Photo: Selamawit Desta, PMA2020/Kenya

PMA2020 METHODOLOGICAL REPORT NO. 2:

FERTILITY DATA IN PERFORMANCE MONITORING AND ACCOUNTABILITY 2020 SURVEYS

PMA2020
Performance Monitoring and Accountability 2020

JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

BILL & MELINDA GATES INSTITUTE for POPULATION and REPRODUCTIVE HEALTH

PMA2020 Methodological Report

Title: Fertility Data in Performance Monitoring and Accountability 2020 Surveys

Authors: Yoonjoung Choi, Qingfeng Li, and Blake Zachary

Acknowledgement: The authors are grateful for a valuable internal review by Stan Becker.

Suggested citation: Choi, Yoonjoung; Li, Qingfeng; and Zachary, Blake. 2017. Fertility Data in Performance Monitoring and Accountability 2020 Surveys. Performance Monitoring and Accountability 2020 Methodological Reports No. 2. Baltimore, Maryland, USA: Bill & Melinda Gates Institute for Population and Reproductive Health, Johns Hopkins University Bloomberg School of Public Health.

Table of Contents

Tables

Figures

Preface

Performance Monitoring and Accountability 2020 (PMA2020) employs an innovative survey approach to gather population data on family planning and water, sanitation, and hygiene. Data are collected at both the household and health facility levels via mobile phones through a network of local female data collectors, known as Resident Enumerators, stationed throughout the country.

PMA2020 aims to generate high quality, rapid-turnaround data. As such, PMA2020 continues to assess, revise, and publicize the methodology with which the data are gathered. The *Methodological Report* series aims to examine various issues relevant for survey data quality, to enhance the understanding and analysis of PMA2020 survey data for researchers, policy makers, and survey specialists.

This report could not have been assembled without the critical contributions of PMA2020 Principal Investigators, Data Managers, Supervisor, and Resident Enumerators from Burkina Faso, Democratic Republic of Congo, Ethiopia, Ghana, India, Indonesia, Kenya, Niger, Nigeria, and Uganda, each of whom helped to assemble information. The PMA2020 project is funded by the Bill & Melinda Gates Foundation, whose support is gratefully acknowledged.

Scott Radloff, PhD
Director, PMA2020

Abstract

PMA2020 surveys have collected data on recent fertility to monitor total fertility rate (TFR) during two years before the survey. Collecting and using information only on recent fertility is a new approach to measure and monitor TFR, in addition to innovative approaches of the PMA2020 survey platform–which uses mobile phones for data collection through a network of local female resident enumerators. These innovative features improve timeliness and cost-effectiveness and provide opportunities to learn and advance survey methodologies. Employing new approaches, however, raise the need to clearly document the methods and assess any implications for data quality. The purpose of this report is to provide a guide to better understand and use fertility data in PMA2020 surveys and document lessons learned during the first four years of the project. The specific aims are: to document PMA2020's methodology to measure TFR; to assess the quality of fertility data in PMA2020 surveys; and, to estimate the TFR adjusted for identified issues. Findings suggest that use of the simple questionnaire introduced only under-counting of multiple births, which can be and have been adjusted in data analysis. However, it was also identified that there was relatively high level of incomplete reporting of birth month, which is critical to estimate TFR during the reference period. Use of default January in the case of missing birth month also inadvertently led to underestimation of TFR, depending on the timing of the survey in a calendar year. Addressing the two issues – undercounting of multiple births and excess January births – TFR estimates were upward adjusted by 2.4% and 1.6%, respectively, on average among 39 surveys analyzed. Combined adjustment resulted in an increase of TFR by 3.9%, on average. Implications for training of enumerators and data collection programming will inform future surveys in PMA2020. The study findings will be used to discuss implications of the methods used in PMA2020 surveys and recommend revisions in future PMA rounds and other surveys.

Introduction

Performance Monitoring and Accountability 2020 (PMA2020) is a global survey project, developed to meet data needs for monitoring under the Family Planning 2020 (FP2020) partnership, which aims to enable 120 million additional women and girls to have access to contraceptive methods by 2020. With governments and stakeholders pledging to contribute to achieve the FP2020 goal, there is increased need for more frequent monitoring of key family planning indicators especially in countries where political and financial commitments have been made. To meet these data needs, PMA2020 conducts both household and service delivery point surveys annually, after semi-annual implementation during the first two years. PMA2020 employs innovative approaches to collect and disseminate data rapidly – by using mobile technologies and an open source software to capture and manage data – and at low cost, by working with female data collectors, known as resident enumerators (REs) who live in or near the sampled enumeration areas with a minimum qualification of high school completion (Hawes et al. 2017; Zimmerman, OlaOlorun, and Radloff 2015). Since its inception in 2013, over 40 surveys have been conducted in 10 countries. PMA2020 survey results have been used both at the country-level for family planning programming, including development of family planning costed implementation plans, and at the global-level for monitoring (FP2020 2016; United Nations, Department of Economic and Social Affairs, Population Division 2016).

In addition to contraceptive use data, PMA2020's household surveys collect fertility data and estimate the total fertility rate (TFR), for the two-year period before each survey, which was initially considered a core indicator under FP2020 monitoring framework (FP2020, 2013). Contraceptive use, a key indicator monitored in PMA2020, is a key proximate determinant of fertility (Bongaarts 1982), which has implications for health of women and children, environment, and economic development as it relates with population age structure changes (Starbird, Norton, and Marcus 2016). Adolescent fertility rates, in particular, have been adopted as an indicator to monitor the Sustainable Development Goal 3, "Ensure healthy lives and promote well-being for all at all ages" (Inter-agency Expert Group on SDG Indicators 2016). However, while PMA2020 surveys have become a critical data source for family planning, its data on fertility have not been used as widely – partially because of new methods used in PMA2020 surveys and unanswered questions about its data quality implications.

First, PMA2020 surveys do not collect full birth history data, a conventional approach to collecting fertility data in household surveys. Rather, to keep the interview short and to have questionnaires that can be more readily administered by REs, the surveys initially used a short list of questions to capture births in the last two years before the survey. Currently, the surveys use a list of questions to capture up to three births per women, regardless of the timing of birth. Second, in most countries, the sample is nationally representative,[a] and its sample size is calculated to estimate the modern contraceptive prevalence rate among all women with margin of error of 3% by sampling

[a] In a few countries, the survey sample is not representative at the national level, but at selected administrative regions.

strata – typically urban/rural and, in some cases, aggregate administrative regions. The resulting sample size generates a substantially larger sampling error for TFR estimates than that in other surveys which measure TFR as a primary indicator. Finally, while innovative features regarding data collection improved timeliness and cost-effectiveness, there has been no systematic assessment of survey implementation and data quality regarding fertility data.

This report provides a guide to better understand and use fertility data in PMA2020 surveys and document lessons learned during the first four years of the project. The specific aims are: to document PMA2020's methodology to measure TFR; to assess the quality of fertility data in PMA2020 surveys; and, to estimate the TFR adjusted for identified issues. The study findings will be used to discuss implications of the methods used in PMA2020 surveys and recommend revisions in future PMA rounds and other surveys.

Methodology to collect fertility data and estimate TFR in PMA2020[b]

Sampling

PMA2020 surveys are planned to occur every six months for the first two years in each country and then annually after that. A representative sample for the population is selected in country using a two-stage cluster sampling approach. In the first round, a sample of enumeration areas (EAs) is selected and the sampled EAs are used for four rounds of surveys. In each round, an independent random sample of households is selected per sampled EA. After four successive rounds, the sample of EAs is redrawn to avoid any potential bias introduced by repeated interviews (Hawes et al. 2017), while continuously employing the recruited and trained REs. Therefore, in round five, an EA adjacent to the initially sampled EA is randomly selected.

Resident Enumerators

REs recruited by PMA2020 are required to have completed at least secondary school. but prior survey experience is not required. They should have a basic understanding of the use of smart phones. Paid healthcare workers are not eligible. Without attrition, the same REs will work in the same area for the life of the project. Further information on recruitment of REs are described in detail elsewhere (Hawes et al. 2017).

The REs complete two weeks of training initially and, before each subsequent survey, a two to three-day refresher training is conducted. The initial training focuses on the logistics of collecting data on a mobile phone, survey protocols, and content specific technical knowledge. Refresher trainings cover changes in the questionnaire and data quality issues from the previous survey. RE's knowledge is assessed using quizzes and a final exam. Only those who satisfactorily complete the training and assessments are hired. During training, for summary fertility questions, REs are instructed to ensure that they capture all live births even if the child later died. When recording

[b] PMA2020 has two components: population-based household surveys and service delivery point surveys. In this report, only the population-based survey is discussed.

dates, REs are trained to probe using memorable historic events and seasons of the year to estimate when a respondent is unsure.

Questionnaire

PMA2020 surveys are conducted using two questionnaires, household and female questionnaires. The household questionnaire collects information on the characteristics of the household which are used to report on water and sanitation indicators and to calculate a wealth index. The questionnaire also lists all household members by age and sex to screen for eligible females (all women 15-49 years of age in sampled households). The eligible women are then interviewed separately using a female questionnaire. The female questionnaire collects data on: age, marital status, education, fertility, contraceptive awareness and use, fertility intentions, sexual activity, and in alternating rounds, menstrual hygiene and diarrheal disease among children. A majority of the questionnaire is regarding contraceptive use.

The benchmark for collecting fertility information in a survey setting is to count all live births to the female respondent in the form of a retrospective birth history. First, a summary of the total number of births by sex and survival status is obtained and then each child is listed separately, including information on the date of birth, age, if the child was a multiple birth, and current survival status. Prompts ensure that no live births are missed as the children are listed in chronological order. From this information, age specific fertility rates and TFR are calculated. This is the method employed by the Demographic and Health Surveys (DHS) and involves extensive training especially around determination of dates of birth and probing to ensure that children who died are still listed. However, even these full retrospective birth histories do not necessarily capture all births completely or provide unbiased estimates (Pullum and Becker 2014; Schoumaker 2014). Possible errors include the omission of births, usually children who died very young or before the date of interview, and systematic displacement beyond the reference period.

PMA2020 surveys have collected fertility information using different methods. Earlier surveys only asked women for the total number of births in their lifetime and then asked date of last birth and if that last child was still alive (version 1). Subsequent surveys asked about births separately for children who are currently living and those who have died with a confirmation check on the total number and then if their last child was still alive (version 2). Questions regarding the summary of births have been replaced more recently with the conventional summary birth history questions (version 3). In each version, the woman was asked to provide the month and year of birth for up to three births, based on the total number of births determined from the summary birth questions: for the most recent birth if she has had only one birth; the most recent and first birth if she had two births; and the most recent, next most recent, and first birth if she has had three or more births. To calculate fertility rates, the information on date of birth is used, as described below. In PMA2020 surveys, multiple births are considered a single birth event with only one date recorded for that birth. Table 1 presents fertility questions by version.

Programming to record birth year and month reported by respondents

A customized version of Open Data Kit (ODK) called JHU Collect is programmed with the questionnaire and used on the RE's Android smart phone. The electronic questionnaire includes automatic skip patterns and validation checks. In recording dates, ODK uses a date spinner (Figure 1). On the left are the months January through December; on the right are the years. The default date that automatically appears is January 2021. Internal validation checks require that the date cannot be in the future except for January 2020, which is used when no response is given. A response option of 'don't know' has not been given to encourage probing.

Calculation of TFR

The two most recent birth event dates are used to calculate age specific fertility rates and a two-year TFR. The TFR is calculated using the tfr2 command in Stata (Schoumaker 2013). Since the questionnaire ascertains delivery events not live births, the estimated age-specific fertility rates are adjusted for multiple births. Age-specific twinning adjustment factors were obtained from birth history data for children born in the five years prior to the latest DHS as of 2013 in each country.

Table1*. Questions regarding fertility in PMA2020 surveys*

Version	Questions
1	How many times have you given birth? Were all of those live births? **When was your first birth?** **When was your most recent birth?** **When did you give birth before the most recent one?** Is your last baby/child alive? When did your last baby/child die?
2	How many times have you given birth? Were all of those live births? How many sons and daughters have you given birth to and who were born alive? Have you ever given birth to a boy or girl who was born alive, but later died? How many have died? Just to make sure I have this right: you had a total of ___ births(s) during your life, resulting in ___ son(s) or daughter(s) born alive. Is this correct? **When was your first birth?** **When was your most recent birth?** **When did you give birth before the most recent one?** Is your last baby/child alive? When did your last baby/child die?
3*	Have you ever given birth? Do you have any sons or daughters to whom you have given birth who are now living with you? How many sons live with you? How many daughters live with you? Do you have any sons or daughters to whom you have given birth who are alive, but do not live with you? How many sons are alive, but do not live with you? How many daughters are alive, but do not live with you? Have you ever given birth to a boy or girl who was born alive but later died? How many boys have died? And how many girls have died? Just to make sure that I have this right, you have had in TOTAL ___ births during your life. Is that correct? **When was your first birth?** **When was your most recent birth?** **When did you give birth before the most recent one?** Is your last baby/child alive? When did your last baby/child die?

Questions in **bold** provide data to calculate TFR during the reference period, and most relevant for main objectives of this report.

*Subsequently, the question “How many times have you given birth?” was added just after “Have you ever given birth?” to differentiate multiple births.

Figure1. *Screenshot for birth month and year question*

Note: The wheel contains all months and years, including future years, but future dates cannot be selected except January 2020, as described earlier.

Quality of fertility data in PMA2020 surveys

The above description of the methods raises two data quality questions. First, is bias undercounting births in the two-year reference period for TFR due to the questionnaire–i.e., collecting and using the date of up to two delivery events, compared to all live births during the two years. The other is a question regarding whether PMA2020's REs can ascertain quality data on births and timing of births, even using the simpler questionnaire. In this section, we present methods and results addressing both issues.

Magnitude of omission of births due to the questionnaire

To assess the level of underestimation due to the questionnaire, we simulated births that would be counted using the current PMA questionnaires–hereinafter referred to as PMA births–using full birth history data from the DHS. We employed the latest DHS in 10 countries where PMA2020 surveys have been implemented (Table 2). The number of PMA births in the two-year period would be lower than the total births captured in full birth history for two reasons: omission of a majority of multiple births as PMA2020 counts delivery events that resulted in live births; and, omission of births that would be missed by using only up to two most recent births in each woman.

Importantly, this simulation was to assess the downward bias, compared to the number of births captured using a full birth history questionnaire, but not necessarily compared to the true number of births (Pullum and Becker 2014; Schoumaker 2014).

All births in the two-year reference period (i.e., births born between 1-24 months before the survey) were classified into three types: PMA births, omitted multiple births, and omitted births that are neither the most recent nor penultimate. Distribution of the three birth types was examined in the most recent DHS survey in each of these 10 countries.

On average, across the 10 countries, 1.50% of births would be omitted by simulating PMA births (range: 0.47%-2.07%). The amount of underestimation is lower in populations with relatively low fertility (i.e., 0.47% in Rajasthan, India and 0.78% in Indonesia). Underestimation due to the two-birth limit did not exist (n=7) or was observed, but extremely rare in three countries. Thus, practically all bias was due to omitted multiple births (Figure 2) (mean=1.49%, range: 0.47%-2.07%, n=10).

Figure 2. *Magnitude of omitted births during two years before the survey: distribution among 10 countries*

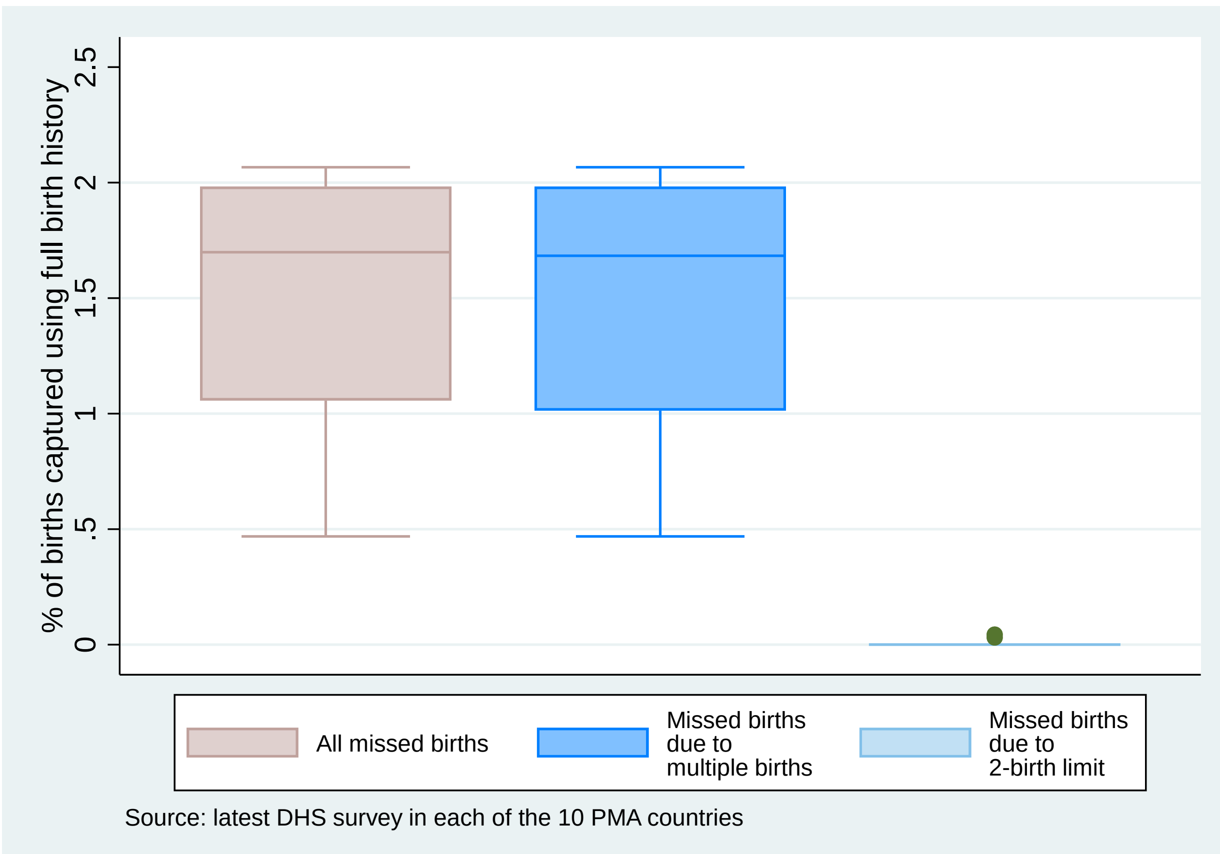


Table2. *Distribution of births during two years before the survey ascertained by full birth history in the latest DHS*

Survey	Total number of births	Distribution of births (%)		
		PMA births	Omitted multiple births	Omitted births that are neither the most recent or penultimate birth
Burkina Faso 2010	6164	98.0	1.98	0.000
DRC 2013	7741	97.9	2.07	0.000
Ethiopia 2011	4520	98.9	1.01	0.044
Ghana 2014	2476	98.0	2.04	0.000
India, Rajasthan 2005	800	99.5	0.47	0.000
Indonesia 2012	7498	99.2	0.78	0.000
Kenya 2014	8389	98.6	1.40	0.005
Niger 2012	5151	98.3	1.69	0.031
Nigeria 2013	13285	98.2	1.77	0.000
Uganda 2011	3233	98.3	1.67	0.000
Average (un-weighted)	**5926**	**98.5**	**1.49**	**0.008**

Percent estimates were adjusted for sampling design. The number of births is un-weighted.

Quality of data ascertained by resident enumerators

Quality of fertility data can be examined in various ways including: investigating completeness of reported birth year and month, displacement of birth year and month, and omission of live births (Pullum and Becker 2014). Given the PMA2020 questionnaire, there are no obvious reasons for interviewers or interviewees to systematically displace birth year and month to reduce workload, as there are no follow-up questions for specific births within a reference period. Omission of live births, especially those who died at a very early age, is a critical data quality issue in fertility as well as mortality estimation. Assessing the magnitude of the omission typically requires further data on sex, survival status, and age at death (Pullum and Becker 2014). With limited survival data and no information on age at death, in addition to a sample size that is not designed to measure child mortality, we are unable to assess potential omission of live births in this paper. We, however, acknowledge that it is likely problematic in PMA2020 surveys since the questionnaire has less probing on missing live births than conventional full birth history questions.

Thus, we focus on the completeness of reporting in birth year and month. However, since PMA2020 surveys have not allowed a response category of 'don't know' for birth month/year questions, we are not able to assess reporting completeness directly. Nevertheless, as enumerators were trained to select January and 2020 when birth month and year was unknown assessing distributions of birth month and year allows indirect examination of reporting completeness. All distributions were not adjusted for sampling weights, as the purpose was to study distributions among responses, not a nationally representative distribution. We analyzed all PMA2020 surveys that were publicly available as of early May 2017.

A total of 39 surveys were included in the study. Table 3 presents the list of surveys, the version of fertility questions used in each, and summary statistics. Any major change in the total number of births collected in a country or region reflects either changes in the questionnaire or increases in the sample size.[c]

Reporting of birth year

On average, 1.5% of births across surveys had an unknown birth year (i.e., 2020 was recorded for the birth year).[c] The estimate, however, ranged from 0% in the Kinshasa, Democratic Republic of Congo Round 1 survey to 6.9% in the Kaduna, Nigeria Round 1 survey. Further analysis was conducted to assess the current age of mothers who reported at least one birth with an unknown birth year out of maximum three births (Appendix A). The median age of those women was 37 years across the surveys, suggesting that births with a missing year likely occurred in the distant past. In addition, in most countries or regions where multiple rounds of surveys have been conducted, the level of unknown birth year has decreased (Table 3).

Table3. *List of PMA2020 surveys included in the study, total number of births, and percent of births with unknown birth year*

	Data Collection		Fertility questionnaire version used in the survey	Total number of women interviewed in the survey	Total number of births collected in the survey	Percent of births with unknown birth year
Survey[X]	**Start**	**End**				
Burkina Faso R1	Nov-14	Jan-15	v1	2094	3629	4.0
Burkina Faso R2	Apr-15	Jun-15	v2	2150	3657	2.9
Burkina Faso R3†	Mar-16	May-16	v2	3353	5497	1.3
DRC, Kinshasa R1*	Oct-13	Jan-14	v1	2118	2225	0.0
DRC, Kinshasa R2	Aug-14	Sep-14	v1	2877	3819	0.5
DRC, Kinshasa R3	May-15	Jun-15	v2	2683	3654	0.4
DRC, Kinshasa R4	Nov-15	Jan-16	v2	2741	3636	0.2
DRC, Kongo Central R4	Nov-15	Jan-16	v2	1573	2726	2.0
Ethiopia R1*	Jan-14	Mar-14	v1	6514	7519	0.1
Ethiopia R2	Oct-14	Dec-14	v1	6713	9389	1.1
Ethiopia R3†	Apr-15	May-15	v1	7628	10844	0.7
Ethiopia R4	Mar-16	Apr-16	v2	7537	10823	0.9
Ghana R1*	Sep-13	Nov-13	v1	3708	2859	1.3
Ghana R2	Mar-14	May-14	v1	3974	5931	2.4
Ghana R3	Sep-14	Nov-14	v2	4621	6888	2.4
Ghana R4	May-15	Jul-15	v2	5234	7432	1.9
India, Rajasthan R1	Apr-16	Jul-16	v1	5454	8451	2.6
Indonesia R1	May-15	Aug-15	v1	10566	15682	0.7

[c] Birth year is not imputed for those with unknown year, and all such births are excluded in fertility estimation in PMA2020.

Kenya R1	May-14	Jul-14	v1	3792	6834	1.3
Kenya R2	Nov-14	Dec-14	v1	4370	7503	1.7
Kenya R3	Jun-15	Jul-15	v2	4433	7603	0.8
Kenya R4	Nov-15	Dec-15	v2	4960	7836	0.4
Niger, Niamey R1	Jun-15	Aug-15	v1	1351	2114	1.5
Niger, Niamey R2**	Mar-16	Jun-16	v1	1281	1916	2.8
Nigeria, Kaduna R1	Sep-14	Nov-14	v1	2575	4381	6.9
Nigeria, Kaduna R2	Sep-15	Nov-15	v1	2943	5190	1.3
Nigeria, Kaduna R3	Apr-16	Jun-16	v2	2897	5327	0.4
Nigeria, Lagos R1	Apr-16	Jun-16	v1	771	1158	2.0
Nigeria, Lagos R2†	Sep-15	Nov-15	v1	1449	2234	0.7
Nigeria, Lagos R3	Sep-14	Nov-14	v2	1452	2132	0.9
Nigeria, Anambra R3	Apr-16	Jun-16	v2	1313	1715	0.5
Nigeria, Kano R3	Apr-16	Jun-16	v2	1689	3115	0.2
Nigeria, Nasarawa R3	Apr-16	Jun-16	v2	1654	2934	0.3
Nigeria, Rivers R3	Apr-16	Jun-16	v2	1284	1873	0.5
Nigeria, Taraba R3	Apr-16	Jun-16	v2	860	1490	1.0
Uganda R1	May-14	Jun-14	v1	3754	6778	2.0
Uganda R2	Jan-15	Feb-15	v1	3654	6289	2.1
Uganda R3	Aug-15	Sep-15	v2	3705	6529	2.7
Uganda R4	Mar-16	Apr-16	v2	3816	7115	2.0

[X] R1 refers to Round 1 surveys, R2 refers to Round 2 surveys, and so on.
*In these surveys, only penultimate births in the two years before the survey were asked about birth year and month.
** Niger Round 2 was a national survey, including Niamey. Tocompare Rounds 1 and 2, we chose to analyze only Niamey data from Niger Round 2.
†In Burkina Faso, the sample size increased from 1,855 households in Round 2 to 2,905 in R3. In Ethiopia, the sample size increased from 6,813 households in Round 2 to 7,643 in Round3. In Lagos, Nigeria, the sample size increased from 1,014 households in Round 1 to 1,777 in Round 2.

Reporting of birth month

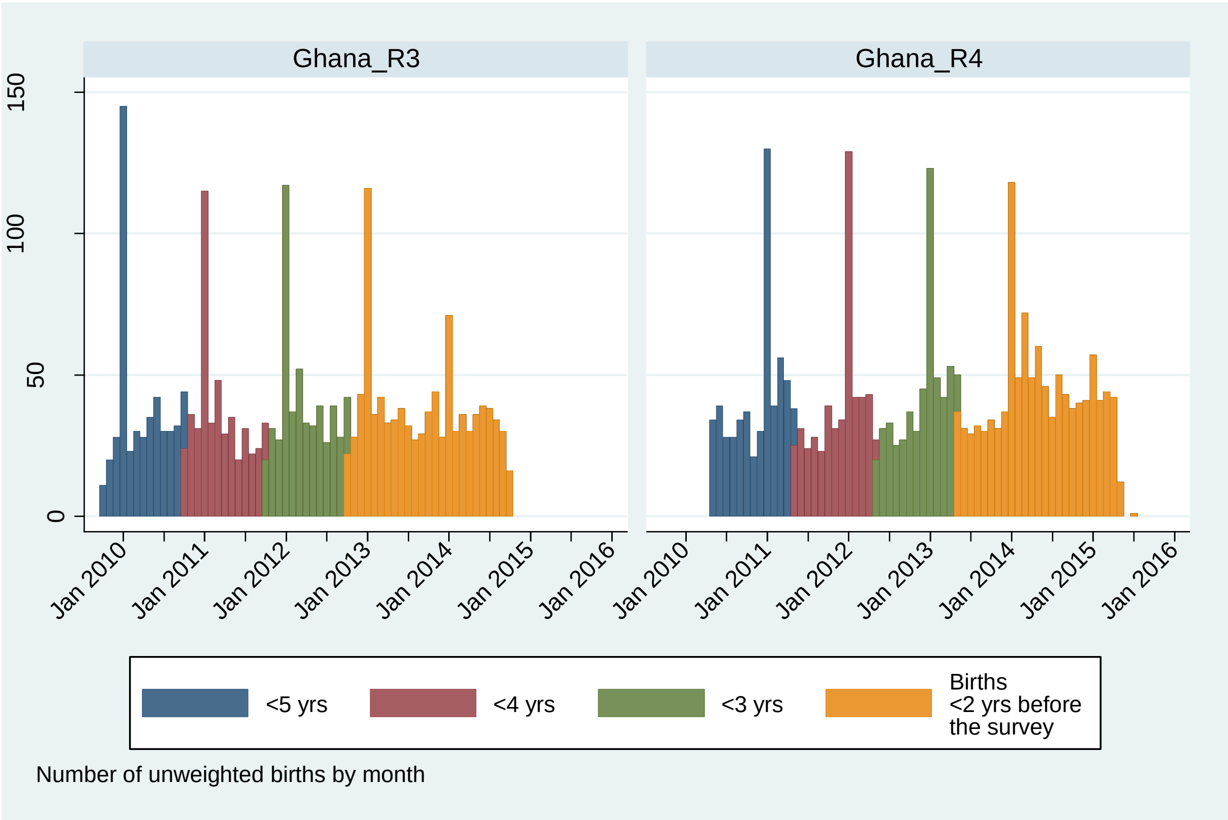
To study the distribution of birth month, we restricted analyses to reported births in the last five years.[d] Across countries, it was noted that there was significant heaping in January, as shown in an example (Figure 3). Further investigation with field staff revealed that, despite the instruction, many enumerators left January–a default response programmed in ODK–when respondents could not report birth month.

This excess of January births has implications for the TFR estimation. Since all births in a calendar year with an unknown birth month were recorded by default to be born in January, there can be a downward bias in estimating recent fertility. For example, in Ghana Round 4, suppose a woman interviewed in March 2016 had a birth in October 2014 (an orange bar in Figure 3), but reported

[d] Since PMA2020 collects data on up to three births, the annual number of births in 3-5 years before the survey may be slightly lower than actual number of births by sampled women. However, the distribution by birth month would not be affected in those years.

only birth year, not birth month. If that birth was recorded to be in January 2014 (the green heaped bar), the birth would be excluded from estimating TFR during the 2-year period preceding the survey. It is therefore important to identify the level of excess January births and to explore approaches to address this issue. In the following section, we quantify the magnitude of excess January births and illustrate two potential adjustment approaches.

Figure 3. *Distribution of birth month in Ghana Round 3 and Round 4 surveys*



The magnitude of excess January births and adjustment approaches

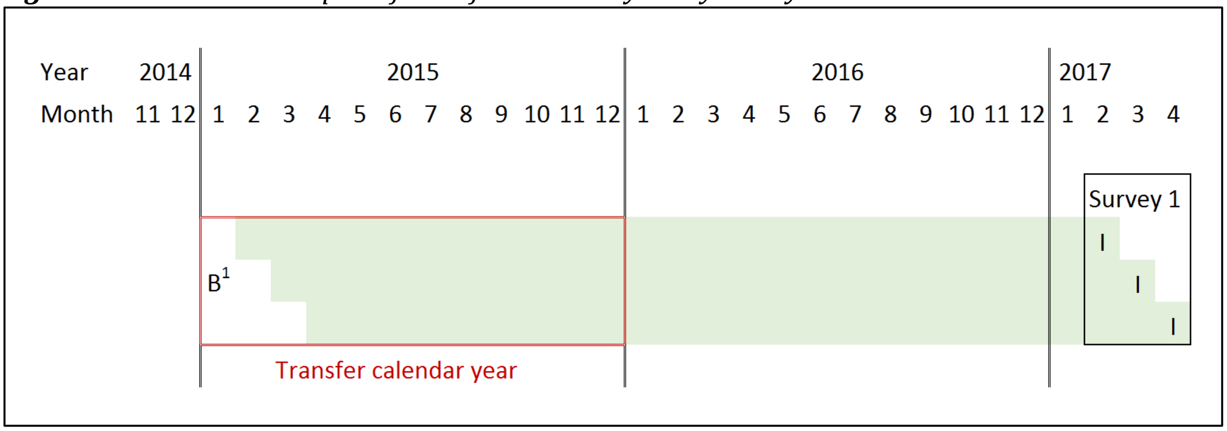
In each full calendar year, during the five years before the survey, we first calculated the percent of births recorded to be in January out of total births in the year. In the absence of heaping, it is expected to be roughly 1/12 or 8%. We also estimated the excess number of January births. In each calendar year, it was calculated:

Excess January births = January births – Monthly average births between February and December

When the excess January births is negative, we assumed that there were no excess January births. Finally, the percent of excess January births out of total births in the calendar year was calculated, and the metric was used as a proxy for the level of births with unknown month, in the absence of the 'don't know' category in the questionnaire.

We particularly focused on the level of excess January births during a transfer calendar year, i.e., during which the two-year reference period starts (Figure 4), because–at the aggregate level–excess January births in other calendar years do not lead to potential underestimation of TFR for the two years before a survey. For example, suppose interviews for Survey 1 were conducted between February and April 2017, and three illustrative interview dates are shown in. All live births reported during the two years before the survey (light green) are included in the TFR calculation, and the transfer calendar year is 2015. Births recorded to be born in January 2015 (B[1]) are outside the two-year reference window but might have been incorrectly recorded. If they are adjusted to other months during the year, TFR estimates will change.

Figure4. *Illustrative examples of transfer calendar year by survey*



I: Interview, B: Birth

Table 4 presents the results for the transfer calendar year. On average, 18% of births during the transfer year were recorded to be born in January (range: 6.4% to 38.4%), far exceeding the expected 8.3%. The percent of excess January births out of total births was on average 12% (range: 1.0% - 32.8%). In three surveys (DRC, Kinshasa Round 1; Nigeria, Lagos Round 2; and Nigeria, Lagos Round 3), the number of births in January was lower than the monthly average between February and December. When the level of excess January births was examined across calendar years, not just the transfer calendar year, there were notable decreases in years closer to the survey implementation within a survey–as the recall period was shorter–as well as decreases across surveys in a country/geography, indicating improved quality (Figure 5).

Table 4. *Number of total annual births, recorded January births, and estimated excess January births during transfer calendar year, by survey*

Survey[x]	Transfer year	Number of births recorded in January	Number of births in the year	% of January births out of total births in the year	Number of monthly births, February-December	Difference between January births and monthly births (February-December)	% of excess January births out of total yearly births
Burkina Faso R1	2012	84	311	27.0	20.6	63.4	20.4
Burkina Faso R2	2013	70	292	24.0	20.2	49.8	17.1
Burkina Faso R3	2014	91	456	20.0	33.2	57.8	12.7
DRC, Kinshasa R1	2011	17	251	6.8	21.3	-4.3	n/a
DRC, Kinshasa R2	2012	37	311	11.9	24.9	12.1	3.9
DRC, Kinshasa R3	2013	41	311	13.2	24.5	16.5	5.3
DRC, Kinshasa R4	2013	58	314	18.5	23.3	34.7	11.1
DRC, Kongo Central R4	2013	62	244	25.4	16.5	45.5	18.6
Ethiopia R1	2012	124	667	18.6	49.4	74.6	11.2
Ethiopia R2	2012	116	713	16.3	54.3	61.7	8.7
Ethiopia R3	2013	210	827	25.4	56.1	153.9	18.6
Ethiopia R4	2014	180	803	22.4	56.6	123.4	15.4
Ghana R1	2011	63	408	15.4	31.4	31.6	7.8
Ghana R2	2012	140	467	30.0	29.7	110.3	23.6
Ghana R3	2012	117	516	22.7	36.3	80.7	15.6
Ghana R4	2013	123	541	22.7	38.0	85.0	15.7
India, Rajasthan R1	2014	115	412	27.9	27.0	88.0	21.4
Indonesia R1	2013	86	721	11.9	57.7	28.3	3.9
Kenya R1	2012	80	511	15.7	39.2	40.8	8
Kenya R2	2012	115	522	22.0	67.8	47.2	9
Kenya R3	2013	70	556	12.6	44.2	25.8	4.6
Kenya R4	2013	52	564	9.2	46.5	5.5	1
Niger, Niamey R1	2013	37	202	18.3	15.0	22.0	10.9
Niger, Niamey R2	2014	38	181	21.0	13.0	25.0	13.8
Nigeria, Kaduna R1	2012	173	450	38.4	25.2	147.8	32.8
Nigeria, Kaduna R2	2013	130	496	26.2	33.3	96.7	19.5
Nigeria, Kaduna R3	2014	123	524	23.5	36.5	86.5	16.5
Nigeria, Lagos R1	2012	9	88	10.2	7.2	1.8	2.1
Nigeria, Lagos R2	2013	11	172	6.4	14.6	-3.6	n/a
Nigeria, Lagos R3	2014	12	157	7.6	13.2	-1.2	n/a
Nigeria, Anambra R3	2014	15	146	10.3	11.9	3.1	2.1
Nigeria, Kano R3	2014	77	323	23.8	22.4	54.6	16.9
Nigeria, Nasarawa R3	2014	39	252	15.5	19.4	19.6	7.8
Nigeria, Rivers R3	2014	17	141	12.1	11.3	5.7	4.1
Nigeria, Taraba R3	2014	29	155	18.7	11.5	17.5	11.3
Uganda R1	2012	97	682	14.2	53.2	43.8	6.4

Uganda R2	2013	113	609	18.6	45.1	67.9	11.2
Uganda R3	2013	120	619	19.4	45.4	74.6	12.1
Uganda R4	2014	105	671	15.6	51.5	53.5	8
Average (un-weighted)		**82**	**425**	**18.4**	**32.0**	**49.9**	**11.9**

X R1 refers to Round 1 surveys, R2 refers to Round 2 surveys, and so on.

Figure 5. *Percent of excess January births out of total yearly births, by calendar year and survey*

Note: The number of January births is less than the average number of monthly births between February-December in 11 out of 157 survey-calendar years. Those 11 survey-calendar years are not presented in this figure.

Given the high level of excess January births, we explored two approaches to adjust the distribution of months during the transfer year to improve the estimation of the number of births in the two-year period (i.e., the numerator for the two-year age-specific fertility rate (ASFR) estimation). The first approach is to assign the excess January births to July, a mid-year point (hereinafter referred to as the July Approach). While it is a conventional approach used in demographic methods with an unknown reference month in a given year, the consequence of this approach is sensitive to the timing of survey fieldwork. For example, in Figure 3, the Ghana Round 3 survey was conducted in September to November 2014. The two-year reference period starts from October 2012 and it is reasonably expected that some of the excess January births must have occurred during the three months October to December 2012, part of the two-year reference period. However, by redistributing all excess January births to July 2012, there would be no change in the number of births during the two-year reference period. In other words, when the reference period starts in August or later in the transfer calendar year, this approach will have no impact on the number of births during the reference period. On the other hand, for the Ghana Round 4 survey that was conducted in May to July 2015, redistributing all excess January births to July 2013 will result in overcorrection: all the excess January births will be included in the two-year reference period while some of them must have occurred from January to May 2013, which is outside of the reference period. To solve this problem, we developed the second adjustment approach that randomly redistributes the excess January births evenly across the 12 months in the calendar year (hereinafter referred to as the Random Redistribution Approach). This approach does not introduce any systematic bias.

Table 5 shows the total number of births falling in the two-year reference period, after each adjustment. Adjustments were done in 36 surveys in which excess January births were identified during the reference year. Applying the July Approach, the number of births changed in 21 out of 36 surveys. Among those with a change in the number of births (n=21), the increase was 5.8% on average (range: 1.0% -12.2%). Applying the Random Redistribution Approach, the number of births did not change in two surveys (Ethiopia Round 2 and Uganda Round 2) where the reference period perfectly overlapped calendar years. Therefore, redistributing births within a calendar year does not affect the recent fertility estimation. On average, among the other 34 surveys, the adjusted number of births was 3.3% (range: 0.1% - 11.2%) higher than the unadjusted number of births.

Two factors determined the difference between the number of adjusted and unadjusted births during the two-year reference period: the level of excess January births in the transfer calendar year as well as the timing of the survey. Applying the July Approach, among the 21 surveys in which the number changed (i.e., surveys in which the reference period started in July or earlier in the transfer year), the relative change in the number of births and the level of excess January birth during the transfer calendar year showed a tight linear association (diagonal scatter plots in navy symbol, Figure 6). Applying the Random Redistribution Approach there was a positive association, but with much more variation. Much of the variation is explained by the timing of the surveyor, in other words, when the two-year reference period started in the transfer calendar year. Under the July Approach, the number of births in the reference period did not change (blue dots with 0% change) when the reference period started in August or later in the year. Figure 7 shows a decreasing relative change in the number of births, as the reference period starts later in the year– i.e., as fewer number of months gained the excess January births that were evenly distributed across the 12 months.

Table 5. *Total number of births in the two-year reference period: recorded vs. adjusted, by survey*

Survey[x]	Beginning of the two-year reference period	Number of births in two years before the survey	Adjusted number of births in two years before the survey		% increase in the number of births: from unadjusted to adjusted	
			July Approach	Random Redistribution Approach	July Approach	Random Redistribution Approach
Burkina Faso R1	2012, Nov	655	655.0	665.6	0.0	1.6
Burkina Faso R2	2013, Apr	661	710.8	698.4	7.5	5.7
Burkina Faso R3	2014, Mar	1013	1070.8	1061.2	5.7	4.8
DRC, Kinshasa R1	2011, Nov	569	n/a	n/a	n/a	n/a
DRC, Kinshasa R2	2012, Aug	671	671.0	676.0	0.0	0.8
DRC, Kinshasa R3	2013, May	686	702.5	697.0	2.4	1.6
DRC, Kinshasa R4	2013, Nov	613	613.0	618.8	0.0	0.9
DRC, Kongo Central R4	2013, Nov	475	475.0	482.6	0.0	1.6
Ethiopia R1	2012, Jan	1420	1420.0	1420.0	0.0	0.0
Ethiopia R2	2012, Oct	1500	1500.0	1515.4	0.0	1.0
Ethiopia R3	2013, Apr	1635	1788.9	1750.4	9.4	7.1
Ethiopia R4	2014, Mar	1709	1832.4	1811.8	7.2	6.0
Ghana R1	2011, Sep	865	865.0	875.5	0.0	1.2
Ghana R2	2012, Feb	905	1015.3	1006.1	12.2	11.2
Ghana R3	2012, Oct	949	949.0	969.2	0.0	2.1
Ghana R4	2013, May	1099	1184.0	1155.7	7.7	5.2
India, Rajasthan R1	2014, Jun	833	921.0	884.3	10.6	6.2
Indonesia R1	2013, Jun	1424	1452.3	1440.5	2.0	1.2
Kenya R1	2012, May	995	1035.8	1022.2	4.1	2.7
Kenya R2	2012, Nov	969	969.0	976.9	0.0	0.8
Kenya R3	2013, Jun	1057	1082.8	1072.1	2.4	1.4
Kenya R4	2013, Nov	1069	1069.0	1069.9	0.0	0.1
Niger, Niamey R1	2013, Jul	405	427.0	416.0	5.4	2.7
Niger, Niamey R2	2014, Mar	348	373.0	368.8	7.2	6.0
Nigeria, Kaduna R1	2012, Sep	716	716.0	765.3	0.0	6.9
Nigeria, Kaduna R2	2013, Aug	865	865.0	905.3	0.0	4.7
Nigeria, Kaduna R3	2014, May	988	1074.5	1045.7	8.8	5.8
Nigeria, Lagos R1	2012, Sep	155	155.0	155.6	0.0	0.4
Nigeria, Lagos R2	2013, Sep	323	n/a	n/a	n/a	n/a
Nigeria, Lagos R3	2014, May	316	n/a	n/a	n/a	n/a
Nigeria, Anambra R3	2014, May	305	308.1	307.1	1.0	0.7
Nigeria, Kano R3	2014, May	594	648.6	630.4	9.2	6.1
Nigeria, Nasarawa R3	2014, May	479	498.6	492.1	4.1	2.7
Nigeria, Rivers R3	2014, May	277	282.7	280.8	2.1	1.4
Nigeria, Taraba R3	2014, May	302	319.5	313.7	5.8	3.9
Uganda R1	2012, Apr	1391	1434.8	1423.9	3.2	2.4
Uganda R2	2013, Jan	1274	1274.0	1274.0	0.0	0.0
Uganda R3	2013, Aug	1206	1206.0	1237.1	0.0	2.6

Uganda R4	2014, Mar	1439	1492.5	1483.6	3.7	3.1
Average (un-weighted)*		**850**	**918.3**	**915.8**	**3.4**	**3.1**

X R1 refers to Round 1 survey, R2 refers to Round 2 surveys, and so on.
n/a: not applicable for surveys with no excess January births (Table 3.3).
*Average among 36 surveys

Figure 6*. Association between the relative change in births after adjustment and excess January births: 36 surveys with excess January births identified*

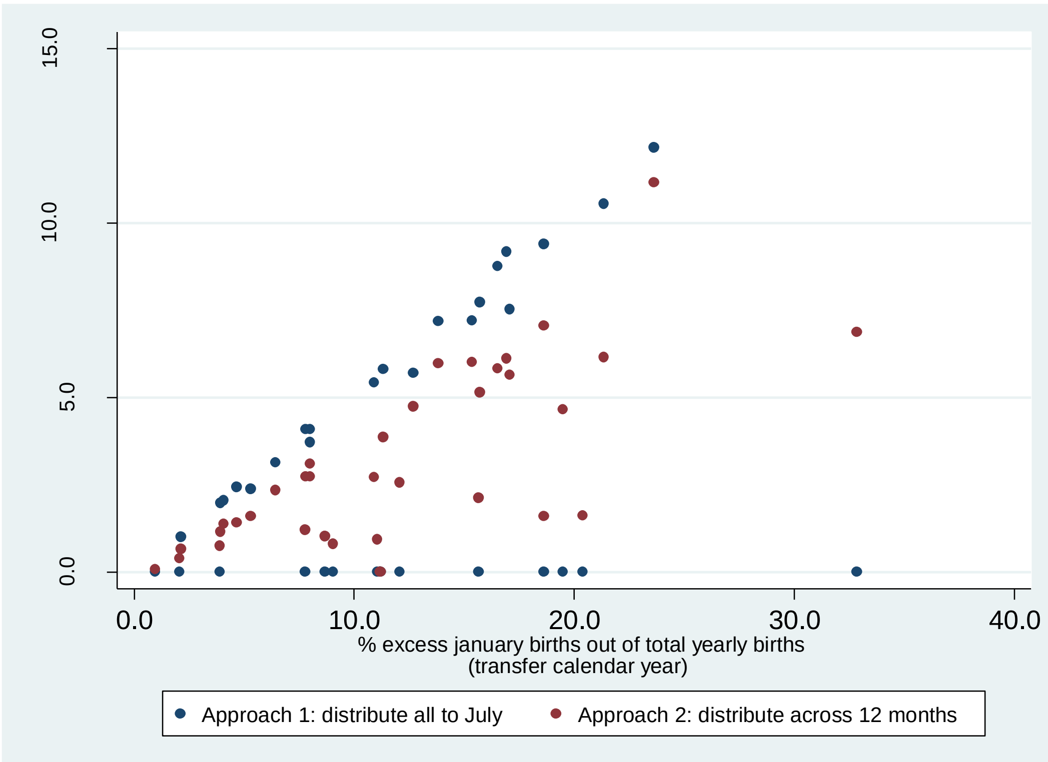
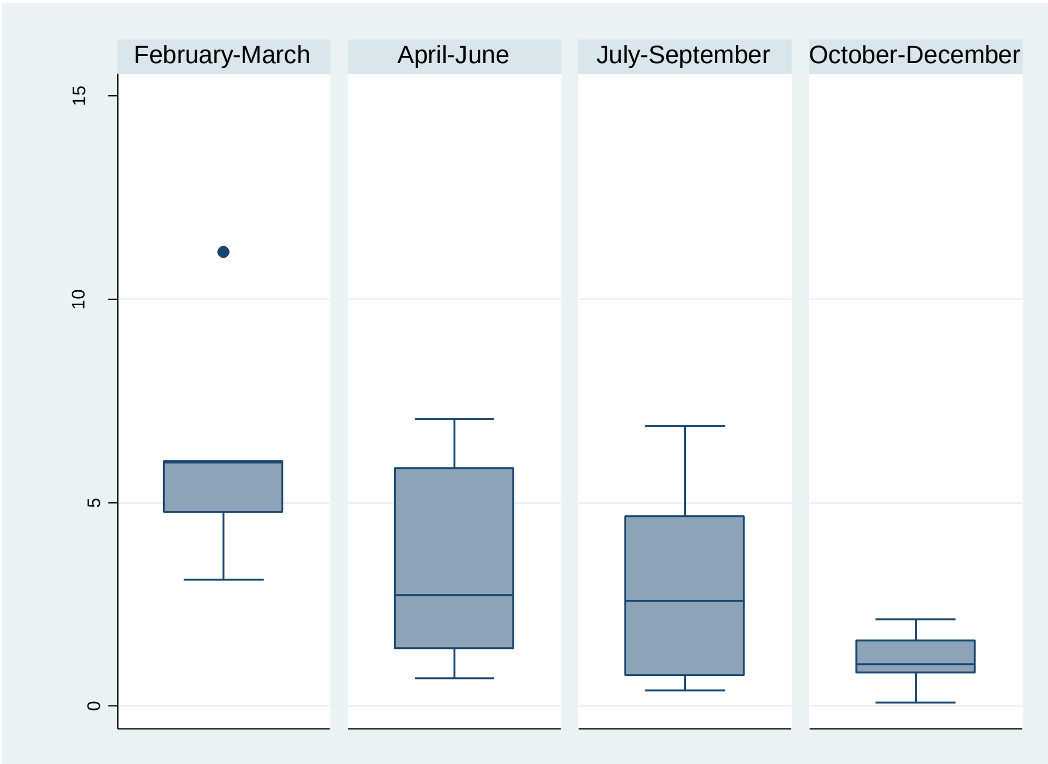


Figure 7. *Relative change in number of births in two-year period based on random redistribution approach, by beginning month of the two-year reference period*



Note: Excess January births distributed across 12 months evenly.

Estimation of TFR addressing identified issues

This section presents the TFR estimates after addressing issues identified in previous sections. Particularly, we compare the TFR estimates from the following methods: (1) no adjustment; (2) adjusted for multiple births (i.e., current PMA approach used to generate TFR in key findings briefs); (3) adjusted for excess January births using the random redistribution approach; (4) adjusted for both multiple births and excess January births. All four estimates were adjusted for sampling weights.

In the adjustment for multiple births, we used the relationship below.

$$\frac{N}{N_{pma}} = \frac{N_s + 2 * N_m}{N_s + N_m}$$

$$N = N_{pma} * \frac{N_s + 2 * N_m}{N_s + N_m} = N_{pma} * \left(1 + \frac{N_m}{N_s + N_m}\right)$$

where N is true total number of live births; N_{pma} is total number of deliveries resulting in at least one live birth; N_m is the number of deliveries resulting in multiple births; N_s is the number of deliveries resulting in a single birth.

Here we consider all multiple births as twins. The percent of deliveries that result in more than two births is extremely low (below 0.1% in most countries) and distinguishing different types of multiple births substantially complicates the adjustment formula. We obtained the adjustment factor, $\left(1+\frac{N_m}{N_s+N_m}\right)$, for each five-year age range for women of reproductive ages for the PMA2020 countries from their most recent DHS surveys. Then we applied the adjustment factor to each corresponding ASFR and calculated TFR using the adjusted ASFR.

Table 6 compares unadjusted TFR with three types of adjusted TFR: adjusted for excess January births by using the Random Redistribution Approach; adjusted for multiple births; and, adjusted for both excess January births and multiple births. Among those 33 surveys with excess January births, the Random Redistribution Approach on average increased the TFR estimate by 2.7% (range: 0.4 – 7.6%). In all 39 surveys, the adjustment for multiple births leads to an increase of TFR by 1.6% (range: 0.7 – 2.1%). The two adjustments together increase the TFR estimate by 3.9% (range: 0.9 – 9.9%) (Figure 8).

Figure 8. *The impacts on TFR estimation by adjustment for multiple births and excess January births*

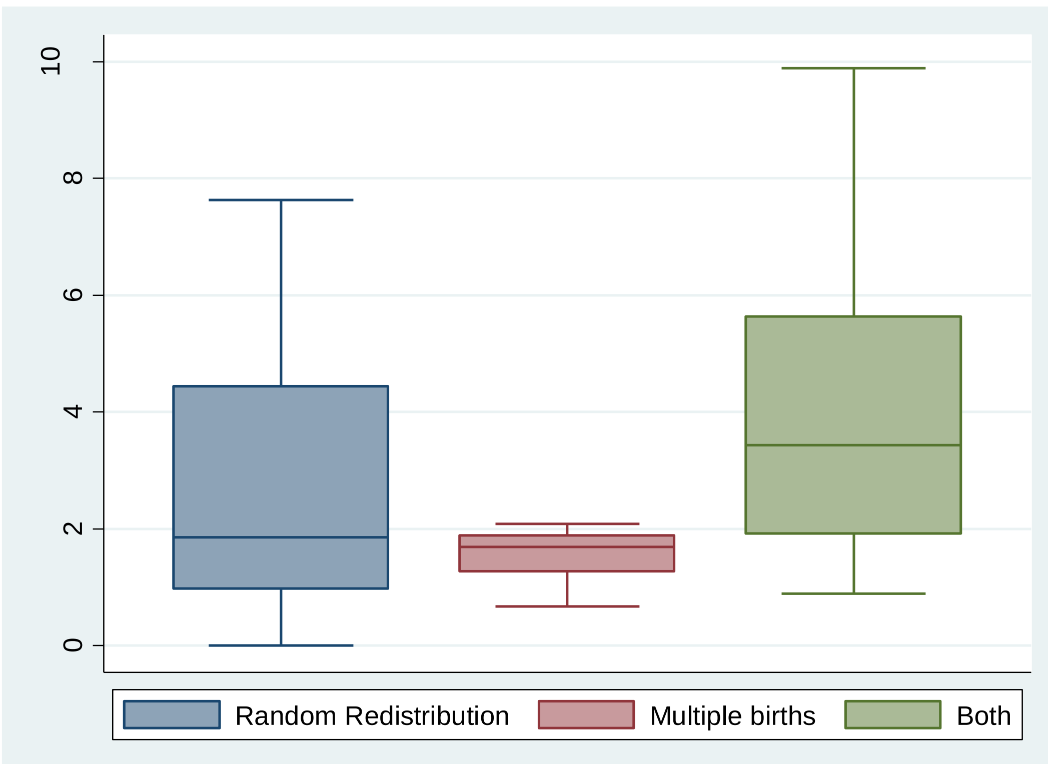


Table 6. *Total fertility rate unadjusted and adjusted for excess January births, multiple births, and both, by survey*

	Total fertility rate				% change compared to the unadjusted rate		
Survey[x]	**Un-adjusted**	**Adjusted for excess January births**	**Adjusted for multiple births**	**Adjusted for both**	**Adjusted for excess January births**	**Adjusted for multiple births**	**Adjusted for both**
Burkina Faso R1	5.5	5.5	5.6	5.6	-0.6	1.8	1.2
Burkina Faso R2	5.7	5.9	5.8	6.0	3.7	1.9	5.6
Burkina Faso R3	5.5	5.8	5.6	5.9	4.8	1.9	6.8
DRC, Kinshasa R1	4.3	4.3	4.3	4.3	n/a	1.9	1.9
DRC, Kinshasa R2	3.8	3.8	3.9	3.9	0.4	1.9	2.4
DRC, Kinshasa R3	4.2	4.3	4.3	4.4	1.6	1.9	3.6
DRC, Kinshasa R4	3.6	3.6	3.7	3.7	0.0	2.0	2.0
DRC, Kongo Central R4	4.9	4.8	4.9	4.9	-1.0	1.9	0.9
Ethiopia R1	4.0	4.1	4.0	4.2	4.4	1.1	5.6
Ethiopia R2	4.3	4.4	4.4	4.4	1.2	1.2	2.4
Ethiopia R3	3.9	4.2	4.0	4.2	6.6	1.2	7.8
Ethiopia R4	4.1	4.3	4.2	4.4	4.4	1.2	5.6
Ghana R1	3.6	3.6	3.6	3.7	1.3	2.1	3.4
Ghana R2	3.4	3.7	3.5	3.8	7.6	2.1	9.9
Ghana R3	3.0	3.0	3.0	3.1	1.6	1.9	3.5
Ghana R4	3.2	3.3	3.3	3.3	2.9	2.0	5.0
India, Rajasthan R1	2.1	2.2	2.1	2.2	5.3	0.7	6.1
Indonesia R1	2.3	2.3	2.3	2.3	0.9	0.7	1.6
Kenya R1	3.6	3.6	3.6	3.7	1.9	1.2	3.0
Kenya R2	3.3	3.3	3.4	3.4	0.3	1.2	1.5
Kenya R3	3.5	3.5	3.5	3.5	0.5	1.3	1.8
Kenya R4	3.3	3.3	3.3	3.3	0.2	1.2	1.3
Niger, Niamey R1	4.6	4.7	4.7	4.7	0.9	1.8	2.7
Niger, Niamey R2	4.5	4.8	4.6	4.9	5.9	1.8	7.8
Nigeria, Kaduna R1	3.9	4.1	4.0	4.2	5.0	1.6	6.7
Nigeria, Kaduna R2	4.5	4.7	4.5	4.8	6.1	1.6	7.9
Nigeria, Kaduna R3	5.0	5.3	5.1	5.4	6.1	1.6	7.8
Nigeria, Lagos R1	3.1	3.1	3.2	3.2	0.0	1.7	1.7
Nigeria, Lagos R2	3.4	3.4	3.5	3.5	n/a	1.8	1.8
Nigeria, Lagos R3	3.4	3.4	3.4	3.4	n/a	1.8	1.8
Nigeria, Anambra R3	3.6	3.6	3.6	3.7	1.0	1.8	2.7
Nigeria, Kano R3	5.9	6.1	6.0	6.2	3.1	1.7	4.9
Nigeria, Nasarawa R3	4.4	4.5	4.5	4.6	2.6	1.6	4.2
Nigeria, Rivers R3	3.0	3.0	3.0	3.0	0.4	1.8	2.2
Nigeria, Taraba R3	4.7	4.8	4.8	4.9	2.4	1.6	4.0
Uganda R1	5.8	5.9	5.9	6.0	1.9	1.6	3.5
Uganda R2	5.7	5.7	5.7	5.8	1.0	1.6	2.7
Uganda R3	5.0	5.1	5.1	5.1	1.8	1.7	3.4

Uganda R4	6.0	6.1	6.1	6.2	1.8	1.6	3.4
Average (unweighted)					**2.4***	**1.6**	**3.9**

X R1 refers to Round 1 surveys, R2 refers to Round 2 surveys, and so on.
n/a: not applicable for surveys without excess January births (Table 3.3).
*Average among 36 surveys

Discussion

PMA2020 surveys have collected a relatively limited amount of information on fertility, compared to a full birth-history, but do provide data to measure a two-year TFR. Simulation of PMA2020 births using full birth history data from DHS suggests that any bias introduced by the simpler questionnaire is practically absent at 0.01% on average. And, virtually all bias in most surveys is due to missed multiple births, which can be and have been corrected by adjusting the TFR by the multiple birth rates. With proper training and supervision, the questions used in PMA2020 surveys may be sufficient –though unconventional –for monitoring fertility, although we were not able to assess magnitude of omitted live births.

However, assessment of completeness of birth year and month revealed challenges in administering the questions during interviews. The level of incomplete or unknown years and especially months was high, although it has improved over a short period especially in settings where the problem was initially severe. Considering the cultural context of the countries where the surveys were conducted, it is not surprising that correct reporting and recording of birth year and month is challenging. Other surveys conducted in similar countries have faced the same challenges, but have minimized incomplete reporting (Appendix B) by intensive training and supervision on birth history data collection. This is because a main objective of such surveys is to measure demographic outcomes, fertility, and mortality. Resident Enumerator training for the first round of PMA2020 is two weeks and then two to three days before each subsequent round, which is substantial especially considering that the survey focuses on a limited number of topics. However, the data suggest that training and supervision on fertility data was not optimal to ascertain date of birth. The high level of incomplete reporting might be exacerbated by employing REs with minimum qualifications and the fact that the enumerators had to familiarize themselves with the mobile phone system at the same training session as the questionnaire. Ultimately, it will require strategic and careful tradeoffs between resources and data quality, within an acceptable range, considering that the main goal of PMA2020 is to monitor family planning indicators that are expected to change rapidly (e.g., annually) given political, financial, and programmatic commitment in a country.

In addition, the choice of a default month in data collection software and its impact was another lesson learned. Analysis suggested the underestimation was in large part due to this programming and data management decision. PMA2020 has revised the questionnaire to allow 'don't know' for birth month, instead of assigning a default month. It will enable a more direct assessment of data quality. It will also allow analysts to address the incomplete month data differently, as needed, in their research and estimation of fertility rates.

Further, moving forward, PMA2020 may consider collecting truncated birth history data when fertility is measured in a survey. It will eliminate underreporting of multiple births and minimize any confusion among data collectors as well as data users. It will further provide a basis for collecting any data related to maternal and child health, by identifying index children or pregnancies explicitly. A simulation using DHS data suggests that, by employing a 5-year or 3-year truncated birth history, the number of births collected will reduce substantially –by 58% and 74%, respectively –potentially reducing the fieldwork burden for enumerators. By collecting a truncated birth history and the first birth, which is used currently to measure and monitor age at first birth, the reduction will be 25% and 39%, if a 5-year or 3-year reference period is used, respectively (Appendix C).

Finally, while this report focuses on births, another potential data quality issue is relevant for fertility rate estimation: age displacement of eligible respondents. However, unless displacement is systematically done differentially by recent fertility, the impact is likely minimal. Further, fertility rates among age groups that are potentially exposed to displacement (i.e., 15-19 and 45-49) are typically low in most settings.

In summary, this report documents methods used to collect and analyze fertility data in PMA2020 surveys. According to data quality assessment, any under-counting of births introduced by not using the full birth history approach is almost exclusively due to under-counting of multiple births, which have been adjusted during data analysis in any PMA2020 publications. However, it was also identified that there is relatively high level of incomplete reporting of birth month. Use of default January in the case of missing birth month also inadvertently led to underestimation of TFR, depending on the timing of the survey in a calendar year. Addressing the two issues – undercounting of multiple births and excess January births –TFR estimates were upward adjusted by 2.4% and 1.6%, respectively, on average. Combined adjustment resulted in an increase of TFR by 3.9%, on average. Implications for training of enumerators and data collection programming will inform future surveys in PMA2020 and can be beneficial for other surveys.

References

Bongaarts, John. 1982. "The Fertility-Inhibiting Effects of the Intermediate Fertility Variables." *Studies in Family Planning* 13(6/7):179. Retrieved September 28, 2016 (http://www.jstor.org/stable/1965445?origin=crossref).

FP2020. 2013. *Progress Report 2012-2013: Partnership in Action*. Washington, DC. Retrieved (http://www.familyplanning2020.org/images/content/documents/FP2020_Partnership_in_Action_2012-2013.pdf).

FP2020. 2016. *FP2020 Momentum at the Midpoint 2015-2016*. Retrieved (http://progress.familyplanning2020.org/uploads/08/01/FP2020_DIGITAL_Single_LoRes.pdf).

Hawes, Meagan et al. 2017. *Response Patterns on Behavioral Outcomes in Relation to Use of Resident Enumerators over Multiple Survey Rounds*. Baltimore, MD.

Inter-agency Expert Group on SDG Indicators. 2016. "Compilation of Metadata Received on Indicators for Global Monitoring of the Sustainable Development Goals and Targets." Retrieved (http://unstats.un.org/sdgs/files/metadata-compilation/Metadata-Goal-3.pdf).

Pullum, Thomas W. and Stan Becker. 2014. "Evidence of Omission and Displacement in DHS Birth Histories ." *DHS Methodological Reports No. 11* . Retrieved (http://dhsprogram.com/pubs/pdf/MR11/MR11.pdf).

Schoumaker, Bruno. 2013. "A Stata Module for Computing Fertility Rates and TFRs from Birth Histories: Tfr2." *Demographic Research*.

Schoumaker, Bruno. 2014. "Quality and Consistency of DHS Fertility Estimates, 1990 to 2012 ." *DHS Methodological Reports No. 12* . Retrieved (http://dhsprogram.com/pubs/pdf/MR12/MR12.pdf).

Starbird, Ellen, Maureen Norton, and Rachel Marcus. 2016. "Investing in Family Planning: Key to Achieving the Sustainable Development Goals." *Global Health, Science and Practice* 4(2):191–210. Retrieved July 22, 2016 (http://www.ncbi.nlm.nih.gov/pubmed/27353614).

United Nations, Department of Economic and Social Affairs, Population Division. 2016. *World Contraceptive Use 2016*.

Zimmerman, Linnea, Funmilola OlaOlorun, and Scott Radloff. 2015. "Accelerating and Improving Survey Implementation with Mobile Technology: Lessons from PMA2020 Implementation in Lagos, Nigeria." *Etude de La Population Africaine*.

Appendix A. *Level of missing birth year and age of women who report at least one birth with missing birth year, by survey*

Survey[X]	Number of births with missing year	Number of women who reported at least one birth with missing year	Current age of the women who reported at least one birth with missing year	
			Mean	Median
Burkina Faso R1	146	118	36.8	38.0
Burkina Faso R2	106	101	36.9	37.0
Burkina Faso R3	73	68	35.8	35.0
DRC, Kinshasa R1	0	0		
DRC, Kinshasa R2	19	15	35.4	41.0
DRC, Kinshasa R3	16	14	36.7	38.5
DRC, Kinshasa R4	7	6	34.9	38.0
DRC, Kongo Central R4	54	40	36.4	37.0
Ethiopia R1	10	9	34.6	36.5
Ethiopia R2	99	84	34.1	35.0
Ethiopia R3	73	59	37.4	40.0
Ethiopia R4	95	68	34.2	35.0
Ghana R1	36	23	38.9	41.0
Ghana R2	145	101	36.0	37.0
Ghana R3	164	126	38.5	39.5
Ghana R4	142	105	37.4	39.0
India, Rajasthan R1	218	179	37.2	38.0
Indonesia R1	113	93	42.5	45.0
Kenya R1	91	70	33.7	34.0
Kenya R2	124	76	36.0	36.0
Kenya R3	64	54	38.8	40.0
Kenya R4	34	29	38.6	41.5
Niger, Niamey R1	31	20	35.4	37.0
Niger, Niamey R2	54	40	37.7	39.0
Nigeria, Kaduna R1	301	215	30.8	30.0
Nigeria, Kaduna R2	69	61	30.8	30.0
Nigeria, Kaduna R3	23	20	29.4	27.0
Nigeria, Lagos R1	23	14	35.1	35.0
Nigeria, Lagos R2	16	13	40.1	40.0
Nigeria, Lagos R3	20	14	35.7	40.0
Nigeria, Anambra R3	8	7	35.8	36.0
Nigeria, Kano R3	7	7	31.9	30.0
Nigeria, Nasarawa R3	8	8	39.9	38.5
Nigeria, Rivers R3	10	8	40.7	41.0

Nigeria, Taraba R3	15	12	33.7	35.0
Uganda R1	135	92	33.2	32.0
Uganda R2	135	101	35.1	35.0
Uganda R3	174	123	34.5	34.0
Uganda R4	143	107	35.5	35.0

[X] R1 refers to Round 1 survey, R2 refers to Round 2 surveys, and so on.

Appendix B. *Levels and trends of births with complete year and month in Demographic and Health Surveys*

	First DHS			Latest DHS		
Country	**Survey year**	**Total number of births**	**Percent of births with complete birth year and month reported**	**Survey year**	**Total number of births**	**Percent of births with complete birth year and month reported**
Burkina Faso	1992	20597	70.7	2010	56031	98.9
DRC	2007	29463	97.1	2013	59081	99.0
Ethiopia	1992	44064	89.3	2011	45419	96.3
Ghana	1988	14169	75.2	2014	23077	97.0
Rajasthan, India	1992	16329	95.6	2005	10163	99.7
Indonesia	1987	39656	75.9	2012	83484	93.8
Kenya	1988	25106	96.5	2014	83421	98.5
Niger	1992	23745	57.1	2012	44052	82.3
Nigeria	1990	28040	84.6	2013	119101	99.1
Uganda	1988	16030	99.9	2011	28516	97.8
Average			**84.2**			**96.2**

Appendix C. *Simulation of the number of births by approach using Demographic and Health Surveys*

Survey	Total number of births captured by full birth history	Total number of births that would be captured by current PMA questionnaire	Number of births that would be captured by truncated birth history		Percent decrease in the number of births, compared to the number of births captured by current PMA questionnaire		Number of births that would be captured by truncated birth history and the first birth*		Percent decrease in the number of births, compared to the number of births captured by current PMA questionnaire	
			5-year	3-year	5-year	3-year	5-year	3-year	5-year	3-year
Burkina Faso 2010	56031	33229	15128	9170	54.5	72.4	25520	20711	23.2	37.7
DRC 2013	59081	34775	18750	11464	46.1	67.0	29318	23375	15.7	32.8
Ethiopia 2011	45419	26589	11737	6815	55.9	74.4	20294	16373	23.7	38.4
Ghana 2014	23077	15476	5928	3667	61.7	76.3	11090	9330	28.3	39.7
India, Rajasthan 2005	10163	7026	2036	1197	71.0	83.0	4308	3661	38.7	47.9
Indonesia 2012	83484	68678	18143	11035	73.6	83.9	43653	39041	36.4	43.2
Kenya 2014	83421	55619	21138	12605	62.0	77.3	39510	32919	29.0	40.8
Niger 2012	44052	23859	12632	7709	47.1	67.7	19947	15772	16.4	33.9
Nigeria 2013	119101	68773	31866	19263	53.7	72.0	53079	42891	22.8	37.6
Uganda 2011	28516	16069	7931	4786	50.6	70.2	12838	10277	20.1	36.0
Average					**57.6**	**74.4**			**25.4**	**38.8**