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ASSESSMENT OF THE DATA QUALITY IN DEMOGRAPHIC AND HEALTH SURVEYS IN EGYPT

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Abstract

The aim of this paper is to check the quality of fertility data collected through Demographic and Health Surveys in Egypt between 1988 and 2014. We are particularly interested to assess whether fertility changes observed since 2000 that point at a stall in fertility decline followed by a substantial increase between 2008 and 2014 are real and not due to imperfect data. We show through several exercises that data quality has increased since the first Demographic and Health Survey in 1988 and that the data imperfections do not explain the fertility trajectories in Egypt.

Keywords

Egypt, Demographic and Health Surveys, data quality.

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Assessment of the Data Quality in Demographic and Health Surveys in Egypt

Zakarya Al Zalak and Anne Goujon

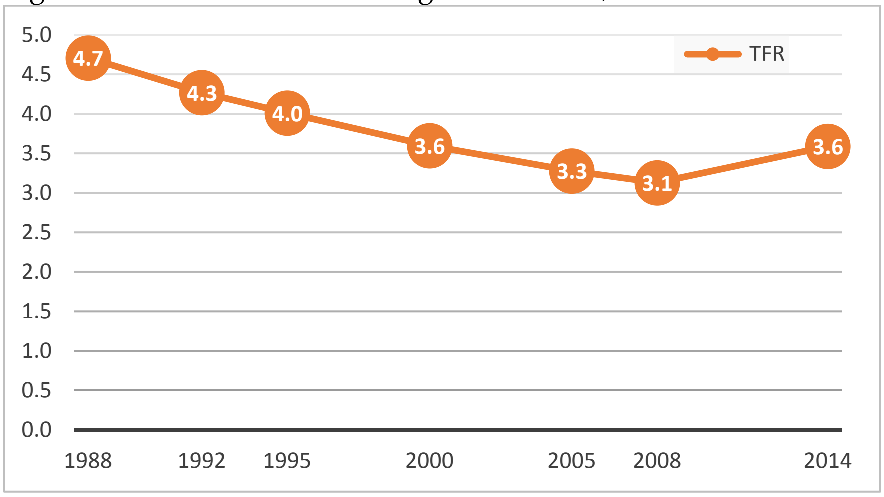
1. Introduction

Egypt is the most populous country in the Middle East and North Africa region. Its 92 million population according to CAPMAS (2016) accounted for 23% of the population in the region. Egypt is heavily constrained by the environment and particularly in terms of water availability. Moreover the economic crisis has hit Egypt very hard in a context of civil conflicts and loss of revenues from tourism. In this setting, sustained population growth could be particularly difficult to envisage. However since 2000, the fertility transition to low fertility birth rates has been stalling around on average three children per woman which will cause the population to grow fast in the years to come. Furthermore, between 2008 and 2014, the total fertility rate has increased to 3.5 children. We examined the reasons for the stall in Al Zalak and Goujon (2017) which seem to be mostly explained by the economic crisis and high unemployment rates among women.

Data on fertility in Egypt rely mostly on the Demographic and health Surveys (EDHS). Seven EDHS have been collected in 1988, 1992, 1995, 2000, 2005, 2008, and 2014. While Egypt has a long tradition of conducting censuses, and has had a compulsory vital registration system of births and deaths for many decades, registration of birth events is estimated to be incomplete, particularly in rural areas. Thus, the numbers provided by the Central Agency for Public Mobilization and Statistics (CAPMAS) cannot be considered as fully accurate (Engelhardt 2005). Hence most analysis related to fertility (but also to mortality) are using data from the DHS.

In the case of Egypt, the analysis of the fertility data as summarized on Figure 1, calls for a quality control of the data, i.e. whether the data used for the analysis are biased and the observed trend – stalled fertility decline since 2000 followed by a fertility increase between 2008 and 2014 – is or is not an artifact of the collected data. We have looked at the several quality aspects that could affect fertility indicators as they change the number of women exposed to pregnancy in each age group, or the number of births that they experienced during survey periods.

Figure 1: Trend in TFR according to the EDHS, 1988-2014



Source: All EDHS, 1988 to 2014; not weighted by sample weight.

The seven EDHS surveys consist each of a household questionnaire and a women questionnaire. In the latter, nationally representative samples of ever-married women aged 15-49 were interviewed. Table 1 shows the sample size of all EDHS from 1988 to 2014, and the number of households.

Table 1: Number of ever-married women and number of households, 1988 to 2014

DHS	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Women (total number)	Households (total number)
1988	418	1,402	1,679	1,567	1,597	1,219	1,029	8,911	10528
1992	437	1,384	1,993	1,819	1,721	1,404	1,106	9,864	10760
1995	704	2,167	2,770	2,606	2,554	2,003	1,975	14,779	15567
2000	595	2,246	2,844	2,701	2,688	2,223	2,276	15,573	16957
2005	858	3,008	3,780	3,189	3,186	2,827	2,626	19,474	21972
2008	636	2,621	3,318	2,703	2,553	2,440	2,256	16,527	18968
2014	738	3,051	4,718	4,133	3,473	2,902	2,747	21,762	28175
Total	**4386**	**15879**	**21102**	**18718**	**17772**	**15018**	**14015**	**106890**	**122927**

Source: All EDHS, 1988 to 2014; not weighted by sample weight.

In section 2, we use the list of potential quality criteria developed by Schoumaker (2014) to analyze the EDHS data. In section 3, we conclude by standardizing the scores obtained from calculating the main indexes for measuring quality for each index ranked on a standardized score ranging from 1 (very rough data) to 5 (highly accurate data).

2. Quality Concerns

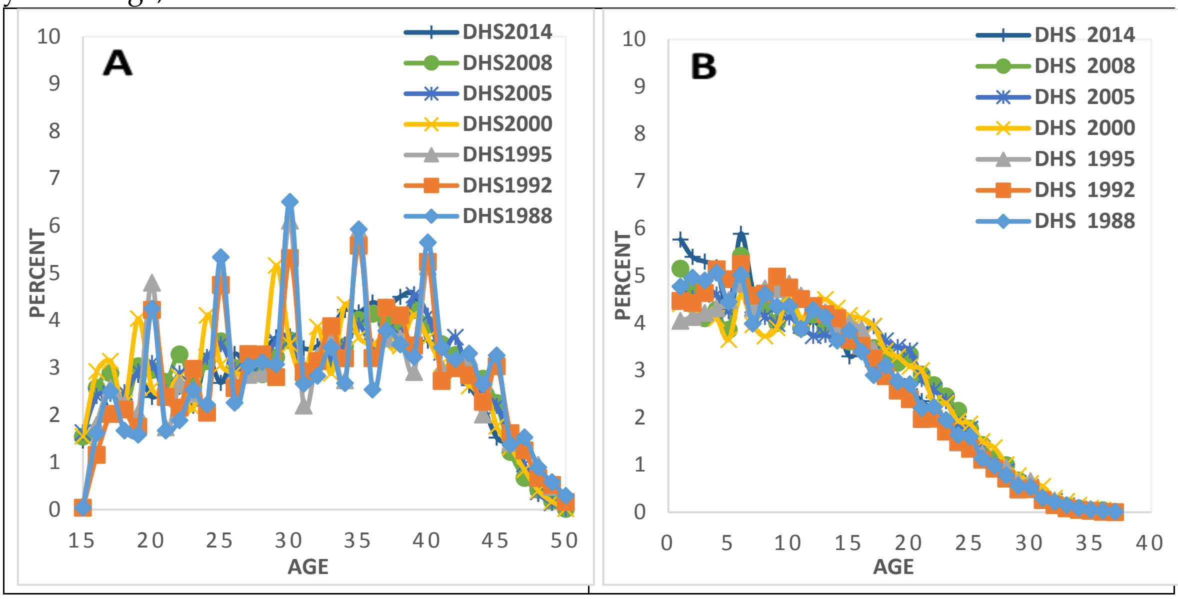
We have looked at several quality aspects that could affect fertility indicators as they change the number of women exposed to pregnancy in each age group, or the number of births that they experienced during survey periods. We looked at many of the areas of quality concerns developed by Schoumaker (2014) as mentioned below[1]:

- Heaping and misreporting of women's age and year of birth of children
- Omission of recent births and displacement of births to avoid additional questions
- Potter effect affecting reporting of distant births
- Sample implementation (over or under sampling of some groups).

2.1. Misreporting and Heaping of Women's Age and of Year of Birth

Misreporting and heaping of women's age and year of birth of children can influence TFR calculation. The distribution of all respondents (women and children) in the EDHSs by single years of age as plotted on Figure 2A, confirms the presence of heaping at selected ages. Most respondents have a high preference for digits (0) and (5). To a lesser extent, age heaping is also present for children as shown on Figure 2B, but the heaping pattern in that case is rather linked to displacement of births to avoid additional questions than to preference for a certain digit. We will look more closely at the issue in section 2.2.

Figure 2A-B: Distribution of ever-married women (A) and both sexes children (B) by single years of age, 1988-2014



Source: All EDHS, 1988 to 2014; weighted by sample weight.

[1] We excluded some other potential problems: that of selection bias in terms of mortality and international migration that are more difficult to measure and less likely to affect fertility measurements in Egypt.

We used two measures to evaluate the extent of the inaccuracy (in terms of age heaping and digit preference) in age reporting: the Whipple's index and Myers' blended index.

The Whipple index was originally computed for population aged between 23 and 62 years. To comply better with the DHS data that provide particularly information on women in reproductive ages, we applied the index to ages between 18 and 47 years –as mentioned by Engelhardt (2005) and as shown in the following formula:

$$Whipple's-5-year-range=\frac{\sum(P_{20}+P_{25}+P_{30}+P_{35}+...+P_{45})}{(\frac{1}{5})\sum(P_{18}+P_{19}+P_{20}+P_{21}+...+P_{47})}100$$

The Whipple index reflects the preference for ages ending with 0 and 5. It ranges from 100 (indicating no preference for age ending in 0 or 5) and 500 (full preference for ages ending with 0 and 5. According to Shryock and Siegel (1976), the data are highly accurate if the Whipple Index is equal or below 105, fairly accurate if its value lies between 105 and 109.9, approximate if the value is between 110 and 124.9, rough if it is between 125 and 174.9, and very rough if the value is above or equal to 175. Table 2 shows that the data has greatly improved since the first EDHS in 1988 which was classified as rough. The 2008 ranks as approximate and the 2010 as fairly accurate.

The Myer's blended index, a variant of the Whipple Index, calculates the excess or deficit of people in ages ending in any of the10 digits expressed as percentages from the age of 10 years and above. It is based on the assumption that the people are equally distributed among the different ages, therefore its value should be close to 1 (or 100) when ages are reported accurately. We applied it to children between the age of 0 and 29 years and for women between the age of 15 and 44 years. As with the Whipple index, the Myers' index indicate the improvement in the data and rather good quality in the last two surveys that are particularly of interest to us.

Table 2 also shows that the incompleteness of reporting about the dates of birth of women and children has decreased along the survey years: from 58% in 1988 to 5% in 2014 for women's birth information and from 37% in 1988 to 3% in 2014 for children's birth information.

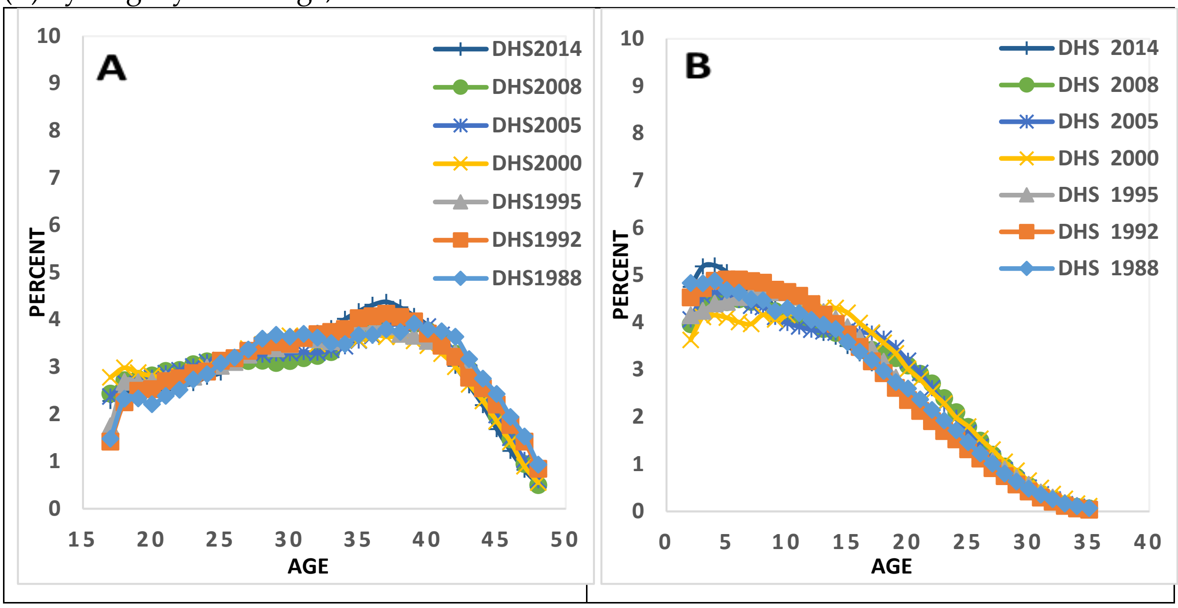
Table 2: Share of ever-married women and births by incompleteness of reporting of age information and digit preference

EDHS	Birth date incompleteness (Percent)		Digit preference		
	Women	Children	Myers' Blended Women 15-44	Whipple's Women 18-47	Myers' Blended Children 0-29
1988	58.36	37.49	12.67	166.94	1.88
1992	39.29	15.73	8.98	147.18	1.04
1995	47.93	27.86	11.86	163.22	1.52
2000	40.08	14.7	7.64	141.44	1.34
2005	22.35	10	5.14	129.30	1.23
2008	10.6	5.18	3.48	120.01	1.37
2014	5.32	2.99	3.04	109.47	1.89

Source: All EDHS, 1988 to 2014; weighted by sample weight.

Among others, Siegel and Swanson (2004) propose several solutions to correct the data for age heaping, the simplest one being by smoothing the age distribution applying five-year moving averages as shown on Figure 3A and B.

Figure 3A-B: Smoothed distribution of ever-married women (A) and both sexes children (B) by single years of age, 1988-2014



Source: All EDHS, 1988 to 2014; weighted by sample weight.

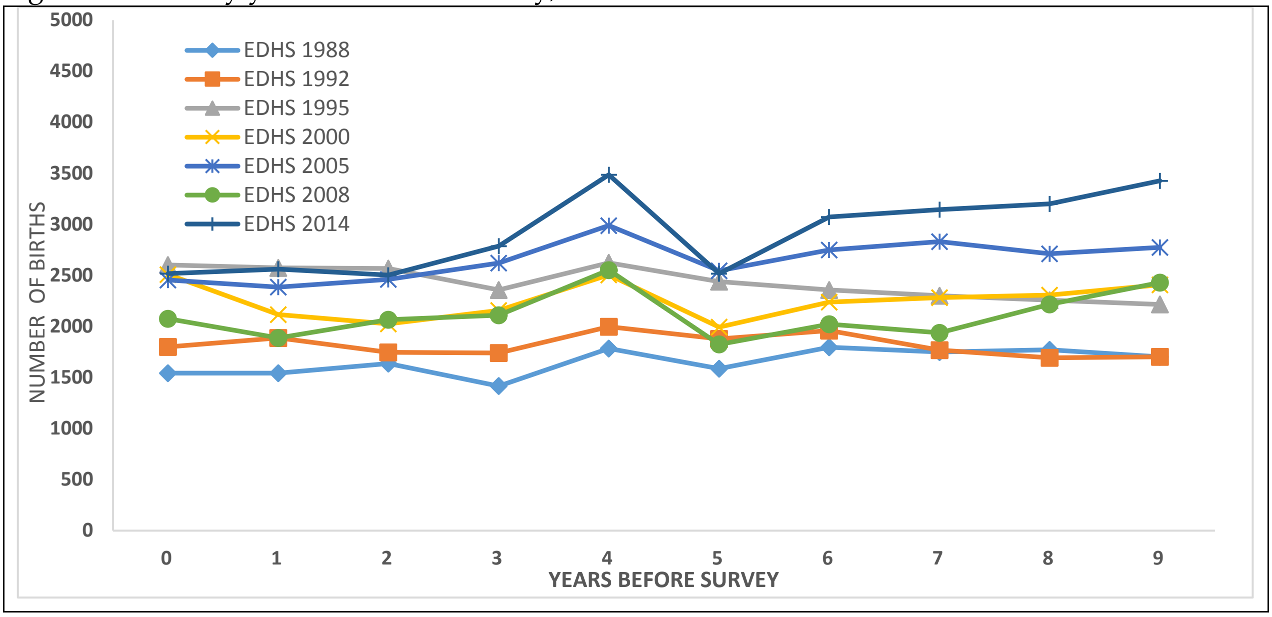
2.2. Omission and Displacement of Births

One of the most commonly mentioned problems of DHS birth histories is the displacement of births, meaning that dates of birth are moved from on calendar year to another (Pullum and Becker 2014; Arnold 1990; Pullum 2006; Schoumaker 2011). While this can happen for several non-intentional reasons e.g. due to forgetfulness of interviewee or reporting error of interviewer, this issue is also linked to the design of the DHS questionnaire, and to the fact that some interviewers can change the birth dates of certain children to avoid having to administer the lengthy health modules in the DHS that has to be filled if the child is 5 years and older. This problem which is very present particularly in DHS conducted in Sub-Saharan Africa was identified early within the DHS program (Arnold 1990).

Its measurement is difficult but it was significantly advanced by Schoumaker (2011). He argues that while it is present in Egypt as well, it is not as substantial as in many Sub-Saharan African countries (Schoumaker 2014). We look below into the issue, adding earlier and most recent samples (1988 and 2014) that were not present in Schoumaker (2014).

The phenomenon of birth displacement is visible when looking at Figure 4 showing the number of births occurring to women in the 10 years preceding the survey. It shows that the number of reported births shows a sudden spike 4 years before the survey and a fall afterwards, and this particularly since the early 2000s, when the questionnaire was expanded and requires additional time. It is particularly acute for the 2008 and 2014 DHS.

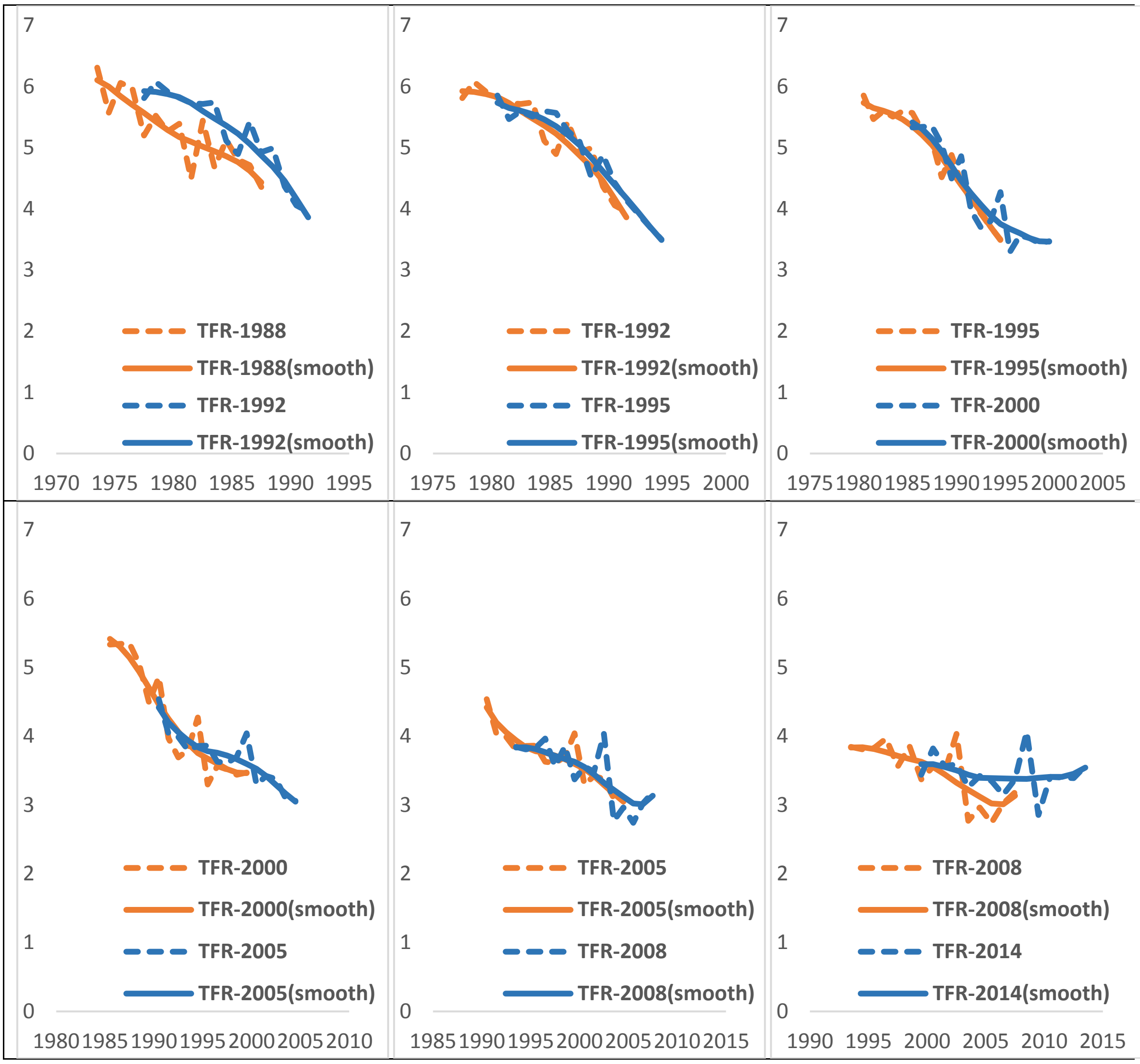
Figure 4: Births by years before the survey, 1988-2014



Source: All EDHS, 1988 to 2014; weighted by sample weight.

To evaluate the extent of birth displacement, we computed retrospective estimates of total fertility rates for 15 calendar years before the different surveys, comparing them in pairs: EDHS 1988 and 1992, EDHS 1992 and 1995, etc. Results are represented on Figure 5 which shows the discrepancy between the TFR measured by the 1988 and the 1992 EDHS surveys, due mostly to omissions of recent births. Later surveys are more homogeneous although they show more cases of omission of recent births and birth displacement; the latter is particularly present between 2005 and 2008, and between 2008 and 2014. Figure 5 also shows the same smoothed TFR using a Lowess[2] regression model. The smoothed lines point to large discrepancies between the fertility measurement in 1988 and 1992 – the 1988 DHS most likely underestimating fertility as the 1992 values seem to be in line with the 1995 smoothed values – and between 2008 and 2014. The smoothed line for 2014 seems to imply a flattening of fertility levels since 2005 at a level close to 3.5 children.

Figure 5: Comparison of retrospective fertility trends for 15 single years before the EDHS (smoothed using Lowess model), 1988 to 2014



Source: All EDHS, 1988 to 2014; weighted by sample weight.

[2] LOWESS (locally weighted scatterplot smoothing) is a non-parametric regression method.

We further calculated the displacement of birth index using the method developed by Pullum (2006) in the following way:

$$\hat{c} = (b+c).\frac{(\frac{d}{a})^{1/a}}{1+(\frac{d}{a})^{1/a}} \qquad \& \qquad \hat{b} = (b+c).\frac{1}{1+(\frac{d}{a})^{1/a}}$$

$$DISPL = \frac{\hat{c}-c}{\hat{c}} \qquad and \qquad DB = \hat{b}-b = \hat{c}-c$$

where a is the number of births in cutoff year minus 2, b is the number of births in cutoff year minus 1, c is the number of births in the cutoff year, and d is the number of births in cutoff year plus 1 and DB is the difference between the number of births before and after estimation see table 3.

Table 3: Number of births to women ten years before the EDHSs (around cutoff year) and displacement index

year before	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**DB**	**DISPL**
cutoff				**d=2**	**b=1**	**c=0**	**a=-1**	**s=-2**				
1988	1542	1543	1637	1416	1783	1585	1796	1750	1771	1703	32	0.02
1992	1801	1887	1747	1741	1998	1879	1959	1770	1693	1704	21	0.01
1995	2601	2574	2569	2356	2623	2440	2359	2301	2257	2215	91	0.04
2000	2509	2117	2026	2157	2506	1993	2238	2284	2307	2407	242	0.11
2005	2456	2385	2461	2621	2989	2546	2749	2830	2713	2776	200	0.07
2008	2075	1888	2067	2111	2553	1824	2023	1938	2216	2431	380	0.17
2014	2517	2562	2503	2787	3486	2516	3072	3145	3200	3426	436	0.15

Source: All EDHS, 1988 to 2014; weighted by sample weight.

The table basically shows that although the displacement index has been rising since 2000, it is within a range which according to Schoumaker (2014) does not contradict the fertility measurement.

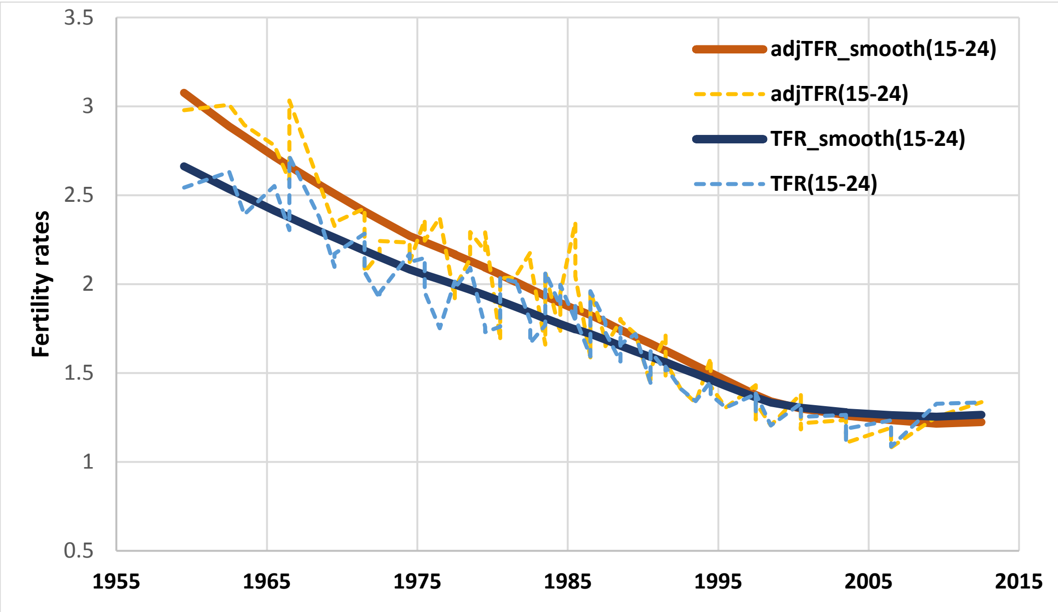
We also looked at a third approach to assess birth displacement by compares under-five and infant mortality rates between every consecutive surveys, 0-4 years, 5-9 years, and 10-14 years prior to the survey by using direct and indirect methods (Odwe et al 2015; Rutstein and Rojas 2006). We found that the mortality estimates in the 10-14 year period for the EDHS2014 are consistent with the mortality estimates in 5-9 year in EDHS 2008 and also with 0-4 in EDHS 2005.

2.3. Potter Effect Affecting Reporting of Distant Births

Finally, we controlled for the Potter effect, which arises when respondents misreport first births, and usually as being closer to the survey time than it actually occurred, meaning that they report first births at higher ages. Schoumaker (2012) proposes two steps: first, to reconstruct the fertility rates of women aged 15-24 over a period of 30 years. The Potter effect would become visible when the fertility of the 15-24 year old increases in the past, because of the underestimation of fertility at young ages. In a second step, in order to remove the Potter effect, the births are spread over a longer time period, without changing the total number of births for each woman (see more details in Schoumaker 2012).

Figure 6 shows the possible Potter effect in the fertility rates for women aged 15-24 years in the 30-year period preceding each EDHS, and the same indicator but based on corrected birth histories using a 10-percent increase of birth interval. When comparing the adjusted and non-adjusted curves, we see that correcting for a Potter effect has a strong impact on the fertility trends, and also consistency across surveys. It shows that a Potter effect was present in the data for earlier surveys that were underestimating fertility, but not in the most recent surveys. The figure below shows also the flattening of the fertility rates for the last 10-15 years.

Figure 6: Reconstructed fertility rates of women in age group 15-24 over a 30-year period preceding each survey, with and without corrected birth histories, (smoothed using Lowess model), 1988 to 2014

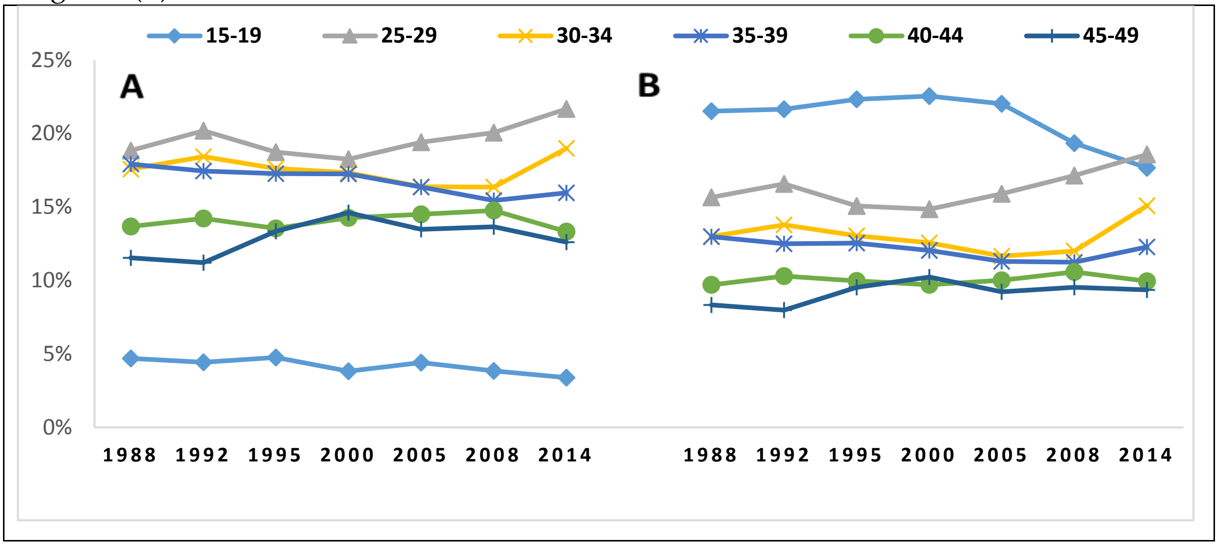


Source: All EDHS, 1988 to 2014; weighted by sample weight.

2.4. Sample Implementation

Another possible bias which could potentially affect fertility estimates is the accuracy in the percentage of ever-married women by age that is needed to compute exposure in surveys, especially since the proportion of ever-married women at younger ages may be underestimated (Schoumaker 2014). Figure 7A-B shows the difference between the percentages of women by age groups, whether the data are unweighted and weighted. The difference is large for some age groups, particularly for the 15-19 age group, where they represent less than 5% the unweighted sample, and between 18% and 23% in the weighted sample.

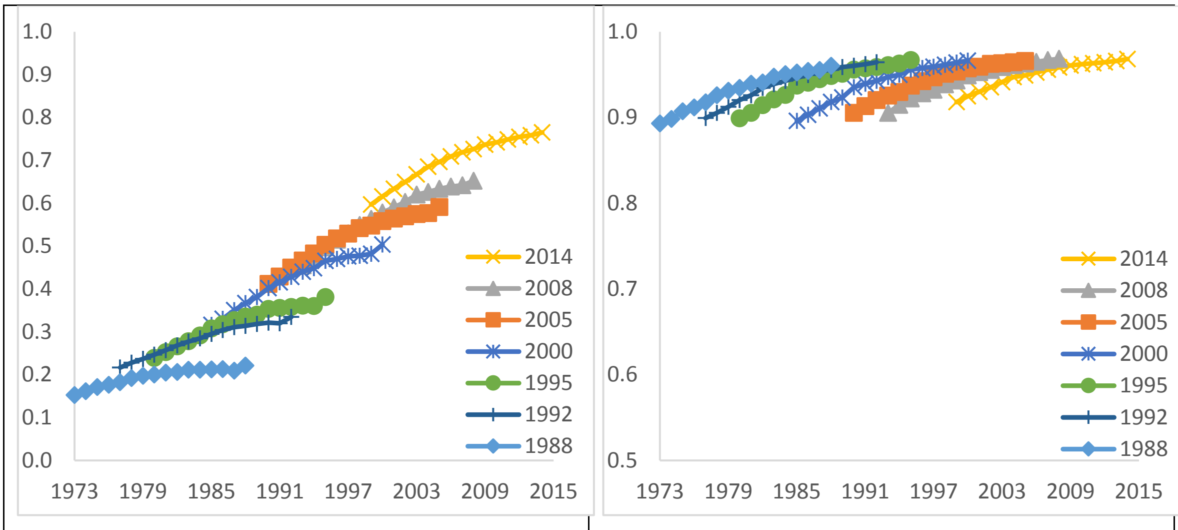
Figure 7A-B: Distribution of ever-married women by age groups, unweighted (A) and weighted (B) data, 1988-2014



Source: All EDHS, 1988 to 2014; unweighted (A) and weighted by sample weight.

This difference is not in itself an indication of unreliable data. We rather follow the method suggested by Schoumaker (2014) to compare across surveys the marital and education of women aged 15-34 as computed directly during fifteen years before the survey. Figure 8A-B shows no significant discrepancies between every two sequencing surveys although marital status seems to match better across surveys than education.

Figure 8A-B: Comparisons across surveys of retrospective trends in the percentage of women aged 15-34 with secondary education and in the percentage of women who have ever been married, 1988-2014



Education (A)	Marital status (B)

Source: All EDHS, 1988 to 2014; weighted by sample weight.

3. Conclusion Based on Standardized Scores

In summary, we found data quality problems have been present in the EDHS samples from 1988 to 2014 but the reliability of the surveys has been increasing over the years, especially in the last 3 surveys that are of particular interest because they show a stalling of the fertility decline with a TFR around 3 children per woman followed by an increase to 3.5 children from 2008 to 2014. However, we found out that the displacement index has been rising since 2000, although it is within a range which according to Schoumaker (2014) does not contradict the fertility measurement.

Table 5 summarizes the standardized scores obtained from calculating the main indexes for measuring quality. Each index is ranked on a standardized score ranging from 1 (rough data) to 5 (highly accurate data) using a Likert scale (Table 4).

Table 4: Likert scale used in the standardization of quality assessment

code	Likert scale	Quality of data
1	Strongly disagree	very rough data
2	Disagree	Rough data
3	Neither agree nor disagree	Approximate
4	Agree	Fairly accurate
5	Strongly agree	Highly accurate

Table 5: Summary of the extent of the main data quality problems affecting fertility estimates (women's and children) in all EDHSs (1988 to 2014), standardized scores[3]

DHS EGYPT	WOMEN				CHILDREN			
	Incompleteness of dates of birth[4]	Age heaping measured by Whipple's index for women aged 18-47[5]	Age heaping measured by Myers' Blended index for women aged 15-44[6]	Sample implementation[7]	Incompleteness of dates of births[8]	Age heaping measured by Myers' Blended index for children aged 0-29[9]	*Displacement*[10]	*Potter effect* [11]
1988	1	2	1	2	2	5	*5*	*5*
1992	2	2	1	5	4	5	*5*	*5*
1995	2	2	1	5	3	5	*5*	*5*
2000	2	2	2	5	4	5	*3*	*4*
2005	3	2	3	4	4	5	*4*	*4*
2008	4	3	4	4	5	5	*1*	*4*
2014	5	4	4	4	5	5	*2*	*5*

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[3] 1= very rough data; 2 = rough data; 3 = approximate data; 4 = fairly accurate data; and 5= highly accurate data.
[4] Standardized scores based on the percentage of women who did not provide information about their dates of birth.
[5] Standardized scores based on the Whipple's index which shows the excess or deficit of people in age ending in any of the 10 digits (0 to 9) (Hobbs 2004).
[6] Standardized scores based on the Myers' Blended index which shows the excess or deficit of people in age ending in any of the 10 digits (0 to 9) assuming equal distribution of the population among the different ages (Myers 1940).
[7] Standardized scores based on the comparison of the percentage of ever-married women at all ages for weighted and unweighted samples in all DHS.
[8] Standardized index based on the percentage of women who did not provide information about the dates of birth of their children.
[9] Standardized scores based on the Whipple's index which shows the excess or deficit of people in age ending in any of the 10 digits (0 to 9)
[10] Standardized scores based on comparison of retrospective fertility trends for 15 years before the survey for all individual EDHS.
[11] Standardized scores based on the reconstruction of fertility rates over a time period of 30 years (Potter 1977; Schoumaker 2014).

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