PAA EXTENDED ABSTRACT 2018

The Quality and Consistency of Self-Reported Age and Date of Birth in the Demographic and Health Surveys, 2000-2015

Sarah Staveteig[1,2]
Thomas Pullum[2,3]

[1] Avenir Health; [2] The Demographic and Health Surveys Program; [3] ICF

Abstract:

Accurate self-reports of ages and dates are foundational to the computation of a number of demographic indicators from household surveys. However, accuracy of reporting may be low in areas where innumeracy is prevalent. In this study we assess completeness and heaping of self-reported ages and dates in 148 DHS surveys. We find that around 15% of surveys show evidence of non-negligible incompleteness or heaping. We compare these findings with results from two mixed-methods surveys fielded recently in Ghana and Nepal that re-asked respondents their age and date of birth within a few weeks of their DHS interview. In the 2014 Ghana DHS, where the Myers' index among women 15-44 is around the median for DHS surveys, 8 percent of the follow-up sample did not know their year of birth and 19 percent report a different year upon follow-up. The results from Nepal are embargoed until December of 2017.

This analysis is supported by the United States Agency for International Development (USAID) through The DHS Program (#AIDOAA-C-13-00095). The views expressed are those of the authors and do not necessarily reflect the views of USAID or the United States Government.

Surveys conducted by The Demographic and Health Surveys Program (DHS) are a principal source of data for vital rates and health in developing countries. Ages and dates are foundational to a number of key demographic indicators computed by The DHS Program. Age and date of birth are subject to misreporting, particularly in areas where literacy and numeracy are low (Bignami-Van Assche 2003; Pullum 2006). Periodic assessments of the quality of age and date data are an important element of program monitoring and can help improve data quality. To that end, this study examines the quality and consistency of age and date reporting in DHS surveys conducted since 2000 using DHS datasets and mixed methods studies conducted by The DHS Program.

The first part of the study assesses the quality of self-reported ages and dates of birth using two types of measures: incompleteness and heaping. A total of 11 indicators are used. For each indicator, the distribution across all surveys is described and the surveys with the most extreme levels are identified.

The second part of the study examines the results from two mixed methods follow-up surveys that were fielded among a subset of 2014 Ghana DHS respondents (Staveteig 2016) and 2016 Nepal DHS respondents (forthcoming). These surveys were fielded in order to understand barriers to family planning, but offer a unique opportunity to examine the consistency and quality of date reporting in DHS surveys. We examine follow-up results in tandem with age and date heaping in these DHS surveys to assess the consistency and quality of date recall. The current extended abstract reflects results from the Ghana study only, as the Nepal study is embargoed until December 2017.

Data and Methods

The DHS Program has fielded multistage household surveys in low- and middle-income countries since 1985. In these surveys, after sampling and household selection are complete, interviewers approach each eligible household for an interview with an adult respondent for the household using the household questionnaire, which includes an inventory of all household members. Household members are defined as individuals who are usual residents as well as individuals who stayed with the household as guests the previous night. Based on the household inventory, interviewers determine which women in the household are eligible for individual interviews and—if the survey includes men and the household is selected for male interviews—which men are eligible for individual interviews. If eligible women and men consent to individual interviews, they are conducted separately, typically within a few days of the household interview. All core questionnaires from DHS-4 through DHS-7 (ICF International 2011, 2015b, 2015a; Macro International 2008b, 2008a; ORC Macro 2001a, 2001b) ask women and men the following items analyzed in this study: *In what month and year were you born?"* and *"How old were you at your last birthday?"*.

We review the misreporting of ages and dates using virtually all of the DHS surveys conducted between 2000 and the closing date for this report—148 surveys in 67 countries. The total number of cases is approximately 1.67 million women in the surveys of women and 0.72 million men in the surveys of men. Misreporting will be described with indicators of incompleteness and heaping. For each of these, three or four indicators will be employed using individual surveys.

Incompleteness applies to an instance in which the respondent provides less information about an age or date than is expected, requiring some imputation during data processing, or when there is an inconsistency between the types of information provided that requires some reconciliation. Heaping refers to a tendency to provide an age that disproportionately has specific final digits, typically 0 or 5, although other final digits such as 2 or 8 can also occur more often than would be expected. The easiest way to describe heaping or digit preference is to calculate the percentage of cases with each possible final digit (0, 1, …, 9), add up the absolute deviations of those percentages from 10%, and divide the total by two. This indicator is an application of the Index of Dissimilarity, which summarizes the deviation of any observed categorical distribution from a distribution that is "expected" under some model. The index is interpreted as the percentage of cases that would have to be shifted from an over-represented category to an under-represented category in order to match the "expected" distribution. The division by two is required because when one case is moved it will simultaneously reduce the excess by one and reduce the deficit by one.

A longstanding indicator of age heaping is Myers' Blended Index (herein Myers' Index). This index is a minor modification of the Index of Dissimilarity that takes into account the overall pattern of most observed age distributions, such that the percentage of the cases at age x+1 tends to be less than the percentage at age x. Such a pattern results from the cumulative impact of mortality, as well as, often, an increasing number of births every year compared with the previous year. For that reason, even in the absence of digit preference, there would tend to be fewer cases with final digit 1 than with final digit 0, fewer cases with final digit 2 than with final digit 1, etc., and fewer cases with final digit 9 than with final digit 8. Myers' Index adjusts the Index of Dissimilarity for that gradient. For either index to be applied correctly, the age range must be a multiple of 10 years. We will calculate this index for age in the survey of women (v012, using ages 20-49) and in the survey of men (mv012, using ages 20-49).

The Ghana follow-up study interviewed 129 matched respondents from three regions. Respondents were selected using an algorithm described by Staveteig et al. (2017). Interviews were typically conducted between one and four weeks after their GDHS interview. The response rate was 92.3 percent. Data shown in the present draft are for the 96 follow-up respondents analyzed in the original study (Staveteig 2017; Staveteig et al. 2017) and will be expanded to the full set of 129 respondents later this year.

Results

Incompleteness and Heaping

Incompleteness of age and date reporting is assessed for the woman's and man's stated age. As stated earlier, the indicator is the percentage of cases for which the age, year of birth, and month of birth are not all provided or are not all consistent with the month and year of interview. Figure 1 gives the distribution of this percentage for the four indicators, across all surveys. The four graphs in the figure have the same horizontal scales, the percentage of responses that are incomplete, but different vertical scales.

When age is incomplete, it is usually because age and year of birth were provided, but not a month, or the month was inconsistent with the year and age, so the month had to be imputed or modified. It is rare for age itself to require imputation. Over all the surveys, the average level of incompleteness is 22% for women's birthdate/age. Incompleteness of woman's age in excess of 50% was found in the 22 surveys listed in Table 1. Overwhelmingly, the incompleteness was only in terms of month, but a threshold of 50% is clearly a high level of any kind of incompleteness. For men's birthdate/age, the mean level of incompleteness is 20.8%. Table 2 lists the 17 surveys that have a level above 50%. The surveys on this list match closely with the surveys on the list for incompleteness of women's birthdate/age. Some of the differences are simply due to the fact that not every DHS survey includes a survey of men. Across surveys, there is close correspondence between the measures of incompleteness. The correlation between the incompleteness levels for women's age and men's age is 0.97 (Figure 2).

As described earlier, age heaping is measured with Myers' Blended Index, which can be interpreted as the percentage of cases that would have to be shifted from over-represented final digits to under-represented final digits, with an adjustment to take account of the general gradient in the age distribution. A heaping index of 0 implies perfect uniformity across final digits 0 through 9, but simply because of randomness we would never expect to achieve that lower limit.

The two graphs in Figure 3 show the distributions of the heaping index for age in the women's and men's survey. The mean level of heaping is 7.1% in the women's survey. The level is 10% or more in 26 countries. The mean level of heaping in the men's survey is 7.0%. Twenty-three surveys were at or above the threshold of 10%, most notably Sierra Leone 2008 with a 21% level of heaping.

Finally, we attempt to summarize changes from 2000 to 2015 by constructing standard scores for the two types of misreporting. The incompleteness and heaping indicators all have natural zeros—they can never be negative, and under ideal conditions they would all be zero except for sampling error. The mean and standard deviation of each indicator were calculated, and then a standard score (or z-score) was calculated by subtracting the mean and dividing by the standard deviation. That is, each indicator is represented by a

new score that has a mean of 0 and a standard deviation of 1. By doing this, we put all indicators, which vary widely in their means and standard deviations, onto the same scale. Third, we calculate the average of the z-scores within each group. "Incompleteness" is the average of the z-scores in that group of indicators, "Age heaping" is the average of the z-scores in that group. In each case, the average is based on the number of indicators of each type that are available.

The purpose of Figure 4 is to see how each of these averages has changed over time, within the interval 2000 to 2015. If, say, there were clear and steady improvement in the level of incompleteness, then the upper left graph would start well above 0 in 2000 and steadily move downward, ending well below 0 in 2015. For all of the figures, a downward trend would be interpreted as improvement in the quality of the age and date reporting. Each indicator measures an undesirable characteristic, so low values are preferable to high values.

All four lines show some decline during the final three years, 2013-2015, but for the full interval 2000-2015 there is no convincing evidence of improvement. All the figures show an upward spike in 2006, to the maximum values for incompleteness, heaping, and displacement, with the exception of the spike for incompleteness in 2001. Each type had a minimum in 2002, moved upward to 2006-2008, had another minimum in 2009-2010, moved upward to 2013, and then moved back down to the most recent year, 2015. Some short-term variation is clear, but, to repeat, there is no clear evidence of long-term improvement between 2000 and 2015.

DHS Follow-up Studies

Table 3 indicates the degree of matching on year of birth from the follow-up study. Of 96 respondents, 70 matched year of birth exactly. Eight did not know their year of birth and did not have an identity card available. Eighteen additional respondents did not match on year of birth. In the most conservative case, if we consider not knowing year of birth to be a discrepant answer, then there was a 27 percent discrepancy in year of birth. This estimate is within the range found from prior follow-up surveys, which ranged from 21 percent in Indonesia (MacDonald, Simpson, and Whitfield 1978 as cited in Bignami-Van Assche 2003) to 81 percent in Pakistan (Curtis and Arnold 1994).

Table 4 indicates the degree to which the reported year of birth differed. In all but two cases the reported year of birth was within four years. In two cases the magnitude of difference reported by follow-up respondents was 10 years different from the GDHS. This level of disparity between initial survey and a follow-up survey is not unprecedented in areas where numeracy is low (Bignami-Van Assche 2003; Curtis and Arnold 1994). In one case (R#09.01), the respondent insisted she was 20 years old, not 30, even though she had given birth to five children. In the second case the respondent guessed her age relative to the translator. She matched on other characteristics and was included in the follow-up sample.

Both follow-up studies displayed the original response, which allowed interviewers to ask about the discrepancy. Generally, discrepancies in year of birth were explained by respondents as having come about through the DHS process of imputing year of birth relative to events if the respondent was not certain of her year of birth. Here is one example of the process of verifying year of birth in the follow-up study:

> Interviewer: *So that I am sure that you're indeed the person to be interviewed can you please give me your date of birth?*
> Respondent [R#04.05]: *December 1981, am 31 years old*
> Interviewer: *Please, your age doesn't correspond with the year of birth. If you're 31, then it should be 1983 and not 1981. Either way, the information I have here from the earlier interviewers doesn't correspond with either date. May I please have your ID card?*
> *The date here is December 1980, it means that you'll be 34 years this December. Please how did they come by this date?*
> Respondent: *Actually, I showed them my ID card after mentioning my age and date of birth. But I understand what you're saying, the age is 31 years on the ID as you can see, and I had it done*

during the last elections. So you're right. I'll be 34 years this December and my date of birth on the ID is even December 1980 and not 1981.
Interviewer: *Thank you, so the information I have is correct?*
Respondent: *Yes, it is.*

In other cases, the original response could not be verified because the respondent did not know it:

Interviewer: *Just to be certain I am speaking with the right person, can you please tell your month of birth?*
Respondent [R#11.04]: *I don't know.*
Interviewer: *Madam, please you told my colleague you were born in 1971?*
Respondent: *No, I didn't, I gave them an event, and they calculated and gave me the age.*
Interviewer: *Okay, Madam.*
Interviewer: *Please can you tell me the month?*
Respondent: *I don't know the month too.*

Month of birth reporting tends to be more unreliable than year of birth reporting. Table 5 indicates the match between reported month of birth and as reported in GDHS. Only 50 of 96 respondents matched month of birth. In 10 cases the GDHS had imputed a month of birth; 25 additional respondents were not indicated as imputed in the GDHS but said that they did not know their month of birth. Note that for the purposes of summary matching, respondents who did not know their month of birth and were indicated as imputed in GDHS were considered "matched." No respondents were indicated as imputed for year of birth, and thus none of the discrepant respondents on year of birth were considered matched.

Results from the follow-up study can be contextualized with data from GDHS. If we consider reported age of women age 15-44 (the pool eligible for consideration in the follow-up study), the percentage with second digits 0 to 9 is shown in Figure 5. Well in excess of the expected 10 percent reported an age at birth ending in 0, 2, 5, and 8. The particularly high responses on 0 and 5 suggest heaping. The Myers' index for the 2014 Ghana DHS among women 15-44 is computed at 5.5, indicating that 5.5 percent of the sample would need to be moved in order to have a normal distribution of ages. This is around the median value of Myers Indices from DHS surveys studied in 2006 (Pullum 2006) and far below the Myers' value of 30.6 for an early survey in Ghana (Rutstein et al. 1990).

Preliminary Conclusions

Our examination of DHS data from surveys conducted from 2000 to 2015 finds that measures of incompleteness and heaping vary substantially. There are many surveys with values close to zero on all measures, and others with very high values. There are some surveys in which month of birth is hardly ever given. Surveys with extreme values are listed. Summary indices of incompleteness and heaping were constructed and tracked over time. The indicators fluctuated substantially from 2000 to 2015 and did not show a systematic trend.

In the absence of independent verification the quality of date recall is difficult to assess. In the Ghana 2014 DHS, a survey with a median value of digit heaping, follow-up data indicate 27 percent inconsistency on year of birth and around 48 percent inconsistency on month of birth upon reinterview. At face value this level of quality is somewhat disconcerting; however, year reporting tends to differ by a median of two years. The respondents (8 percent) who did not know their date of birth and did not have an identity card available to show the interviewers is of most concern. Results from the currently embargoed sample in Nepal and an overall comparison to Myers' indices from recent DHS surveys will be studied in the full paper.

References

Bignami-Van Assche, S. 2003. "Are We Measuring What We Want to Measure? Individual Consistency in Survey Response in Rural Malawi." *Demographic Research* 2003:S1.

Curtis, S.L., and F. Arnold. 1994. *An Evaluation of the Pakistan DHS Survey Based on the Reinterview Survey*. DHS Occasional Papers No. 1. Calverton, Maryland, USA: Macro International. Available at http://dhsprogram.com/pubs/pdf/OP1/OP1.pdf.

ICF International. 2011. *Demographic and Health Surveys Methodology - Questionnaires: Household, Woman's, and Man's*. MEASURE DHS Phase III. Calverton, Maryland, USA: ICF International. Available at http://dhsprogram.com/pubs/pdf/DHSQ6/DHS6_Questionnaires_5Nov2012_DHSQ6.pdf.

ICF International. 2015a. *DHS-7 Man's Questionnaire*. DHS Model Questionnaires - Phase 7 (2013-2018). Rockville, Maryland, USA: ICF International. Available at http://dhsprogram.com/pubs/pdf/DHSQ7/DHS7_Mans_QRE_EN_12Oct2015_DHSQ7.pdf.

ICF International. 2015b. *DHS-7 Woman's Questionnaire*. DHS Model Questionnaires - Phase 7 (2013-2018). Rockville, Maryland, USA: ICF International. Available at http://dhsprogram.com/pubs/pdf/DHSQ7/DHS7-Womans-QRE-EN-07Jun2017-DHSQ7.pdf.

Macro International. 2008a. *Man's Questionnaire*. DHS Model Questionnaires - Phase 5 (2003-2008). Calverton, Maryland, USA: Macro International. Available at http://dhsprogram.com/pubs/pdf/DHSQ5/DHS5-Man's-QRE-22-Aug-2008.pdf.

Macro International. 2008b. *Woman's Questionnaire*. DHS Model Questionnaires - Phase 5 (2003-2008). Calverton, Maryland, USA: Macro International. Available at http://dhsprogram.com/pubs/pdf/DHSQ5/DHS5-Woman's-QRE-22-Aug-2008.pdf.

ORC Macro. 2001a. *Model "A" Questionnaire with Commentary for High Contraceptive Prevalence Countries*. ORC Macro. Available at http://dhsprogram.com/pubs/pdf/DHSQ4/DHS-IV-Model-A.pdf.pdf.

ORC Macro. 2001b. *Model "B" Questionnaire with Commentary for Low Contraceptive Prevalence Countries*. ORC Macro. Available at http://dhsprogram.com/pubs/pdf/DHSQ4/DHS-IV-Model-B.pdf.pdf.

Pullum, T.W. 2006. *An Assessment of Age and Date Reporting in the DHS Surveys, 1985-2003*. DHS Methodological Reports No. 5. Calverton, Maryland, USA: Macro International. Available at http://dhsprogram.com/pubs/pdf/MR5/MR5.pdf.

Rutstein, S.O., G.T. Bicego, A.K. Blanc, N. Rutenberg, F. Arnold, and J.A. Sullivan. 1990. *An Assessment of DHS-I Data Quality*. DHS Methodological Reports No. 1. Columbia, Maryland, USA: Institute for Resource Development/Macro Systems Inc. Available at http://dhsprogram.com/pubs/pdf/MR1/MR1.pdf.

Staveteig, S. 2016. *Understanding Unmet Need in Ghana: Results from a Follow-up Study to the 2014 Ghana Demographic and Health Survey*. DHS Qualitative Research Studies No. 20. Rockville, Maryland, USA: ICF International. Available at http://dhsprogram.com/pubs/pdf/QRS20/QRS20.pdf.

Staveteig, S. 2017. "Fear, Opposition, Ambivalence, and Omission: Results from a Follow-up Study on Unmet Need for Family Planning in Ghana." *PLOS ONE* 12(7):e0182076.

Staveteig, S., R. Aryeetey, M. Anie-Ansah, C. Ahiadeke, and L. Ortiz. 2017. "Design and Methodology of a Mixed Methods Follow-up Study to the 2014 Ghana Demographic and Health Survey." *Global health action* 10(1):1274072.

Figure 1 Histograms showing the level of any type of incompleteness of reported women's and men's age

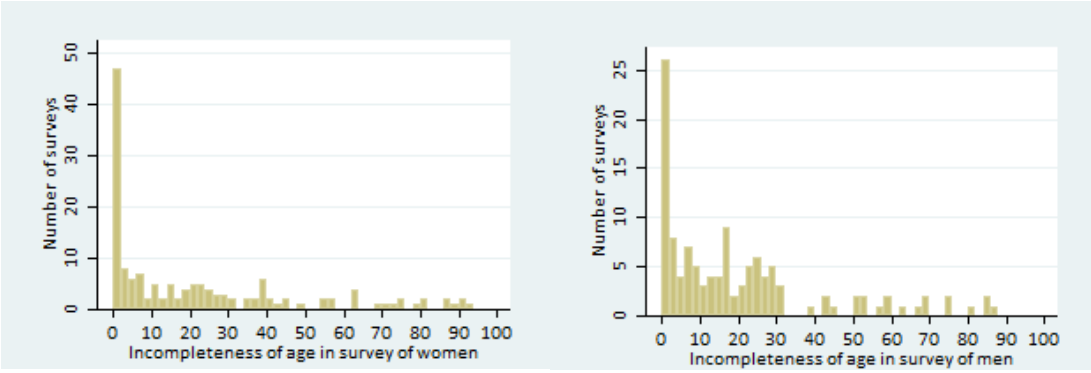

Table 1 Surveys with at least 50% incompleteness in women's reported birthdate/age

Survey	%		
Rwanda 2005	55.0	**Benin 2001**	74.1
Burundi 2010	55.1	**Pakistan 2012-13**	75.6
Nepal 2001	56.2	**Ethiopia 2000**	79.4
Ethiopia 2005	57.2	**Mali 2001**	81.1
Niger 2006	62.1	**Burkina Faso 2003**	81.2
Ethiopia 2011	63.3	**Niger 2012**	86.3
Chad 2014-15	63.5	**Bangladesh 2014**	86.9
Benin 2006	63.8	**Guinea 2005**	89.4
Mali 2006	68.5	**Bangladesh 2011**	91.4
Yemen 2013	70.5	**Bangladesh 2007**	91.8
Pakistan 2006-07	73.6	**Bangladesh 2004**	93.7

Table 2 Surveys with at least 50% incompleteness in men's reported birthdate/age

Survey	%	Survey	%
Niger 2006	50.7	Guinea 2005	68.9
Chad 2014-15	51.5	Ethiopia 2000	69.4
Burundi 2010	52.5	Burkina Faso 2003	74.7
Ethiopia 2005	53.2	Mali 2001	75.2
Ethiopia 2011	56.8	Niger 2012	80.3
Benin 2006	58.6	Bangladesh 2004	84.3
Rwanda 2005	59.3	Bangladesh 2007	84.9
Benin 2001	63.0	Bangladesh 2011	86.5
Mali 2006	66.3		

Figure 2 Scatterplot showing the incompleteness of women's age versus the incompleteness of men's age

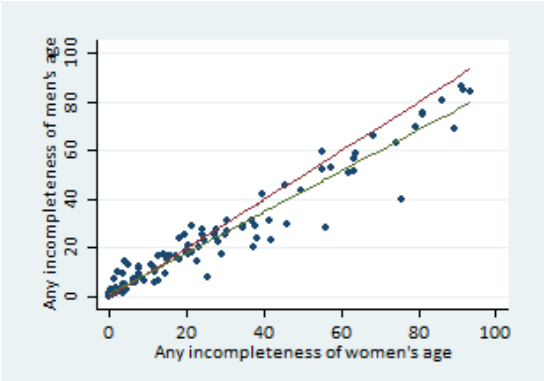

Figure 3 Histograms showing the level of heaping in reported age in the survey of women and in the survey of men

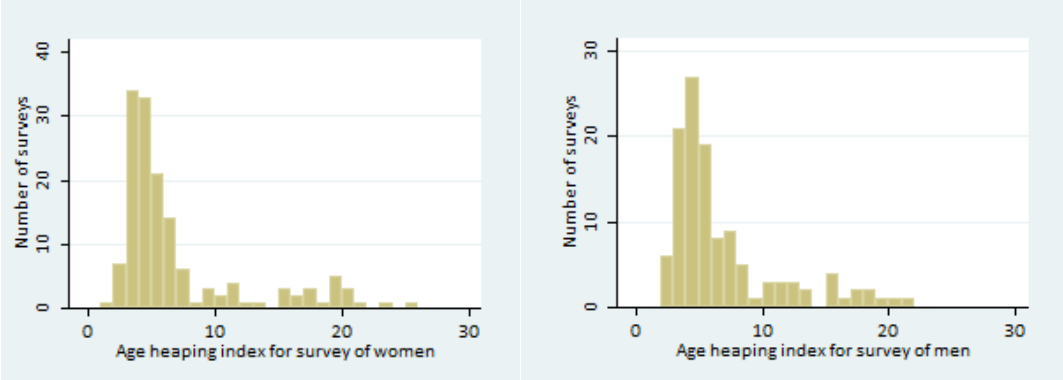

Figure 4 Changes in the levels of incompleteness and heaping in DHS surveys conducted from 2000 to 2015

Table 3. Matching year of birth, Ghana Follow-Up Study

Yes	70
Respondent doesn't know	8
No	18

Table 4. Difference between year of birth in GDHS and follow-up study

-10	1
-3	2
-2	4
-1	4
0	70
1	4
2	1
4	1
10	1
Unknown	8

Table 5. Matching month of birth, Ghana Follow-Up Study

Yes	50
GDHS imputed	10
Respondent doesn't know	25
No	11

Figure 5. Digit heaping, women age 15-44, GDHS