

# Using Network Analysis to Understand Community-Based Programs: A Case Study from Highland Madagascar

**CONTEXT:** Programs using community-based distribution (CBD) of family planning services have had mixed success in Sub-Saharan Africa. Knowledge about why these programs succeed or fail is limited.

**METHODS:** In 1999, a total of 159 women and men of reproductive age were interviewed in a village in highland Madagascar with an active community-based family planning program. Network analysis informed by chi-square tests and multiple regression analysis was used to test whether respondents' communication with CBD agents and the location of their discussion partners were associated with their knowledge and use of family planning.

**RESULTS:** The CBD agents were highly central in the village's family planning network; 35% of women and 19% of men directly communicated with a CBD agent about family planning or were indirectly linked to an agent. Knowledge of family planning was associated with having either a direct or an indirect link to a CBD agent; use of a modern method was associated with discussing family planning only with someone outside the village (odds ratio, 12.6) or with discussing it in the village and communicating directly with a CBD agent (10.8).

**CONCLUSIONS:** Network analysis can improve the understanding of community-based program functioning by providing a way to examine who receives information from and is influenced by CBD agents.

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Community-based programs that include community-based distribution (CBD) of family planning methods have been implemented in many settings for more than 30 years.<sup>1</sup> These programs have had varying degrees of success in their attempts to improve the rate of family planning adoption and continuation.<sup>2</sup> Their effectiveness generally has been measured on an aggregate level, through comparisons of levels of family planning awareness and use in the study population before and after the program got under way, or of the couple-years of protection purchased by the population over time.<sup>3</sup> Although such quasi-experimental studies can demonstrate effectiveness, they often fail to measure factors important to the understanding of why community-based programs do and do not succeed.

Community-based programs attempt to capitalize on local networks by training members of the community in service delivery. These specially trained individuals then use local communication channels to increase awareness of family planning and act as role models, prompting behavior change in their fellow community members. Because of how these programs function, some researchers have suggested using, and others have begun using, study methodologies that focus on community-level processes and interactions to capture the social influence and learning aspects of family planning adoption.<sup>4</sup> We suggest that network analysis can help determine whether and how community-based programs achieve their goals; we illustrate this using data from a case study conducted in Mandrosohasina, a village in the central highland region of Madagascar.

## BACKGROUND

### Study Site

Mandrosohasina, a village of about 400 inhabitants, is a fairly typical rural highland village. Educational levels are low: Seventy-eight percent of the study population have not attended school beyond the primary level. The vast majority of villagers (93%) are farmers, generally growing rice, carrots and potatoes both as cash crops and for their own consumption. Like most highland communities, the village is Christian; its only church is Lutheran, the denomination of 90% of residents. Although Mandrosohasina is rural, it is seven kilometers from a national highway; the large town of Antsirabe is about an hour's drive south, and the capital, Antananarivo, is about three hours to the north.

A community-based program of family planning delivery had been operating in Mandrosohasina for about six years at the time of the survey. The same two CBD agents had been working in the village since the program's inception. They sold condoms, spermicidal suppositories and birth control pills out of their homes, and referred clients to a hospital about nine kilometers away for injectable methods, IUDs and tubal ligations.

### CBD Agents and Diffusion

Diffusion of innovations theory suggests that individuals will hear about an innovation from a new source and then go through three steps: gaining awareness and learning about the innovation; developing a positive or negative attitude about it; and practicing, or using, the innovation.<sup>5</sup> According to the theory, individuals with communication ties outside their

**TABLE 1. Selected characteristics of respondents to survey on family planning knowledge, attitudes and practices, by type of characteristic, according to gender, Mandrosohasina, Madagascar, 1999**

Characteristic	Males (N=81)	Females (N=78)
<b>Background</b>		
Mean age (range, 15–60)	31.1	29.5
% married	67.9	74.4
Mean no. of children ever born (range, 0–14)	na	3.5
% by level of education		
None	4.9	19.2**
Complete primary	70.4	61.5
Complete secondary	20.9	14.1
>secondary	3.7	5.1
Mean socioeconomic score (range, 0–9)	1.6	1.4
% by type of occupation		
Agriculture	88.9	92.3
Other	11.1	7.7
% who travel regularly to urban centers	37.0	14.1**
<b>Network</b>		
Link to CBD agent in advice network		
Isolate	38.3	19.2**
Indirect	53.1	62.8
Direct	8.6	18.0
Link to CBD agent in family planning network		
Isolate	81.5	65.4*
Indirect	6.2	16.7*
Direct	12.4	18.0
Location of family planning discussion partners		
No partner	63.0	46.2*
In village only	16.1	23.1
Outside village only	14.8	12.8
Both	6.2	18.0**
<b>Outcome</b>		
Mean detailed family planning knowledge score (range, 0–14)		
%	5.2	6.8*
% with positive family planning attitude		
%	12.4	24.4
Mean family planning method concerns score (range, 0–6)		
%	1.5	1.8
% who ever used modern method		
%	21.0	32.1
% who currently use modern method		
%	11.1	15.4

\* $p < .05$ . \*\* $p < .01$ . Note: na=not applicable.

community are the first to bring new ideas into their community. These “bridges” then prompt discussion within the community, thus spreading information about the innovation through local channels.<sup>6</sup> Information about an innovation can therefore be examined for how it enters a community and traced as it is diffused within the community.

In this study, we examine the village as a closed network, with attention to the role of the CBD worker as an internal diffusion agent. We investigate three research questions: Are CBD agents centrally located in village communication networks (i.e., are they reached or contacted within networks more often than other network members are)? Do individuals who communicate directly with a CBD agent have higher levels of knowledge and use of modern family planning methods than other villagers? Do individuals with access to information sources outside the village have higher levels of family planning knowledge and use than those who do not have outside information sources?

## METHODS

Data were collected between November and December of 1999 with a structured questionnaire that four trained interviewers administered to every man and woman of re-

productive age in the village, as well as the husband of any woman younger than 50. The questionnaire covered respondents’ background characteristics (age, number of pregnancies and births, number of living children, socioeconomic status, educational background and access to urban centers); experience with and general awareness of family planning (discussion with spouse, ever-use and current use, spontaneous awareness of methods, concerns about each reported method); detailed knowledge about family planning (assessed through a set of true-false questions); and networks for obtaining general advice and discussing family planning.

The following questions were used to ascertain respondents’ communication ties within the village: “Who do you talk to, here in the village of Mandrosohasina, when you have a big decision to make in your life, or when you need advice about a problem? Can you name four people?” and “Have you spoken to anyone here in Mandrosohasina about ways to avoid pregnancy?” If the answer to the last question was yes, the interviewer asked, “Can you name four people you have spoken with?” Influence on family planning knowledge, attitudes and use from communication with persons outside the village was determined by the following question, “Have you spoken to anyone about ways to avoid pregnancy outside of the village of Mandrosohasina?” If yes, “Can you name four people you have spoken with?” Two village communication networks were generated from these responses: an advice network and a family planning network.

A number of analytic techniques were used to examine the work of the CBD agents. Sociograms (available from the authors) were generated to show the advice and family planning networks, as well as the CBD agents’ position in each network. Cross-tabulations were examined using chi-square tests to identify the relationships between links to CBD agents and detailed knowledge, attitudes and use of family planning methods, as well as to study the relationships between location of respondents’ discussion partners and family planning knowledge, attitudes and use. For these tests, respondents were divided into four groups: those who named discussion partners or sources of advice about family planning within the village only; those who named people outside the village only; those who named individuals both in and outside the village; and those who did not name anyone, whom we term family planning communication isolates. Regression analysis was used to further examine these relationships.

Network density (i.e., the observed number of ties divided by the total possible number of ties) illustrates the degree to which network members are tied to other network members. Theoretically, information can diffuse more rapidly in a dense network than in a sparse one. Centrality is an important network analysis measure that indicates the relative position of a network member. Of the numerous centrality measures, we examined in-degree centrality, or the number of times an individual was named by others in the communication network in question.

Detailed knowledge was measured through factor analysis of 14 true-false questions that sought to determine the extent of respondents' understanding of the mechanisms and side effects of most family planning methods being used in the region (birth control pills; injectables; condoms; IUDs; sterilization; and natural family planning, including breast-feeding). Correct responses clustered as one variable with an eigenvalue of 5.12 and a Cronbach alpha of .88.

Respondents' attitudes were measured with two variables, both originating from a list of concerns generated by an open-ended question on family planning method awareness. Factor analysis revealed that concern variables clustered into a factor indicating a positive attitude toward pills, injectables, condoms, IUDs and implants (eigenvalue, 2.07; Cronbach alpha, .67). An additional variable, the number of negative concerns mentioned for any method known to the respondent, also came from the list of concerns. Last, dichotomous variables indicating current use and ever-use of modern family planning methods measured family planning practice.

For each network, we created categories indicating whether each respondent was directly connected to a CBD agent or was linked to a CBD agent indirectly (i.e., someone the respondent named as a source of advice had a direct tie to the agent or served as a bridge in communication between the respondent and someone else who was connected to the agent, either directly or indirectly).<sup>\*</sup> We measured family planning knowledge and attitudes within a respondent's personal network with network knowledge exposure scores, calculated as the average of the knowledge and attitude scores of the respondent's communication partners. (For example, if a respondent named three communication partners, who had self-reported knowledge scores of seven, eight and nine, respectively, the respondent's network knowledge exposure score would be eight.)

Other independent variables of importance were the respondent's age, number of children ever born, use of any family planning method, socioeconomic status, occupation and marital status, and whether the respondent traveled regularly to major urban centers. The socioeconomic status variable was constructed from nine questions measuring ownership of cows, pigs, ducks, chickens, geese, a bicycle, a radio, an oxcart or a motorcycle. For each question, the respondent received a score of zero if she reported owning none and a score of one if she owned any; her final socioeconomic status score therefore could range from zero to nine.

## RESULTS

### Sample and Network Characteristics

Of the 189 people of reproductive age living in the village, 159 (84%) were successfully interviewed. Respondents' average age was about 30, the majority were married and women had borne an average of 3.5 children (Table 1). Levels of education and socioeconomic status were low, and most respondents worked in agriculture. A significantly greater proportion of men than of women traveled regularly to urban centers (37% vs. 14%).

**TABLE 2. Measures of family planning knowledge, attitudes and practice, by link to CBD agents, according to network**

Measure	Advice network			Family planning network		
	Isolate (N=46)	Indirect (N=92)	Direct (N=19)	Isolate (N=117)	Indirect (N=18)	Direct (N=22)
Mean detailed family planning knowledge	4.5	6.4*	6.7†	5.2	8.3**	7.5*
% using modern method	9	13	21	10	17	23
% with positive family planning attitude	11	20	21	15	33*	18
Mean family planning method concerns	1.3	1.6	2.7*	1.4	2.1	2.5*

\*Different from value for isolates at  $p < .05$ . \*\*Different from value for isolates at  $p < .01$ . †Different from value for isolates at  $p < .10$ . Note: An indirect link represents 2-10 steps to the agent in the advice network and 2-5 steps in the family planning network.

Links to the CBD agents differed by gender and by network. A significantly greater proportion of women than of men were connected to a CBD agent in both the advice network (81% vs. 62%) and the family planning network (35% vs. 19%). In the family planning network, the proportion with an indirect connection to a CBD agent also was significantly higher among women than among men.

The density of the advice network was greater than that of the family planning network (not shown).<sup>†</sup> Consequently, greater proportions of both men and women were at least indirectly connected to a CBD agent in the advice network than in the family planning network. Among women, the same proportion in the advice and family planning networks were directly connected to a CBD worker (18%), but among men, the proportion was higher in the family planning network than in the advice network (12% vs. 9%, Table 1). The two networks were quite different; only 20% of the communication ties were the same (not shown).

CBD agents appear to be central to the family planning communication network in Mandrosahasina. In the advice network, one CBD agent was named 11 times, more than any other individual in that network (the next highest number was five). She is therefore the central person in that network and has the potential to contact the most people directly. In the family planning network, both CBD agents were central, having been named by the greatest numbers of network members (14 and eight); again, the next largest number in the network was five. The CBD agents' positions in these communication networks suggest that they actively transmit information about family planning within the village.

Although women reported less schooling than men, they scored significantly higher on detailed knowledge of family planning methods (Table 1). Men and women did not differ significantly with respect to attitudes toward, concerns about or use of family planning.

\*The number of indirect ties varied across networks. This measurement captured anyone who was in the main component of the network and could reach the CBD agent within N ties, where N is the maximum distance within the main component (10 in the advice network and five in the family planning network).

†Given that the village population was 189 and that we asked respondents to name up to four persons in each network, the total possible number of ties was  $(189-1) \times 4$ , or 752. Therefore, density is calculated as observed ties divided by 752; this worked out to  $185/752$ , or 0.25, for the advice network and  $84/752$ , or 0.11, for the family planning network.

**TABLE 3. Background characteristics and measures of family planning knowledge, attitudes and practice, by location of respondent's family planning discussion partners**

Measure	No partner (N=87)	In village only (N=31)	Outside village only (N=22)	In and outside village (N=17)
<b>Background</b>				
Mean age	30.0	29.0	33.0	31.0
% female	41.0	58.0	45.0	71.0*
Mean no. of children ever born	3.0	3.7	4.4	3.3
% with >primary schooling	18.0	16.0	27.0	35.0
Mean socioeconomic score (scale, 0–9)	1.2	1.6	1.7	2.4**
% nonagricultural workers	9.0	3.0	9.0	18.0
% who regularly travel to major urban centers	20.0	26.0	32.0	47.0*
<b>Family planning</b>				
Mean detailed knowledge	4.8	7.9**	5.6	8.1**
% with positive attitude	6.9	32.3**	31.8**	23.5*
Mean method concerns	1.2	2.0	1.7	3.0**
% who ever used modern method	11.5	48.4**	40.9**	35.3*
% currently using modern method	3.4	22.6**	36.4**	11.8
Mean mos. of modern method use†	25	21	78	73

\*Different from value for isolates at  $p < .05$ . \*\*Different from value for isolates at  $p < .01$ . †Among modern users only.

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Table 2 (page 169) shows that in the advice network, those with indirect ties to a CBD agent had a significantly higher level of knowledge than isolates (average scores, 6.4 and 4.5, respectively). The data suggest that the score was even higher among those with direct ties, but the finding achieves only a marginal level of significance. We expected levels of concern about family planning to decline as contact with a CBD agent became more direct, but this was not the case; the level of concern was highest (average score, 2.7) among those with direct ties to an agent. This finding may reflect an internal method bias: Only those aware of methods were asked their concerns about the methods they had reported.

In the family planning network, knowledge was elevated among those either directly or indirectly connected to agents, and the proportion with positive attitudes toward

family planning was highest among those with an indirect link. Again, those with direct ties to CBD agents reported the highest level of concern about methods.

**Diffusion from the Outside**

Given the assumption of diffusion of innovations theory that innovations are introduced outside a community and brought into it, where they then spread, it follows that the earliest family planning adopters should be those who have access to outside sources of information.<sup>7</sup> For the purposes of this case study, our empirical definition of early adoption included those who reported ever having used modern family planning methods and those who reported currently using a modern family planning method.

In Mandrosahasina, respondents' background characteristics differed little according to where they obtained family planning information. Isolates differed from individuals with family planning communication partners both in and outside the village with respect to gender, socioeconomic status and travel to urban centers (Table 3), but were otherwise statistically indistinguishable from individuals with network ties. Furthermore, additional analyses (not shown) indicate that the three groups with network ties were generally similar to each other.

The pattern of association for knowledge, attitudes and practice is different, showing significant distinctions between respondents who had discussed family planning either within or outside the village and isolates. This suggests that having family planning discussion partners is significantly associated with knowledge, attitudes and possibly use, irrespective of background characteristics.

The relationships shown are not as we would have expected within the knowledge, attitudes and practice measures by location of discussion partners. Although the highest rate of current family planning use was among those with communication partners exclusively outside the village (36%), use was low (12%) among those with communication channels both in and out of the village. One finding is consistent with the expectations of diffusion theorists: Among current users of modern methods, the longest durations of use were reported by those with ties exclusively outside the village (78 months, on average) and those with ties both in and outside the village (73 months). However, these averages are based on very small sample sizes and should therefore be interpreted cautiously. Having ties outside the village did not necessarily correspond to more knowledge or better attitudes than having ties exclusively inside the village. Again, concerns and knowledge were positively correlated by category.

We conducted 10 multiple regressions to estimate associations between network variables and family planning knowledge and use, controlling for respondents' age, sex, education, marital status, occupation, socioeconomic status and number of children ever born.\* For location of dis-

**TABLE 4. Coefficients from multiple linear regression analyses examining the association of selected network variables on family planning knowledge score**

Variable	1	2	3	4	5
<b>Link to CBD agent</b>					
Advice network					
Isolate	ref	na	na	na	na
Indirect link	0.19*	na	na	na	na
Direct link	0.12	na	na	na	na
Family planning network					
Isolate	na	ref	na	na	na
Indirect link	na	0.16*	na	na	na
Direct link	na	0.17*	na	na	na
<b>Location of family planning discussion partners</b>					
No partner	na	na	ref	na	na
In village only, indirect CBD link or no link	na	na	0.22**	na	na
In village only, direct CBD link	na	na	0.18*	na	na
Out of village only	na	na	0.01	na	na
In and out of village	na	na	0.13	na	na
<b>Personal network knowledge exposure</b>					
Advice network	na	na	na	0.23**	na
Family planning network	na	na	na	na	0.25**
Model R <sup>2</sup>	0.20	0.22	0.24	0.22	0.23

\* $p < .05$ . \*\* $p < .01$ . Notes: All analyses control for sex, age, marital status, children ever born, socioeconomic status, occupation and education. ref=reference category. na=not applicable.

\*In many cases, these covariates had a significant association with the outcome variables of interest, but they are not the focus of this article, and so we do not report results for the control variables.

cussion partners, we divided respondents who named only people in the village between those with direct ties to a CBD agent and those without direct ties. (The latter group consists of individuals who had indirect links to an agent and those who had only a few communication partners and no links to an agent.) This distinction will help separate the effects of the CBD agent from the effects of other interpersonal communication and is not captured in any previous measures.

Being linked to a CBD agent in either network was associated with an elevated knowledge score (Table 4). For example, being indirectly linked to an agent in the advice network had a beta coefficient of 0.2. Having discussion partners in the village only was associated with greater knowledge than having no partner—coefficients of 0.2 both for those with direct links to a CBD agent and for those without direct links. Network knowledge exposure scores were highly associated with knowledge.

The only variable independently associated with the current use of family planning was the location of family planning discussion partners, with ties to CBD agents also taken into account (Table 5). Compared with isolates, respondents with discussion partners in the village only and a direct communication link to the CBD agents were significantly more likely to use a modern method of family planning (odds ratio, 10.8). Use was also associated with having discussion partners only outside the village (12.6), as our chi-square analysis had suggested.

## DISCUSSION

Nearly 30 years ago, diffusion scholars proposed social networks as a way to study the spread of contraceptive use and fertility decline.<sup>8</sup> More recent research has shown that the network approach has promise for improving the understanding of family planning adoption.<sup>9</sup> In this article, we have suggested that the study of community-based programs can be aided by network methods. We measured an advice network and a family planning network, which probably serve different functions in the diffusion of family planning in the village. We suspect that the advice network remains similar over time, because it comprises deep social relationships such as those between family members or close friends. It may represent sources of social influence for those in this network; ties in the advice network provide the internalization of norms and a basis for models of behavior.<sup>10</sup>

The family planning network, however, is probably composed of weaker ties, which may be more likely to change over time. We suggest that the family planning network is a more functional, or instrumental, network, created among seekers and providers of information and serving as a source of social learning about behavior.<sup>11</sup> This distinction could help explain our finding that respondents' family planning knowledge appeared to increase more consistently with proximity to the CBD agent in the advice network than in the family planning network.

These distinctions in the types of relationships seen in

**TABLE 5. Odds ratios from multiple logistic regression analyses examining the association of selected network variables on modern family planning method use**

Variable	1	2	3	4	5
<b>Link to CBD agent</b>					
Advice network					
Isolate	ref	na	na	na	na
Indirect link	1.3	na	na	na	na
Direct link	1.9	na	na	na	na
Family planning network					
Isolate	na	ref	na	na	na
Indirect link	na	0.7	na	na	na
Direct link	na	2.0	na	na	na
<b>Location of family planning discussion partners</b>					
No partner	na	na	ref	na	na
In village only, indirect CBD link or no link	na	na	4.9	na	na
In village only, direct CBD link	na	na	10.8**	na	na
Out of village only	na	na	12.6**	na	na
In and out of village	na	na	1.5	na	na
<b>Personal network knowledge exposure</b>					
Advice network	na	na	na	1.1	na
Family planning network	na	na	na	na	1.0
<i>Model pseudo-R<sup>2</sup></i>	<i>0.11</i>	<i>0.12</i>	<i>0.23</i>	<i>0.11</i>	<i>0.11</i>

\*\*p<.01. Notes: All analyses control for sex, age, marital status, children ever born, socioeconomic status, occupation and education. ref=reference category, na=not applicable.

each network can also be described as selection differences. Individuals being asked to name those with whom they discuss life concerns and those with whom they discuss family planning are being asked to make choices between their relationships. Individuals' closest personal networks tend to comprise similar people with similar interests and preferences, which could include beliefs and actions about child-bearing or family planning use. We cannot know to what extent results by connection to CBD agent reflect the similarities that people have with one another in general or specifically reflect the work of CBD agents. However, because these two networks differ, we conclude that there is a qualitative difference in the information communicated within them, and that the makeup of the family planning network reflects, at least in part, the agents' active communication with community members.

Consistent with diffusion of innovations theory,<sup>12</sup> we found, in general, an association between outside information sources and family planning use. We did not find, however, a progression of higher knowledge and a better attitude toward family planning among groups with communication sources outside the village. This suggests that the sequence of change in knowledge, attitude and then practice did not occur here; other studies have also reported deviations from this sequence.<sup>13</sup>

This deviation may help explain the relationship found between knowledge and concerns. The data suggest that concerns about family planning are directly related to knowledge about it, but cannot indicate the direction of causality between these two variables. People may learn about a method while using it. If they experience health problems while using the method, they may associate the problems with the method, and this may exacerbate their concerns. This is not to suggest that the findings about method concerns should not be taken seriously. Respondents expressed

a substantial level of concern about family planning use and potentially debilitating side effects. In addition, both those with and those without family planning method experience indicated fear of and discomfort with many methods. The finding that individuals with the highest expected rates of family planning use (those with the highest levels of knowledge and those who named family planning discussion partners both within and outside the village) had low rates of actual use is the strongest indication that method concerns are a serious issue in this context.

This article has illustrated how network analysis can contribute to the understanding of a community-based program. We further suggest that it could serve as a key component in the process evaluation of these programs, allowing more thorough measurement than other methods of the degree to which agents have delivered the intended messages, imparted knowledge and influenced behavior change, and whom they have reached. Network methodology could serve as a program monitoring tool to examine the extent to which family planning CBD agents have reached the community, particularly in instances in which community members learn about methods from the agents but purchase them elsewhere. Through measurements at a few time points, program monitors could assess the degree to which communication with CBD agents has affected behavior in the community, and how much the agents have been able to reach different members of the community.

### Limitations

This research effort has a number of limitations. The most severe limitation is the cross-sectional nature of the study, which prohibits discussion of any causal claims. We cannot know whether people began using family planning following and because of communication with CBD agents, or if people who communicate with CBD agents are similar to CBD agents and are therefore more likely to practice contraception regardless of the community-based program. Additional study time would further the understanding of how the village network changes in shape and form over time when discussing both advice and family planning. This information would help to clarify the nature of the relationships between the agents and their fellow villagers.

The second limitation is the degree of context we were able to measure. The questionnaire asked about the types of concerns respondents had regarding different family planning methods, but details about their concerns in the context of their or others' family planning use were not well captured. Having more in-depth information could have improved our understanding of the relationship between concerns and knowledge found in these data. Further research should consider the content of discussions once the discussion partners are identified. It is important to understand whether communication networks amplify the concerns of the community or alleviate them. This research would have been improved by the addition of a systematic qualitative component that included in-depth, open-ended interviews. Concerns about side effects, hypotheti-

cal or experienced, need to be better understood to both assist CBD agents in performing their work and aid clients in obtaining quality care.

The third limitation is that sociometric network analysis, the kind we used in this study, requires collecting data from a complete network so that all possible links will be included; it therefore requires a clearly defined boundary to the community. However, the village boundary may not be exact. The boundary we used was based on villagers' and village leaders' descriptions, but like many boundaries, it was fluid. Therefore, whether the entire village community was included in the communication networks examined, and whether the distinctions between in and out of the village were clear, may be affected by this limitation.

### Conclusion

This case study of Mandrosohasina showed that the two CBD agents in this village were centrally located in the family planning network, and that one agent was centrally located in a general advice-seeking network. Additionally, we showed that communication with CBD agents was associated with family planning knowledge; however, there is evidence that levels of legitimate concern about method side effects were high and may hinder use of family planning. Classic examples of diffusion were also present in Mandrosohasina, as evidenced by the finding that those with communication ties exclusively to people outside the village were the most likely to use family planning.

We have shown how network analysis can be used to examine whether community-based agents working in a particular locale are integrated into the target community, and whether their communication is associated with elevated levels of knowledge and behavior change. This methodology contributes to an understanding of both the inputs from the agent in effecting the adoption of an innovation and the natural process of diffusion from other information sources. Studies from countries in Sub-Saharan Africa, in particular, have reported equivocal findings concerning the effectiveness of community-based programs, and there has been little explanation for the failures.<sup>14</sup> By providing a means by which to examine community-based agents' patterns of communication, and their effects on family planning use, the network analysis methodology may help explain why these programs fail and suggest strategies for making them more successful.

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## RESUMEN

**Contexto:** Los programas de planificación familiar que recurren a la distribución comunitaria de anticonceptivos (DCA) no siempre han tenido éxito en el África Subsahariana. Es limitado el conocimiento que se tiene acerca del éxito o fracaso de estos programas.

**Métodos:** En 1999, se entrevistó a un total de 159 mujeres y hombres en edad reproductiva en una población montañosa de Madagascar, la cual contaba con un programa DCA activo. Se utilizó un análisis de redes, complementado por pruebas de Chi-cuadrado y análisis de regresión múltiple, para comprobar si la comunicación de los entrevistados con los agentes de planificación familiar y con gente de fuera de su pueblo estaban relacionados con su conocimiento y uso de servicios de planificación familiar.

**Resultados:** Los agentes de DCA estaban colocados en una posición muy importante dentro de la red de planificación familiar de esa población; el 35% de las mujeres y el 19% de los hombres se comunicaban directamente con los agentes de DCA acerca de los servicios o estaban indirectamente vinculados con un agente. El conocimiento sobre la planificación familiar estaba relacionado con tener un acceso directo o indirecto con uno de estos agentes. El uso de un método anticonceptivo moderno estuvo asociado con dos variables—con haber comunicado sobre planificación familiar sólo con alguien de fuera de la población (razón de momios, 12,6) y con haber intercambiado información sobre la planificación familiar sólo con alguien del pueblo junto con tener una vinculación directa con un agente DCA (10,8).

**Conclusiones:** El análisis de redes puede mejorar el conocimiento del funcionamiento de los programas DCA en aportar una forma de examinar de quién se recibe la información y quién es influenciado por los agentes de distribución de servicios.

## RÉSUMÉ

**Contexte:** Les programmes de distribution communautaire de planning familial ont remporté un succès mitigé en Afrique subsaharienne. Les raisons de réussite ou d'échec de ces programmes sont peu connues.

**Méthodes:** En 1999, un total de 159 femmes et hommes en âge de procréer ont été interviewés dans un village des hautes terres de Madagascar disposant d'un programme actif de distribution communautaire de planning familial. L'analyse de réseau informée par tests chi carré et régression multiple a servi à déterminer si la communication des répondants avec les agents du programme et l'emplacement de leurs partenaires de discussion au sujet de la contraception étaient associés à leur connaissance et pratique du planning familial.

**Résultats:** Les agents communautaires étaient nettement au centre du réseau de planning familial du village: 35% des femmes et 19% des hommes communiquaient directement avec un agent sur les questions de planning familial ou étaient indirectement liés à un agent. La connaissance du planning familial était associée à un lien direct ou indirect avec un agent communautaire. La pratique d'une méthode moderne l'était avec la discussion du planning familial avec une personne extérieure au village seulement (rapport de probabilité de 12,6) ou avec la discussion de la question dans le village et la communication directe avec un agent (10,8).

**Conclusions:** L'analyse de réseau est utile à la compréhension du fonctionnement des programmes communautaires en ce qu'elle permet de déterminer qui reçoit l'information des agents et qui en subit l'influence.

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