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A Multi-Level Framework for the Adoption of Modern Contraceptive Use in Tanzania: An Evaluation of Mass Media Communication Programs

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Abstract

Drawing on communication theory, this study evaluates the effects of mass media on the adoption of modern contraception in Tanzania using a multilevel modeling framework. This framework simultaneously examines individual- and community-level effects on the adoption of modern contraception, based on the premise that individuals make decisions about family planning within the social context in which they live. Evaluating the effects of mass media using a multilevel framework allows us to test both the direct effects of mass media on listeners and viewers, as well as the indirect effects via their community-level exposure. We examine how the contextual influences (in the form of community attitudes toward family planning, access to health services, and women's participation in the community) and the processes of diffusion (in the form of community exposure to mass media campaigns) influence adoption of modern contraception. This study uses the 1999 Tanzania Reproductive and Child Health Survey; a nationally representative survey conducted among 4,029 women aged 15-49. Community-level characteristics were collected from a concurrent survey of village leaders. The results from the multilevel models support the hypothesis that health communication efforts can promote family planning knowledge, acceptability and use both through direct exposure and through community-level influences.

A Multi-Level Framework for the Adoption of Modern Contraceptive Use in Tanzania: An Evaluation of Mass Media Communication Programs

Background

A substantial body of evidence indicates that mass media communication activities are effective in altering and improving not just health knowledge and awareness but also health behaviors and outcomes (Kincaid 2000a and 2000b, Valente and Saba 1998, Rogers 1995). In particular, considerable evidence exists for the effectiveness of mass media in informing and creating awareness about family planning methods and availability, entertaining populations and establishing influential role models, and promoting specific behaviors, such as the use of condoms or permanent sterilization methods (Bertrand and Kincaid, 1996; Piotrow et al 1997, Rogers 1995, Montgomery and Casterline 1996).

Numerous theories have been developed to explain the processes by which communication programs influence individuals and societies and ultimately lead to changes in specific behaviors, including the adoption of family planning. A common ingredient in these theories is the idea that individuals are influenced not solely by the direct effects of mass media but also in part by the social context in which they live. For example, as posited by the theory of reasoned action, individuals may evaluate how adopting a new behavior that they have seen via mass media fits with their beliefs, social norms and perceptions about the social consequences of their actions (Fishbein and Azjen 1975). Alternatively, as per social cognitive (learning) theory, they may emulate characters they see in the media, reinforcing their actions by collecting "information and knowledge from others, through interpersonal networks and impersonal sources like mass media" (McNay et al 2002, p. 21, Bandura 1986).

Numerous theories of fertility change have focused on the processes by which new ideas, beliefs and knowledge diffuse through populations, aided by mass media, to foster reductions in completed fertility (Rogers 1995, Valente 1995, Bongaarts and Watkins 1996). Nearly all of these theories focus on "social change in which attitudes and behaviors have become more prevalent in a population through their spread from some individuals to others through informal face-to-face social interaction or at a distance through the mass media" (Casterline 2001 p. 2-3). More recent diffusion theories of fertility change have sought to marry both social learning theory and social network theory,

emphasizing intermediate steps, or ideational factors, by which individuals move through various stages on their way to behavioral change (Piotrow et al 1997, Kincaid 2000a). Fertility change is thus attributed "to the diffusion of new ideas, new behavior, and new technology," emphasizing "the importance of communication in stimulating behavior change – communication via mass media, community activities, and interpersonal discussion that introduces individuals and communities to new ideas and opportunities. As a result, what was previously unknown becomes familiar, and what was previously taboo can become a community norm" (Piotrow et al, 1997, p. 4).

Taking as its basis the key component of the above theories - that individual-level outcomes are shaped by higher-level social and structural factors - this study evaluates the effects of mass media and other health communication activities on the adoption of modern contraception and on other family-planning related indicators in Tanzania using a multilevel framework. Multilevel models are utilized to address issues surrounding hierarchical data, that is, lower-level observations, such as individuals, nested within multiple higher-level observations such as groups, villages, communities, or higher level geographical units (Kreft and De Leeuw 1998, Goldstein 2003). Multilevel models also allow for the simultaneous examination of individual-level and higher-level factors, and their interactions, on individual-level outcomes. "Just as studies examining differences between groups may need to take into account possible differences in group composition (i.e. characteristics of the individuals within them), studies of individuals may need to take into account differences in the properties of the groups to which individuals belong" (Diez-Roux 2000).

Multilevel models have two principal strengths for analyses of family planning: (1) when suitable data are available, multilevel models can incorporate a fuller set of covariates reflecting the different levels of influence on individuals and their decision-making, including in this study, explanatory variables related to individual and group exposure to mass media; and (2) when data are collected using multistage sample designs, multilevel models allow for more complex error variance structures that address correlated observations within and across groups.

Within the literature on the evaluation of family planning programs, a substantial body of evidence indicates the importance of higher level influences on individual-level knowledge,

attitudes, norms, and behaviors. Many of the theoretical influences on contraceptive uptake have clear higher-level constructs – norms related to ideal family size, observed benefits of reduced family size, knowledge transmission, availability of family planning services, etc. Several recent studies have examined fertility and contraceptive use within a multilevel framework, focusing, for example, on aggregate-level effects of education on fertility (Kravdal 2000, McNay et al 2003), finding that less educated women in communities with higher proportions of educated woman benefit from spillover effects from the more educated women, or on aggregate norms related to women's autonomy (Moursand and Kravdal 2003). Other researchers have used multilevel models to measure the effects of economic development and levels of female education on condom use (Ukwuani, Tsui and Suchindran 2003). Still others have examined the effects of higher level structural factors such service availability on the use of family planning services or health services in general (Guilkey and Cochrane 1995; Guilkey and Jayne 1997, Chen and Guilkey 2002, Akin et al 1998),

The use of multilevel models has grown as different disciplines have expanded their theories and evidence bases to incorporate contextual factors reflecting influences at more than just the micro or the macro level. Multilevel models have been used to explain a wide variety of phenomena in many disciplines, including epidemiology (Diez-Roux 2004), demography (Entwisle and Mason 1985, Casterline 1985), education (Goldstein 1987, Bryk and Raudenbush 1988, 1992) and criminology (O'Campo 2003, Diez-Roux 2003). In health, multilevel models have been used to test neighborhood effects on health outcomes and behaviors, including mortality (Kawachi and Berkman 2003) and smoking (Duncan, Jones and Moon 1999).

The use of multilevel models has also grown as statistical computing power has increased. New statistical methods based on simulated maximum likelihood procedures have allowed for solving higher level integrals and therefore an expansion of the problems that can be evaluated numerically (Goldstein 2003, Bryk and Raudenbush 1992). These methods have received increasing scrutiny, including the evaluation of the properties of multilevel estimators under a variety of circumstances (Angeles, Guilkey and Mroz 2002; Blalock 1984).

For our study, the use of a multilevel framework allows us to model the effects of community-level contextual influences – and more specifically the influence of mass media measured via community-level constructs – on individual-level perceptions, knowledge and decision-making. Borrowing from communication theory related to innovation diffusion, as well as social learning and social influence, we seek to distinguish compositional effects – those related to the characteristics of the individuals and households living within communities – from these contextual effects – those related to the social and infrastructural characteristics of the communities themselves – that may influence individual-level knowledge and decision-making.

We focus on several types of contextual community-level factors, including the cumulative effects of group-level exposure to mass media and the potential diffusion of family planning mechanisms through informal channels, the availability and quality of health services, the level of socioeconomic development of the community, and the level of educational attainment. Our primary hypothesis is that mass media family planning efforts have effects on knowledge, attitudes, and behavior beyond those associated with direct exposure to communication programs—the pervasiveness of a program at the community level will have effects on individual outcomes through secondary pathways, for example, by influencing community attitudes and norms. As a result, even women who may not be directly exposed to mass media communication messages can benefit from living in communities where a higher proportion of the women are in fact exposed to mass media. Absent a multilevel focus, analyses focusing solely on individual-level exposure to mass media may in fact substantially underestimate the effect of mass media on individual-level outcomes.

Our motivation for using a multilevel framework is not limited solely to an evaluation of the multiple contextual levels at which we hypothesize relationships to exist but is also necessitated by the multi-stage sampling design used in the collection of the data. Respondents are located within randomly selected households, which have been chosen from among randomly selected clusters so as to be representative of the population of Tanzania. It is the grouping of households within clusters – census enumeration areas in this case – that prohibits assuming non-independence of responses within those clusters and that requires modeling of the level of intra-cluster correlation in within cluster characteristics (Hox 1999, Goldstein 2003). The recognition of non-independence of observations within

clustered groups in multistage sample designs is commonplace, that is like-minded and like-acting individuals often live in close proximity. That these same individuals within groups actively interact and exchange information, information gained from mass media and other sources, is the focus of this analysis.

Demographic and Health Surveys often include questions on exposure to mass media, occasionally including specific health promotion and behavior change campaigns, or specific modes of communication. Numerous studies have made use of this type of information to examine the link between exposure to mass media and health behaviors and health outcomes, including condom use, family planning, attitudes (will add citations). However, the vast majority of these studies have examined only the direct effect of exposure on individual-level outcomes, ignoring the indirect effects of contextual factors that are also likely to influence outcomes.

Tanzania background

In Tanzania, communication campaigns have long been used as a strategy for increasing knowledge about Family Planning (FP) and HIV/AIDS and promoting behavior change. In 1992 the Tanzanian government adopted a national population policy, after which several reproductive health projects—many of which included communication programs—were implemented (Jato et al 1999, Meekers and Silva 2003, Rogers et al 1999). From 1991 to 1994, the MOH implemented the Tanzanian Family Planning Communication Project, which contained a large communication component that included: radio spots, a radio serial drama *(Zinduka!)*[1], Green Star logo promotional activities[2], posters, leaflets, newspapers, and audiocassettes (Jato et al 1999). Other communication programs included: since 1993 a radio drama called *Twende na Wakati* (*TNW)* (Rogers et. al 1999), since 1992 the social marketing of the Salama condom brand by Population Services International (PSI) (http://www.psi.org), in 1993 and 1994 the airing of two radio dramas, one targeting youth (*Umkatae*) and one targeting men (*Haki za Uzazi*) (Jato et al 1999). More recently radio

[1] *Zinduka!* was produced by the MOH in collaboration with the Johns Hopkins University Population Communication Services and focused on the promotion of FP and positive attitudes toward women (The Communication Initiative, 2001).

[2] The Green Star logo promotional activities had as an objective to promote family planning services (National Bureau of Statistics [Tanzania] and Macro International Inc., 2000).

programs that transmit messages about FP and HIV/AIDS have been produced and aired including *Ukimwi Kifo*, *Sema Naye*, *Geuza Mwendo*, and *Vijana Wetu* (National Bureau of Statistics [Tanzania] and Macro International Inc., 2000).

Communication programs in Tanzania have been extensively evaluated (Rogers et. al 1999, Vaughan et al 2000, Meekers and Silva 2003, Mohammed 2001, Jato et. al 1999, Vaughan and Rogers 2000, Vaughan and Rogers[forthcoming]). *Twende na Wakati* was evaluated by means of a quasi-experimental design with an experimental phase and a non-experimental phase—during the first phase, the program was broadcast in seven treatment areas and withheld from a comparison area (Rogers et. al 1999). National sample surveys, such as the Demographic and Health Surveys (DHS) and Knowledge, Attitudes and Practices (KAP) Surveys, have also been used to assess the effects of the communication programs on contraceptive use, discussion of FP, and condom use in Tanzania (Jato et al 1999, Meekers and Silva 2003).

Other studies have examined influences on contraceptive behaviors at multiple levels, though the focus has generally been on measuring the influence of service availability measures (Guilkey and Chen 2002; Ukwuani, Tsui and Suchindran 2003, Mroz et al 1999). To our knowledge, however, no study has attempted to model the influence of mass media on contraceptive behaviors in Tanzania through a multi-level framework.

Multilevel Statistical Analysis

Data

The data for this analysis come from the 1999 Tanzania Reproductive and Child Health Survey (TRCHS-99). The TRCHS-99 collected national level data on reproductive, maternal and child health as well as data on the availability of health services within communities. The survey was implemented by the Tanzanian National Bureau of Statistics and the Reproductive and Child Health Section of the Ministry of Health with technical assistance from Macro International Inc. (National Bureau of Statistics and Macro International Inc. 2000). Community level information (at the cluster level) was collected in 1999 by the MEASURE Evaluation Project at the Carolina Population Center (Ukwauani et al. 2003). The TRCHS-99 is the fourth national sample survey conducted in Tanzania—it is preceded

by the 1996 Tanzania Demographic and Health Survey, the 1994 Tanzania Knowledge, Attitudes and Practices Survey, and the 1991-2 Tanzania Demographic and Health Survey.

We use the sample of all women, regardless of marital or fecundity status.

Dependent Variables

To represent benchmarks in the stages of behavior change in the family planning adoption process, the present analysis considers three dependent variables: (1) knowledge of family planning methods, (2) approval of family planning, and (3) current use of modern family planning methods. Knowledge of family planning methods is a continuous variable ranging from 0 to 9 that captures spontaneous and prompted responses to questions regarding whether a respondent had heard of any of the following modern methods: male sterilization, female sterilization, the pill, intra-uterine device (IUD), injections, implants, condom, female condom, and diaphragm/foam/jelly. Approval of family planning is a dichotomous variable that captures the response to the following question: "Would you say that you approve or disapprove of couples using a method to avoid getting pregnant?" The third variable, use of modern family planning methods, is a dichotomous variable that captures whether the respondent is currently using a modern contraceptive method.

Explanatory Variables

Following a multilevel framework, the econometric models explaining each of the above outcomes includes two sets of variables — individual-level variables and community-level variables. Individual-level variables are captured through an individual questionnaire administered to women aged 15 to 49 from selected households. Community-level variables are either derived (created by aggregating individual-level responses to the cluster level for variables that are thought to have community-level constructs) or integral variables (collected using a village/cluster questionnaire).

Individual-Level Variables

The key explanatory variable of interest for this analysis is the number of sources from which the respondent has heard, seen or read about family planning in the past 6 months. This is a continuous variable ranging from 0 to 8 and captures the number of sources mentioned among the following: radio, television, newspaper or magazine, poster, leaflet or

pamphlet, billboards, community events, or a live drama. The choice of this explanatory variable for exposure is justified for two reasons. First, previous studies have found that the effects of media sources on behavior change are incremental, where the more media sources a person is exposed to the greater the effect (Jato et al, 1999; Backer, Rogers and Sopory, 1992). For example, Piotrow et al (1997 p. 23) note that "most men and women increase their knowledge of family planning gradually, not all in one step, as they are exposed to different sources of information, and as they try one method, learn about its advantages and disadvantages in practice, discontinue, and then try another." Second, health campaigns often use multiple media in order to reach unique sub-audiences with different media types (Backer, Rogers and Sopory, 1992). Since there have been many mass media family planning programs implemented in Tanzania concurrently since the early 1990s, isolating the effects of any single program in the current study would be very difficult. Thus, using a generic exposure variable that captures exposure to multiple sources, not a specific campaign, is deemed most appropriate.

We also include in our model a variable which captures whether the respondent was visited by a family planning worker in the past 12 months. Other individual-level explanatory variables included in the model include: education, age, socioeconomic status (as measured by an index constructed by principal components analysis of living conditions and ownership of common household consumer durables. See Filmer and Pritchett, 2001 for description of the methodology), number of living children, marital status, residence, religion, remunerated employment and frequency of radio listening.

Community-level variables

Our community-level variables are defined at the level of the survey enumeration area. This is done more out of necessity resulting from the structure of the data collection than from any adherence to a particular theoretical construct of community. Considerable debate exists in the multilevel modeling literature regarding the appropriate definition of a 'community' (Casterline 1987; O'Campo 2003, get others). There is no strong theoretical reason to believe that our spatial definition of a community corresponds exactly to a more relevant social definition of a community. Communities that are defined to be too large may exhibit considerable within variation but little between variation, potentially minimizing community effects. In contrast, communities that are defined too narrowly may exhibit considerable

homogeneity and little within variation, leading all variation to be wrongly attributed to community rather than individual effects (O'Campo 2003). Following the example of others in the literature (Ukwuani et al 2003, Chen and Guilkey 2003), we proceed with this necessitated construct of community.

Three aggregated community-level variables are included in the model: (1) the mean number of women who participate in remunerated economic activities, (2) the mean years of education of females of reproductive age, and (3) the mean number of sources from which respondents in the community report hearing about family planning. The first variable is included as a measure of women's participation in the community economy. The second variable measures overall levels of female education in the community, which has been shown elsewhere to influence fertility (McNay et al 2003, Moursand and Kravdal 2003, Kravdal 2002, Caldwell 1980). The third variable is intended to measure the diffusion of information on family planning throughout the community and is included to capture alternative or indirect pathways by which a community member may become exposed to information about family planning. For all derived community-level variables, communities are categorized into low, medium and high levels based on whether a community ranks in the lowest one-third, middle one-third or highest one-third of values for that variable. Using ranges of values for communities, rather than mean values, helps to avoid problems of imprecision with small sample sizes within clusters. In particular, aggregating up variables from the individual to the cluster level makes estimates vulnerable to sampling error (Casterline 1987, Lesthaeghe 1985).

The integral community variables are meant to capture the availability and acceptability of family planning services in the community. Three variables capture availability of family planning services: (1) whether the community has visits from a health assistant or a village health worker, (2) whether the community has a community-based distributor (CBD), and (3) distance to the nearest health facility. To capture the acceptability of family planning in the community, the model also includes a variable that describes the local government's position on family planning, ranging from strong discouragement of family planning to strong encouragement of family planning.

Estimation Method

Correctly estimating the influences of factors measured at multiple levels, requires specifying a model that allows for the multilevel structure of the data, that is, individuals nested within communities. Two distinct issues are addressed by multilevel models: (1) the intracluster correlation resulting from multistage sample designs and (2) the allowance for the levels of influence on individual-level behavior to reflect community-level constructs, including their interactions with individual-level characteristics.

Multi-stage sample designs trade off the increased precision from simple random sampling with the economic practicalities of randomly selecting groups and then individuals within those groups. The key statistical complication of multistage samples is that responses within groups tend to be more alike than responses between groups. As a result, clustered data potentially provide less information than a simple random sample of similar size. Consequently, sampling variances will be incorrect by an amount that is a function of cluster size and the intra-cluster correlation. In the presence of positive intra-cluster correlation, the sampling variance will underestimate the true variance, leading to incorrect hypothesis tests of the model's parameters (Hox 1998). Parameter estimates, on the other hand, will still be unbiased in multistage cluster sampling designs, assuming that there are no other violations of standard regression assumptions (Hox 1998; Angeles, Guilkey and Mroz 2002).

Standard statistical packages (Stata 8.0, SAS, SPSS) that make no efforts to control for cluster effects will produce correct standard errors at the lowest (individual) level but will underestimate group effects at higher levels. For our analysis, therefore, we use the MLWin 1.10 software package for multilevel modeling.

Models

We develop two-level models for our dependent variables that address both the multi-stage cluster design and the hierarchical nature of our data collection. At the first (micro) level are the individual respondents (denoted by the subscript i), while at the second (macro) level we have the communities or census clusters (denoted by the subscript j) in which these individuals live. Adapting the nomenclature of Goldstein (2003) and Diez-Roux (2000), we model the individual-level relationship for outcome y_{ij} as:

$$(1) \qquad y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + \varepsilon_{ij} \qquad \varepsilon_{ij} \sim N(0,1)$$

where X_{ij} is matrix of individual-level variables, and εij and is an independent and normally distributed error term that varies by individual and community. Its variance is standardized to equal one. In the multilevel model, we assume that communities are drawn at random from a larger population of communities, and therefore the coefficients for the intercept β_{0j} and the slope β_{1j} are random terms that differ across these communities. We model the second-level community effects for the intercept and slope terms as follows:

$$(2) \qquad \beta_{0j} = \gamma_{00} + \gamma_{01} C_j + u_{0j}$$
$$(3) \qquad \beta_{1j} = \gamma_{10} + \gamma_{11} C_j + u_{1j}$$

$$\textit{where} \quad \begin{aligned} u_{oj} &\sim N(0, \tau_{00}) \\ u_{1j} &\sim N(0, \tau_{11}) \\ \operatorname{cov}(u_{0j}, u_{1j}) &= \tau_{10} \end{aligned}$$

In the above model, C_{ij} is a matrix of community-level contextual variables, with different effects on the intercept and slope terms in each group, and u_{0j} and u_{1j} are the group level normally distributed error terms with means of zero and variances of τ_{00} and τ_{11} respectively. Plugging (2) and (3) into (1) yields the following full random slopes/random coefficients model:

$$(4) \qquad y_{ij} = \gamma_{oj} + \gamma_{01} C_j + \gamma_{10} X_{ij} + \gamma_{11} C_j X_{ij} + u_{0j} + u_{1j} X_{ij} + \varepsilon_{ij}$$

An interaction term $C_j X_{ij}$ accounts for differing effects of individual level variables for different values of the measured community variables. In our model, the primary interaction term is between a woman's individual level exposure to mass media and the mean level of exposure to mass media for other women in her community. This term allows us to model whether, for example, the effects of being "highly exposed" to mass media at the individual level differ based on whether a woman lives in a low, medium or high exposure community. In theory, it is possible that low exposure at the individual level is made up for by higher levels of exposure among other women in the community, who may in turn transmit

important information to lower exposure women. This effect is distinct from the overall community level exposure variable, which restricts the community-level exposure to have the same effect for all women in a community.

The model contains three error components: ε_{ij} , the individual-level error term; u_{0j} , a random intercept term representing the deviation of the intercept of each group from the overall intercept γ_{00}; and u_{1j}, a random slope term representing a group-specific deviation from the overall slope term γ_{10}. The random intercept u_{0j} and random slope u_{1j} are constant within groups and are therefore correlated.

We make a strong assumption of exogeneity, [3] i.e. that all heterogeneity at the community level related to our outcomes of interest is captured by the measured community-level variables and that the unobserved community heterogeneity component is uncorrelated with any of the included variables in the model.

In the above models, y_{ij} can take on either a continuous or a binary distribution. Two of our outcomes follow roughly continuous distributions – number of media sources seen or heard

[3] A concern in the current analysis is that mass media exposure may be endogenous to contraceptive use decisions. In other words, the use of modern contraception and exposure to family planning messages may be determined in part by the same unmeasured or unobservable influences. This has been shown to be important when governments target mass media messages to areas with underlying (unmeasured) differences in factors affecting the uptake of family planning (local attitudes, norms, acceptability of family planning), thereby introducing cluster-level heterogeneity (Angeles, Guilkey and Mroz 1998, Gertler and Molyneux 1994, Pitt, Rosenzweig, and Gibbons 1993). Further, as our measures of exposure are all self-reported and therefore non-random, the possibility exists that the recall of mass media messages related to family planning is in turn associated with (unmeasured) individual-level factors affecting the uptake of family planning (e.g. underlying motivations, current or past-use of family planning, perceptions of community norms, etc.). In either case, addressing the potential endogeneity of mass media exposure requires modeling the underlying factors associated with exposure – either factors that predispose individuals to hear or see media messages or factors associated with government decisions to target family planning programs. As our measures of exposure to the media campaign are all approximately continuous, we follow the methods outlined in Bollen, Guilkey and Mroz (1995) for addressing the possible endogeneity of non-random exposure to mass media, that is, we use instrumental variables methods to construct an instrument for exposure to mass media that is purged of the effects of the unobservable factors. However, because such an estimation strategy leads to a loss in efficiency in the absence of an endogenous relationship, we conduct a Rivers and Vuong test for endogeneity (Rivers and Vuong 1988). This involves a two-stage procedure in which the residuals from the first-stage estimation of exposure to mass media are included in the second stage estimation of contraceptive use. A statistically significant coefficient on the residual term in the second stage indicates that common observables affect both exposure and contraceptive use, thereby warranting the use of such instrumental variables methods. In spite of this concern, we find no evidence of endogeneity using the Rivers and Vuong test. All models that we present therefore are only single equation estimations of family planning outcomes without controls for endogenous regressors.

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and number of family planning methods known – while two others are binary – respondent approves of family planning and respondent is currently using a modern method. In the latter case, y_{ij} is treated as a latent continuous variable whose discrete realization is given by: $\begin{cases} y_{ij} = 1 \quad if \quad y_{ij}^{*} > 0 \\ y_{ij} = 0 \quad if \quad y_{ij}^{*} \le 0 \end{cases}$.

We assume that ε_{ij} follows a normal distribution and estimate a probit model.

In none of our models do we include aggregated measures of our dependent variables, which is likely to cause the "reflection problem" (Manski 1993, Kravdal 2003, Erbring and Young 1979).

Results

Table 1 presents weighted univariate distributions for the individual and community-level variables included in the model for the final working sample (after excluding cases with missing values). Approximately 53% of the working sample of women report having been exposed to messages about family planning from one or more of eight mass media sources—36% report being exposed to 1-3 sources, 13.2% to 4-6 sources, and 3.3% to 7 or 8 sources. The most common reported source of family planning messages was the radio (41.6%) followed by billboards (24.5%), posters (20%) and live dramas (19%). Knowledge of FP methods is quite high—91% of women know at least one family planning method and 70% know of four or more methods. Most women (73.5%) approve of couples using a method to avoid getting pregnant, but only 15.6% are currently using a modern family planning method. The majority of women (91.2%) live in communities where the local government encourages family planning. In terms of community exposure to family planning messages (measured by aggregating exposure to the community level), 44% of women live in areas of low family planning exposure, 29% live in areas of middle family planning exposure, and 27% live in areas of high community exposure.

Table 2 presents the results from the multilevel models for all outcomes with only the level-one (individual) covariates, while Table 3 presents the results for the same outcomes incorporating the community-level covariates. For ease of explication, only key results across

the outcomes are discussed here. Many of the results for the effects of individual-level covariates are well-documented in the literature and are not discussed here.

First, consistent with other studies, we found that individual-level exposure to mass media (number of sources of family planning messages) was significantly associated with all three outcomes – number of family planning methods known, respondent approval of family planning, and current use of modern contraception. Importantly, this result held even when we included dummy variable measures of medium- and high-level community exposure to mass media.

Second, we found that community-level exposure to mass media (Table 3) also had a statistically significant effect on the number of family planning methods known and the use of modern contraception and a positive association with respondent approval of family planning. This result held even when we restricted our sample to include clusters with more than 20 female respondents to reduce sampling errors. Thus, our principal hypothesis, that the effects of mass media exposure operate both through individual-level direct exposure and higher-level indirect exposure, appears to have been supported. On the other hand, variables interacting individual-level exposure with community-level exposure, measuring differential impact of individual-level exposure for respondents in medium- and high-media exposure areas, were never statistically significant and were omitted from the results presented here.

In order to test whether the effects of individual-level exposure differed across communities, regardless of community-level media exposure, we estimated models allowing for random coefficients across communities for the individual-level exposure variable. These coefficients showed no statistically significant variation across communities and were dropped from the model. Similarly, we allowed for random coefficients across communities for the community-level exposure variables. These too showed no statistically significant variation across communities and are not presented.

In addition to media exposure, other community-level variables were associated with our outcomes of interest, though there were occasional, and baffling, inconsistencies. For example, local government support of family planning programs was positively associated

with a respondent's exposure to mass media, supporting the hypothesis that programmatic support can be important in shaping people's knowledge. However, this same variable was negatively associated with respondent approval of family planning, which counters our hypothesis but perhaps suggests that family planning programs may be targeted to areas with higher fertility preferences, as shown elsewhere (Angeles, Guilkey and Mroz 1998).

Having a local community-based distributor of family planning increased the likelihood of respondent approval of family planning but did not affect use of modern contraception. Similarly, measures of access to health services and family planning supplies – the distance in kilometers to the nearest government health center, whether or not a community had a pharmacy within 2 kilometers, and whether or not a community had all season roads – were not statistically associated with any of the family planning outcomes. Aggregated measures of adults who reported working for cash and of levels of female education were statistically significant in some models.

A final point worth noting is that we found that in all models, once we explicitly control for community-level constructs, the community-level variance represented only a small proportion of the overall variance. In the linear regression models, the community level variation was only 4 percent of the overall variation, indicating that nearly all of the variation in the outcomes was due to variation in individual-level covariates.

Conclusion

This work has attempted to show that mass media works to influence individual-level outcomes both through direct exposure and by creating a community-level exposure effect. These direct and indirect effects are apparent at multiple stages of a behavior change model, affecting not just awareness of family planning methods, but also approval and use of family planning. That mass media has influences at multiple levels implies that analyses that omit measures of such higher-level effects on individual-level outcomes are likely to underestimate the full impact of mass media programs.

A very clear and important omission of this work, however, has been the neglect of social interaction variables in the analysis. While previous studies have focused almost exclusively on social networks, this study has focused almost exclusively on mass media impacts. This

richer analysis of social network influences in conjunction with mass media was not possible with the current data set. The Tanzania Reproductive and Child Health Survey data are rich in community- and cluster-level measures of family planning program effort and attitudes, but are absent important information on the social networks in which respondents live.

A second clear limitation of the current paper is that the community-level data contain information on only a limited number of constructs that could potentially affect individual-level outcomes. Similar to the omission of social interaction variables, we have very little information regarding influential community and social leaders whose impact on individuals would be hypothesized according to common strands of the social influence and social learning theories of behavior change communication theory. The sole indicator of community norms is the variable on local government support of family planning. This indicator does not perform well in the current analysis.

The current paper therefore points to a need for greater emphasis on data collection related to community-level influences on individual-level outcomes. The absence of strong community-level effects is not necessarily indicative of the absence of effects but may well be associated with the availability of data that could be used to test such effects.

One additional limitation of this analysis is that it makes use of cross-sectional data, and statistical associations between variables are ignorant of the timing of events related to changes in knowledge, approval and use. This has important implications for analyses of family-planning related behaviors based on data collected at a single point in time. While models of behavior change focus on intermediate ideational factors influencing contraceptive use, many of these factors – approval of family planning, fertility desires, number of methods known – are likely to suffer from time-order problems associated with cross-sectional data collection. It may be unclear what exactly is measured when a variable, such as respondent approval, is included in an equation for the use of modern contraception. The motivation to include such a term is logical; women are likely to need some minimal level of approval of family planning before initiating use. This in fact is an underlying premise of the Steps-to-Behavior-Change model. However, using cross-sectional data on current users and their current levels of approval, we have no measures of pre-use approval. Users' approval of family planning, in fact, may increase with the duration of use and

increasing familiarity with methods, meaning that use in fact partially determines approval. This argument holds as well for knowledge of methods. Use of one method likely exposes women to information about alternatives. Again, it would be pre-initiation of use levels of knowledge that would be the logical variable for inclusion, but this remains unmeasured in our data. As a result, for analyses seeking to examine the effects of ideational factors on contraceptive use, a strong case can be made that for repeated data collection using cohorts of women exposed to multiple media messages across time so as to better gauge these changes in ideational factors leading to changes in contraceptive behavior. Since this analysis has shown the importance of including community-level factors in such decision models, a case can also be made for repeated data collection of community-level information.

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Table 1. Descriptive Statistics, Individual Characteristics of the Sample

Variables	%
Age	(3,739)
15-19	22.3
20-24	20.4
25-29	18.7
30-34	12.2
35-39	11.2
40-44	7.6
45-49	7.7
Education	
None	27.4
Primary	67.4
Secondary	5.2
Asset quintile	
Lowest	
2nd lowest	
Middle	
2nd highest	
Highest	
Remunerated employment	59.0
No. of living children	
None	27.1
1 to 3	44.3
4 or more	28.6
Marital status	
Never married	23.3
Married	65.8
Separated/Divorced/Widowed	10.9
Lives in rural area	71.6
Muslim religion	34.0
Watches TV every week	4.2
Radio Listenership	
Does not listen to radio at all	39.2
Listens to radio sometimes	35.9
Listens to radio almost every day	24.8
Visited by FP worker in last 12 mos.	6.2
Number of sources of FP messages	
None	9.5
1 to 3	18.9
4 to 6	39.9
7 or more	31.7
No. of FP methods known	
None	47.0
1 to 3	36.4
4 to 6	13.2
7or more	3.3
Respondent approves of FP	73.5
Currently uses a modern FP method	15.6

Table 1a. Descriptive Statistics, Community Level Characteristics of the Sample

Variables	%
	(3,739)
Community Integral Variables	
Has local CBD	21.3
Has Health Asst. or Health Worker	57.6
Government supports FP	91.2
Distance to closest health clinic	
Facility located in community	40.9
Facility within 5 Km	39.1
Facility further than 5 Km	20.0
Pharmacy within 2 K	40.4
Has all year road	66.6
Community Derived Variables.	
Women's educational achievement	
Low Education	40.7
Middle Education	37.3
High Education	22.0
Women's remunerated employment	
Low remunerated employment	33.7
Middle remunerated employment	32.3
High remunerated employment	34.0
Women's exposure to family planning messages	
Low FP exposure	43.8
Middle FP exposure	29.0
High FP exposure	27.1

Table 2. Multilevel Estimations, Individual-level Models

Variables	Number of FP Sources Seen/Heard			No. of Family Planning Methods Known			Respondent Approval of Family Planning			Modern Contraceptive Use		
	Coef	SE	t	Coef	SE	t	Coef	SE	Z	Coef	SE	Z
Number of sources of FP messages				0.282	0.019	14.84	0.134	0.018	7.44	0.066	0.015	4.40
Respondent approval of FP										1.224	0.146	8.38
Age (omitted='15-19")												
20-24	0.376	0.097	3.88	1.226	0.111	11.05	0.228	0.087	2.62	0.334	0.111	3.01
25-29	0.348	0.108	3.22	1.154	0.124	9.31	0.22	0.099	2.22	0.197	0.121	1.63
30-34	0.464	0.125	3.71	1.128	0.144	7.83	0.081	0.114	0.71	0.005	0.139	0.04
35-39	0.447	0.133	3.36	0.998	0.153	6.52	-0.105	0.119	-0.88	0.019	0.147	0.13
40-44	0.337	0.152	2.22	0.792	0.175	4.53	-0.22	0.136	-1.62	-0.198	0.171	-1.16
45-49	0.037	0.16	0.23	0.419	0.184	2.28	-0.418	0.138	-3.03	-0.236	0.185	-1.28
Education (omitted="none")												
Primary	0.506	0.073	6.93	0.658	0.084	7.83	0.516	0.062	8.32	0.175	0.088	1.99
Secondary	1.347	0.113	11.92	0.888	0.133	6.68	0.675	0.113	5.97	0.25	0.121	2.07
Asset quintile												
2nd lowest	-0.072	0.091	-0.79	0.124	0.106	1.17	0.182	0.077	2.36	0.05	0.117	0.43
Middle	0.048	0.096	0.50	0.143	0.112	1.28	0.113	0.083	1.36	0.214	0.115	1.86
2nd highest	0.21	0.108	1.94	0.319	0.126	2.53	0.169	0.095	1.78	0.387	0.121	3.20
Highest	0.501	0.134	3.74	0.455	0.157	2.90	0.243	0.126	1.93	0.337	0.142	2.37
Work for cash	0.266	0.059	4.51	0.377	0.069	5.46	0.169	0.053	3.19	0.192	0.065	2.95
No. of living children	-0.008	0.017	-0.47	0.118	0.02	5.90	0.075	0.015	5.00	0.1	0.018	5.56
Marital status (omitted="never married")												
Married	0.215	0.092	2.34	1.165	0.105	11.10	0.323	0.084	3.85	0.375	0.101	3.71
Separated/Divorced	0.401	0.119	3.37	1.083	0.136	7.96	0.222	0.11	2.02	0.491	0.124	3.96
Rural	-0.657	0.101	-6.50	-0.593	0.137	-4.33	-0.24	0.096	-2.50	-0.294	0.099	-2.97
Muslim	-0.064	0.07	-0.91	-0.067	0.088	-0.76	-0.04	0.067	-0.60	-0.119	0.07	-1.70
Watches TV every week	0.754	0.101	7.47	-0.002	0.117	-0.02	0.068	0.109	0.62	0.034	0.095	0.36
Listen to radio almost every day	1.414	0.089	15.89	0.796	0.106	7.51	0.302	0.082	3.68	0.06	0.09	0.67
Listen to radio sometimes	0.684	0.076	9.00	0.55	0.088	6.25	0.167	0.065	2.57	0.196	0.103	1.90
Visited by FP worker in last 12 mos.	0.543	0.118	4.60	0.426	0.136	3.13	0.16	0.133	1.20	0.066	0.015	4.40
B_{0ij}	0.172	0.146					-0.496	0.131	-3.79	-3.286	0.22	-14.94
σ_u	0.125	0.027					0.112	0.023	4.87	0.107	0.027	3.96
σ_ε	2.675	0.063					1	0		1	0	
	0.04											

Table 3. Multilevel Estimations, Individual-level and Community-level Models

Variables	Number of FP Sources Seen/Heard			Number of Family Planning Methods Known			Respondent Approval of Family Planning			Modern Contraceptive Use		
	Coef	SE	t	Coef	SE	t	Coef	SE	Z	Coef	SE	Z
Number of sources of FP messages				0.279	0.019	14.68	0.133	0.018	7.39	0.063	0.016	3.94
Respondent approval of FP										1.216	0.149	8.16
Age (omitted='15-19")												
20-24	0.375	0.097	3.87	1.223	0.111	11.02	0.231	0.087	2.66	0.34	0.112	3.04
25-29	0.346	0.108	3.20	1.15	0.124	9.27	0.225	0.099	2.27	0.201	0.121	1.66
30-34	0.467	0.125	3.74	1.125	0.144	7.81	0.086	0.114	0.75	0.003	0.139	0.02
35-39	0.437	0.133	3.29	0.991	0.153	6.48	-0.096	0.119	-0.81	0.019	0.148	0.13
40-44	0.341	0.152	2.24	0.789	0.175	4.51	-0.213	0.135	-1.58	-0.195	0.172	-1.13
45-49	0.042	0.16	0.26	0.404	0.184	2.20	-0.432	0.138	-3.13	-0.251	0.186	-1.35
Education (omitted="none")												
Primary	0.504	0.074	6.81	0.647	0.085	7.61	0.502	0.062	8.10	0.153	0.09	1.70
Secondary	1.312	0.114	11.51	0.879	0.134	6.56	0.657	0.114	5.76	0.215	0.123	1.75
Asset quintile												
2nd lowest	-0.064	0.091	-0.70	0.126	0.105	1.20	0.167	0.076	2.20	0.051	0.117	0.44
Middle	0.056	0.096	0.58	0.13	0.111	1.17	0.077	0.083	0.93	0.191	0.115	1.66
2nd highest	0.175	0.109	1.61	0.301	0.127	2.37	0.134	0.096	1.40	0.343	0.123	2.79
Highest	0.435	0.137	3.18	0.461	0.16	2.88	0.279	0.129	2.16	0.317	0.145	2.19
Work for cash	0.261	0.061	4.28	0.352	0.07	5.03	0.14	0.055	2.55	0.174	0.068	2.56
No. of living children	-0.008	0.017	-0.47	0.119	0.02	5.95	0.075	0.015	5.00	0.102	0.018	5.67
Marital status (omitted="never married")												
Married	0.222	0.092	2.41	1.168	0.105	11.12	0.318	0.084	3.79	0.375	0.102	3.68
Separated/Divorced	0.393	0.119	3.30	1.074	0.136	7.90	0.201	0.11	1.83	0.474	0.124	3.82
Rural	-0.514	0.11	-4.67	-0.516	0.174	-2.97	-0.16	0.116	-1.38	-0.157	0.123	-1.28
Muslim	-0.093	0.071	-1.31	-0.091	0.09	-1.01	-0.074	0.068	-1.09	-0.145	0.073	-1.99
Watches TV every week	0.731	0.101	7.24	0.006	0.118	0.05	0.086	0.109	0.79	0.043	0.095	0.45
Listen to radio almost every day	1.397	0.089	15.70	0.775	0.106	7.31	0.282	0.082	3.44	0.032	0.102	0.31
Listen to radio sometimes	0.671	0.076	8.83	0.527	0.088	5.99	0.139	0.066	2.11	0.022	0.09	0.24
Visited by FP worker in last 12 mos.	0.53	0.118	4.49	0.417	0.136	3.07	0.162	0.133	1.22	0.189	0.103	1.83
Community Integral Variables												
Has local CBD	0.012	0.098	0.12	0.136	0.136	1.00	0.302	0.091	3.32	0.066	0.096	0.69
Has Health Asst. or Health Worker	0.046	0.081	0.57	0.267	0.115	2.32	-0.035	0.073	-0.48	0.076	0.083	0.92
Gov't support of FP	0.275	0.133	2.07	-0.147	0.185	-0.79	-0.248	0.12	-2.07	-0.174	0.135	-1.29
Dist. To closest health clinic				0.007	0.008	0.88	0	0.005	0.00	0.007	0.006	1.17
Pharmacy within 2 K				0.056	0.133	0.42	0.104	0.086	1.21	0.15	0.093	1.61
Has all year road	0.245	0.092	2.66				-0.042	0.08	-0.53	-0.034	0.103	-0.33

Variables	Number of FP Sources Seen/Heard			Number of Family Planning Methods Known			Respondent Approval of Family Planning			Modern Contraceptive Use		
	Coef	SE	t	Coef	SE	t	Coef	SE	Z	Coef	SE	Z
Community Derived Variables.												
Middle Education	-0.037	0.096	-0.39	0.059	0.141	0.42	0.175	0.087	2.01	0.187	0.111	1.68
High Education	0.169	0.127	1.33	-0.093	0.202	-0.46	-0.147	0.132	-1.11	0.097	0.147	0.66
Middle Cash Employment	0.004	0.097	0.04	0.027	0.134	0.20	0.033	0.084	0.39	0.063	0.101	0.62
High Cash Employment	0.065	0.097	0.67	0.289	0.133	2.17	0.181	0.087	2.08	0.124	0.099	1.25
Middle FP seen				0.357	0.145	2.46	0.166	0.090	1.84	0.286	0.113	2.53
High FP seen				0.405	0.219	1.85	0.256	0.148	1.73	0.322	0.161	2.00
B_{0ij}	-0.382	0.222	-1.72	1.31	0.3	4.37	-0.533	0.208	-2.56	-3.614	0.293	-12.33
Cluster-level σ_u	0.107	0.025		0.281	0.049	5.73	0.072	0.019	3.79	0.086	0.025	3.44
Individual-level σ_ε	2.672	0.063		3.476	0.082	42.39	1.000	0.000		1.000	0.000	
	0.039											