162.4	229.8	219.1	195.2	142.7	106.7	81.6	25.6	42.7
2	119.2	113.3	191.9	174.8	223.8	188.3	180.6	183.0	79.4	109.9	30.5	36.7
3	195.9	191.8	353.1	376.7	309.9	347.5	249.6	292.4	107.9	161.9	48.8	49.9
4	233.6	223.6	408.1	449.4	364.5	452.6	383.2	514.3	157.8	234.1	53.5	43.0
1	170.7	160.4	282.4	298.4	349.1	362.5	288.9	387.3	148.1	209.7	54.8	80.9
2	152.5	138.0	178.3	212.8	266.9	231.1	220.3	246.6	143.1	154.4	29.7	50.5
3	222.5	209.3	291.9	267.2	303.7	343.9	249.3	254.9	119.7	160.8	32.8	55.7
4	236.7	208.1	353.2	304.5	410.7	401.1	356.7	343.3	202.0	218.3	68.5	74.0
1	101.0	93.7	197.0	207.3	219.2	193.7	245.4	217.5	159.0	161.2	55.1	97.4
2	105.7	86.4	185.1	164.5	178.2	146.6	150.6	151.2	109.1	115.7	64.4	54.7

= Treatment

= Comparison

Table E?: Age Specific Quarterly Unadjusted Birth Rates FPHSP Treatment and Comparison Areas, July 1974 to June 1980

Year	Quarter	Age Group											
		15-19		20-24		25-29		30-34		35-39		40-44	
		T	C	T	C	T	C	T	C	T	C	T	C
1974	3	183.7	199.8	308.2	278.8	280.0	281.3	223.9	215.5	108.9	114.0	47.6	65.1
	4	216.8	234.6	340.2	359.4	409.1	380.7	317.5	339.7	165.1	161.5	58.7	60.4
1975	1	118.1	115.4	240.5	272.1	290.2	262.4	157.9	238.1	109.3	141.4	39.1	51.3
	2	97.4	77.0	157.0	144.6	126.9	152.2	158.8	133.8	109.1	75.5	39.1	40.0
	3	138.1	153.2	203.8	186.8	183.7	193.9	146.8	163.5	117.8	81.8	25.0	63.6
	4	129.5	133.2	176.4	210.1	185.7	227.1	216.1	188.8	84.0	105.9	74.5	42.2
1976	1	91.1	98.7	167.2	159.7	162.6	214.2	173.4	194.8	69.4	111.3	27.4	39.6
	2	100.1	105.6	197.0	184.7	220.4	198.5	187.5	191.9	93.9	102.5	40.9	46.3
	3	187.4	197.8	330.8	406.2	240.9	352.0	288.1	289.0	163.5	133.7	43.3	59.7
	4	216.0	233.8	421.1	430.9	404.9	420.4	479.1	452.9	200.8	196.5	80.5	95.8
1977	1	155.5	156.7	275.5	321.4	298.4	354.2	275.9	375.3	170.5	161.9	77.1	74.8
	2	131.5	142.0	189.9	205.4	236.9	209.7	220.9	195.5	147.5	135.6	58.0	60.9
	3	178.6	205.5	253.3	316.4	297.9	312.8	254.2	264.0	160.1	123.3	68.1	47.1
	4	204.7	230.6	323.6	358.5	375.2	391.7	306.6	392.4	229.8	212.9	75.4	87.2
1978	1	75.3	106.2	192.2	170.2	177.7	208.9	225.5	276.7	123.0	177.5	82.5	100.1
	2	86.9	102.8	166.9	159.3	121.5	130.5	160.5	166.2	91.8	105.3	53.6	46.6
	3	141.0	152.5	202.9	247.4	151.6	193.2	195.4	178.2	87.0	144.0	30.4	55.2
	4	175.8	232.1	279.9	369.9	227.4	319.7	216.5	301.2	104.0	228.5	42.8	68.2
1979	1	92.9	89.0	211.7	244.7	211.2	235.7	188.4	282.2	107.8	206.1	25.0	83.1
	2	92.1	112.2	170.9	217.3	151.6	198.0	137.3	255.7	63.7	160.7	19.9	58.6
	3	154.5	165.5	201.8	294.6	201.5	235.2	109.6	190.5	104.8	169.8	19.8	28.1
	4	226.6	251.3	339.2	479.7	324.0	429.2	237.1	409.3	117.0	275.4	51.6	62.5
1980	1	111.5	90.5	238.4	264.8	204.6	281.1	186.1	242.5	131.3	219.4	46.4	118.0
	2	100.3	117.5	163.7	198.3	134.8	183.7	341.5	200.1	103.3	135.6	46.1	55.4

T = Treatment

C = Comparison

Fig.E1.1: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 15-19 IN CDP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1978

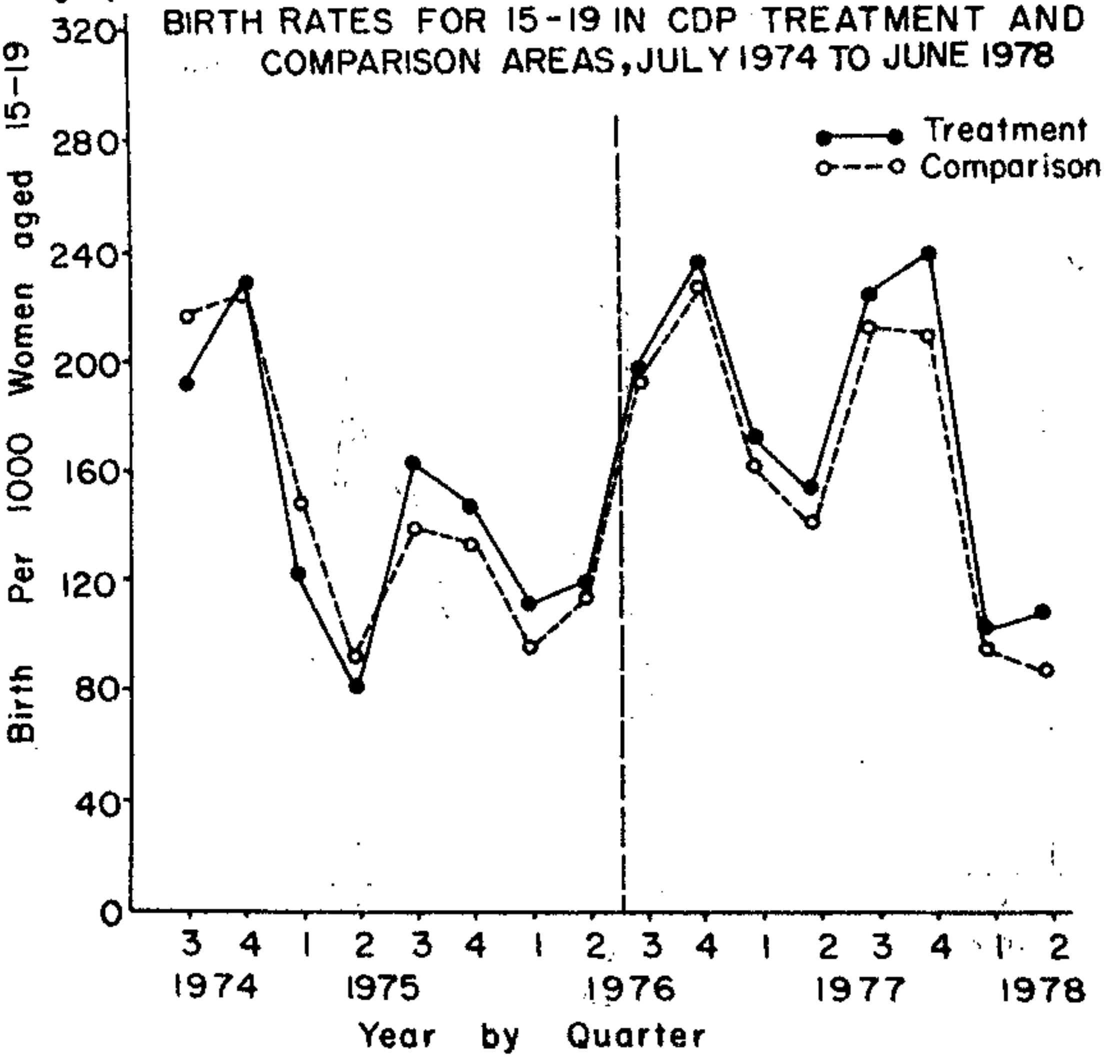


Fig. E[1]. 2: QUARTERLY SEASONALLY UNADJUTED AGE SPECIFIC BIRTH RATES FOR 20-24 IN CDP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1978

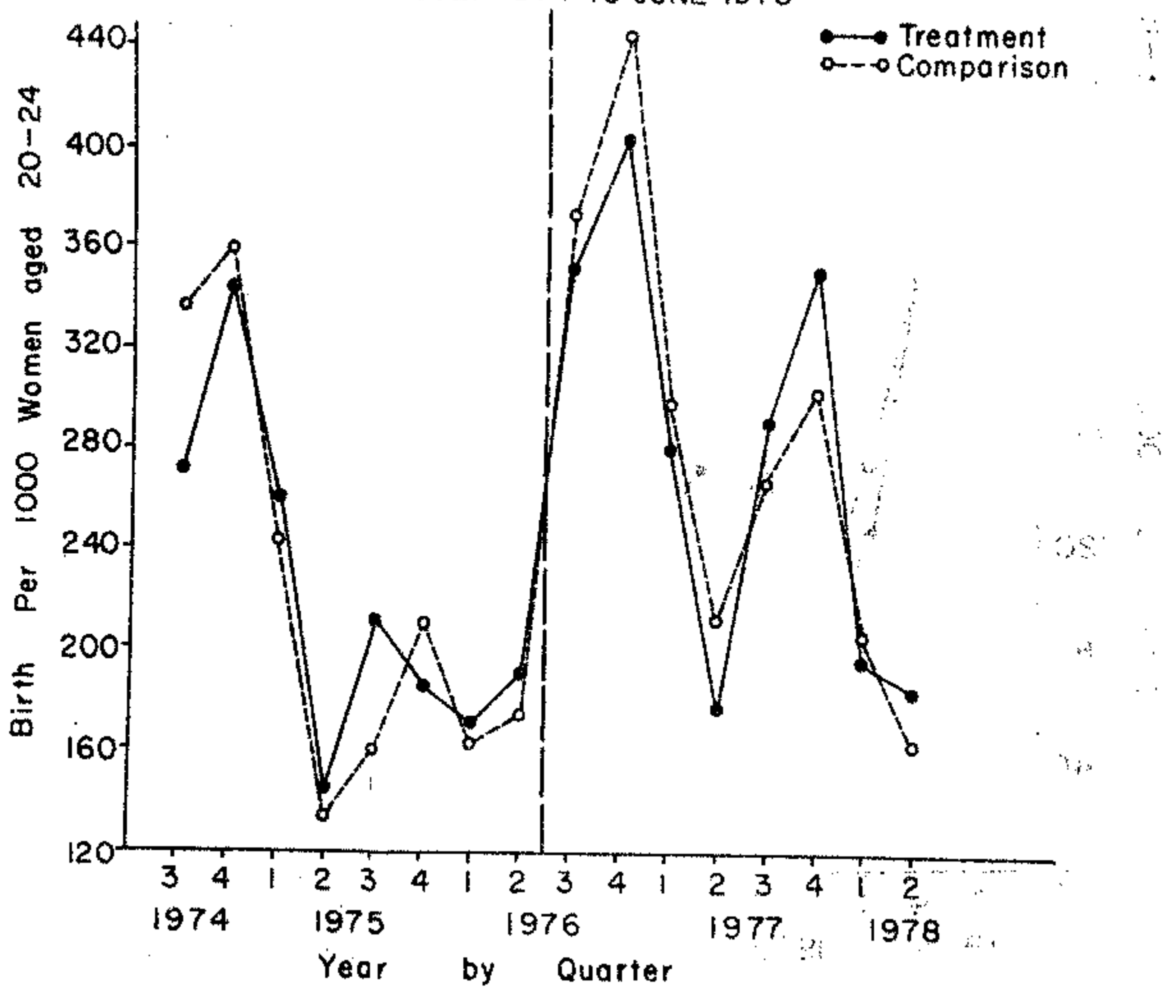


Fig. E | . 3. QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 25-29 IN CDP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1980

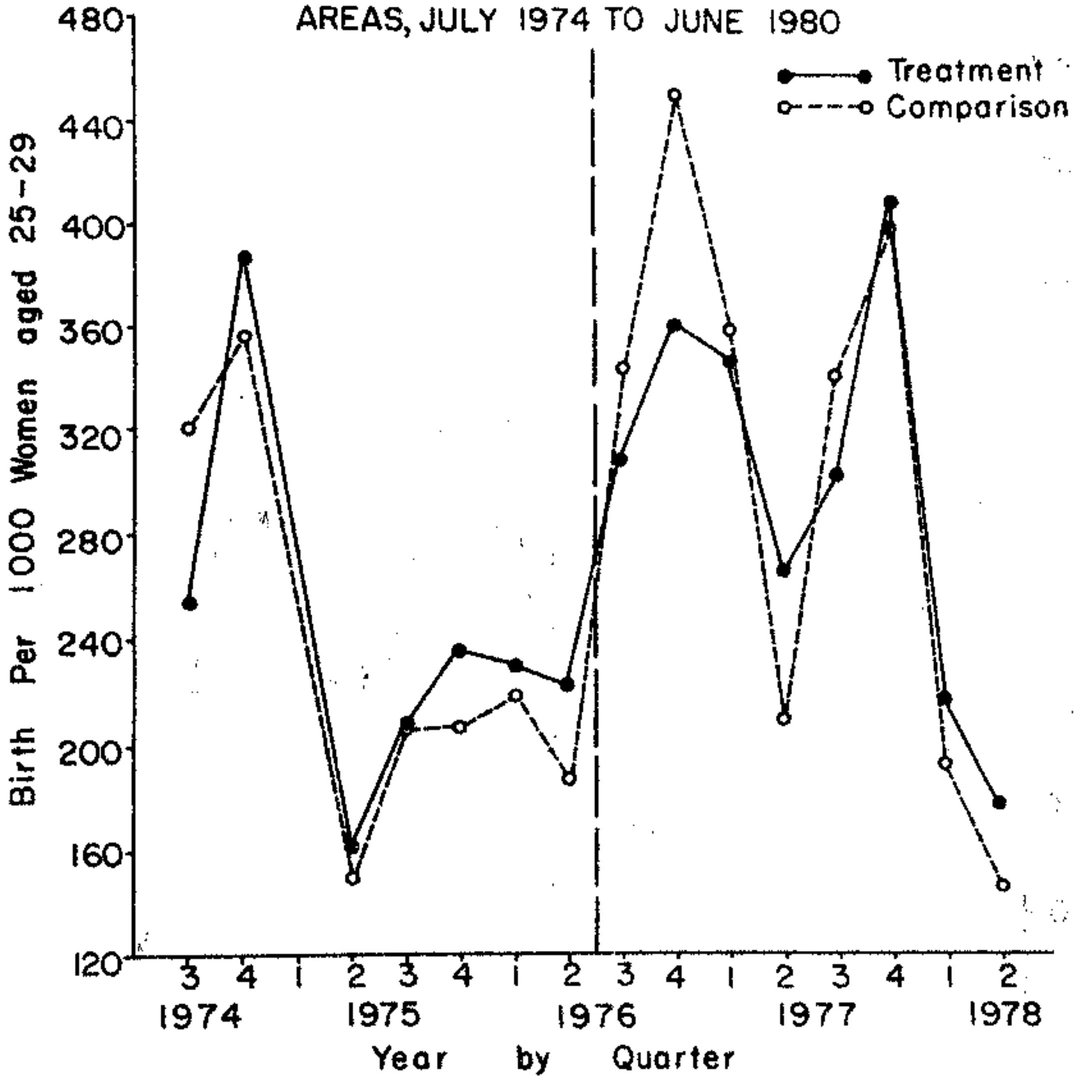


Fig. EI. 4: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 30-34 IN CDP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1978

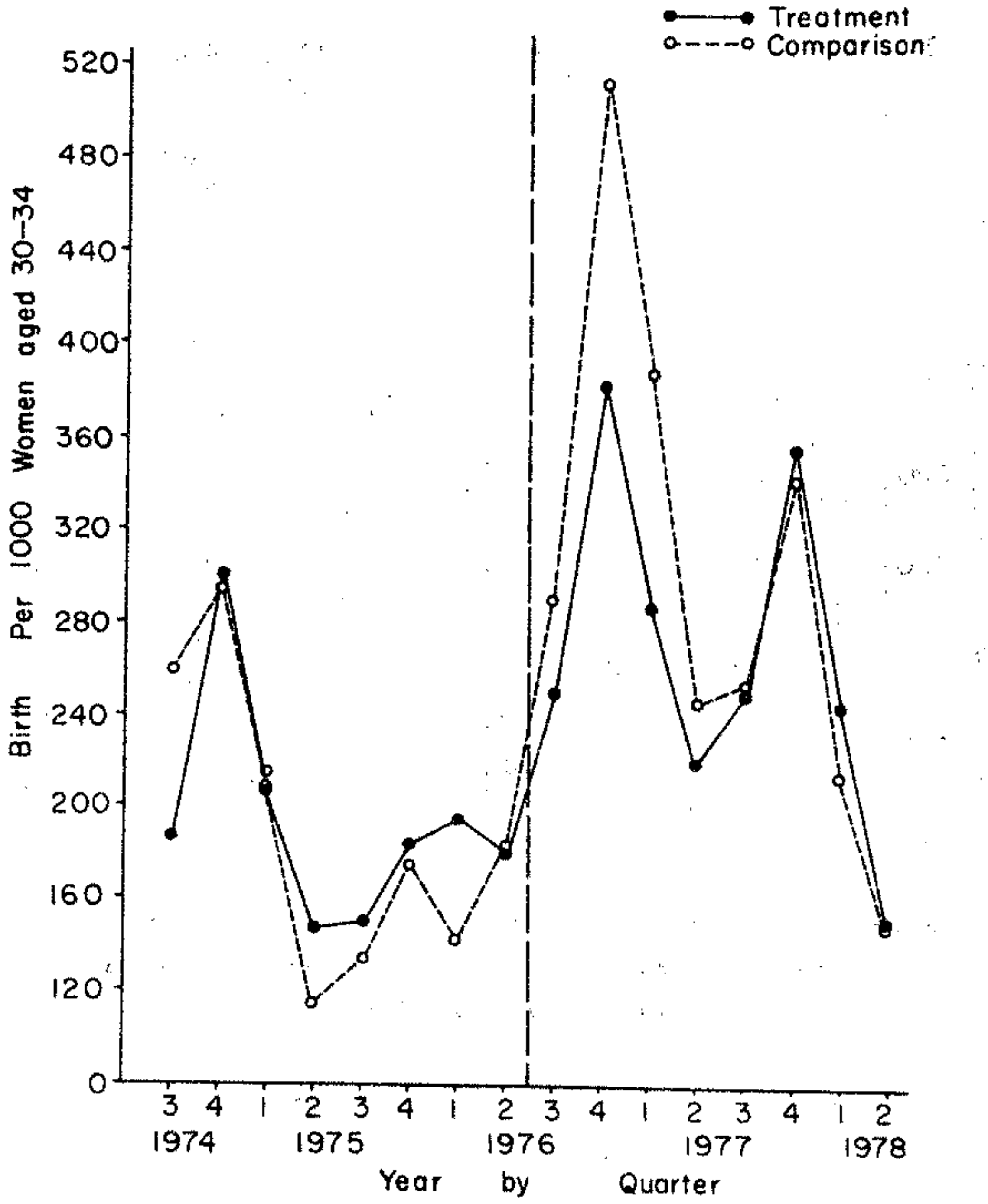


Fig. E1.5: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 35-39 IN CDP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1978

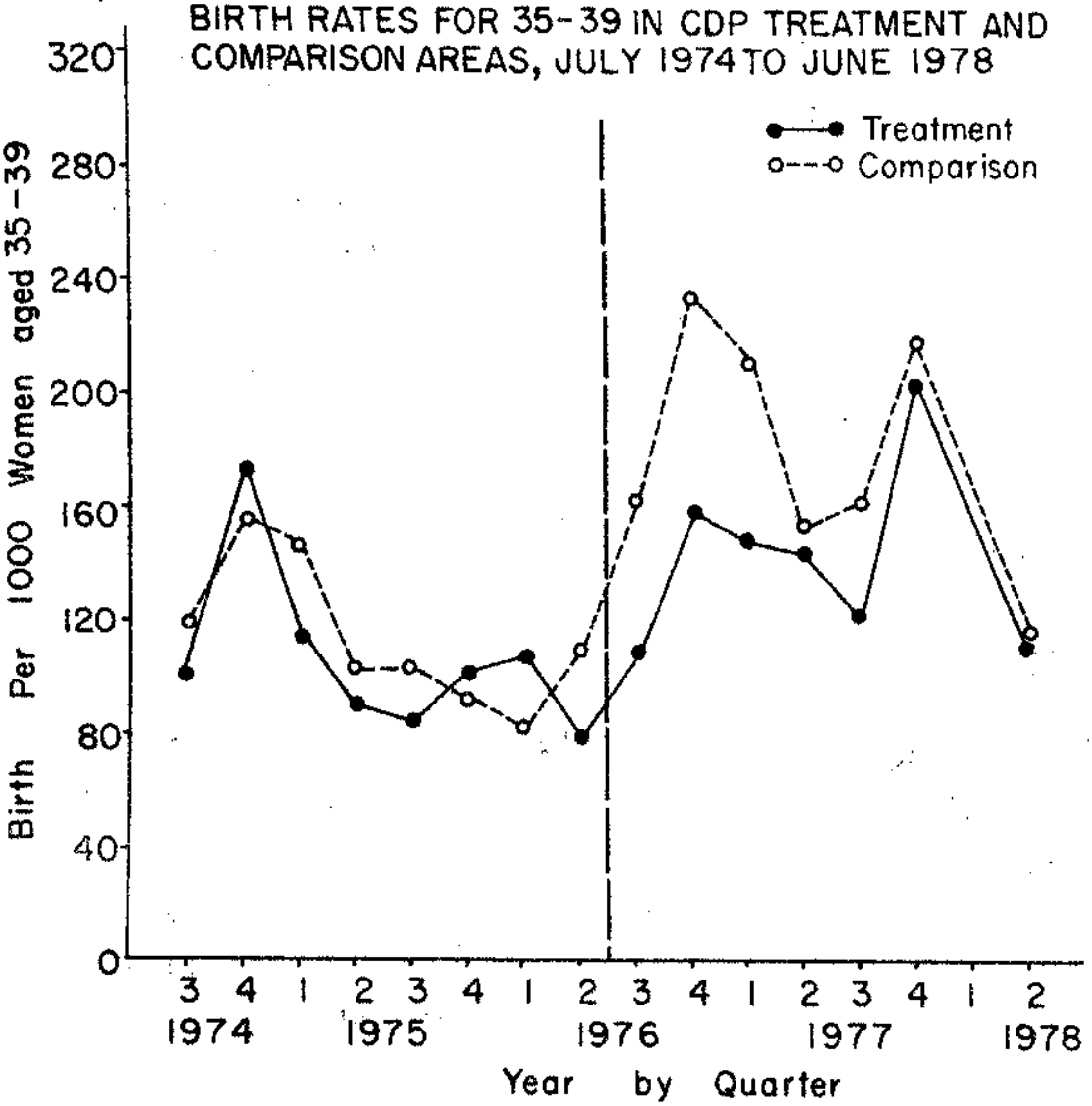


Fig. E1.6: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 40–44 IN CDP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1978

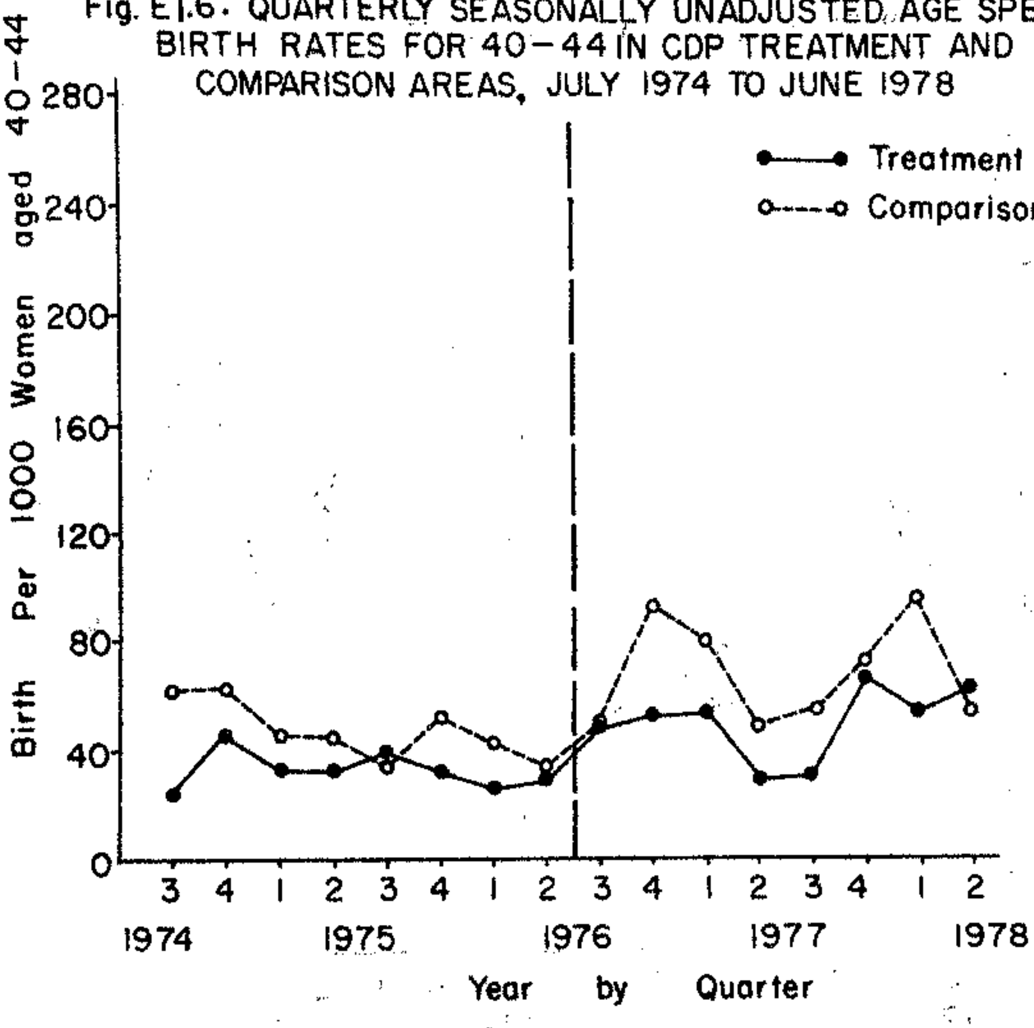


Fig. E2. 1: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 15-19 IN FPHSP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1980

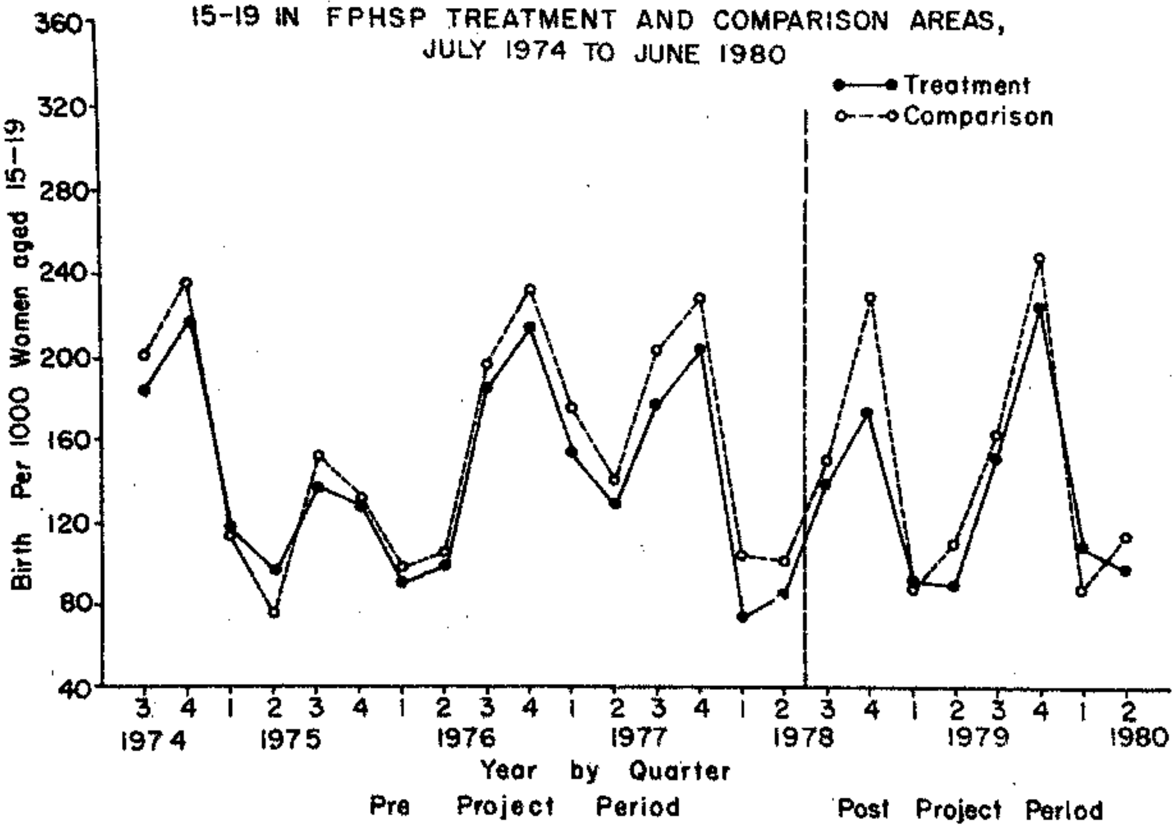


Fig. E2.2: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 20-24 IN FPHSP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1980

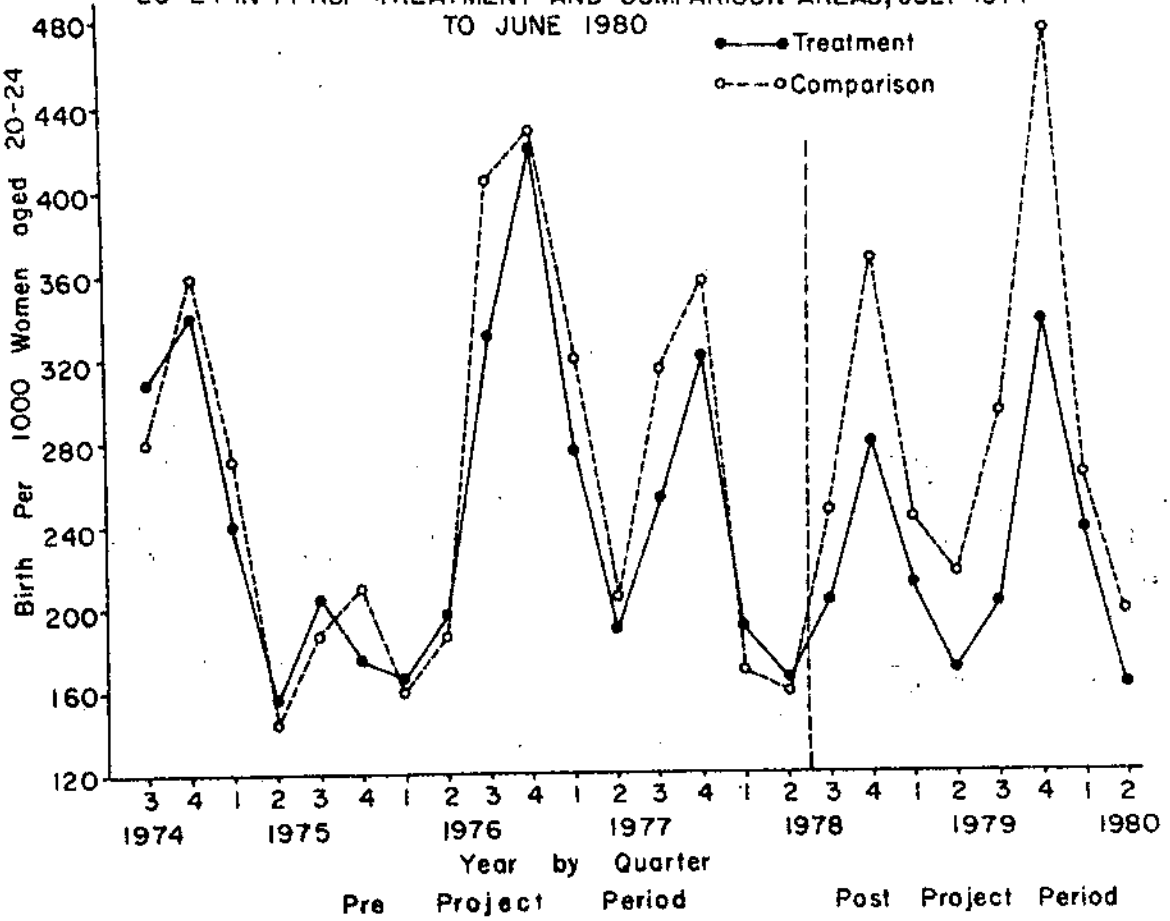


Fig. E23: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 25-29 IN FPHSP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1980

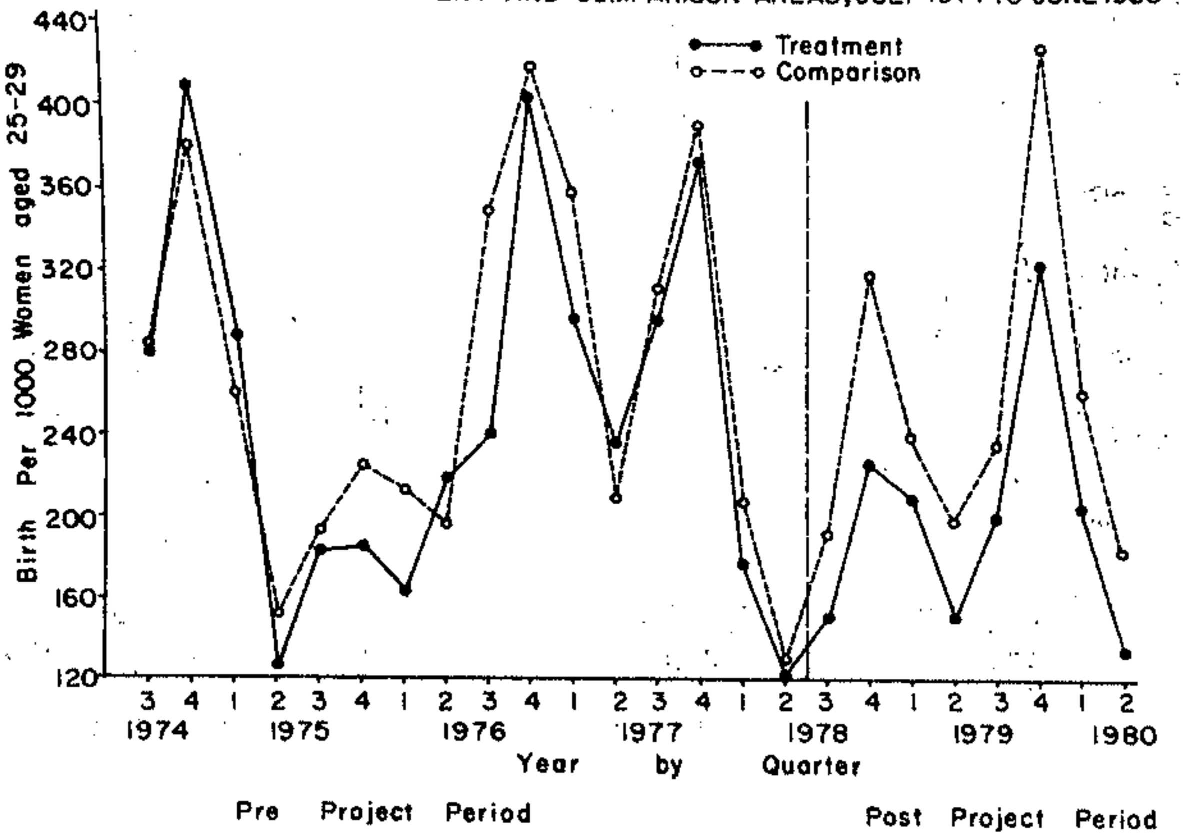


Fig. E2.4: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 30-34 IN FPHSP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1980

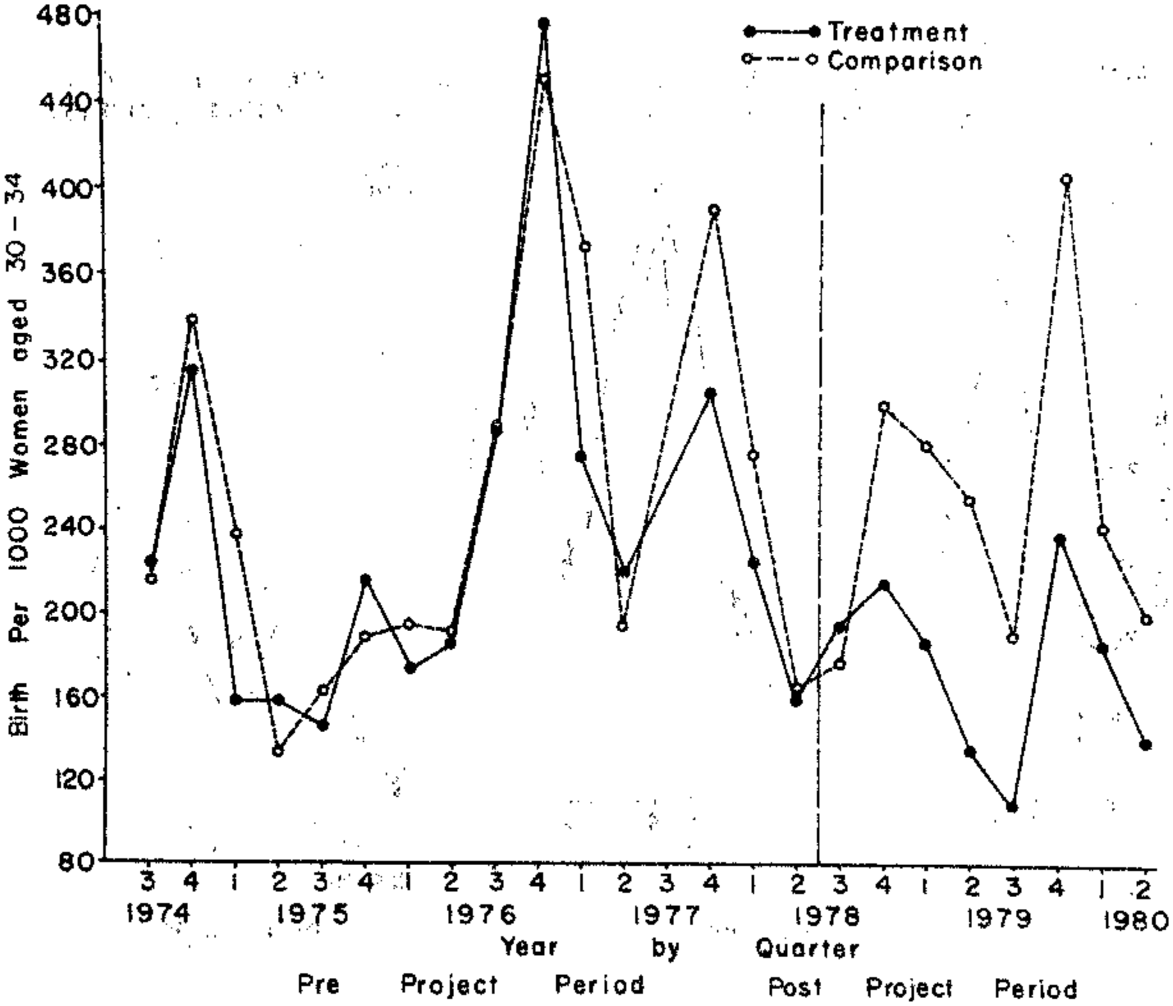
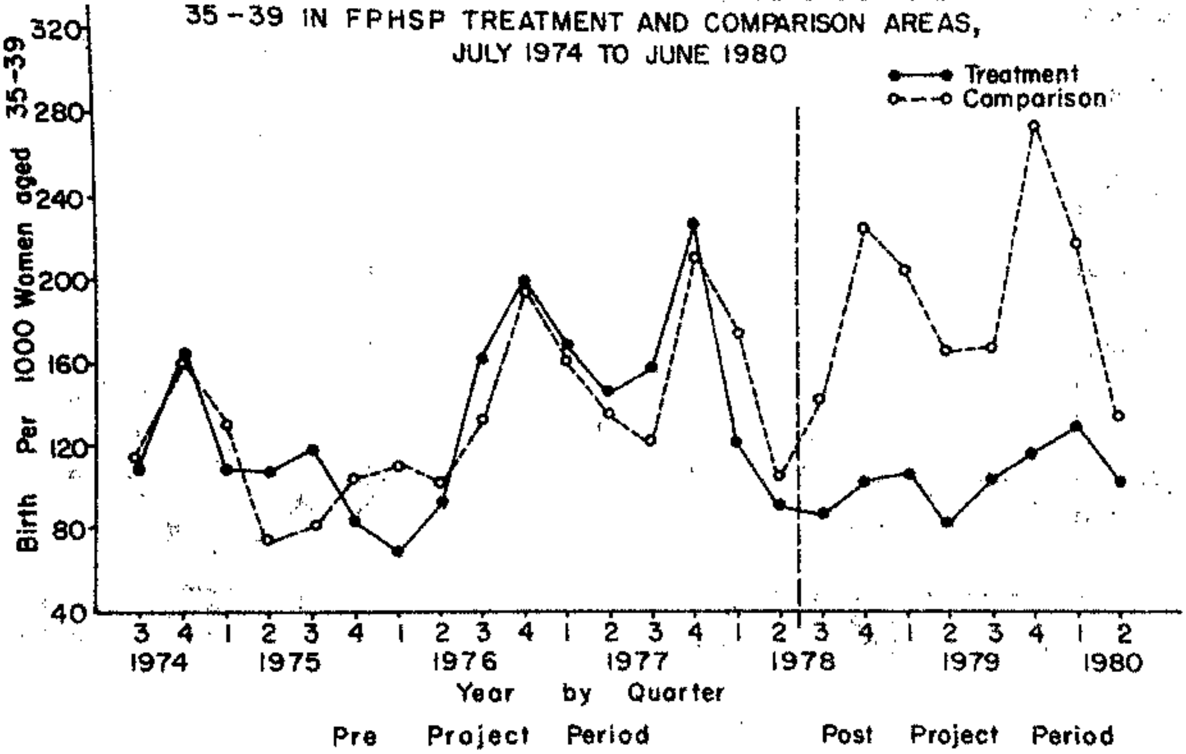


Fig. E2.5: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 35 - 39 IN FPHSP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1980



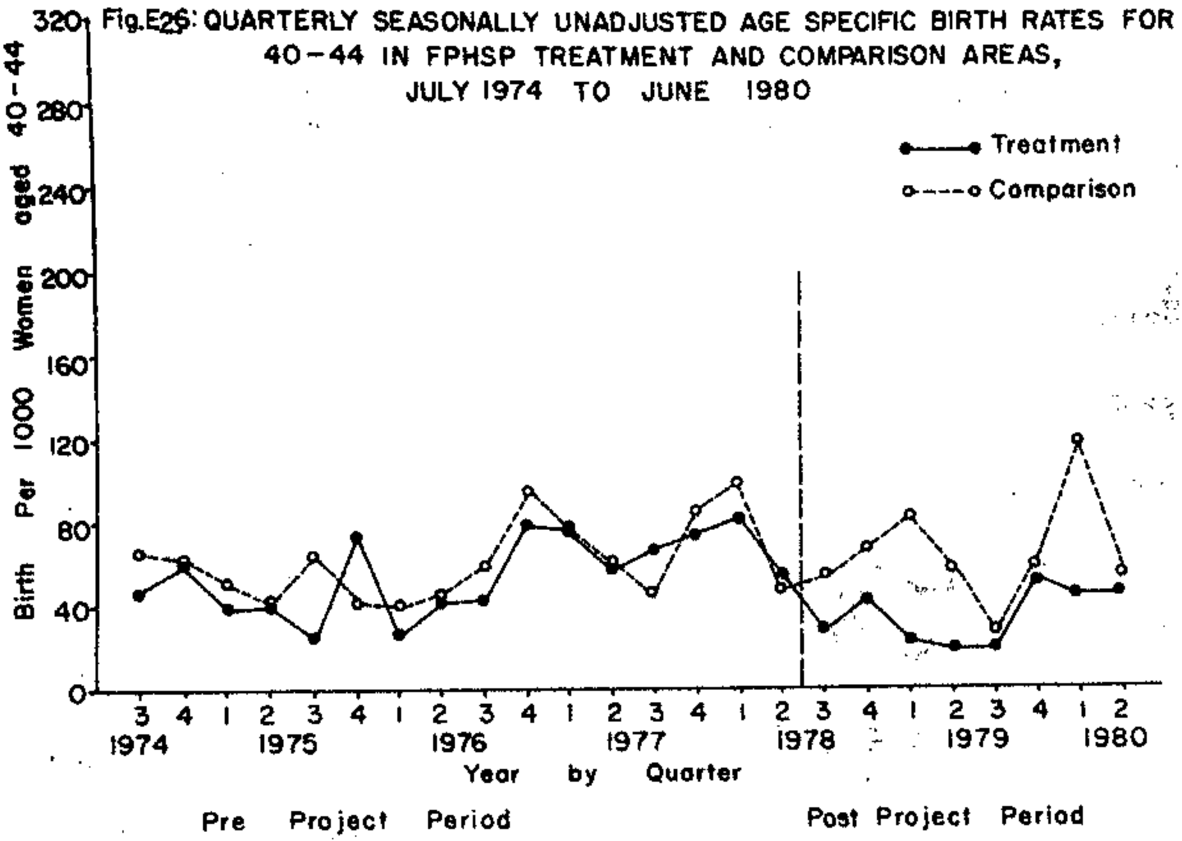


Fig.E26: QUARTERLY SEASONALLY UNADJUSTED AGE SPECIFIC BIRTH RATES FOR 40-44 IN FPHSP TREATMENT AND COMPARISON AREAS, JULY 1974 TO JUNE 1980

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