EXTENDED ABSTRACT: Estimating the prevalence of infertility in Nigeria: application of a current duration methodological approach to Demographic and Health Survey data

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INTRODUCTION

Addressing the causes, prevalence, and sequelae of infertility in developing countries is a critical and understudied concern in sexual and reproductive health. The consequences of infertility in developing countries can be severe. For example, an inability to bear children can result in being socially ostracized or divorced, which may have physical, economic, mental health, and other implications.[1] While men and women are equally likely to be infertile, women are often blamed.[2] Fears related to infertility impact women's willingness to utilize certain contraceptive methods,[3, 4] and impacts of infertility on unsafe sex and other health outcomes are understudied. Furthermore, having a longer time to conception impacts risk of adverse pregnancy outcomes, gravid diseases, and later-onset adult disease. [5-8]

Improving our ability to more accurately estimate the prevalence of infertility using nationally representative data is essential. Different estimation approaches have been used to estimate infertility prevalence, making it difficult to compare across populations and to distinguish true differences from those due to design and data collection instruments.[9-11] Measures of time to pregnancy (TTP) have been proposed for monitoring couple fecundity, or the biologic capacity of couples to conceive.[12, 13] It provides a sensitive indicator of the full range of fecundity levels – from normal to the complete inability to conceive, but can also be used to examine standard measures, such as 12-month infertility.[14] While prospective cohort studies are often considered the gold standard for accurately estimating TTP, they are less feasible at a national level. The current duration approach is an alternative approach that estimates a population-level TTP distribution based on respondents' current duration "at risk" of pregnancy at the time of interview. Using this approach, estimated 12-month infertility prevalence was shown to be consistent with infertility estimates obtained from prospective cohort studies in the United States.[15]

In this study, we aim to determine the criteria necessary to apply a current duration approach to measuring infertility in low- and middle-income countries (LMIC) through the use of Demographic and Health Survey (DHS) data, which are nationally representative surveys conducted in over 90 LMIC. To our knowledge, the current duration methodological approach to estimating infertility has not been applied to date in LMIC. In addition, using sensitivity analyses, we aim to explore the impact of underlying assumptions on infertility prevalence estimates in the context of a low contraceptive prevalence population, in this case, Nigeria.

METHODS

Study Population and design

The 2013 Nigeria DHS was a nationally representative cross-sectional survey which used a stratified three-stage cluster sampling design. Details on the methodology can be found in the final DHS report.[16] The questionnaire used in our analysis was administered to women aged 15-49, and 98% of eligible women were interviewed.

Our sample includes women who were "*at risk*" of pregnancy at the time of interview. We considered a woman at risk of pregnancy if she: 1) did not report using contraception at the time of the interview, 2) reported being sexually active in the two months prior to the time of interview, and 3) was not pregnant at the time of the interview or had not recently (within 3 months) given birth. We excluded women from the analysis if they met any of the following exclusion criteria at the time of interview: 1) younger than 18 years of age or older than 44 years of age, 2) currently pregnant, 3) not currently living with a partner (married or cohabitating), 4) has not been sexually active in the last 2 months (or provided inconsistent information about sexual activity), 5) currently using contraception or used DMPA within the last 9 months, 6) given birth in the last 3 months, 7) undergone hysterectomy or menopause, 8) never menstruated, or 9) missing information related to the timing of first sexual intercourse with current partner.

Statistical analysis

Calculation of current duration

We will calculate current duration for being at risk of pregnancy for each respondent. The current duration corresponds to the time elapsed between the start of unprotected intercourse and the interview. The calculation for current duration depends on contraceptive history, pregnancy history, or start of the current relationship (Table 1). An underlying assumption is that intercourse occurs regularly (i.e., monthly, and corresponding with the fertile window) during the calculated current duration.

Table 1: Calculation of current duration by respondent characteristics

Respondent Characteristic	**Current Duration Calculation**
Women who previously used birth control and did not have a pregnancy since most recent use of birth control	Date of interview – date of last birth control method used
Women who have been pregnant and either never used birth control or did not use birth control after most recent pregnancy	Date of interview – (date of end of last pregnancy – three months of postpartum infecundity)*
Nulligravid women who never used birth control	Date of interview – date of first intercourse with current partner

* Note: 3 months of postpartum infecundity was not subtracted for miscarriage, abortion, or stillbirth

Estimation of the probability of pregnancy and 12-month infertility

In general, a current duration approach applies to cross-sectional designs and has been used to infer an underlying distribution of the total (unobserved) time until a given event occurs from the distribution of the partial time elapsed at the time of interview.[17-21] The statistical assumptions required by this approach are stationarity (i.e., the start of pregnancy attempts occur at a constant rate) and the distribution of TTP is independent of time. Given the cross-sectional design and sampling of those at risk at the time of interview, the current durations are inherently length-biased (i.e., there is an overrepresentation of couples who take longer to become pregnant) and right censored (i.e., the total length of pregnancy attempt is never observed). However, these issues are accounted for in the current duration approach under the given assumptions.

For this study, we apply a current duration approach to estimate a survival function of the total TTP or stopping for other reasons, such as due to the end of a relationship, using the calculated duration of time at risk of pregnancy. Because this approach does not follow respondents to observe a TTP, this approach cannot distinguish between whether the reported current duration sampled at the time of interview ended in a pregnancy or for other reasons. To implement this approach, we will use weighted maximum-likelihood analysis (e.g., assuming a piece-wise exponential distribution) to estimate the survival function and confidence intervals will be calculated by bootstrap methods. This procedure generates a summary TTP-like distribution that can be used to derive a 12-month infertility estimate of TTP > 12 months. We use the definition of infertility provided in the WHO revised glossary of Assisted Reproductive Terminology (ART), which defines infertility as "*the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected intercourse*."[14]

Sensitivity analyses

We will conduct several sensitivity analyses to explore potential bias in our analytic assumptions. First, we will examine the impact of pregnancy intention on our estimates of infertility prevalence by excluding women who do not report wanting a pregnancy in the near future. Next, we will assess the impact of excluding women who declare themselves infecund for reasons other than a hysterectomy or menopause. We will exclude other groups of women from our analytic sample for additional sensitivity analyses, such as women who report amenorrhea for at least 12 months or women with very low reported coital frequency in the 12 months preceding the interview. In our main analysis, we allow a 3-month window following a live birth to account for post-partum infecundity; in a sensitivity analysis, we will assess the impact of increasing

this window to 6 months. Lastly, women who report not living with their partner are excluded from our main analysis; however, it is possible that these women are still trying to conceive, thus we will include them in a sensitivity analysis to assess impact.

EXPECTED RESULTS

This analysis includes 10,395 women ages 18 - 44 from the 2013 Nigeria DHS. Preliminary results and a description of expected results are provided below (full analysis will be completed by the end of 2015).

Table 2: Characteristics of analytic sample (N=10,395)

Characteristics	N	%
Sociodemographic		
Age		
15-24	2,354	22.7
25-34	4,490	43.2
35-44	3,551	34.2
Married	10,177	97.9
Non-polygynous	6,448	62.0
Urban	2,881	27.7
Highest educational level		
No education	5,917	56.9
Primary	1,868	18.0
Secondary or higher	2,610	25.1
Religion		
Catholic or other Christian	3,079	29.6
Islam	7,163	68.9
Other	153	1.5
Reproductive		
Total children ever born		
0	815	7.8
1-2	2,743	26.4
3-5	3,858	37.1
6-16	2,979	28.7
Correct knowledge of fertile period	2,005	19.3
Ever terminated a pregnancy	1,205	11.6
Never used contraception	9,559	92.0
Currently breastfeeding	4,380	42.1
Currently amenorrheic	2,947	28.4
Fertility preferences		
Wants within 2 years	5,178	49.8
Wants after 2+ years	2,912	28.0
Wants, unsure timing	194	1.9
Wants no more	1,079	10.4
Declared infecund	183	1.8
Missing or undecided	849	8.2
Husband wants more children than wife	4,694	45.2

Estimate of infertility prevalence

We will report the estimated infertility prevalence for Nigeria derived from the current duration approach. A survival curve will show the estimation of the proportion of women not yet pregnant as a function of the number of months of unprotected intercourse for pregnancy. This will be examined for the overall sample, nulliparous and parous women, and women who reported wanting another child soon or now.

Insert: Figure1: Survival function for the time until pregnancy or end of attempt

Results of sensitivity analyses

We will report the infertility prevalence estimate for each sensitivity analysis conducted and compare it to the infertility prevalence estimate obtained from the main analysis.

Insert: Table 3: Infertility prevalence estimates from sensitivity analyses

DISCUSSION

In this section, we will discuss the feasibility of applying the current duration approach to low and middle-income countries with DHS data and low contraceptive prevalence. We will also compare our infertility prevalence estimate for Nigeria derived from the current duration approach to estimates derived through other approaches. Next, we will discuss assumptions made in applying the current duration approach to a low-contraceptive prevalence population by describing the results of the sensitivity analyses, highlighting potential biases, and recommending revisions and/or additions to survey questions to improve our ability to accurately estimate infertility in LMIC. Lastly, we will highlight the strengths and limitations of using DHS data to apply the current duration approach to a low contraceptive prevalence population for the estimation of infertility prevalence.

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