

Social network and social normative characteristics of married adolescents participating in a family planning intervention in rural Niger: associations with family planning use

Abstract

In this study we analyzed the social networks of married adolescents in rural Niger (N=322) as part of a family planning (FP) intervention. Girls were asked to name individuals important in their lives (alters) using three different name generating questions as part of a larger survey including questions about reproductive health, social norms, and FP. Each girl was asked specific questions about their alters. One alter per girl was then separately interviewed (N=250), with a subset of questions asked of the primary girl respondent. We found that girls with no alters were more likely to be nulliparous, and that those with the most alters had participated in the intervention. Alters of treatment participants were more likely to have heard of the intervention and more likely to have used FP. Respondents were more likely to have used FP when their sisters or in-laws had, but there was no correlation with friends.

Introduction

Though many sub-Saharan African countries have gone through significant demographic changes, Niger has seen few advances in health indicators and remains the country with the world's highest total fertility rate (7.6 births per woman) and adolescent fertility rate. (Institut National de la Statistique, 2013) In Niger, child marriage is highly prevalent with about one-fourth of girls married by the age of 15 and three-fourths by the age of 18. (Institut National de la Statistique, 2013) Importantly, work in low- and middle-income countries (LMICs) shows that girls married early lack decision-making power, particularly with respect to health-related decisions like contraceptive method use. (Hameed et al., 2014; Shahabuddin et al., 2017; Shahabuddin et al., 2016) While this indicates that others are either making or significantly influencing contraceptive use decisions for girls, little is known about the social networks and norms that influence girls attitudes and practices related to family planning (FP).

A social network approach to FP interventions amongst adolescent wives can work in multiple directions. Demographic research suggests that adoption of FP is frequently associated with an *ideational shift*, or a shifts in thinking including changes in ideas around the benefits of large families, the acceptability of FP with proximal networks, and self-efficacy to successfully acquire and use FP (Babalola, John, Ajao, & Speizer, 2015; Kincaid, 2000; Montgomery & Casterline, 1996). On the one hand, because young wives like those in Niger may not make the decisions regarding their own fertility, a social network approach can help identify social barriers to a girls uptake. On the other hand, a social network approach can help intervention programmers understand the possible diffusion of FP messages from the girls they are engaging to others in the community. Diffusion of intervention messages is a critical but often overlooked aspect of the impact of an intervention in a community (Kohler, Behrman, & Watkins, 2000). FP interventions frequently work specifically with individual women, therefore evaluation studies often fail to assess the impact of the intervention on the social context. In

both the case of networks as barriers or networks facilitating diffusion, an understanding of social norms within these populations is a crucial piece of the puzzle.

Prior research has delineated two fundamental mechanisms by which diffusion can occur: social learning and social influence (Kohler, Berman, & Watkins, 2001; Lowe & Moore, 2014; Montgomery & Casterline, 1996; Shakya, Christakis, & Fowler, 2014). Social learning occurs when an individual observes others adopt a new behavior, and concluding that the behavior has some utility, decides to adopt it herself (Cislaghi & Shakya, 2018; Maccoby, 2007). This is consistent with what social psychology scholar Cialdini has termed *descriptive norms* (Cialdini, 2007). Descriptive norms are behaviors people engage in that can be observed in the environment. Seeing others engage in those behaviors individuals are likely to conclude that the behavior is appropriate and that it may have some utility. Social influence occurs when others actively strive to influence the behavior of another. This is a case of *injunctive norms*-behaviors around which others in one's proximal network have some perceived stake (Cialdini et al., 2006; Cislaghi & Heise, 2018). In the case of injunctive norms, violating the norm may mean a social sanction such as disapproval or ostracization (Mackie, Moneti, Shakya, & Denny, 2015). Norms against FP held by proximal people in a girls network may impede her ability to adopt FP even if she herself would like to. Similarly such norms would work against a possible diffusion effect. However if FP diffuses by social learning, then injunctive norms are not at play and simply exposing people to the new information may be sufficient to instigate change.

There is evidence that in some contexts, FP adoption messages may spread through diffusion (Gayen & Raeside, 2010; Murphy, 2004). A study on a FP media campaign conducted in a community in rural Nepal found that approximately half of the community was exposed to the program indirectly, meaning that they heard of it through someone else, and that those reached indirectly had a high likelihood of adopting FP (Boulay, Storey, & Sood, 2002). The authors determined that once this indirect effect was accounted for, the overall reach of the program was 50-75% greater than initially reported. In Malawi, researchers conducted qualitative interviews with community members about FP communication, and found that people in the community heard about FP primarily through discussion (Paz Soldan, 2004). Women spoke to each other in depth about the intricacies of FP use, such as methods, side effects, and covert use while men discussed the issue of limiting family size in general. In rural Kenya, research showed that social learning dynamics were primarily at play, and that network impacts were stronger for men than for women (Behrman, Kohler, & Watkins, 2002). However complex dynamics around FP uptake were also identified. In areas where there were active markets, and people were frequently exposed to individuals outside of their proximal networks, social learning was the dominant means by which FP ideas spread. However in areas with less outside interaction, family planning decisions were mainly determined by social learning (Kohler et al., 2001). Research in rural Honduras found that while social influence at the community level may play a role (Shakya, Weeks, & Christakis, 2019), the factor most strongly associated with adolescent birth is the adolescent birth experiences of proximal network members (Shakya et al., under review).

Social influence is a trickier dynamic than social learning, partially because social influence works within the context of injunctive norms. The maintenance and enforcement of injunctive norms involves more complex levels of social reinforcement. The reference groups, or the people to whom an individual turns for expectations regarding appropriate behavior

tend to be more proximal (Mackie et al., 2015), and the level of influence stronger the more densely connected the individuals within the networks (Kohler et al., 2001; Madhavan, Adams, & Simon, 2003). Injunctive norms can be difficult to change, but once changed may be more sustainable. Injunctive norms around FP are often strongly tied to fertility norms (Madhavan et al., 2003), and programs that do not successfully address fertility norms may increase the use of FP, while making no impact on overall fertility (Murphy, 2004). Injunctive norms against FP use may also be in the domain of the husband rather than the wife. In Mali women reported that their husbands were unwilling to allow them to use contraception because its use was associated with a reputation for marital infidelity, and violated local fertility norms (Bove, Vala-Haynes, & Vallengia, 2012). In Uganda, community level aggregate gender role norms attenuated the effect of perceived benefit on FP use (Paek, Lee, Salmon, & Witte, 2008). While the woman's report of the perceived benefit of FP use was predictive, that association was weaker in communities in which people reported support for inequitable gender roles.

The vast majority of FP interventions target wives, and while some interventions engage male partners, they are less likely to succeed in the long-term because they do not engage the girl's social network to transform social norms. To improve FP utilization in this population, it is crucial to make significant and sustainable changes in the norms that shape FP attitudes, norms and behaviors, including those related to women's reproductive autonomy. This study is one of the first in Francophone West Africa to collect social network data specific to married adolescent girls' social norms regarding FP. The results we present represent a significant advance in current understanding of the motivations for use or non-use of contraceptive methods and have the potential to inform innovative approaches to create demand for family planning (FP) services among highly vulnerable populations. Here we analyze the characteristics of girls reported networks; the associations of girls' perceptions of their network members (perceived norms) with girls' FP use; with the self-reported behaviors of network members and girls' FP use; and how the nature of the relationship between the respondent and her network members potentially moderates these associations.

Methods

Data Source

The present social network analysis was conducted among married adolescent girls and their husbands in 16 villages in the Dosso district of the Dosso region of Niger as a supplement to the Reaching Married Adolescents (RMA) study (a study to assess the effectiveness of a family planning intervention among married adolescent girls and their husbands in Niger). Data from the primary study were collected across 48 villages clustered within the Dosso, Doutchi, and Loga districts (16 villages per district) in the Dosso region of Niger as part of the baseline data and Time 2 collection for a cluster randomized control trial evaluating Reaching Married Adolescents, a family planning use promotion intervention that targets married adolescent girls, their husbands, and communities led by Pathfinder International. Participants were administered surveys at baseline (2016) and Time 2 (2018). Of the 16 villages in each district, 4 were randomly assigned to the control condition. Villages were randomly selected among all of

those meeting the following inclusion criteria: 1) having at least 1000 permanent inhabitants; 2) primarily Hausa or Zarma-speaking (the two major languages of Niger); and 3) including no known recent intervention specifically around family planning or female empowerment with married adolescent wives or their husbands.

Twenty-five married female adolescents ages 13-19 years from each of the 48 villages and their husbands were randomly selected from a list of all eligible married female adolescents provided by each village chief. Eligibility criteria for the married female adolescents include: 1) ages 13-19 years old; 2) married; 3) fluent in Hausa or Zarma; 4) residing in the village where recruitment was taking place with no plans to move away in next 18 months or plan to travel for more than 6 months during that period; 5) not currently sterilized; and 6) provided informed consent to participate. Of those who were randomly selected, 81.6% participated in the baseline survey. The major reason for non-participation was the inability to locate many of the households included on the original list provided by the chief. No significant differences in wife age, husband age, or time spent away from the village were observed across those who did and did not participate.

Separate surveys with the young women and their husbands were conducted by sex-matched trained research assistants from the Dosso region who could fluently read and speak French and fluently speak Hausa and/or Zarma. Research assistants visited the randomly selected households and conducted a Household Recruitment Screener to confirm eligibility. If the household was found not to include an eligible wife and husband dyad, a randomly selected replacement was recruited in their place. Up to three visits were made to each of the selected participants, after which no additional efforts were made.

Surveys were administered in a private location (out of earshot of another person, a place the participant indicated as private, typically in an outside area) in the village. Surveys were conducted in either Hausa or Zarma language, depending on participant's language preference. The survey took approximately 40-60 minutes to complete and was administered using pre-programmed tablets.

The social network module

Data for this analysis were taken from the Social Networks Module of the main RMA study Time 2 survey plus a separate module administered to one nominated social contact (referred to here as *alters*) per RMA participant. The social networks module of the main RMA study Time 2 survey was administered only to respondents in the Dosso district, including those enrolled in the RMA intervention and controls. All participants (adolescent wives and their husbands) in the 16 selected villages were asked three questions to identify the names of individuals important in their lives. These questions were chosen after in-depth qualitative network interviews that allowed us to assess how these questions would perform as possible predictors of family planning use. Questions included: 1. Who do you trust to talk to about personal and important matters, 2. With whom do you discuss decisions about family, including decisions around fertility and family planning and 3. Any additional people who helps you make decisions about delaying or spacing pregnancy. For each of these three questions, participants could

name up to three alters. Participants were asked to rank these (up to nine) people in on a ladder scale of 1-6 on how influential they are in the participants life.

Because husbands were interviewed as part of the main RMA study, we asked participants to name alters besides their husbands. Alters could be anyone within the village over the age of 13, regardless of gender or relationship. For each person nominated, participants were asked a series of follow-up questions to help understand influential relationships and identify the alter for follow up interview including: name, place of residence, gender, relationship to participant, age, marital status, and number of children. After all RMA respondents were interviewed and had nominated alters, final alter lists were compiled. Alters were approached, recruited, consented for participation, and interviewed by trained, gender-matched Research Assistants (RAs) fluent in French and Hausa and/or Zarma (local languages) using pre-programmed tablets. The alter survey took approximately 45-60 minutes to complete, and included a subset of questions from the main RMA survey, including reproductive health history, use of modern contraception, social norms and attitudes around gender roles, and approval of contraception use. Alters were also asked to nominate alters via the social network module questions, although none of the alters' alters were interviewed. At no point was it disclosed to alters who had nominated them. This study was approved by the Institutional Review Board (IRB) of the University of California San Diego (UCSD) as well as the Nigerian Ministry of Health IRB. Because the alter survey consisted of a subset of questions from the main RMA study survey (which included the Social Networks module), alters, when interviewed, were asked if they were participants in the main RMA study. If the alter was a primary participant (including the participant's husband or wife), their nomination was noted but they were not re-interviewed as an alter since their data would have already been captured in the main RMA study survey.

Measures

Data for the current study, therefore, come from two separate sources. First we have, the primary participants survey, including their own behavioral and demographic measures, as well as their answers to the social network module. Besides the identifying characteristics and demographics provided by the primary participants about their alters, participants were asked questions to assess their perceptions of the alters support for family planning, support for men who listen to their wives fertility preferences, and belief in optimal age for a first birth after marriage. Second, we have data from the Alter survey with measures for one alter per primary respondent. The Alter Survey included a subset of questions asked of participants in the main survey including: 1. Socio-demographics and reproductive history, 2. Use of modern contraceptive methods, 3. Acceptance of modern contraceptive methods, 4. Behavioral intentions regarding contraceptive method use, 5. Perceived social norms regarding gender roles, intimate partner violence (IPV), fertility, etc., 6. Women's autonomy. Alters were also administered a Social Network Module in which they nominated alters but these second degree alters were not interviewed See Figure 1 for a visualization of the data collected.

Analysis

Consistent with the two sources of data, analysis was divided into two primary components. In the first component we analyzed the primary respondents' answers to questions about their alters, and looked at them in conjunction with their answers regarding their own behaviors. A total of 322 female respondents were administered the social networks survey. Of those 283 provided information regarding at least one alter. The remaining 39 female respondents (12%) noted no one that they could name in response to the network questions. Matching each respondent with each of their alters resulted in 439 unique dyads, an average of 1.36 alters per respondent, which is what we used for this first analysis. Because participants who named more than one alter would be represented in the data more than once, we used a general estimating equation in our regression analyses to adjust the standard errors for multiple observations of the same participants. Analyses used adjusted logistic regression models, controlling for girl's baseline parity, education, age, age at marriage, age difference between herself and her husband, number of alters, and husband's baseline migration. The second component of the analysis used data from the Alter survey (N=250), with alters' own responses to questions regarding their own attitudes and behaviors. Alter surveys were matched with the nominating primary respondent so that associations between the respondents and their alters could be assessed. For each participant we interviewed one alter, ideally the one which they named first as being the most influential, but if that person was not available we attempted to interview the second most influential. Of the 283 participants who named alters, we were able to interview alters for 250 of them (87%). Of these 4 were men, who we excluded from the present analysis. Again for analyses that included information from both respondents and their alters, we used dyadic analyses, but because each respondent only had one alter in the alter survey, there were no repeated observations of any of the respondents. Analyses were adjusted multi-level logistic regression models, clustering on village and controlling for alter age, alter parity, number of alters named, and alter education.

Results

Descriptive

Participants on average nominated 1.36 (SD 0.81) people. The majority named 1, but 40% of participants nominated more than one person. The alter relationships identified by participants included friends (37%, mean age), her family (29%, excluding mother or sister), mothers (5%), sisters (11%), and in-laws (10%). A large portion of respondents were unable to provide any answer regarding the alters age. All alters with the exception of 4 were female, and almost all alters were married (95%). Despite the fact that many respondents were unable to provide the age of the alter, all of them could provide the alters number of children (mean 2.6, SD 2.0).

Network composition

Our first analysis was to get an understanding of the 12% of respondents who did not nominate anyone as an alters. We found that girls with no alters were more likely to be nulliparous [AOR AOR 2.48 (95%CI 1.01,6.12)], and to be more than 4 years younger than their husband [AOR 1.08 for each year of age difference (95%CI 1.00-1.17)]. We then looked to see if the type of alter differed for nulliparous compared to parous girls (Figure 2). We found that girls who nominated mothers [AOR 0.38 (95% CI 0.11-1.14)], sisters [AOR 0.43 (95% CI 0.17-1.13)] and in-laws [AOR 0.30 (95% CI 0.10-0.96)] were more likely to be nulliparous than those who nominated friends. Because of small cell size however, estimate for mothers and sisters are not statistically significant at $p < 0.05$. We also found that while participants in the RMA intervention were no more likely than controls to have nominated any alters, they were 1.98 times more likely (95%CI 1.04-3.79) to nominated more than one alter.

Respondents reports on alters

We next looked at the respondents reports of whether they think their alter would support their use of family planning, support men who listen to their wives' fertility preferences, and how soon alter thinks a new wife should have her first baby. Overall respondents were likely to believe that alters support a first birth within one year of marriage, with a significant proportion (25%) saying that they don't know. Categorizing a longer first birth timing for adolescent girls (2 plus years, i.e., recommended birth spacing) and shorter (less than two years or don't know), we found that RMA intervention participants were 2.25 more likely than controls (95%CI 1.07-4.73) to think that their alters support a longer time for first birth, as were respondents with a greater number of alters (AOR 1.8 (95%CI 1.18-2.7) for each additional alter). Treatment respondents were also more likely to think that their alters would support their use of family planning AOR 3.53 (95%CI 1.81-6.86), and to think that alters would support a man who listens to his wife's fertility preferences (AOR 2.9 (95%CI 1.6-5.3), as were respondents with more alters [AOR 1.43 (95% CI 0.93-2.21) for the former, AOR 2.9 (95%CI 1.6-5.3) for the latter]. See Figure 3 for a representation of treatment versus control respondents on all three measures. When we broke down the respondent's belief in whether their alter would support the respondents use of family planning, there was evidence that respondents who believed that alters who were extended family members and mothers were less likely to support respondent FP use, though due to small cell sizes this did not reach significance.

For our last analysis using the primary respondents survey, we consider respondents use of family planning. We find that alters who have ever used family planning, or are currently using modern family planning, are more likely to believe that their alter supports their use of family planning [AOR 2.89 (95%CI 1.4-5.9) for ever use and AOR 2.27 (95% CI 1.1-5.7) for current use]. Looking a little further, we find that the association between respondents use of family planning and their perception of alter's support of family planning is significant for new users (those who had not reported ever using at baseline), but not for previous users (see Figure 4). Respondents with no alters are less likely to have used family planning, although this is partially attenuated by parity. Including parity in the model dampens the association of having no alters, but does not eliminate it. The chance that a respondent reports ever having used family planning also differs by who that respondent has named as an alter. Respondents who name

mothers are alters are significantly less likely to have used family planning than those who named friends [AOR 0.25 (95%CI 0.08-0.87)].

Alter demographics

In the second component of our analysis, we looked at the alter survey. The proportion of alters in each relationship category was very close to what we observed in the respondent survey, however in this case, because we were interviewing alters directly, we had accurate measures of alters age. Alters on average were 7 years (SD 8.5) older than the respondent, but this varied by type of relationship. Mean ages for alters were: 38.7 years for mothers (SD 10.6), 23.1 for sisters (SD 5.7), 28.5 for extended family (SD 11.7), 24.6 for in-laws (SD 8.5), and 21.5 for friends (SD 5.4). It is interesting to note that the in-law category was relatively young, and did not fit the age profile of an elder in-law, but was more consistent with women closer to the respondents own age (e.g., a sister-in-law or co-wife).

Alter RMA associations

One of the research questions that inspired the social network module, was whether there was evidence for diffusion of the RMA intervention. Our first question then was whether or not alters that were nominated by RMA intervention participants were familiar with the RMA program (excluding those who were themselves RMA participants). We found that 60% of treatment alters reported familiarity with the RMA program, and of those, approximately half had discussed it with other people, primarily with friends. We then found that alters who were nominated by RMA intervention participants were more likely to have reported ever use of family planning as compared to alters of control participants, AOR 2.29 (95%CI 1.07-4.93), but that this association was lost when knowledge of the RMA program was included in the model. A cross-sectional mediation analysis was significant ($p=0.03$ with 40% of the direct effect explained by the mediation), suggesting that being nominated by an intervention respondent led to knowledge of RMA, which potentially increased the likelihood that the alter used family planning (see Figure 5). We would like to emphasize, however that these results are cross-sectional, and using a relatively small sample size, so we would be remiss to make any claims regarding causality. However, the results are compelling evidence towards diffusion of the intervention effect and warrant further investigation.

Association between respondent and alter FP use

To investigate 1.) whether socially connected people (i.e., respondents and their alters) in this context are similar in their use of modern contraception, and 2.) whether this differs by relationship type. We then conducted analyses of the associations between the respondents use of modern family planning and that reported by the alter. We first looked descriptively at the alter's reported ever use of modern family planning by relationship to the respondent. We found that mothers were significantly less likely to have used family planning compared to most other groups [for example age-adjusted odds of mothers using family planning are 0.30 compared to friends]. Our next finding is that there is evidence of an association between the respondent's family planning and that of the alter, but it is not quite significant at $p<0.05$ [AOR 1.65 (95%CI 0.92-2.97)]. However when we break that analysis down by the alters relationship

to the respondents we find that the association between the respondent and the alter's use of family planning varies greatly. Respondents ever use of family planning is strongly associated with that of alters in the in-law category and the sister category, but not at all related to that of friends or extended family. Respondents ever use of family planning is, however, significantly associated with perceived approval by extended family, but not by in-laws or friends (Figure 6).

Our final set of analysis will include the social networks of the alters, looking at the association between alters perception of their alters, and their own use of family planning as well as that of the primary respondent.

Discussion

We used rare social network and reproductive health data from rural Niger to look at the social network and social normative factors that are associated with family planning use among married adolescents. We had several compelling findings that provide a unique understanding of the social contexts of these married adolescents, as well as the association with that context on FP use.

We first found that there were several distinct factors related to being socially isolated, measured here by the inability to name any alters in the survey. Girls that were nulliparous and girls that were significantly younger than their husbands were more likely to be socially isolated. These girls were also less likely to nominate friends, more likely to nominate mothers, and much less likely to have used family planning. It is not surprising that in a high fertility country like Niger, with a cultural emphasis on motherhood and large families, girls who have not yet given birth will be unlikely to use family planning. However, the social isolation points to an interesting dynamic by which access to the larger community is potentially facilitated by motherhood. These girls were not only more likely to have nominated no one, but those who did were far less likely to have nominated friends, controlling for age and education.

There is an interesting and somewhat mysterious dynamic around girls' mothers that can only be answered with longitudinal data. Girls who nominated mothers are more likely to be nulliparous, to not have nominated friends, and to not have used family planning. Mothers are less likely than any other alters to have used family planning, and girls are less likely to think that mothers will support family planning use than other types of alters. Marriages in Niger are patrilocal, meaning that wives move into their husbands' home compound, usually with his nuclear and extended family. Unlike in India, where mother-in-laws significantly contribute to decision making around fertility, in this context mother-in-laws did not appear to play a major role. Many of these girls are still interacting with their mothers, but these mothers may be enforcing social norms of high fertility, low levels of autonomy, and reluctance to use family planning. It is clearly a complex dynamic that can only be untangled with further study.

As girls that have friends are more likely to use family planning, it would seem reasonable to think that there is a peer diffusion effect taking place in this context, as found in some other studies (Valente, Watkins, Jato, Van Der Straten, & Tsitsol, 1997). However our analysis showed

absolutely no correlation between the respondents use of family planning and that of her friends, and no correlation between the respondents perception of her friends approval of family planning, and her own use. The benefit of friendship, therefore, seems to be a result of increased autonomy and social access after childbirth, and unrelated to any shared interest or shared beliefs around controlling family size. Instead the strongest correlation between respondents and their alters on family planning use seems to be with in-laws, and with sisters. This is consistent with some prior research that has identified kin networks as important influences on family planning use, as kin are the ones with the highest stake in fertility outcomes (Musalia, 2005). While low fertility can reflect poorly on a girl and her family (Madhavan et al., 2003), high fertility puts an added strain on family members who are tasked with childcare assistance. In our own unpublished formative research in these communities, we found that many mother-in-laws were keen to limit fertility amongst daughter-in-laws as large numbers of children are difficult to care for, and often suffer from illnesses that add to the childcare burden. It is important to realize, however, that both in-laws and sisters in this sample are relatively young. These are not elders, but in an age range more consistent with slightly older peers. While girls may be observing in-laws use of family planning and potentially copying it (a descriptive norm facilitated by social learning), girls use is not correlated to whether these younger in-laws approve of her own use. The norm would therefore seem to be descriptive, or based on observation, rather than injunctive or based on overt social approval. The reference group for approval in this context may be the extended family. Again the average age of this extended family, while older than the girls, is much younger than that of the mothers.

Finally we observed differences between girls that were part of the RMA intervention and those that were not. Girls who were part of the RMA intervention were more likely to perceive that their alters supported family planning and healthy birth spacing, had larger networks, and named alters who were more likely to have reported ever of use family planning, potentially as a result of those alters also being more likely to know about the RMA program. While we cannot claim causality, there is evidence that the RMA program increased girls social networks, increased their likelihood of believing that their alters are supportive of healthy reproductive choices, and that the program messages diffused to girls' alters through knowledge of the program. Potential network diffusion of the messages in reproductive health programs in low resource countries is a tremendously important question in terms of program affordability and sustainability. Untangling the associations between increased social access, family planning use, and RMA intervention participation will be a crucial insight for intervention planning, including efforts to increase girls reproductive agency.

Our study has limitations. First, the data is cross-sectional, and therefore we cannot track time dependent changes. Second, the sample size is relatively small, and so while we were able to successfully capture many interesting dynamics, for some questions small cell sizes prevented us from being able to conclusively rule out certain possibilities. Third the data was collected in one district in Niger, and therefore regional cultural tendencies could impact how these results extrapolate to other locations, Finally, our respondents only provided answers to the first of our network questions, perhaps to due fatigue or lack of enumerator motivation to collect more

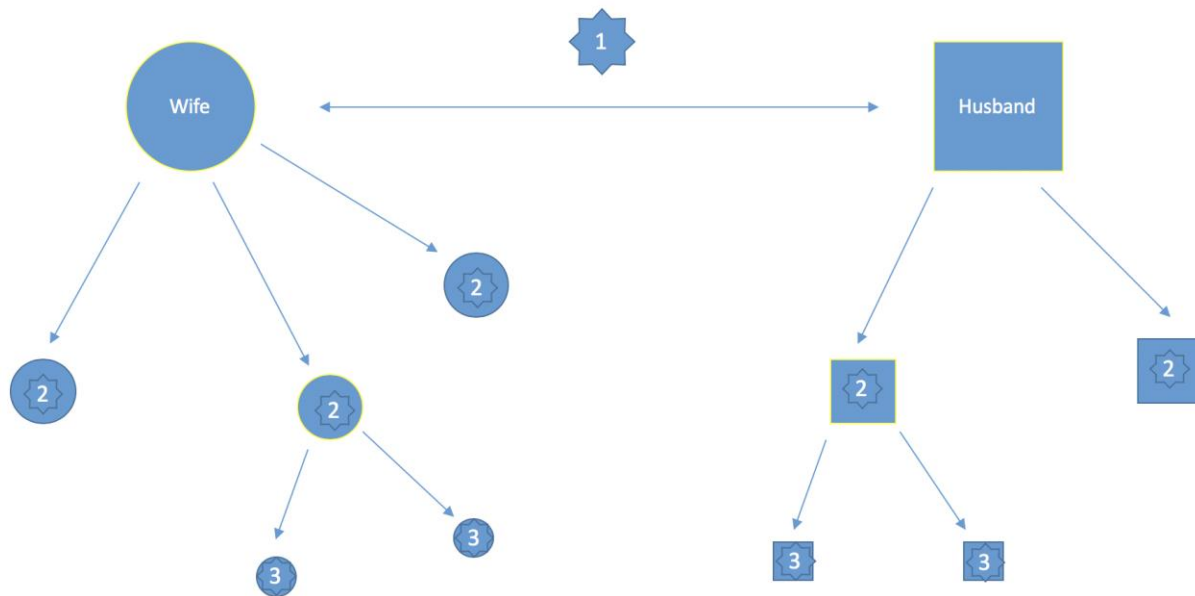
data. In our subsequent studies, we will attempt to ensure that respondents are accurately reporting the appropriate alters for each question.

Despite these shortcomings, our results provide very compelling evidence towards strong social dynamics around the use of family planning in these communities. Some of these findings were surprising, such as the non-correlation between girls and their friends in family planning use, and what seems to be an important role of mothers in family planning use, a girls social network, and the relationship with those dynamics and parity. While we cannot make any definitive conclusions with these findings, the relationships are statistically strong, and certainly warrant further research to investigate these dynamics more carefully. Access to and support for family planning for married adolescents in Niger, who have the highest fertility rates of almost any demographic sub-section in the world, is a crucial resource for promoting girls reproductive autonomy and the long term health outcomes of herself and her children. An understanding of how social dynamics impact the uptake and acceptability of family planning should be a key component of these efforts.

References

- Babalola, S., John, N., Ajao, B., & Speizer, I. (2015). Ideation and intention to use contraceptives in Kenya and Nigeria. *Demographic Research*, 33, 211-238.
- Behrman, J. R., Kohler, H.-P., & Watkins, S. C. (2002). Social networks and changes in contraceptive use over time: Evidence from a longitudinal study in rural Kenya. *Demography*, 39(4), 713-738.
- Boulay, M., Storey, J. D., & Sood, S. (2002). Indirect exposure to a family planning mass media campaign in Nepal. *Journal of health communication*, 7(5), 379-399.
- Bove, R. M., Vala-Haynes, E., & Vaggia, C. R. (2012). Women's health in urban Mali: Social predictors and health itineraries. *Social Science & Medicine*, 75(8), 1392-1399.
- Cialdini, R. B. (2007). Descriptive social norms as underappreciated sources of social control. *Psychometrika*, 72(2), 263-268.
- Cialdini, R. B., Demaine, L. J., Sagarin, B. J., Barrett, D. W., Rhoads, K., & Winter, P. L. (2006). Managing social norms for persuasive impact. *Social influence*, 1(1), 3-15.
- Cislaghi, B., & Heise, L. (2018). Using social norms theory for health promotion in low-income countries. *Health Promotion International*.
- Cislaghi, B., & Shakya, H. (2018). Social norms and adolescents' sexual health: an introduction for practitioners working in low and mid-income African countries. *African journal of reproductive health*, 22(1), 38-46.
- Gayen, K., & Raeside, R. (2010). Social networks and contraception practice of women in rural Bangladesh. *Social Science & Medicine*, 71(9), 1584-1592.
- Hameed, W., Azmat, S. K., Ali, M., Sheikh, M. I., Abbas, G., Temmerman, M., & Avan, B. I. (2014). Women's empowerment and contraceptive use: the role of independent versus couples' decision-making, from a lower middle income country perspective. *PLoS One*, 9(8), e104633. doi: 10.1371/journal.pone.0104633
- Institut National de la Statistique, I. I. (2013). 2012 Demographic Health Survey of Niger: Institut National de la Statistique, ICF International.
- Kincaid, D. L. (2000). Social networks, ideation, and contraceptive behavior in Bangladesh: a longitudinal analysis. *Social Science & Medicine*, 50(2), 215-231.
- Kohler, H.-P., Behrman, J., & Watkins, S. (2000). Empirical assessments of social networks, fertility and family planning programs: Nonlinearities and their implications. *Demographic Research*, 3.
- Kohler, H. P., Berman, J. R., & Watkins, S. C. (2001). The density of social networks and fertility decisions: Evidence from South Nyanza District, Kenya. *Demography*, 38(1), 43-58.
- Lowe, S. M., & Moore, S. (2014). Social networks and female reproductive choices in the developing world: a systematized review. *Reproductive health*, 11(1), 85. doi: 10.1186/1742-4755-11-85
- Maccoby, E. E. (2007). Historical overview of socialization research and theory. *Handbook of socialization: Theory and research*, 13-41.
- Mackie, G., Moneti, F., Shakya, H., & Denny, E. (2015). *What are Social Norms? How are they measured?* UNICEF and UCSD. New York.
- Madhavan, S., Adams, A., & Simon, D. (2003). Women's networks and the social world of fertility behavior. *International family planning perspectives*, 58-68.

- Montgomery, M. R., & Casterline, J. B. (1996). Social learning, social influence, and new models of fertility. *Population and Development Review*, 22, 151-175.
- Murphy, E. (2004). Diffusion of innovations: Family planning in developing countries. *Journal of health communication*, 9(S1), 123-129.
- Musalia, J. M. (2005). Gender, social networks, and contraceptive use in Kenya. *Sex Roles*, 53(11-12), 835-846.
- Paek, H.-J., Lee, B., Salmon, C. T., & Witte, K. (2008). The contextual effects of gender norms, communication, and social capital on family planning behaviors in Uganda: a multilevel approach. *Health Education & Behavior*, 35(4), 461-477.
- Paz Soldan, V. A. (2004). How family planning ideas are spread within social groups in rural Malawi. *Studies in family planning*, 35(4), 275-290.
- Shahabuddin, A., Nostlinger, C., Delvaux, T., Sarker, M., Delamou, A., Bardaji, A., . . . De Brouwere, V. (2017). Exploring Maternal Health Care-Seeking Behavior of Married Adolescent Girls in Bangladesh: A Social-Ecological Approach. *PLoS One*, 12(1), e0169109. doi: 10.1371/journal.pone.0169109
- Shahabuddin, A. S., Nostlinger, C., Delvaux, T., Sarker, M., Bardaji, A., Brouwere, V. D., & Broerse, J. E. (2016). What Influences Adolescent Girls' Decision-Making Regarding Contraceptive Methods Use and Childbearing? A Qualitative Exploratory Study in Rangpur District, Bangladesh. *PLoS One*, 11(6), e0157664. doi: 10.1371/journal.pone.0157664
- Shakya, H. B., Christakis, N. A., & Fowler, J. H. (2014). Social network predictors of latrine ownership. *Social Science & Medicine*.
- Shakya, H. B., Weeks, J. R., & Christakis, N. A. (2019). Do Village-Level Normative and Network Factors Help Explain Spatial Variability in Adolescent Childbearing in Rural Honduras? *SSM-Population Health*, 100371.
- Valente, T. W., Watkins, S. C., Jato, M. N., Van Der Straten, A., & Tsitsol, L.-P. M. (1997). Social network associations with contraceptive use among Cameroonian women in voluntary associations. *Social Science & Medicine*, 45(5), 677-687.



- Level 1:*** Interview each couple plus SNA
- Level 2:*** Interview one alter per respondent plus SNA
- Level 3:*** No interview of alter's alter

Figure 1: Primary respondents were couples interviewed individually (Level 1), during which time they were also asked the questions from the social networks module. One alter per participant was then interviewed (Level 2), including a social network survey. Alter's alters (Level 3) were not interviewed, however data was provided regarding them from the alter.

Did nulliparous and parous girls nominate different types of people?

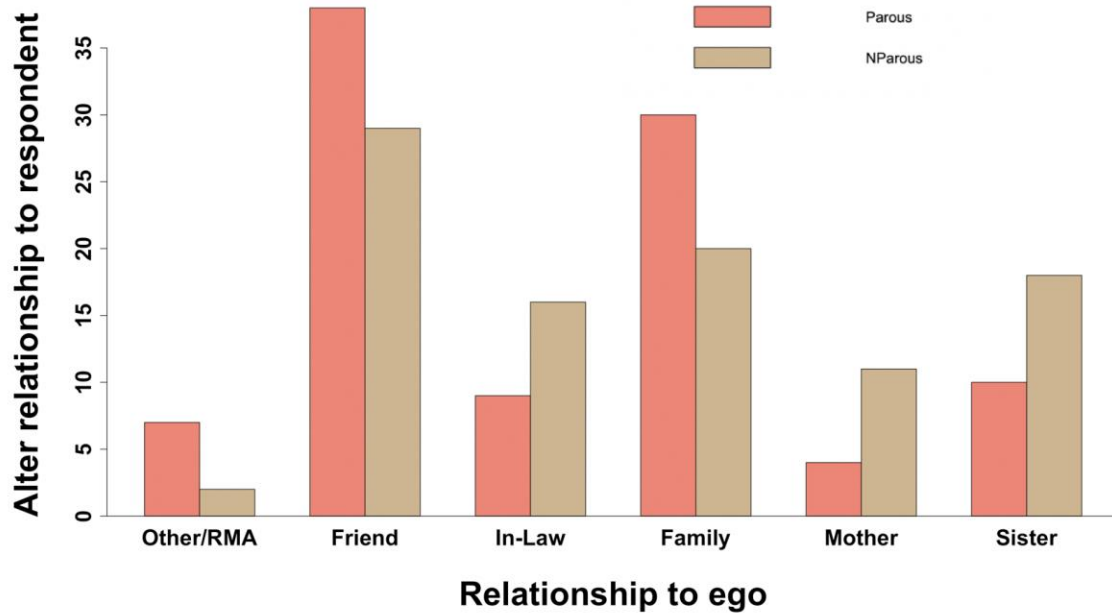


Figure 2: Difference between the types of relationships identified by parous versus nulliparous girls.

Treatment group respondents more likely to believe that alters support healthy practices

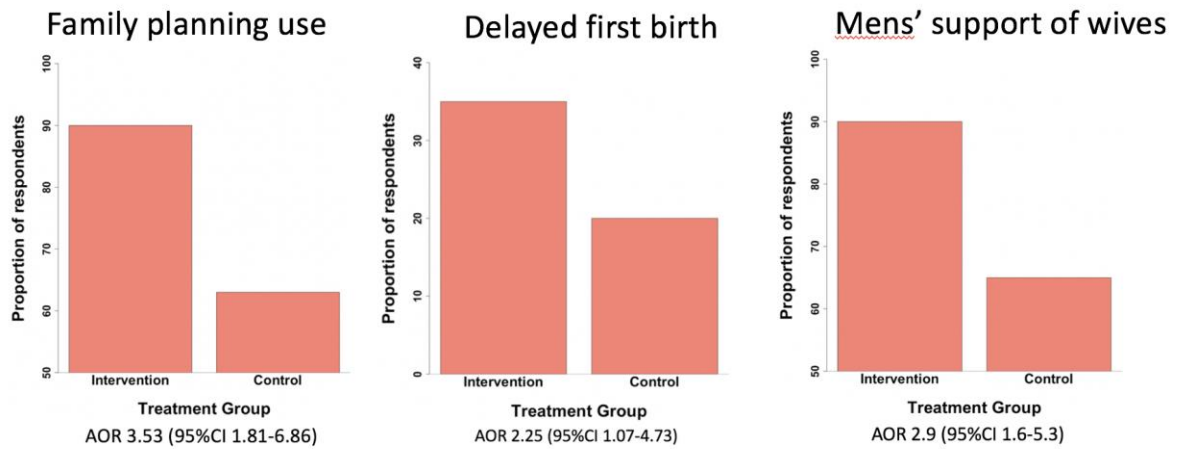
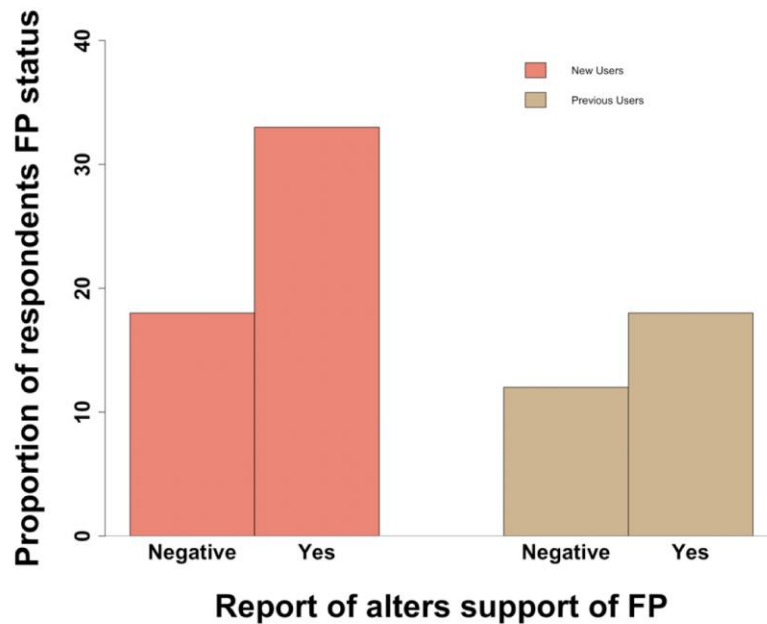


Figure 3: Compared to the control group, respondents in the RMA treatment group are more likely to report that their alters would be supportive of their family planning use, agree with a later amount of time between marriage and first birth, and would be supportive of men who listen to their wives fertility preferences.

Respondents who report alter supports their use of FP are more likely be new users



AOR 2.8 (95%CI 1.4-5.5) for new users



Figure 4: The association between the likelihood that a respondents believes that their alter supports FP and the respondents report of ever having used FP is significant for new users (those who did not report use at baseline), but not for previous users.

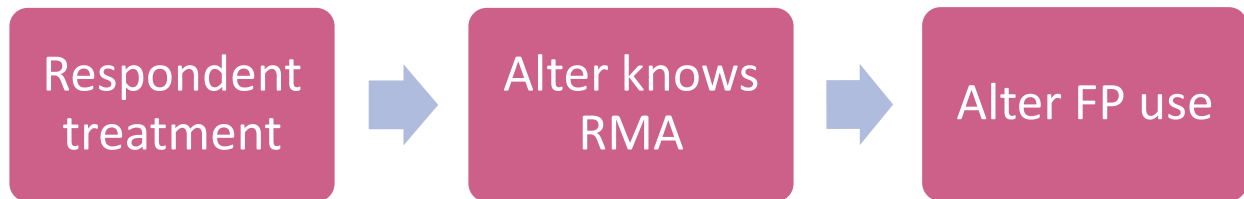


Figure 5: There is evidence of possible mediation between the association of a respondent's treatment group, and the use of FP by an alter through the pathway of the alter's knowledge of the RMA program. Longitudinal data will be necessary to understand this dynamic more clearly.

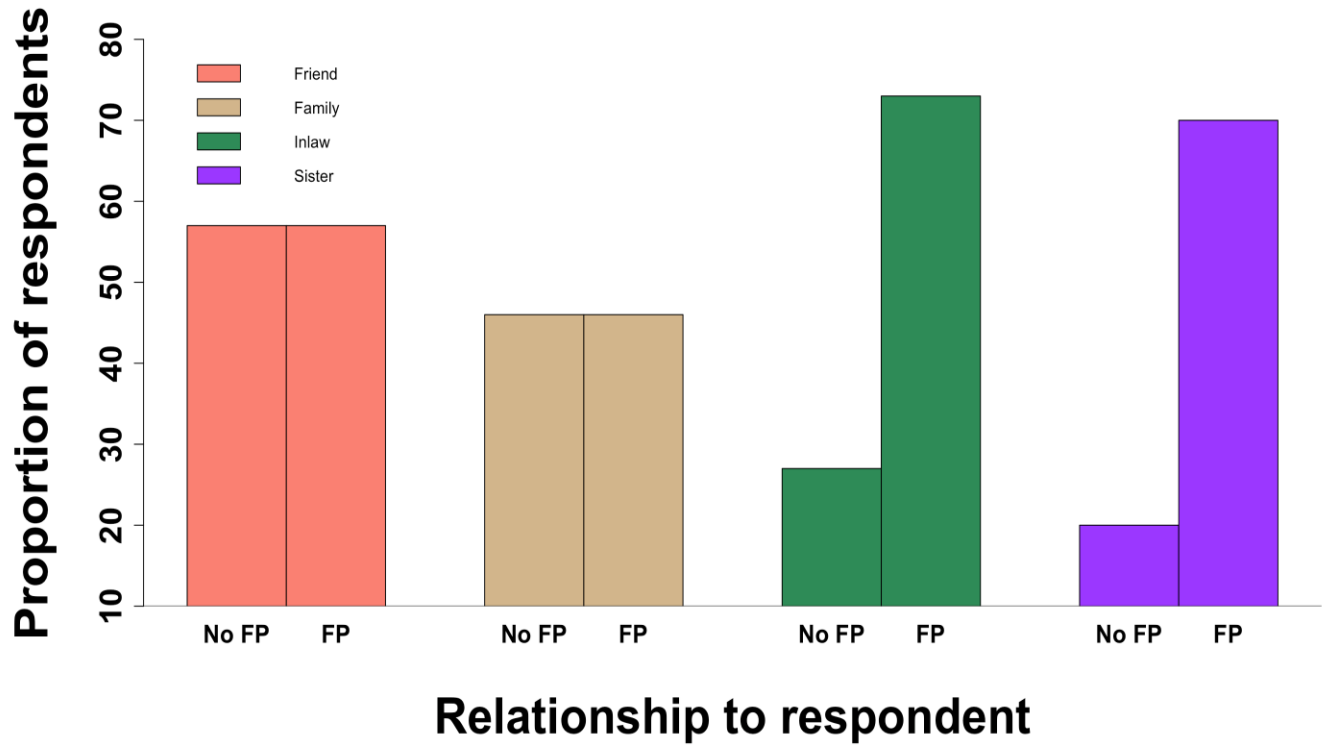


Figure 6: The association between the respondents use of FP (y axis), and the alters use of FP differs by relationship of the alter to the respondent (x axis). Respondents use of FP is strongly correlated with that of Inlaws and sisters, but not at all related to that of friends or extended family.