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Technical Paper
No. 2014/3

The Impact of Including Reports from Male Respondents on Estimates of Maternal Mortality from Demographic and Health Surveys

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Sara Hertog and Victor Gaigbe-Togbe

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NOTE

PREFACE

The Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat is responsible for providing the international community with up-to-date and scientifically objective information on population and development. The Population Division provides guidance on population and development issues to the United Nations General Assembly, the Economic and Social Council and the Commission on Population and Development and undertakes regular studies on population estimates and projections, fertility, mortality, migration, reproductive health, population policies and population and development interrelationships.

The purpose of the *Technical Paper* series is to publish substantive and methodological research on population issues carried out by experts within and outside the United Nations system. The series promotes scientific understanding of population issues among Governments, national and international organizations, research institutions and individuals engaged in social and economic planning, research and training.

This paper assesses whether the reports of sibling survival obtained from male respondents should be included when estimating proportions of maternal deaths among women 15 to 49 years old (PMDF) from Demographic and Health Surveys (DHS). In a number of countries with DHS data, male respondents were asked about the survival of their sister siblings and in the case of their death if the cause of death was related to a pregnancy. The PMDF were calculated using sibling histories from DHS data for 11 countries with both a module for female respondents and male respondents. The standard errors and confidence intervals of the proportion of maternal deaths were calculated for the samples without male respondents and with male respondents using a Jackknife procedure. The paper was co-authored by Sara Hertog and Victor Gaige-Togbe of the Population Division. A preliminary version of the paper was presented at the Maternal Mortality Estimation Inter-Agency Group (MMEIG) in Geneva in February 2014. Preparation of this report benefited from comments received from Patrick Gerland and Barney Cohen of the Population Division.

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THE IMPACT OF INCLUDING REPORTS FROM MALE RESPONDENTS ON ESTIMATES OF MATERNAL MORTALITY FROM DEMOGRAPHIC AND HEALTH SURVEYS

Sara Hertog and Victor Gaigbe-Togbe

A. INTRODUCTION

The United Nations Maternal Mortality Estimation Inter-Agency Group (MMEIG) endeavours to produce globally consistent estimates of maternal mortality risks and numbers of maternal deaths for the purposes of monitoring progress towards the Millennium Development Goal (MDG) 5 target of reducing the maternal mortality ratio (MMR) by three quarters of its 1990 level by 2015. The most recent set of estimates published in 2014 indicated that 210 maternal deaths occurred per every 100,000 live births globally in 2013, representing a reduction of 45 per cent from the 1990 level of 380 maternal deaths per 100,000 live births WHO and others (2014). Out of 88 countries with MMR over 100 maternal deaths per 100,000 live births in 1990, thirteen countries had made insufficient progress since 1990 in reducing maternal mortality, meaning that if they continued on their same trajectories they would not attain the MDG target by 2015, while another two countries had achieved no progress , suggesting that maternal mortality measurement and monitoring will remain important beyond the 2015 MDG target date as the international community moves forward with the United Nations post-2015 development agenda.

Despite advances in data collection and quality, generating estimates of maternal mortality ratios that are comparable across countries and over time is a daunting task. In 2011 the Commission on Information and Accountability for Women's and Children's Health recommended that "by 2015, all countries [should] have taken significant steps to establish a system for registration of births, deaths and causes of death, and have well-functioning health information systems that combine data from facilities, administrative sources and surveys" (WHO, 2014). Yet today more than half of countries still rely exclusively on surveys, such as the Demographic and Health Surveys (DHS), for the estimation of maternal mortality.

As part of its contribution to the work of the MMEIG, the United Nations Population Division is tasked with processing maternal mortality information from DHS household surveys. The Division uses standardized procedures to estimate the proportion maternal of deaths to females of reproductive age (PMDF) with standard errors in a way that is consistent across countries and surveys. To collect the data necessary for the estimation of maternal mortality, the DHS asks respondents to report on the survival status of their sisters and, for deceased sisters, to report on the pregnancy status around the time of death. Traditionally the surveys have collected such information only from female respondents, but a small minority of surveys have collected male respondents' reports of their sisters' survival as well. The conventional wisdom has been that reports from males could lead to biased estimates because males are thought to be less likely than females to be in touch with their siblings as adults and therefore will report sibling survival status and current age less accurately than females, will report age at death and years since death less accurately than females, and will be less likely to know if a sister died during pregnancy or childbirth. However, recent analyses have challenged that conventional wisdom. A 2013 study assessed the differences between female and male responses for estimation of adult mortality (35q15), the proportion of maternal deaths among females aged 15 to 49 years (PMDF) and the maternal mortality ratio for 10 DHS surveys and concluded that reports of males generally yielded similar adult and maternal mortality estimates to reports of females (Merdad, Hill and Graham, 2013). Moreover, the improvement in efficiency that was achieved by expanding the sample to include male respondents led the authors to recommend that future surveys include the maternal mortality module in male questionnaires.

Past MMEIG revisions have used the PMDF as calculated from tables published in the final report corresponding to each survey, which has resulted in some inconsistencies in the width of the time period to which the PMDF estimate refers and in whether male responses were taken into account in the estimation. Only one survey—the Cameroon 2004 DHS—included male respondents in the estimation of adult and maternal mortality from sibling survival as presented in the final report. The remaining surveys thus reflect only the survival of siblings reported by female respondents.

To understand the implications of including or excluding male respondents' reports of their sisters' survival on the estimate of PMDF used as inputs to the MMEIG models, this paper performs an analysis similar to that from Merdad, Hill and Graham (2013), but using the 7-year reference periods, standardized processing tools, and the jackknife standard errors approach developed for the work of the MMEIG. In addition, the paper explores the implications of including or excluding male respondents for estimates of age pattern of the PMDF across 5-year age groups from 15 to 49 years.

B. DATA

In the DHS surveys, the maternal mortality module contains questions on the number of siblings of the respondent irrespective of place of residence, sex or survival status. The module also contains questions on the age of the sibling: If alive, respondents are asked the current age of the sibling in years. If deceased, respondents are asked how many years ago the death occurred and how old the sibling was when he or she died. In addition, if the death occurred to a sister between the ages of 15 and 49, respondents are asked whether the sibling was pregnant when she died, whether she died in childbirth or whether she died within two months following the end of a pregnancy or birth. The standard question for this item of the maternal mortality module is two months, although it varies somewhat across surveys. For example, the Zimbabwe 1994 DHS asked whether the death occurred within six weeks following the end of the pregnancy and the Indonesia 2002-2003 DHS asked whether the death occurred within 42 days after the end of a pregnancy. Finally, some surveys include additional questions such as how many live born children the deceased sister gave birth to during her lifetime or whether the sister's death was caused by an injury or accident.

The full maternal mortality module has been included in 119 DHS surveys for which data are currently in the public domain (a handful of other surveys have included sibling survival modules but have been excluded from this total either because the data are not in the public domain or because only summary sibling histories were collected enabling only indirect estimation of adult mortality, rather than the direct estimation method used here).

Thirteen of these 119 surveys asked male respondents to complete the maternal mortality module. Out of those 13 surveys, 11 included the responses to the maternal mortality module included in the male recode files. Two surveys—the Cote d'Ivoire 2005 AIDS Indicator Survey and the Nigeria 1999 DHS included the maternal mortality on the male questionnaire, but the responses are missing in the data. The 11 surveys for which we have data on sibling survival from both male and female respondents are Brazil 1996, Cameroon 2004, Congo 2005, Indonesia 2007, Malawi 1992, Nigeria 2008, Tanzania 1996, Uganda 1995, Zambia 2007, Zimbabwe 1994 and Zimbabwe 2005-2006.

The DHS sibling history file treats each respondent as an observation with information on siblings included as part of this observation. For the purpose of this analysis, the respondent record was transformed into sibling records. Each record corresponds to each year of observation the sibling is alive. An observation is also recorded for their year of death if they die.

C. METHODS

The approach used in this paper to estimate the PMDF is similar to that used by Merdad, Hill and Graham (2013). But, unlike in the Merdad and colleagues study, this study refers to a period of 7 years wide covering the period 0 to 6 years before the survey. Merdad and colleagues (2013) and Hogan et al. (2010) studies cover 0-4 years before the survey. The analysis of sibling histories by Masquelier, Reniers and Pison (2013) suggested a decline in the completeness of death reporting as the interval between the death and the survey enumeration increases with a distinct heaping at 10 years before the survey, and more than 20% omissions of deaths occurring in the 7-15 years before the survey. This recall bias affects the overall adult mortality level, but by concentrating on the period 0-6 years before the survey this bias is minimized while increasing the number of person-years of exposure to minimize the PMDF variance. In addition this study only focuses on the comparison of the PMDF if male respondents are included or not in the computation, and thus the use of a longer recall period should not be affected by the recall bias. The approach also allows the flexibility to change the reference period. The procedure used to deal with missing data in this paper follows DHS standard procedures and therefore differs slightly from the procedure used in previous studies. Sibling records are excluded if they are missing survival status. In general, very few sibling records are missing survival status: less than one per cent of siblings reported by female respondents are missing survival status across all of the surveys, and the same is true for the siblings of male respondents, except for the Uganda 1995 DHS, in which 1.6 per cent of the siblings reported by male respondents were missing survival status.

The imputation of age for surviving siblings for whom current age is missing also followed the DHS procedure of imputing the age based on birth order and information on other siblings when available. Less than one per cent of surviving siblings were missing current age across both male and female respondents in all surveys except Uganda 1995, for which 1.4 per cent of females' surviving siblings and 1.1 per cent of males' surviving siblings were missing current age. Siblings' exposures were excluded from the adult and maternal mortality estimation where the DHS has been unable to impute a current age.

The DHS procedure for missing data has also been followed where the date at death was missing. For deceased siblings, the DHS calculates the date of death based on the reported information about the siblings' age at death and the number of years ago that the death occurred. When the information required to approximate a date of death could not be supplied by respondents, those deaths and the exposures of those siblings are excluded from the mortality estimation. The proportion of siblings excluded for this reason ranges from less than one per cent in the Zimbabwe and Malawi surveys, to close to 5 per cent of males' deceased siblings in the Uganda survey, and it reaches close to 80 per cent of males' deceased siblings in the Brazil survey. The absence of sufficient information to determine the date of death for male's deceased siblings in the Brazil survey severely limits the utility of the male responses to that survey for the estimation of maternal mortality.

Finally, female siblings who died between ages 15 and 49 and for whom maternal status at death was unknown are excluded from the estimation of the maternal mortality rate, following the standard DHS approach. It is worth mentioning that while deaths with unknown maternal status are excluded from the estimation of the maternal mortality rate, they are included in the estimation of the adult all-cause mortality rate, which may likely lead to an underestimation of the PDMF.

A handful of studies have assessed the selection bias that could occur since mortality is expected to cluster within siblings. In the event that no sibling survives to be a potential respondent (Merdad, Hill and Graham, 2013), the bias will be greater. Gakidou and King (2006) proposed weights (the inverse of the number of surviving siblings of the respondent to recover the death rates of sibship with at least one surviving respondent. But, Masquelier (2013) argued that the reported bias was overestimated due to the incorrect application of the weights in each survey and recommended that researchers apply the DHS standard approach. Still, to account for underestimation of the PMDF in DHS, the MMEIG method adjusts it by a factor of 1.1. Merdad, Hill, and Graham (2013) used an alternative approach that entailed assigning a proportion of unknown cause deaths as maternal according to the age distribution of known maternal deaths.

Standard errors of the PMDF are estimated using a jackknife resampling procedure (Shao and Tu, 1995) . DHS routinely uses a jackknife procedure to estimate sampling errors for selected mortality and fertility rates, although adult mortality and maternal mortality are usually not included among these. An exception is the Nigeria 2008 DHS report that included sampling errors for the maternal mortality ratio for the full age range 15-49, but not for adult and maternal mortality rates by age group. Merdad, Hill, and Graham (2013) alternatively used a bootstrapping procedure to obtain standard errors for their estimates of adult mortality, the PMDF and the maternal mortality ratio.

D. RESULTS

Table 1 presents the characteristics of the sample both when males are excluded and when they are included as respondents, the overall number of deaths and person years of exposure for the 11 DHS surveys. Adding the reports of male respondents increases the number of maternal deaths by just one, from 28 to 29 deaths for the Brazil 1996 DHS (not shown in Table 1). This survey was indeed plagued with missing dates of death for the deceased sisters of male respondents. Consequently, for the remainder of the analysis, the 1996 DHS survey of Brazil has been omitted. Other surveys report a much more substantial increase in the number of maternal deaths captured once reports of male respondents are included, ranging from a low of a 12 per cent increase in the number of maternal deaths in the Congo 2005 DHS, to a high 77 per cent increase in the number of maternal deaths captured in the Zimbabwe 2005-2006 DHS.

TABLE 1. HOW MUCH DOES SAMPLE SIZE INCREASE WITH MALE RESPONDENTS?

Country	*Survey year*	*Maternal deaths without males*	*Maternal exposures without males*	*Maternal deaths with males*	*Maternal exposures with males*	*% increase in maternal deaths*	*% increase in maternal exposures*
Cameroon	2004	153	125 221	219	184 197	43	47
Congo	2005	114	91 066	128	129 188	12	42
Indonesia	2007	57	382 162	81	451 399	42	26
Malawi	1992	68	52 033	81	65 483	20	26
Nigeria	2008	398	378 798	545	542 670	37	43
Tanzania	1996	117	99 680	142	124 979	21	25
Uganda	1995	112	87 969	141	111 183	26	26
Zambia	2007	106	87 654	162	164 569	53	88
Zimbabwe	1994	50	84 165	62	112 293	22	33
Zimbabwe	2005-2006	98	112 915	174	195 793	77	73

Figure 1 presents the PMDF and 95 per cent confidence intervals estimated with male respondents' sisters included in the sample, indicated by the blue bars, and without the sisters of male respondents indicated by the red bars. The figure shows that the inclusion of male respondents generally results in a reduction in the PMDF, with the exception of a few cases like Cameroon 2004, Indonesia 2007 and Zimbabwe 2005-2006 where the PMDF increases slightly when male respondents are included in the sample. The addition of male respondents results in a considerable narrowing of the confidence intervals for some surveys, particularly among some of the more recent surveys that had larger sample sizes (e,g,. Congo 2005, Nigeria 2008 and Zambia 2007).

Figure 1. Proportion of maternal deaths among females 15-49 years (PMDF) estimated while including and excluding male respondents' reports of their sister's survival, 11 DHS surveys

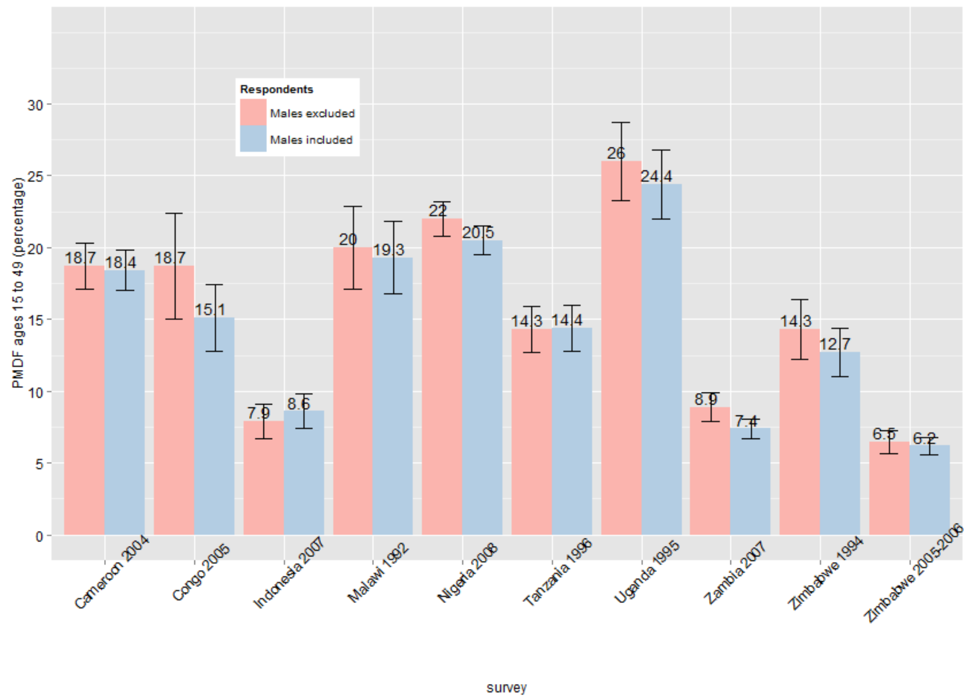


Table 2 presents in tabular form the same results. With the addition of data from male respondents, the PMDF shrinks by as much as 19 per cent in the case of Congo 2005, the percentage maternal of deaths to females falls from 18.7 to 15.1 and the standard error associated with the PMDF also shrinks by 26 per cent. The change in PMDF is smaller in the case of the 2008 Nigeria DHS where adding male respondents results in a smaller shrinkage of the PMDF from 22.0 per cent to only 20.5 per cent, but a substantial reduction in standard error by 19 per cent. It is worth mentioning that for each of the surveys, the reduction in the standard error is larger in magnitude than the change in the PMDF estimate that results from the addition of male respondents to the sample.

TABLE 2. CHANGE IN THE PMDF AND STANDARD ERRORS WHEN MALE RESPONDENTS ARE INCLUDED

Country	*Survey year*	*PMDF without males*	*SE without males*	*PMDF with males*	*SE with males*	*% change in PMDF*	*% change in SE*
Cameroon	2004	18.7	1.6	18.4	1.4	-1.8	-12.6
Congo	2005	18.7	3.2	15.1	2.3	-19.0	-26.2
Indonesia	2007	7.9	1.2	8.6	1.2	9.5	0.4
Malawi	1992	20.0	2.9	19.3	2.5	-3.9	-14.2
Nigeria	2008	22.0	1.2	20.5	1.0	-6.8	-18.9
Tanzania	1996	14.3	1.6	14.4	1.6	0.4	-0.2
Uganda	1995	26.0	2.7	24.4	2.4	-6.4	-13.1
Zambia	2007	8.9	1.0	7.4	0.7	-16.5	-30.9
Zimbabwe	1994	14.3	2.1	12.7	1.7	-10.8	-18.2
Zimbabwe	2005-2006	6.5	0.8	6.2	0.6	-4.1	-26.8

As mentioned earlier, the numbers of maternal deaths on which the PMDF estimates are based can be quite small, especially in countries where the most recent DHS was carried out during the mid-1990s when overall sample sizes were smaller than for the more recent surveys. Small numbers of siblings and deaths yield wide confidence intervals, and this is especially true when the PMDF estimates are disaggregated by age.

Figure 2 presents the age pattern in the PMDF for the 11 DHS surveys with reports on male respondents on their sisters' survival. The red line and shading indicates the PMDF estimate and 95 per cent confidence interval when male respondents are excluded from the sample, while the blue line and shaded area shows the corresponding estimates once males are added. In the case of the Malawi 1992 DHS, for example, the confidence bands are quite wide because the number of maternal deaths on which the PMDF are based are quite small. For the 15-19 age group, for example, the PMDF for both samples is around 25 per cent while the confidence interval extends from around 10 per cent to close to 40 per cent. Adding males to the sample changes the age-pattern of PMDF only a little, especially for the 30-34 and 40-44 age groups, and yields a moderate reduction in the width of the confidence interval

The results are also similar for the Zimbabwe 1994 DHS and for the Tanzania 1996 DHS: the age pattern of PMDF remains largely similar with the addition of male respondents and the confidence intervals narrow moderately. On the other hand, more recent DHS surveys that benefitted from larger sample sizes see much narrower confidence intervals around the age-disaggregated PMDF estimates, while the pattern changes little with the addition of male respondents. In the case of the Nigeria 2008 DHS, for the 15-19, age group the PMDF is 24 per cent when males are excluded and 22 per cent when males are included, while the confidence interval once males are included ranges from 18 per cent to 26 per cent. In the case of Zimbabwe 2005-2006 DHS, the age pattern of PMDF is similar to that observed for Nigeria with narrower confidence intervals when males are included as respondents. Similar gains in efficiency with the inclusion of males are seen also for the recent surveys in Zambia 2007 DHS.

Figure 2. Proportion of maternal deaths (PMDF) by age group according to the type of respondents (males excluded or males included)

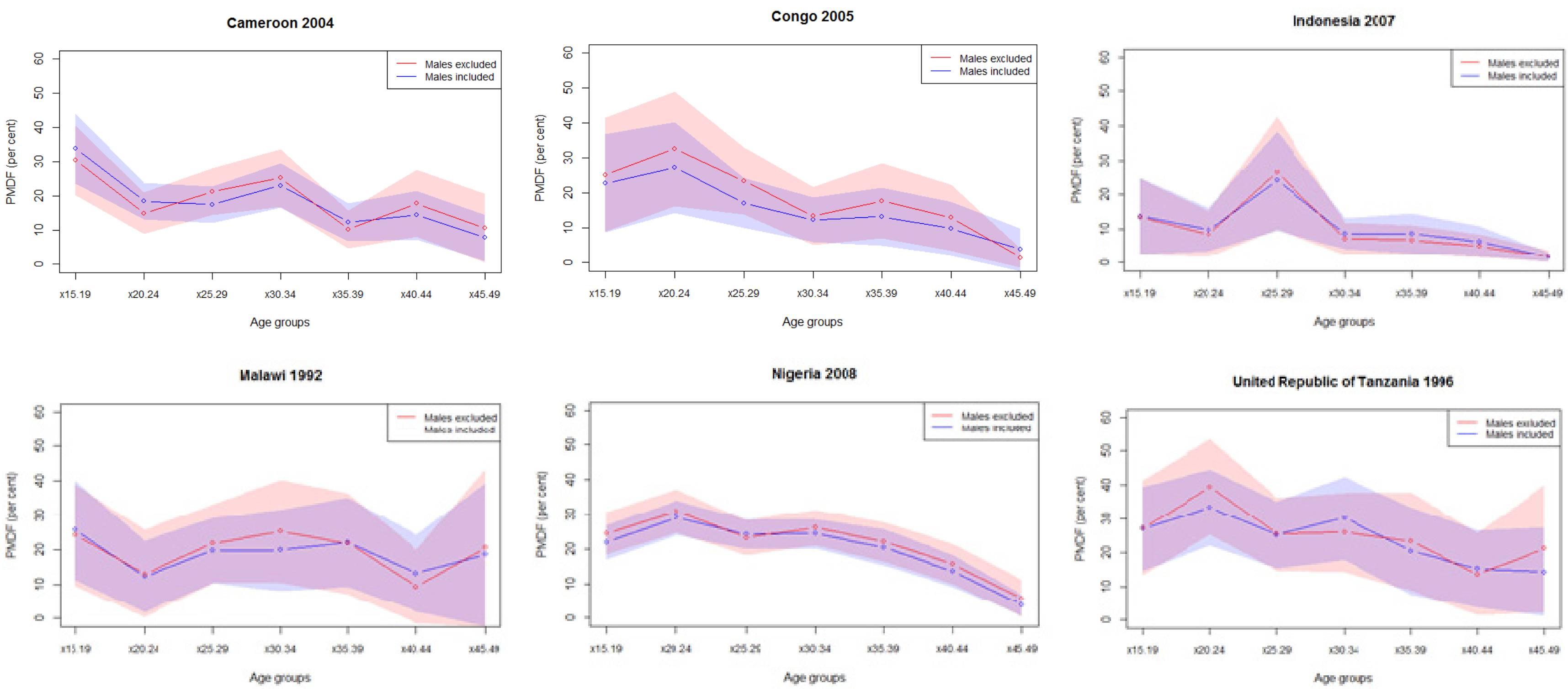
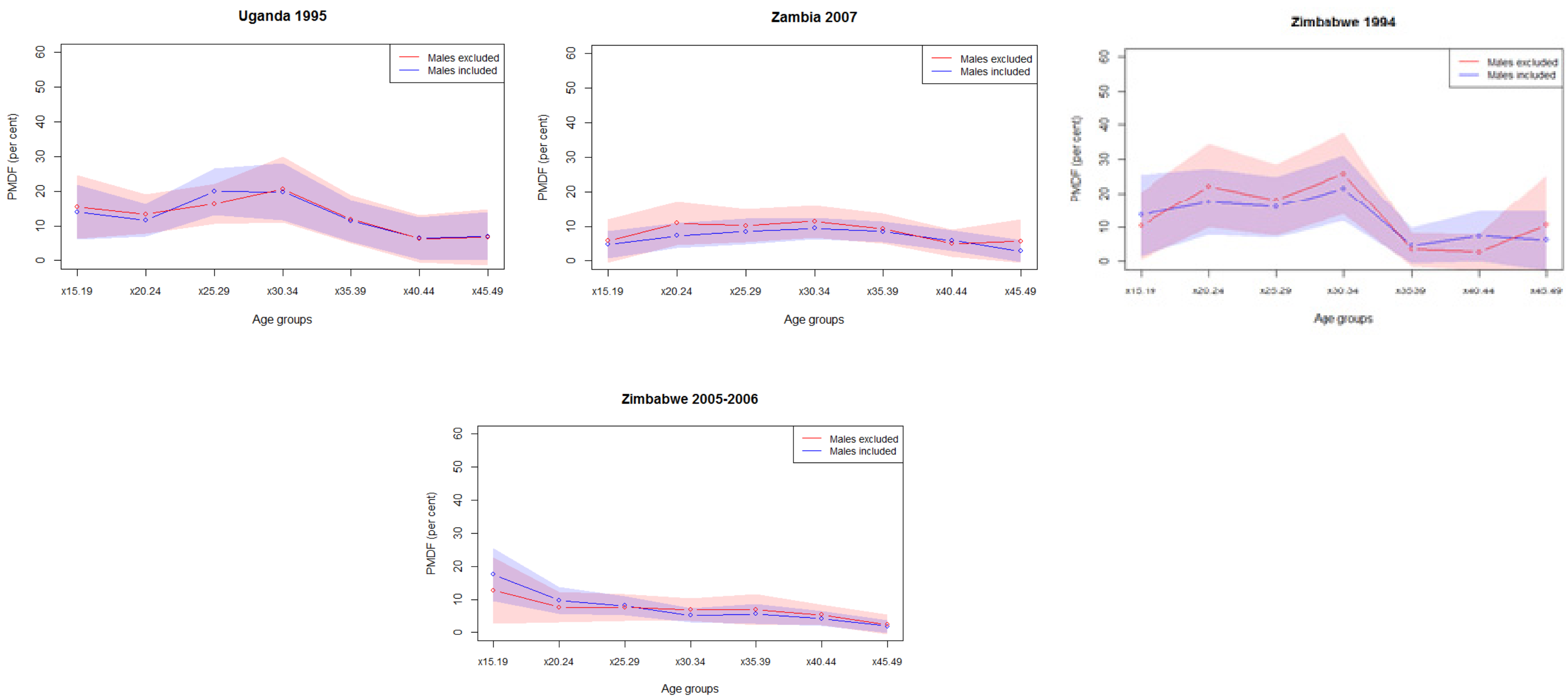


Figure 2. Proportion of maternal deaths (PMDF) by age group according to the type of respondents (males excluded or males included) (cont'd)



E. DISCUSSION

Because of the typical size of samples used in DHS surveys, the estimation of maternal mortality comes with large standard errors. As in Merdad and colleagues' paper, the present study suggests that the inclusion of male respondents on their sibling histories could improve the estimation exercise and leads to efficiency gains in the estimation of adult and maternal mortality.

As in previous studies, the analysis shows that the proportions of maternal deaths to women aged 15-49 do not change substantially when males are included in the sample. The inclusion of male respondents leads in general to lower estimates of the PMDF except for the Indonesia 2007 DHS and Tanzania 1996 DHS. In contrast to results from Merdad and colleagues study, the PMDF for Congo 2008 DHS was smaller with the addition of male respondents than when males are excluded. This difference may be explained by the difference in the reference period adopted by both studies. While the present study uses a reference period of 7 years before the survey, Merdad and colleagues study adopted a reference period of 5 years.

The study found that the proportion of maternal deaths among female respondents 15-49 years old based on sibling histories obtained with the inclusion of males is in general a little smaller than those obtained with only females respondents' sibling histories. The study also found similar results to Blanc and colleagues (2013) and Nove and colleagues (2014), namely that there is a substantial heterogeneity in the age pattern of the PMDF. While some countries show a J –shaped curve with adolescent having a smaller PMDF than other age groups, other countries show a higher PMDF in the age group 15-19 years.

The study also found that the standard errors of the PMDF are smaller when male respondents are included than those with only female respondents. The inclusion of male respondents results in larger samples and consequently reduces the standard errors.

The age pattern of the PMDF remains unchanged when male respondents are included. In general, PMDF is a little higher in the age group 15-19 and decreases in the subsequent age groups. But in the case of Nigeria 2008 DHS, PMDF is higher in the age group 20-24 than in the age group 15-19.

F. SUMMARY AND CONCLUSIONS

This paper shows that 11 DHS have included the maternal mortality module on the men's questionnaires and have placed the data in the public domain. For the Brazil 1996 survey, the extent of missing data for siblings reported by males is such that it is probably not useful to include for estimating PMDF. Only one additional maternal death is picked up in the 7 years preceding the survey when the Brazil male respondents are added.
For the remaining surveys, there are gains to efficiency from including male respondents, especially for the more recent surveys (since 2000) for which including male respondents increases the sample size substantially.

In general, the age pattern of the PMDF across 5-year age groups between ages 15 and 49 changes very little once male respondents are added, and given that the confidence intervals surrounding the PMDF disaggregated by age tend to be quite large, the reduction in standard errors that occurs with the addition of male respondents may be especially valuable when examining age patterns of maternal mortality.

Given that the inclusion of reports from male respondents yields similar estimates of PMDF as when male respondents are excluded but provides gains in efficiency through narrower confidence intervals, the study recommends that sibling histories from both females and males be included in future surveys designed to use the direct sisterhood method for the estimation of adult mortality and maternal mortality. The provision of male respondents also provides an independent mean of validating estimates from female respondents, and therefore can contribute to increase the reliability of PMDF estimates when both male and female respondents provide similar estimates. This supplementary information in turn can improve the accuracy of tracking progress and monitoring trends in adult and maternal mortality.

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