June 20, 2019

Title: Social Network-Based Methods for Measuring Abortion Incidence in Ethiopia and Uganda

Background:

Documenting the incidence of induced abortion provides valuable information about unintended pregnancy and the extent to which women are controlling their fertility post-coitally or post-conception, and may highlight deficiencies in reproductive health services. Further, in order to investigate policy impacts on abortion outcomes, documentation of trends in abortion incidence is needed. However, a major challenge in the field of abortion research is accurately measuring the incidence of induced abortion, especially in restrictive settings where abortion is more likely to be clandestine. Standard methods such as using administrative health records or surveying women directly tend to result in an underestimation of abortion incidence, that is a result of differential underreporting.[1,2] Over the past several years, the most rigorous and widely used method to estimate abortion incidence has been the Abortion Incidence Complications Methods (AICM).[3] However, the rise in medication abortion drug availability is increasingly allowing women to self-manage their induced abortions entirely outside the formal healthcare system. As such, abortions are becoming more hidden from the medical system and knowledgeable informants, which may be diminishing the accuracy of the AICM.

There is a growing body of research exploring the use of indirect estimation methods that rely on individuals' social networks to measure the incidence of abortion. The main assumptions shared by these social network-based methods are that 1) women will be more likely to report the abortions of their friends and family members rather than their own, and 2) women's social networks are, on average, representative of the general population.

One promising alternative is the Network Scale-Up Method (NSUM). Assuming respondents' social networks are, on average, representative, we can then measure the incidence of a hidden population by estimating the size of respondents' social networks, and then asking respondents how many people they know in the hidden population. Respondents' social network sizes are determined through a series of questions about members of their social networks for which the national prevalence is relatively rare and a known quantity. Then respondents are asked how many women in their network have had an abortion. Researchers have successfully used this method to estimate the size of many hidden populations.[4,5] One previous study used the NSUM to measure abortion incidence in Iran.[6] However, that study did not include a nationally representative sample, nor did it employ a number of internal validation checks that indicate how well the estimator is performing. A strength of the NSUM is that it produces nationally representative data and social networks are estimated irrespective of the hidden population of interest, removing potential biases and selection effects in who respondents report abortions on.

Another new indirect social network-based approach to investigating the incidence of abortion is the Confidante Method.[7–9] In this method, each respondent is asked to think of up to three women with whom she has a reciprocal relationship that includes sharing secrets. For each confidante, information is collected on her socio-demographic characteristics and whether she has had an abortion in a designated window of time. The main strength of the confidante method is that it affords a sense of anonymity while still allowing for the collection of women's background characteristics (an opportunity for sub-group estimation) and detailed information about each reported abortion, as respondents can provide more information for a smaller number of abortions.

The paper presents an application of the NSUM and Confidante Method for measuring abortion incidence in Uganda and Ethiopia through community-based surveys. We present one-year abortion

estimates in each country calculated from respondents' direct reports of abortion, the NSUM, and the Confidante Method. We compare these estimates to the most recent AICM in each country. We discuss the performance, strengths, and weakness of both the NSUM and Confidante methods, and we present a case for the use of both methods to better understand the incidence and safety of abortion in specific contexts.

Methods:

This study uses data from the 2018 round of the Performance Monitoring and Accountability 2020 (PMA2020) data collection in Uganda and Ethiopia, which includes a nationally representative survey of women of reproductive age. In 2018, 7,546 women were interviewed in Ethiopia and 4,288 in Uganda, half of which (Ethiopia: N = 3,815; Uganda: N = 2,196) were randomized to receive the NSUM module, and the other half of which were randomized to receive the Confidante module (Ethiopia: N=3,725; Uganda: N=2,089).

Self-Reported Abortions

Interviewers asked respondents directly if they had successfully ended a pregnancy in the past year. One-year incidence estimates were calculated as the number of women who reported an induced abortion in the past year divided by the number of women in the sample. Estimates were then multiplied by 1,000 to get the incidence per 1,000 women, and weighted using the PMA-generated individual sample weights.

Network Scale-Up Method

The first step in the NSUM is to determine the size of individuals' social networks. For the purpose of this study, women were considered to be a member of the respondent's social network if the respondent had been in contact with the woman in the past 12 months, whether in person, by phone, or over the computer. We use the "known population" approach to estimate network sizes,[10,11] where each respondent is asked to report the number of people she knows who have a certain characteristic. For example, respondents in Ethiopia were asked "how many women do you know who live in a household that owns a camel?" If a respondent reports that she knows 1 woman who fits this description, and we know from the most recent Ethiopian Demographic and Health Survey that approximately 529,000 women live in a household that owns a camel, we estimate that the respondent knows 1 out of 529,000 Ethiopians. We can then estimate that the size of her social network is 51 by multiplying 1/529,000 by the total number of women age 15-49 living in Ethiopia (26,737,000). The more "known population" questions asked of each respondent, the more accurate the network size estimate becomes. The formula for calculating personal network sizes using the maximum likelihood method is as follows:

$$\widehat{c_i} = \frac{\sum_j m_{ij}}{\sum_j e_j} * t$$

Here, $\widehat{c_i}$ is the estimated personal network size of respondent *i*, m_{ij} is the number of people with a particular characteristic *j* that respondent *i* knows, e_j is the size of the sub-population with characteristic *j*, and *t* is the size of the general population.[10,11]

The next step in the method is to estimate the size of the key population of interest. Each respondent is asked how many women they know who have ever done anything to successfully induce an abortion in the past year. One-year abortion incidence estimates in each country are calculated using the following formula:

$$\widehat{e} = \frac{\sum_i m_{ij} * \pi_i}{\sum_i \hat{c}_i \ * \ \pi_i}$$

In this case, $\widehat{e}$ is the estimated one-year induced abortion incidence estimate in each country, m_{ij} is the number of women that respondent *i* knows with characteristic *j* (induced abortion), π_i is the inverse probability of selection for respondent *i*, and $\hat{c}_i$ is the size estimated personal network size of each respondent *i* .[10,11]

Confidante Method

In order to identify confidantes, interviewers asked each respondent to think of to up three female friends or relatives with whom she shares intimate secrets and who shares intimate secrets with her. Eligible confidantes were limited to women that the respondent has been in contact with in the past year, who are between the ages of 15 and 49, and who currently live in their country. This process resulted in the identification of 3,209 confidantes in Uganda and 4,611 confidantes in Ethiopia.

For the one-year abortion incidence estimates within each country, the numerator consists of the number of confidantes who respondents identified as having an induced abortion in the past year, and the denominator is the number of confidantes in each country. We then multiplied estimates by 1,000 to get the incidence per 1,000 women. We also weighted these estimates using confidante sample weights, which we produced to ensure the distribution of confidante characteristics matched that of the respondents.

Measures

To measure abortion among respondents, women were asked if they have ever done anything to try to end a pregnancy. Respondents who indicated "yes, and I succeeded" we coded as ever having had an abortion. Respondents were then asked for the month and year of the last time the most recent abortion occurred.

We added several NSUM questions to the 2018 female PMA surveys in each country, including 12 "known population" measures. Appropriate known populations were determined using 2016 DHS data; 5 questions were asked in both countries, and 7 questions were specific to Ugandan and Ethiopian contexts. The question used to measure induced abortion for the NSUM was, "Of the women you have had contact with in the past 12 months, how many have ever done something to intentionally end a pregnancy?", and "Thinking of these *X* women who you have had contact with in the past 12 months and who have ever ended a pregnancy, how many have ended a pregnancy in the past 12 months?" Finally, we included two questions to measure transmission bias (a potential source of underreporting as abortion is likely not to be perfectly visible among social contacts). Women who self-reported ever having an induced abortion were asked how many women in their social networks know that they had ever intentionally ended a pregnancy.

For each confidante, respondents were asked, "as far as you know, has [*confidante*] ever done something that intentionally ended a pregnancy?" Response options included "yes, I'm certain", "yes, I think so", and "no". Across all three confidantes in both countries, respondents who replied "yes, I think so" constitute less than 2% of the responses. Therefore, for ease of interpretation, the "certain" and "probable" responses were collapsed to identify abortions among confidantes. For each reported confidante abortion, respondents were then asked for the year in which it last happened. If the respondent was not sure, she could choose from the following categories: "less than 1 year ago", "1 to less than 3 years ago", "3 to less than 5 years ago", or "5 or more years ago".

Socio-demographic characteristics, including age, educational attainment, region, and current use of an IUD or implant, were measured for both respondents and confidantes. Because the NSUM creates an aggregate estimate, no additional follow-up questions were asked about the social network members that respondents reported as having had an abortion.

Sensitivity Analyses

One assumption of the NSUM and the Confidante method is that all respondents have perfect knowledge about all people in their social network (i.e. if someone in your social network has cancer, then you know they have cancer). Violations of this assumption are called "transmission effects". However, abortions are not likely to be known by everyone in someone's social network, or potentially even among one's confidantes. We attempt to adjust both the NSUM and Confidante estimates to account for this transmission bias. For the NSUM, we ask women who directly report their abortions in the survey how many people in their social network they have told that they had an abortion. This estimate of "visibility", or τ, can be used to adjust the NSUM estimate for transmission bias. For the Confidante Method, we calculate the proportion of women in our sample who self-reported an abortion and reported sharing this information with each of their confidantes. In both cases, we use the inverse of this proportion to inflate the corresponding incidence estimate.

For the Confidante Method, we additionally explored the existence of recall error and barrier effects. In order to determine the extent to which recall bias, in which one's detailed memories of significant events often lead to a false impression of recency, is present in the current study, we calculated three-year incidence rates and then divided these estimates by three to create an annualized 1-year abortion incidence estimate. The extent to which these estimates differ from the 1-year direct report estimate provides insight into whether recall bias may be influencing our confidante abortion incidence estimates. Barrier effects refers to the phenomenon that certain groups of people tend to know people in different groups, and women may be more likely to know other women who are like themselves. To consider how barrier effects influence the Confidante Method, we used chi-squared tests to assess whether the distribution of characteristics in the sample of confidantes matches that of the respondents and whether respondents who report no confidante are likely different from respondents who report any confidantes.

Preliminary Results

Figures 1 and 2 display the one-year induced abortion incidence estimates for each of the three methods in Ethiopia and Uganda, as well as the most recent AICM estimate in each country. In both countries, the directly reported abortion incidence estimate is the lowest. Additionally, the unadjusted NSUM estimated is lower than the unadjusted Confidante method. This is unsurprising, as transmission bias is hypothesized to be a larger problem for the NSUM, which generates estimates for large numbers of network members with weak ties, as opposed to the Confidante method, which generates estimates for a smaller number of women with strong ties.

The final paper will include results from the sensitivity tests and present estimates produced using both methods to estimate the prevalence of another reproductive behavior (IUD and contraceptive implant use), for which representative data are already available, to assess the success of each method. The paper will further discuss the strengths and weaknesses of each method, as applied in each country.

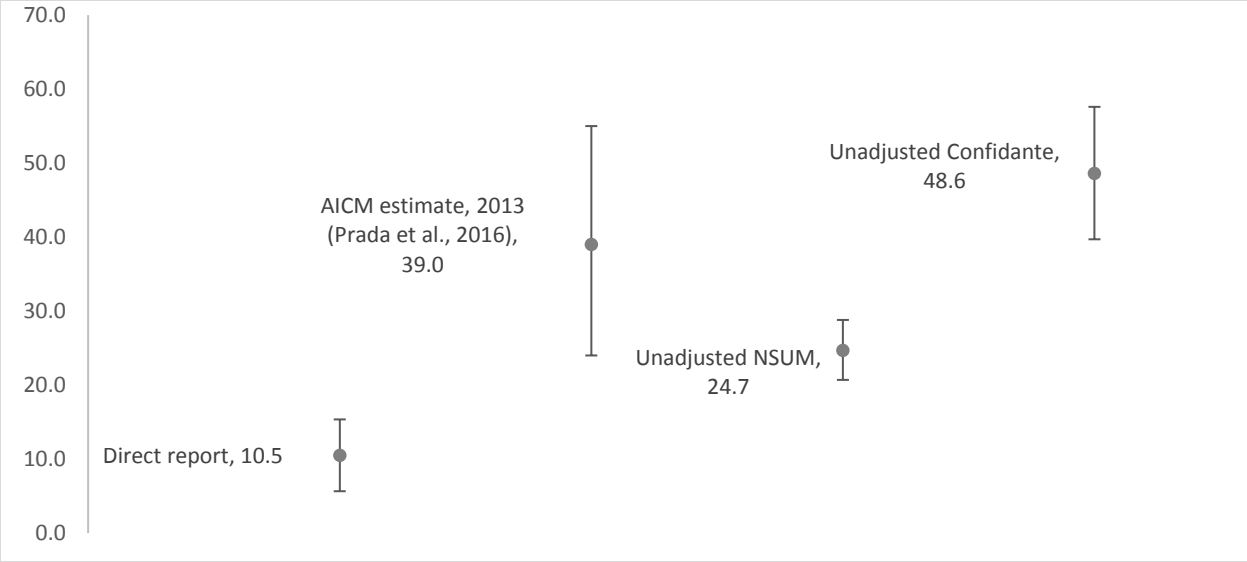

Figure 1. Comparison of Uganda abortion incidence estimates including three methodologies (confidante method, NSUM, and direct report) employed in a recent survey, and the most recent AICM study, 2018

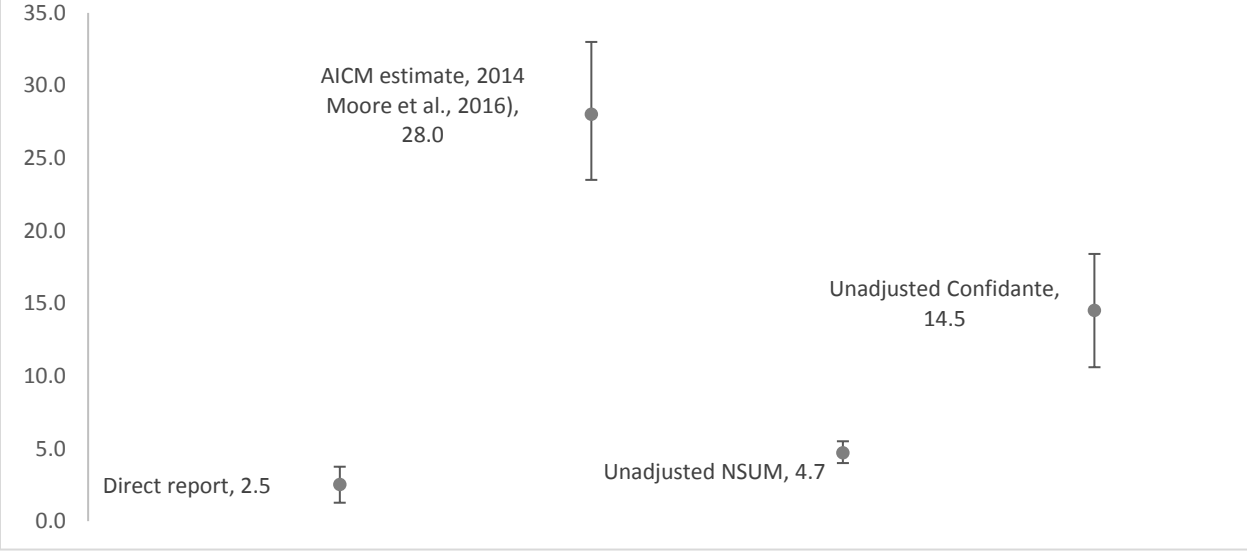

Figure 2. Comparison of Ethiopia abortion incidence estimates including three methodologies (confidante method, NSUM, and direct report) employed in a recent survey, and the most recent AICM study, 2018

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