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COMMUNITY AND INDIVIDUAL ACCEPTANCE: FAMILY PLANNING SERVICES IN THE SUDAN

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INTRODUCTION

During the last three decades, the need for family planning services within less developed countries has been increasingly recognized. Not only are the problems of rapid population growth becoming more evident at the national level, but there is growing awareness that adequate birth-spacing is also an important component of improving the health of mothers and children. However, there are still differences of opinion regarding how family planning programs can and should be introduced. In this paper we examine the Sudan Community-Based Family Health Project as an example of what can be achieved in an underdeveloped rural area with a community-based approach to providing contraceptive services. This project utilized village midwives to provide four family health and planning services -- oral rehydration therapy, nutritional care for mothers and children, birth-spacing, and immunization.

This paper utilizes logistic regression techniques to examine various determinants of current contraceptive use. Data were obtained from two surveys: one conducted prior to the introduction of project services and one conducted afterward. Our principal findings are that (1) community-level variables, such as village location along the Nile and village proximity to a paved road, affect current contraceptive use independently of numerous individual-level and socioeconomic variables; (2) fertility and child mortality have important and opposite effects on contraceptive use; (3) several socioeconomic variables including maternal education, affect contraceptive behavior in expected directions, although variables such as father's

education and occupation fail to differentiate between users and nonusers; and (4) village midwives can be used successfully not only to promote contraceptive use but also to promote health attitudes and practices that in turn are positively associated with fertility regulation. In general, we find that a well-designed community-based delivery system can be successful in promoting utilization of child health and family planning services and may have differentially greater impact on subgroups of the population hypothesized to be least predisposed to utilization of such services.

THE PROJECT

The Sudan Community-Based Family Health Project (CBFHP) was undertaken by the Department of Community Medicine, University of Khartoum, in cooperation with the Sudan Ministry of Health. The project was initiated in 1980 with financial support from the US Agency for International Development (USAID) Research Division of the Office of Population and administrative support from USAID/Khartoum. Technical assistance to the project was provided by the Center for Population and Family Health of Columbia University.

The principal purpose of the project was to test the proposition that village-level government midwives could provide needed maternal-child health and birth-spacing services to their communities. To this end, a project site was selected consisting of 93 villages in the northern part of Khartoum Province, stretching for about 140 kilometers along both banks of the Nile. After a lengthy period of field study, community meetings and

curriculum development, the 93 village midwives living in the area attended a three-week training course. Beginning in March 1981, four health interventions -- oral rehydration therapy, birth-spacing, nutritional information for mothers and children, and immunization were introduced to the project villages over a five-month period. These were introduced during three rounds of household visits by the village midwives, who had short refresher courses before each round of visits. The beginning of each round was coordinated with a visit by a mobile unit of the Expanded Program for Immunization, which provided immunization for DPT and poliomyelitis.

THE DATA SOURCE

In order to assess the impact of the four interventions introduced through the project, both baseline and postintervention sample surveys were carried out. The baseline survey was conducted during October and November 1980, some three months before the introduction of services at the village level. The postintervention survey was carried out 10 months after the initiation of services and about one year after the baseline survey. In both surveys, eligible women aged 15-49 were drawn from random samples of housing units in the project area. A total of 2,112 women in the baseline survey and 2,420 women in the follow-up survey were interviewed.

Generally, the baseline questionnaire contained the following sections: background socioeconomic and demographic variables; variables on diarrheal episodes and treatment among young children; variables on breastfeeding attitudes and

practices, antenatal care, and vaccination status; and variables on contraceptive knowledge and use. The follow-up questionnaire was similar to that for the baseline survey except that it included detailed questions on oral rehydration therapy and other specific interventions introduced through the project.

The coding, initial cleaning, and punching of the data were carried out in Khartoum. Further data cleaning and subsequent analysis were carried out using the computer facilities at the Center for Population and Family Health, Columbia University.

The immediate objective of this paper is to measure the impact of the project on contraceptive use among eligible women in the project area. Of particular interest will be the assessment of community-level correlates and developmental determinants of contraceptive behavior. The empirical findings will be buttressed by a simplified theoretical exposition incorporating both socioeconomic and project-related factors. The major goal will be to further our understanding of how latent forces in the community are activated to change motivations, attitudes, knowledge, and practice related to contraceptive behavior.

THE POPULATION

The total population served in the project villages is about 92,000, about two percent of the total rural population of the country and 20 percent of the rural population of Khartoum Province. Socially, economically, and demographically, this population is distinct from the urban population, which has undergone significant changes during the last three decades

(Farah and Preston, 1982).

Like most of Sudan's rural inhabitants and many of the Third World's rural poor, people in the project area suffer from basic problems of underdevelopment -- low levels of education and income and high levels of morbidity, mortality, and fertility. Culturally, the area is strongly patrilineal and patrilocal, with male dominance a marked feature. Extended families are the norm; households are often multigenerational, with numerous members. An individual's position in the society is determined more by the status inherent in membership in a particular family than by status acquired during the course of life. As a result, this is a decidedly conservative society, with individuals, especially females, largely content to accept the role and status assigned by their families and communities.

In the course of their lives, women are expected to fill the successive roles of daughter, wife, mother, and grandmother. Role expectations for these stages are distinctly defined by the community, and women conform to them carefully. Within this framework, marriage is virtually universal. Early in one's life, marriage is arranged by the family. Subsequently, marriages occur at relatively young ages, with age at marriage substantially lower for females than for males. According to the 1973 census, 43 percent of the women were married by ages 15-19, while only 29 percent of the men in that age-group were married (Department of Statistics, 1977).

Reproduction and childrearing are considered to be the main functions of women. Childbearing in turn gives them social

recognition and prestige, especially if they produce male children. The Arabic expression "Abu_Elbanat," "the father of daughters," is widely used as a derogatory description of fathers without sons. Sons are perceived to have more economic potential and, correspondingly , to provide security for their families (Farah and Preston, 1982; El-Deen, 1982).

The desired number of children is considerably high, and so is the actual number produced. The burden of rearing a large number of children is to some extent ameliorated by other members in the extended family. The perceived benefits and utilities derived from children often o ,weigh the perceived costs (El-Hamamsy, 1972), in part because many of the costs can be distributed among extended family members.

Some of the basic fertility-related characteristics of this population are shown in Table 1. The measure of fertility in this table is the cumulative number of live births as of the date of each survey. This increases monotonically with maternal age, and with a high degree of consistency across the two dates (1980 and 1981). The data do not show the decline of mean parity in the oldest age-group often caused by misreporting of age, or, more probably by recall lapses. Nevertheless, it does show that mean parity for women aged 45-49 is only barely above that for those aged 40-44, suggesting sizeble underreporting. Even so, women aged 45-49 reported an average of about 7.4 live births. This figure indicates a very high fertility rate compared with that for the nation as a whole, which showed a total fertility rate of 7.1 in 1973 (Farah, 1981).

With regard to contraceptive behavior, Table 1 also shows

that the percentage of women who ever used contraceptives increased from 22.1 percent to 28.5 percent, while the percentage of women currently using contraceptives increased from 10.6 percent to 13.9 percent. The age pattern of contraceptive use follows an inverted U-shaped curve, with a higher concentration of contraceptive use in the central age-range than in earlier or later age-ranges. Between the two surveys, the overall level of contraceptive behavior rose, and the modal point shifted. In 1981, the modal age-group was 30-34, while in 1980, the modal point for contraceptive use was in the age-group 25-29.

The contraceptive use rate in the project communities is considerably higher than the national average. In 1979, the percentage of ever-married women who had ever used any contraceptive method (modern or traditional) was 12 percent (Department of Statistics, 1979). In fact, the percentage of women who had ever used contraceptives as of the postintervention survey (28.5 percent) is slightly higher than that in the urban sector in Sudan in 1979 (27.5 percent), and slightly lower than that in the Khartoum metropolitan area (32 percent).

Given the traditional characteristics of the population in the project area, we think that the initial phase of the project had a substantial impact. More importantly, the project changed many unfavorable views and perceptions about family planning that were observed before the interventions. The proportion of women who were not practicing contraception because they believed that it was against their religion or that it was harmful fell from approximately 21 percent prior to the project to 10 percent

afterward. This was true both among those who had never attended school and among those who had. The data also indicate declines in the proportions of women reporting that contraceptive use was not possible because their husbands or their families forbade it.

THE THEORETICAL FRAMEWORK

The generalization that traditional societies produce strong motivations for high fertility and low contraceptive utilization is supported by a body of cross-cultural data drawn primarily from KAP-type surveys. The arguments and controversies along this line have led many researchers, in attempts to explain how the fertility transition may occur in traditional societies, to propose a theoretical framework in which the characteristics of such societies come to bear on motivation and attitudes (Easterlin, 1974; Freedman, 1965; Caldwell and Caldwell, 1976). In the view of these authors, modernization factors must be introduced into the traditional setting to motivate parents to have fewer children. Modernization, in the form of higher education, increased urbanization, higher income, and better health, is assumed to influence fertility regulation through changes in attitudes, knowledge, and access to contraceptive methods.

However, socioeconomic development is an extended and painful process for many developing countries, and a body of counterevidence indicates that in spite of the immense long-range importance of development in generating the necessary conditions for a contraceptive revolution, the manner in which such services are provided can be highly significant. The Sudan experience is

that a community-based approach can have a direct and decided impact on contraceptive behavior. Community-based approaches that place great reliance on the utilization and development of appropriate local resources and put family planning services within a broader health and service delivery context can provide a much needed shortcut to achieving attitudes and behaviors characteristic of broader development.

Because such programs tend to contact subgroups selectively, changes occur unevenly in the population. Also, certain segments of the population are more interested than others and respond better to public programs. In the Sudan CBFHP, for example, the aggregrate increase in contraceptive prevalence was 3.3 percent, rising from 10.6 percent to 13.9 percent of eligible women in the project area. In one sense, this was substantial, in that the relative change was 31 percent, yet it was still an increase of only three percentage points. However, a careful look at which segments of the population were most responsive gives some measure of confidence that substantial achievement occurred. The Sudan CBFHP encompasses communities at various stages of development and may be assessed in these differential terms.

As has been stated earlier, in the project area there were unfavorable attitudes toward, little or no motivation for, and little access to the means of fertility regulation. In such a situation, the advent of a maternal-child health and family planning project can be assumed to have constituted a new external force that impinged on each of the theoretical determinants of contraceptive use.

The family planning component of the project included

information about the benefits of spacing children and, to a lesser extent, of having fewer children. It also disseminated information about specific methods of birth control and promoted acceptance and use of oral contraceptives at low cost. The health components of the project are hypothesized to have increased motivation for family planning by alerting women to possible improvement in the survival of their children to adulthood.

Multiple factors can be hypothesized to influence fertility behavior. Entwisle, Hermalin , and Mason (1982) identify three broad contextual factors: culture and ethnicity, the level of socioeconomic development, and the extent and vigor of organized family planning programs. The effects of these factors can be examined within different units of analysis. For example, the impact of socioeconomic factors and family planning programs on fertility and contraceptive use has been examined on both an areal and an individual level (Hermalin, 1975). Within a single cultural or ethnic group, other area-level variables, such as community location and the percentage of the population in an urban setting, have also been used (Freedman, 1974). As we propose to do here, different levels of aggregation have also been used in the same analysis (Duncan, 1964; Casterline, 1981; Entwisle et al., 1984). In this study, the factors that are hypothesized to influence contraceptive use can be placed in three general categories: individual-level, community-level, and project-related variables. A list of the variables in each category appears below.

(1) Individual Factors

- Demographic: woman's age, number of children ever born, number of deceased children, presence of children under five years of age.
- Socioeconomic: maternal and paternal education, husband's occupation, size of land holdings, presence of an indoor latrine, ownership of TV and/or radio.

(2) Community Factors

- Location: East or West bank of the Nile, proximity to a paved road.

(3) Project-Related Factors

- Health: vaccination practices, attitudes toward breastfeeding, use of foods and fluids for treatment of diarrhea in infants.
- Service Delivery: by midwife or others.

The selection of these variables is limited by the data available from the project baseline and posttest surveys. Many variables that are assumed to have direct relevance to contraceptive behavior are missing from the above list because we do not have information on them. For instance, the surveys did not include questions about the desired number of children or about the sex composition of living and deceased children, both of which are important in inferring the state of motivation a woman has as well as in distinguishing between spacers and controllers of fertility. Nevertheless, despite such omissions, the analysis includes a number of variables that have rarely if ever been examined in this context.

THE SAMPLES

The extent to which we can relate changes in contraceptive behavior to project interventions is of course dictated by the extent to which we can demonstrate that the two survey samples drawn before and after the project interventions do not differ significantly in their individual and community-level characteristics. Given that the two surveys utilized independent random samples, apparent trends could be due merely to sampling variation. Moreover, real increases in current contraceptive use could be tied not to project interventions but to mobility toward the east bank or other advantaged areas. Thus we must find whether the two samples are similarly distributed across characteristics thought to be relevant to contraceptive behavior. Of course, we are most concerned not with establishing that there are no differences at all between the two samples but rather with establishing that the differences that do exist do not account for the observed increase in the proportion of women currently using contraceptives. Table 2 presents the means of the variables hypothesized to have an effect on current contraceptive use and the significance level of the differences between them.

In comparing the preintervention and postintervention regression samples, the percentage living along the east bank of the Nile drops from 59 percent to 55 percent and the percentage living along paved roads drops from 45 percent to 41 percent respectively. While these differences are small, they are nevertheless significant, and they should make it more difficult to detect an increase in current contraceptive use after the project intervention, as contraceptive use is known to be higher

on the east bank than on the west and higher along paved roads than unpaved roads.

Similarly, there are slight but significant differences in the age distributions of the two samples. There is no difference, however, in the proportion of women in the age-group 25-34. This is reassuring given the relationship between age and current contraceptive use, in which current use is highest in the middle age-range and lowest in the youngest and oldest age-ranges. The two samples did not differ in terms of the number of children born alive or the number of deceased children. The preintervention sample has a higher proportion of respondents with one or more children under age five. This again may limit our ability to find an increase in current contraceptive use, since women with children under age five report higher levels of current use than do those with no children under five years of age.

Compared to the preintervention sample, the postintervention sample has a slightly higher proportion of women with an intermediate level of education, offset by a slightly lower level of women with an elementary education. Both of these groups report higher levels of current contraceptive use than do women with no education, among whom there is no difference between the two samples.

Husband's education differs across the two samples at the extreme ends of the distribution only. The preintervention sample has a slightly higher proportion of husbands with no education and a slightly lower proportion of husbands with a high

school education than does the postintervention sample. There are also slight differences in the distribution of husband's occupation. Neither husband's education nor husband's occupation emerged as a significant predictor of current contraceptive use before or after the project intervention. And while the differences in their distributions before and after the project are statistically significant, they do not appear to suggest that the two samples differ drastically in terms of the socioeconomic status of the respondents. There is no significant difference between samples in the average size of a family's land holdings.

The respondent's ownership of television and radio, another possible indicator of socioeconomic status, appears to be the only variable whose distribution in the two samples may be cause for concern. The percentage of respondents owning both a television and a radio increases from 13 percent prior to the project to 22 percent following the project. Ownership of these items is thought to be positively associated with current contraceptive use. However, because this was the only variable whose differences across samples were thought to relate to the increase in current contraceptive use, and as there are other variables in the model whose differences would lead us to expect a decline in current contraceptive use, no effort was made to remove any of these differences between the two samples prior to the regressions. Of course, the regressions themselves include certain controls within each survey, which helps give a clear comparative picture of relationships before and after the introduction of project services.

THE METHODOLOGY

Our analytical strategy is to use logistic regression to generate a number of equations that reflect the different levels of aggregation detailed earlier. Community-level variables, having the highest aggregative values with regard to the number of people affected by them, are thought to have a similar effect on all community members. They are defined here as those variables that have a common impact on an individual's behavior, if differences among individual traits are controlled for. Freedman (1974) reviewed various hypotheses pertaining to independent impacts of community-level characteristics on fertility-related variables apart from those of individual traits, and suggested types of analysis, interpretation, and data collection. On the basis of Freedman's discussion, we have used two ecological variables: east or west location of villages with regard to the Nile, and closeness or remoteness of villages to a paved road. The specification of community-level variables in this manner arises from our assumptions and concerns about the differential effects of either or both of them on the likelihood of contraceptive use. Location on the east bank is assumed to be positively associated with contraceptive use, since this area is more developed than the west bank in various socioeconomic aspects. With regard to proximity to a paved road, we assume that such a road provides greater access to and interaction with persons and institutions in the Khartoum metropolitan area and thereby heightens not only interest but also psychological readiness to act in accordance with new concepts about reproduction and family planning. For both the preintervention

and the postintervention data, our first equations will thus introduce these two community-level variables alone.

However, the analysis of the impact of community-level variables on contraceptive behavior is not of much value unless the effects of individual-level variables on that behavior are also considered. Therefore, for both the preintervention and the postintervention data, the second set of equations will contain both community and individual characteristics. The latter characteristics have been specified in the preceding list. They combine some demographic, economic, and social characteristics that are assumed to have an impact on contraceptive behavior through changing motivations, attitudes, and access to contraceptive means. In addition, these two equations include two project-related variables pertaining to health attitudes and practices that have been encouraged by the project. Inclusion of these variables in the analysis of contraceptive use will help determine the degree to which the various components of an integrated system of health and family planning can function in a compatible and complementary fashion.

A third project-induced variable concerns the information drawn from a posttest question on the source of knowledge and contraceptive supply for ever-users and current users. The project has channeled this service through the village midwives. The testable hypothesis here concerns whether or not those women who were approached by a project midwife were significantly more likely than those who were not to practice contraception. This last variable will be introduced in a third and final equation

from the postintervention data.

We are most interested in an analysis of the relative effect of each variable described above on contraceptive behavior in the presence of other competing variables. Such an analysis would typically require a multiple regression approach, but our ability to do this is complicated by the fact that in our model, contraceptive use is a dichotomcus dependent variable, with a zero representing women who do not currently use contraceptives and a one representing women who do.

As is now well known, binary dependent variables are not efficiently estimated by ordinary least squares regression (OLS), particularly when the distribution of the dependent variable is as unbalanced as ours is. To estimate current contraceptive use, we chose instead to utilize logistic regression, in which the dependent variable is transformed into the natural logarithm of the odds of falling into the category of users rather than nonusers. (A more detailed examination of the problems encountered in the use of OLS and a description of logistic regression as the solution to these problems appear in the Appendix.)

Logistic regression generates Maximum Likelihood Estimates of the effect of various exogeneous variables on contracepting. The coefficients obtained for the independent variables in the model estimate the additive effect of a unit increment in a given independent variable on the natural logarithm of the odds of being a current user as opposed to not being a current user. As such, these estimates are not thought to be readily interpretable. However, they can be transformed to reflect

instead the extent to which a unit change in an independent variable multiplies the likelihood of contracepting (or, for dummy variables, the extent to which membership in one category multiplies the likelihood of contracepting relative to membership in the reference category). The untransformed coefficients, their standard errors, and significance levels were estimated in a series of equations presented in Table 3. The transformed coefficients and their significance levels for the same equations are presented in Table 4. Both these tables present two predictive equations from the baseline survey and three from the postintervention survey.

In Table 4, Equation 1(a) from the baseline data, and Equation 2(a) from the postintervention data give the multiplying factors of two community-level variables (geographical location and type of road) on the likelihood of contracepting. For the location construct, living on the west bank of the Nile is the reference category, while location along an unpaved road is the reference category for the type of road construct.

Equation 1(b) from the baseline and Equation 2(b) from the posttest data give the multiplicative magnitudes of the effects on the likelihood of contracepting of both the community-level and the individual-level socioeconomic and demographic variables. The number of children a woman had borne and the number of her children who had died are continuous variables. The other individual-level variables are discrete, and their respective reference categories are footnoted in the table. In addition, these two equations contain two project-related indicator

variables concerning health attitudes and practices. The first indicates whether or not the respondent's children had been vaccinated, the second, whether or not the respondent felt that breastfeeding of diarrheal infants should be increased or continued. Equation 2(c) pertains only to the postintervention stage and includes an additional project-induced variable: contact with the village midwife.

In our analysis, comparisons will often be made between the coefficient for a given variable in one equation and the coefficient for the same variable in another equation. This is thought to be considerably more useful than simply comparing changes in the significance level of the given variable. Changes in significance can easily occur with little actual change in the coefficients themselves. The size of our samples allows us to use the t-statistic (detailed in Cohen, 1983), in which the difference between the two coefficients being tested is divided by the square root of the sum of the coefficients' variances. With this background established, we can begin to examine the results of the various predictive models.

THE COMMUNITY-LEVEL VARIABLES

As has been discussed, the community can have an effect on the contraceptive behavior of its individual members that is either independent of or related to the effects of individual socioeconomic and demographic traits. The community is thought to channel its influence on fertility regulation through intermediate effects on motivation and attitudes toward, and accessibility of, methods of contraception. Women who are

members of the relatively wealthier and better educated community on the east bank and or women who live near paved roads have more motivation toward and more access to means of contraception than do their counterparts on the west bank and those living near unpaved roads.

The coefficients of the two community variables estimated in Equation 1(a) prior to the project interventions indicate that location on the east bank and location along a paved road are both positively and significantly associated with contracepting. Women in villages on the east bank are 1.6 times as likely to contracept as are women in villages on the west bank, and women in villages on paved roads are nearly three times as likely to contracept as are women in villages along unpaved roads.

We are more interested, however, in the extent to which the community-level variables maintain their effect on contracepting when we also include numerous individual-level variables in the model. If community-level variables worked only through their effects on individual characteristics that in turn determined contraceptive use, we would expect inclusion of the individual-level variables to lessen the effect of the community-level variables. If, on the other hand, community-level variables had an independent impact on contracepting that could not be captured through inclusion of individual-level characteristics, we would expect the impact of the community constructs to remain when we control for individual-level characteristics.

It is interesting to note that these coefficients retain their levels of significance when the individual demographic and socioeconomic differences have been controlled for (Equation

1[b]). The magnitude of the effect of location on the east bank remains the same, while the magnitude of the effect of location along a paved road drops somewhat, so that in Equation 1(b), women living along a paved road are slightly less than twice as likely as women along unpaved roads to be currently contracepting. That these large differences persist between east and west banks and between paved and unpaved roads, even after the education of women, presence of a latrine, ownership of a television and radio, and reproductive behavior are controlled for, suggests that the differences in contraceptive behavior observed above are, in general, not attributable to differences in the distribution of these individual-level variables.

In Equation 2(a), which focuses on the community-level variables following the project interventions, only the effect of location along a paved road retains the magnitude and level of significance observed in the preintervention data. Inclusion of the individual-level variables in Equation 2(b) again does not significantly change the observed effects of the community-level variables. The effect of living on along the east bank is insignificant in both Equation 2(a) and Equation 2(b, and significantly different from the effect observed in Equation 1(b). This difference in the effects is thought to be due to the dramatic increase in contraceptive prevalence on the west bank and the comparatively slight increase on the east bank. In the initial stage, 13.1 percent of the women on the east bank reported current contraceptive use, compared with only 6.3 percent on the west bank. Following the project intervention,

14.8 percent of the women on the east bank reported current contraceptive use, compared with 12.3 percent on the west bank.

The project itself did not attempt to introduce any selectivity based on bank location in terms of training, supervision, or service delivery. The disappearance of the difference between the two banks is thus extraordinary, particularly given the heightened responsiveness to fertility regulation hypothesized for more economically privileged and educated women, such as those on the east bank. The difference in the effect of living on the east bank before and after the project suggests that the project intervention was less effective among precisely those women who were thought to be most inclined to contracept.

THE INDIVIDUAL-LEVEL VARIABLES

Woman's Age and Reproductive Behavior

Age was categorized into three groups: 15-24, 25-34, and 35-49, the last being treated as the reference category. This was done to accomodate the fact that the bivariate relationship between age and current contraceptive use was not linear. Rather, current contraceptive use was highest in the middle age-range and lowest in the younger and older age-groups, a common pattern. Nevertheless, age failed to make any significant contribution to the model and is not included in the regression tables . It is our hypothesis that the inability of woman's age to predict current contraceptive use was due to the fact that the model included three other variables pertaining to reproductive behavior.

The effects of reproductive behavior on current contraceptive use were estimated using the number of children born alive, the number of deceased children, and an indicator for the presence of one or more children under five years of age. Membership in the oldest age-group was of course positively and significantly related to the number of children ever born as well as the number of deceased children, and the opposite was true for women in the younger age-ranges. Also, younger women tended to have children under age five in the household, while older women did not.

The coefficients in the row for the number of live-born children are positive and significant in the columns for Equations 1(b) and 2(b): The likelihood of contracepting increases by a factor of 1.12 and 1.14, respectively, with a unit increase in the number of children born. In Equation 2(b), for example, the change from a childless state to having one child increases a woman's tendency to contracept by a factor of 1.14, to five children, by a factor of 1.93 (1.14^5), and to 10 children, by a factor of 3.71 (1.14^{10}).

Other things being equal, an increase in the number of children ever born pushes a woman toward fertility regulation. The extent to which this effect is counteracted by a unit increase in the number of deceased children has received a great deal of attention in the literature. Given that high fertility is a necessary response to high mortality, the decline of mortality becomes a necessary condition for a decline in fertility. In an earlier study in the Sudan, Farah and Preston (1981) found that in the Khartoum metropolitan area, the death of

a child in a family increases considerably the proportion of women wanting more children and reduces significantly the proportion using contraceptives.

Similarly, in the postintervention data, we find that an increase in the number of deceased children significantly reduces the likelihood of contracepting, in our case by a factor of .76. Although this effect is not significantly different from that observed in the preintervention data, its significance in the postintervention data suggests that child mortality is an important negative determinant of contraceptive use that persists in the presence of an active program and counteracts the positive effect of an increase in the number of children born. This in turn suggests the importance of integrating child health interventions with family planning programs.

This latter point is also supported by the fact that in Equation 1(b), the presence in the family of one or more children under five years of age positively and significantly increases the likelihood of current contraceptive use, by a factor of 1.7. The fact that this is not the case in the postintervention data is related to the fact that the vaccination intervention was aimed only at those respondents with children under five years of age. As a result, respondents with children under five are more likely to have been exposed to the other project interventions as well. Inclusion of the project-related variables in both Equation 2(b) and Equation 2(c) could thus be expected to wash out the effect of having children under five years of age in the household.

Maternal Education

Prior to the project interventions, the coefficients associated with different categories of maternal education demonstrate that the likelihood of using contraceptives rises with increasing level of education. As Equation 1(b) shows, compared to women with no education, those with at least some elementary schooling are more than one and a half times as likely to contracept and those with an intermediate education or more are three times as likely to contracept.

From the viewpoint of our theoretical framework, the channels through which a woman's education influences contraceptive behavior can be well documented. Increases in maternal education are thought to reduce child mortality (Caldwell, 1979; Preston, 1978) and thereby impinge on a woman's motivation to contracept by increasing the potential supply of children (Bourgeois-Pichat, 1979). Through its various effects on motivation for fertility regulation, and attitudes toward and knowledge of family planning techniques, maternal education is considered one of the most important factors influencing contraceptive behavior.

The coefficients observed for maternal education in the postintervention model (Equation 2[b]) are not significantly different from those observed prior to the project (Equation 1[b]). It is worth noting, however, that in the postintervention model, women with an intermediate education or more are not significantly more likely to contracept than are women with no education at all. The fact that the effect of an intermediate education after the project does not differ significantly from

the effect observed before the project prevents us from drawing any dramatic conclusions from the loss of significance observed in the postintervention model. However, the fact that the effect of an intermediate education does not differ across the intervention, coupled with the loss of significance in the postintervention model, does not confirm the hypothesis that highly educated women in the project area would be more predisposed to contraceptive use than women with no education at all.

Additional Socioeconomic Characteristics

In our initial analyses of the preintervention data, several socioeconomic variables hypothesized to affect current contraceptive use failed to make any significant contributions to our regression models. Both husband's occupation and husband's education were dropped from the model for failing to significantly improve the model chi-square. The same was true for the size of the respondent's family land holdings. These variables also failed to contribute statistically to the postintervention models and were excluded from the final analyses. The insignificance of the husband's education lacks an easily comprehended explanation. However, one tentative interpretation may be that husbands in general are quite uniform in their receptivity to the idea of family planning, and hence their educational differences do not discriminate among them.

Two socioeconomic variables emerged in the analysis of the preintervention data as significant predictors of current contraceptive use. The first concerned the presence of a latrine

in the respondent's household. In the project communities, this variable is clearly associated with economic well-being and the previously described predispositions toward contraceptive use that such well-being engenders. Respondents with latrines in their houses were nearly twice as likely to be current contraceptive users as were respondents without them in both the preintervention and the postintervention models. This suggests that in addition to maternal education, other characteristics associated with increasing levels of development continue to impinge as described above on the readiness of community members to accept modern methods of contraception. The second variable associated with socioeconomic status that was significantly related to current contraceptive use was the respondent's ownership of both a television and a radio. In our initial models, we also controlled for ownership of either a television or a radio, but found no differences in current contraceptive use between this group and those owning neither. In Equation 1(b), prior to the project interventions, we found that those owning both items were more than one and a half times as likely to be currently contracepting as were those with one of them or neither.

In addition to confirming the important effect of socioeconomic characteristics on fertility regulation, this result probably reflects the paramount effect of mass media on widening the general awareness of women and thereby freeing them from traditional cultural values. As Caldwell (1967) suggests, the spread and growth of mass media items reflect the breaking

down of cultural barriers and the diffusion of universal fertility norms. This in turn tends to enhance parental attitudes toward fertility regulation and actual methods of contraception.

However, the postintervention model indicates that following the project, this effect dissappeared entirely. We draw this conclusion both because in Equation 2(b), ownership of these items is insignificant and because the postintervention effect, or lack thereof, is significantly different from that observed in the preintervention model (Equation 1[b]). We are cautioned by the fact that the proportion of respondents owning both a television and a radio was significantly higher after the project than before and that there may have been smaller differences between those who do not own both and those who do. Nevertheless, the findings do not appear to support the hypothesis that those who are receptive to external sources of information would be most receptive to the new ideas and services provided by the project. We may perhaps have found precisely the opposite -- that the project was more successful in reaching those who had been hypothesized to be less predisposed to the project interventions.

THE PROJECT-RELATED VARIABLES

Two variables related to the project itself were included in both Equation 1(b) from before the introduction of services and Equation 2(b) from after the introduction. These variables concerned vaccination of children under five years of age and women's attitudes toward breastfeeding diarrheal children. The

third project variable, an indicator for the village midwives being the source of family planning knowledge and services, is included only in the final postintervention model (Equation 2[c]). This variable could not be included in the pre-intervention model for the simple reason that the village midwife did not function in that capacity prior to the project.

In the preintervention model, Equation 1(b), neither the vaccination of children under five nor the belief that diarrheal children should receive continued or increased breastfeeding was significantly related to current contraceptive use. Both could have been dropped from the model without adversely affecting the model's ability to estimate current contraceptive use. Nevertheless, because the project interventions would focus on these variables in addition to family planning services, they were included in the analysis.

In Equation 2(b), we found that both the vaccination of children under five years of age and the belief that breastfeeding of diarrheal children should be increased or continued were significantly related to current contraceptive use. Those with vaccinated children were nearly twice as likely to currently contracept as were those with unvaccinated children, and those who felt that breastfeeding should be increased or continued were slightly less than one and a half times as likely to contracept as were those who did not. While the effect of the vaccination variable is not significantly different from that observed prior to the project, the effect of the breastfeeding attitudes variable is. The significant and positive relationship between these variables and current contraceptive use, coupled

with the significant shift in the relationship between breastfeeding attitudes and current use, indicates to us that the project was able to develop consistent attitudes and behavior among the community women concerning child health and fertility regulation.

In Equation 2(c), we introduce the project-induced variable indicating that the village midwife was the source of the respondent's family planning knowledge and supplies. This equation also controls for all the variables appearing in Equation 2(b). Those respondents who used the village midwife to obtain family planning knowledge and services were 1.7 times as likely to be currently contracepting as were those who did not. Inclusion of this variable in Equation 2(c) did not significantly alter any of the coefficients obtained in Equation 2(b). It is worth noting that although the effect of breastfeeding attitudes on current contraceptive use in the latter equation is no longer significant, it remains significantly different from the effect observed prior to the project intervention in Equation 1(b), primarily because of the shift in the direction of the relationship. As was the case with the presence of children under five years of age, this variable's loss of significance in Equation 2(c) is thought to be related to the fact that in addition to providing family planning knowledge and services, the midwives were heavily involved in promoting both vaccination practices and breastfeeding of diarrheal infants. We thus would expect inclusion of the variable concerning use of the village midwife's family planning services to slightly reduce the effects

of the remaining two variables concerning vaccination practices and breastfeeding attitudes.

The significance and magnitude of the effect that contact with the village midwife had on the likelihood of currently contracepting indicates that the project was highly successful in using village midwives to promote contraceptive use in their communities. The effect of vaccination practices and the shift in the effect of breastfeeding attitudes indicate further that the midwives were capable of promoting child health practices and attitudes consistent with those entailed in fertility regulation. It is our hypothesis that women who were stimulated by the project to take additional steps regarding the health of their children were also more likely to be innovative regarding fertility regulation.

The comparative analysis of the role of the project-related factors with that of the development-related factors demonstrates that the community-based project, with its low-cost, multiphasic approach, has had a significant impact on the contraceptive behavior of the target population. This finding does not mean that development-related factors are unimportant in determining contraceptive use. Nevertheless, their role in this regard is considerably more costly, in terms of capital investment and time, than the role of integrated health and family planning programs initiated at the community level. Clearly, such programs can contribute in the short run, while the effects of development-related factors appear more slowly.

CONCLUSIONS

This analysis is primarily an attempt to assess the effect of the Sudan Community-Based Family Health Project on the contraceptive behavior of women living in villages in the rural part of Khartoum Province. The project recruited government-trained village midwives and provided them with appropriate additional training and supervision to deliver health and family planning information and services to the community. The midwives introduced the program in three rounds of household visits, during which they provided education and services to mothers in their respective communities. Data for this analysis were obtained from surveys conducted before and after the project interventions. The overall proportion currently contracepting increased during eight months from 10.6 percent to 13.9 percent, and the proportion who ever used contraceptives rose from 22 percent to 28.5 percent, with greater increases in certain subgroups.

To examine factors assumed to have differential impact on current contraceptive use, we employed logistic regression with current use as the dichotomous dependent variable. The independent variables included community and individual-level characteristics as well as three project-related variables. The findings were as follows:

First, prior to the project intervention, the community-level variables (bank location and proximity to a paved road) retained their strength and significance even when we controlled for individual demographic and socioeconomic characteristics. Following the project interventions, the effect of village

location along a paved road remained unchanged, while the effect of location on the east bank significantly declined. We hypothesized that loss of this effect was due to a reduction in the difference between the proportions of women currently contracepting on the two banks. This reduction was thought to contradict hypotheses that the more advantaged women on the east bank would be more predisposed to accepting the information and services provided by the project and indicated that the project was successful in reaching a remote and relatively disadvantaged population.

Second, we found in the postintervention equations that the positive effect of family size on current contraceptive use was counteracted by the negative effect of child mortality, and we concluded that this finding offered additional support for integrating family planning services with maternal and child health interventions.

Third, individual-level variables concerning fertility behavior, and socioeconomic variables such as maternal education, presence of an indoor latrine, and ownership of television and radio, were found to be significant predictors of current contraceptive use prior to the project interventions. Variables such as woman's age, husband's education and occupation, and the size of family land holdings failed to significantly predict current contraceptive use and were dropped from the analyses. In comparing the coefficients obtained for the individual-level variables prior to the project intervention (Equation 1[b]) with those obtained afterward (Equation 2[b]), only the effect of

owning both a television and a radio differed significantly. Cautioned by changes in the proportion of respondents owning these items, we hypothesized that loss of this effect following the intervention failed to confirm the hypothesis that those with access to the mass media would have more modern attitudes that might predispose them to contraceptive use.

Fourth, project-related variables concerning vaccination practices and breastfeeding attitudes were not found to affect current contraceptive use significantly prior to the project interventions. Following the project, in Equation 2(b), both these variables were significantly and positively associated with current contraceptive use, although only the effect of the variable concerning breastfeeding diarrheal children was significantly different from that observed prior to the interventions. Inclusion of the project-induced variable concerning use of the village midwives' family planning knowledge and services (Equation 2[c]) indicated that the midwives played as important a role in promoting current contraceptive use as did any of the other variables included in the model. Additionally, we concluded that the project was successful in promoting health attitudes and practices that were consistent with the need to regulate fertility.

Finally, the overall question at hand involves the extent to which low-cost community-based project interventions in maternal-child health and family planning can be effective in communities characterized by low levels of development and little access to education, employment, medical care, and large metropolitan areas. Our data suggest that while the overall increase in

current contraceptive use certainly rests upon the present state of developmental variables, project interventions can significantly increase the likelihood of current contraceptive use in these communities, even among those subgroups of the population considered to be the least predisposed to fertility regulation.

APPENDIX

One of the most commonly cited problems in using ordinary least squares regression (OLS) to estimate binary dependent variables is that of heteroscedastic or nonconstant error variance (Goldberger, 1964; Swafford, 1980; Neter and Wasserman, 1974). These authors show that the variance of error terms will systematically differ with different levels of the independent variables, thus violating the OLS assumption of homoscedastic error terms. As a result, OLS generates estimates with non-minimum variance and thus the efficiency of these estimates, or rather the ease with which we can accept their significance, is threatened.

However, this violation's threat to OLS has recently been minimized. Large sample sizes and/or a mean response, between 0.2 and 0.8 are thought to keep efficiency losses from OLS estimation small. This, however, offers us little reassurance, since the mean response of our dependent variable, current contraceptive use, is considerably below 0.2. Goldberger (1964) and Neter and Wasserman (1974) also point out that rather than abandoning OLS for this reason, the two-stage weighted least squares approach will successfully address the problem. Swafford (1980) also proposes the Grizzle, Starner, and Koch approach as a solution. While these solutions decrease the standard deviations of the estimates and thus improve their efficiency, as Hanushek and Jackson (1977) note, they "treat the central problem of estimation as the efficiency of the parameter estimates".

Numerous authors (Hanushek and Jackson, 1977; Neter and Wasserman, 1974; Nerlove and Wilson 1973), however, note that in fact the initial specification of a linear model itself may generally be incorrect. Both theoretical and empirical evidence suggest "that when the dependent variable is an indicator variable, the shape of the response function will frequently be curvilinear" (Neter and Wasserman, 1974). More specifically, given the constraint that the dependent variable is limited to 0 and 1, nonlinear functions approximating the general S-shape are usually more appropriate. This is to say simply that changes in probability at one extreme or the other require greater changes in the independent variable than changes in probability around the midpoint. If in fact the relationship between the independent and dependent variables is S-shaped, the OLS parameters will be highly sensitive to the distributions of the independent variables.

Use of a linear model also fails to constrain predicted values of the dependent variable between 0 and 1. This can be both embarassing and problematic; embarassing in that predicted values beyond 0 or 1 are conceptually impossible; problematic in that as Hanushek and Jackson (1977) note, the estimated error variance $[Y_i(1-Y_i)]$ is then negative.

Swafford (1980) argues that this problem is easily overestimated and that in practice linear probability modeling seldom produces out-of-range predictions. Nevertheless, Hanushek and Jackson (1977) note a common example in which this occurs,

and, in addition, the mean level of our dependent variable makes such predictions considerably more likely.

Given these considerations, numerous authors agree that the most attractive alternative to OLS is the use of a logit model, in which the dependent variable is transformed into the natural logarithm of the odds of being in one outcome as opposed to the other. Use of this technique, referred to as logistic regression, provides maximum likelihood estimates that fit independent variables to the S-shaped logistic response function. Contrary to the opinion of Swafford (1980), logistic regression can be used with both categorical and continuous independent variables (Hanushek and Jackson, 1977; Smith and Cheung, 1981) and in this regard operates with no other constraints than those that apply to OLS. Additionally, the logit of the dependent variable is a linear function of the exogenous variables, and while the logit is unlimited in range, the estimated probabilities are bounded by 0 and 1 (Hanushek and Jackson, 1977). Thus, logistic regression and the Maximum Likelihood Estimates it generates successfully address the problems encountered in using OLS. It is considered to be more robust than discriminant function models in the face of nonnormal independent variables (Press and Wilson, 1978), and given a model in which one variable is considered to be dependent on the others, logistic regression is generally thought to be preferrable over the usual and more complicated log-linear models (Goodman, 1970; Swafford, 1980).

The functional form underlying the logit model we intend to

use is presented by the following:

$$P = 1/(1-e^{-XB})$$

where P equals the probability that a woman currently contracepts, X is the vector of independent variables, and B is the vector of estimated coefficients.

This distribution ranges from 0 to 1 as XB goes from - to + infinity. Estimation of this probability is achieved through estimating the natural logarithm of the odds ratio, represented as Log [P/(1-P)]. Coefficients generated by logistic regression relate independent variables to the log of the odds ratio in the following manner:

$$\text{Log } [P/(1-P)] = (B_0 + B_1X_{1i} + B_2X_{2i} + \ldots + B_jX_{ji})$$

where X_{1i} = value of the first variable for woman i

X_{ji} = value of the j^{th} variable for woman i

B_0, B_1, B_2, B_j = maximum likelihood coefficients of the independent variables.

The value of B1 is the maximum likelihood estimate of the additive effect of a unit increment in variable X_1 on the log of the odds of being a current user as opposed to not being a current user (or, for dummy variables, the estimate of membership in a category relative to being in the reference category). These coefficients, however, are only interpretable as additive effects on the logit of contraceptive behavior. To avoid discussing exogenous effects on the logit of contracepting, it is

worth noting that the previous equation can be transformed by taking the antilog of both sides. This yields the following:

$$[P/(1-P)] = B_0 * B_1X_{1i} * B_2X_{2i} * \ldots * B_jX_{ji}$$

These estimates reflect the extent to which a unit change in an independent variable multiplies the likelihood of contracepting. In the case of independent dummy variables, these estimates reflect the extent to which membership in one category multiplies the likelihood of contracepting in comparison to membership in the reference category. As these coefficients are estimates of the multiplicative effect of an independent variable on the dependent variable, the reader should note that a coefficient of 1.0 represents no effect at all, while coefficients less than one represent a negative effect and coefficients greater than one represent a positive effect.

Table 1. Mean of Children Ever Born, Percentage of Women Who Ever Used Contraceptives, and Percentage of Women Currently Using Contraceptives by Age-Group at Time of Pre and Postintervention Surveys.

	Preintervention (1980)			Postintervention (1981)		
Age-Group	Mean Parity	Ever-Use	Current Use	Mean Parity	Ever-Use	Current Use
15-19	1.439	12.4	04.7	1.845	10.1	07.5
20-24	2.415	22.6	12.1	2.418	28.4	13.9
25-29	3.881	26.8	13.3	2.583	33.6	15.0
30-34	5.660	25.0	12.8	5.178	38.3	20.5
35-39	6.651	25.3	10.3	6.681	28.3	12.5
40-44	7.348	19.9	11.5	7.349	29.4	14.6
45-49	7.357	08.3	02.5	7.445	12.6	06.6
Average	4.576	22.1	10.6	4.433	28.5	13.9

Table 2. Means and Proportions of Selected Variables.

Variable	Preintervention (N=1,677)	Postintervention (N=1,438)	Significance of Difference
East Bank	.592	.554	<.05
West Bank	.408	.446	
Paved Road	.448	.412	<.05
Unpaved Road	.552	.588	
Age of Mother	30.7	31.5	<.05
15-24	.256	.225	<.05
25-34	.357	.350	NS
35+	.388	.425	<.05
Live-Born Children	4.85	4.71	NS
Deceased Children	.471	.471	NS
One or More Children Under 5	.720	.634	<.001
No Children Under 5	.280	.366	
Woman's Education			
Never Attended School	.574	.589	NS
Preschool or Elementary	.382	.347	<.05
Intermediate or more	.045	.064	<.05
Husband's Education			
Never Attended School	.389	.324	<.001
Preschool or Elementary	.439	.465	NS
Intermediate	.113	.120	NS
High School or more	.060	.090	<.01
Husband's Occupation			
Farmer/Shepherd	.329	.386	<.001
Merchant	.094	.134	<.001
Laborer	.367	.296	<.001
Govt. Employee	.088	.091	NS
Other/Retired/Unknown	.123	.093	<.01
Ownership of Land	.490	.582	NS
Ownership of TV & Radio			
TV or radio	.541	.560	NS
TV and radio	.133	.223	<.001
No TV or Radio	.326	.216	<.001
Vaccinated Children	.127	.380	<.001
No Vaccinated Children	.873	.620	
Breastfeed diarrheal child	.152	.266	<.001
Midwife Source of Information	NA	.625	<.001
Current Contraceptive Use	.104	.133	<.05

Note: NS= not significant
NA= not applicable

Table 3. Maximum Likelihood Coefficients of Explanatory Variables Derived from the Pre and Postintervention Surveys (Standard Errors in Parentheses).

Variable	Preintervention (N=1,677)		Postintervention (N=1,438)		
	Equation 1(a)	Equation 1(b)	Equation 2(a)	Equation 2(b)	Equation 2(c)
East Bank[1]	.484** (.197)	.459** (.202)	-.071 (.172)	-.006 (.177)	.003 (.177)
Paved Road[2]	.987* (.184)	.620* (.202)	.647* (.170)	.542* (.185)	.608* (.186)
Live-Born Children		.117* (.035)		.129* (.035)	.122* (.035)
Deceased Children		-.130 (.122)		-.275** (.128)	-.269** (.128)
One or More Children Under Five[3]		.542** (.230		.215 (.231)	.157 (.233)
Woman's Education[4]					
Preschool or Elementary		.501** (.196)		.476** (.190)	.469** (.191)
Intermediate or more		1.116* (.360)		.584 (.347)	.651 (.350)
Presence of Indoor Latrine[5]		.577* (.216)		.566* (.213)	.559* (.214)
Ownership of TV & Radio[6]		.522** (.207)		-.008 (.195)	.034 (.196)
Vaccinated Children[7]		.376 (.213)		.615* (.201)	.535* (.204)
Breastfeed Diarrheal Child[8]		-.283 (.271)		.344** (.178)	.310 (.179)
Midwife Source of Information[9]					.547* (.190)
Intercept	-3.036 (.177)	-4.573 (.349)	-2.138 (.131)	-3.802 (.316)	-4.093 (.336)
Model Chi-Square	54.71	123.26	15.95	73.11	81.80
Degrees of Freedom	2	11	2	11	12

*p<.01

**p<.05.

Respective reference groups of the variables footnoted are as follows:

1. Living on the west bank.
2. Living on an unpaved road.
3. No children under five.
4. Never attended school.
5. No latrine in the house.
6. Not owning both a TV and a radio.
7. No vaccinated children.
8. Decreasing or stopping breastmilk.
9. Midwife did not discuss family planning.

Table 4. Multiplying Factors of Explanatory Variables Derived from Maximum Likelihood Coefficients.

Variable	Preintervention (N=1,677)		Postintervention (N=1,438)		
	Equation 1(a)	Equation 1(b)	Equation 2(a)	Equation 2(b)	Equation 2(c)
East Bank[1]	1.622**	1.583**	.931	.994	1.003
Paved Road[2]	2.684*	1.859*	1.910*	1.720*	1.837*
Live-Born Children		1.124*		1.138*	1.129*
Deceased Children		.878		.760**	.764**
One or More Children Under Five[3]		1.719**		1.240	1.170
Woman's Education[4]					
Preschool or Elementary		1.650**		1.610**	1.599**
Intermediate or more		3.054*		1.793	1.917
Presence of Indoor Latrine[5]		1.780*		1.760*	1.749*
Ownership of TV & Radio[6]		1.685**		.992	1.035
Vaccinated Children[7]		1.456		1.850*	1.707*
Breastfeed Diarrheal Child[8]		.754		1.410**	1.363
Midwife Source of Information[9]					1.727*
Intercept	0.048	0.103	0.119	.022	.017
Model Chi-Square	54.71	123.26	15.95	73.11	81.80
Degrees of Freedom	2	11	2	11	12

*p<.01.

**p<.05.

Respective reference groups of the variables footnoted are as follows:

1. Living on the west bank.
2. Living on an unpaved road.
3. No children under five.
4. Never attended school.
5. No latrine in the house.
6. Not owning both a TV and a radio.
7. No vaccinated children.
8. Decreasing or stopping breastmilk.
9. Midwife did not discuss family planning.

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