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Accumulating Contraceptive Calendars across Surveys

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ABSTRACT

This paper extends the Demographic and Health Survey (DHS) Working Paper No. 177 that presented a framework for accumulating retrospective data. In that paper, the accumulation technique, which is widely known as data pooling, was applied to birth history data in DHS surveys. Childhood mortality rates were calculated based on cumulated birth histories, which are also known as accumulated rates. The estimated confidence intervals of the accumulated rates were more narrow than their counterparts from the separate survey datasets. The accumulated birth histories reduced fluctuations in the time series for national and subnational mortality rates, and established time trends that were more stable and reliable than those based on single-survey data. In this paper, we examine another application of the accumulation technique on the contraceptive calendars of DHS surveys from Bangladesh, Egypt, Peru, and Senegal. We examined the consistency of data collected in the contraceptive calendar by comparing monthly contraceptive use across different surveys in overlapping calendars. The results showed some differences in the contraceptive prevalence rate based on the overlapping calendars from two consecutive surveys, particularly in Bangladesh and Egypt. The Peru and Senegal DHS showed more consistent contraceptive prevalence rate estimates between the two sources of data. Some differences were more prevalent for specific contraceptive methods. We accumulated calendar data across surveys of Peru and Senegal, where consistent contraceptive prevalence rate estimates were observed. The accumulated data had more narrow confidence intervals when compared to the trends in the separate datasets. However, the application on calendar data did not show promising potential similar to the application on birth histories as found in the DHS Working Paper No. 177.

Key words: Contraceptive calendars, contraceptive use, accumulating survey data, pooling survey data, DHS surveys

1 BACKGROUND

Since 1984, the Demographic and Health Surveys (DHS) Program has conducted millions of interviews with women and men. In these interviews, individuals are asked about their demographic characteristics, their home and living conditions, their own and their children's health behaviors, and other topics such as nutrition or domestic violence, depending on the survey. The data might reflect a concurrent status or event, such as the current use of contraceptives, or retrospective events or actions that happened in the past, such as the data collected in the DHS birth histories and contraceptive calendars. Such retrospective data allow for calculating indicators based on a reference period that ends on the date of interview. For example, total fertility rates (TFRs) are typically calculated for the previous 3 years before the survey, while childhood mortality rates are calculated for 5 years before the survey. Indicators can be calculated based on calendar data, such as fertility and mortality rates for specific calendar years, or contraceptive prevalence calculated for specific calendar months. The retrospective data can be full, such as the entire birth history, or partial, such as the calendar data that collects a complete history of women's reproduction and contraceptive use for a period of 5 to 7 years prior to the survey (Croft at al. 2018; DHS 2018).

Data for the DHS calendar is a month-by-month history of key reproductive events in the life of respondents such as births, pregnancies, terminations, contraceptive use, and reasons for discontinuation of contraceptives. Unlike birth histories, only recent calendar data are collected. These are events that occur in the year of the survey, plus the 5 full calendar years preceding the current year. In surveys in which data collection overlapped for 2 years, 6 full years are considered for the calendar. The calendar data can be used to calculate indicators such as pregnancy termination rates, early neonatal mortality data, and perinatal mortality rates, as well as contraceptive discontinuation rates, failure rates, and switching rates. The calendar can also be used to calculate the contraceptive prevalence rate (CPR) over time, or between specific calendar dates (Croft at al. 2018; DHS 2018).

Schmidt and Elkasabi (2020) outlined a framework for accumulating retrospective data across surveys, especially when the data have overlapping periods based on retrospective recall from different surveys. The accumulated birth histories across several national DHS/Multiple Indicator Cluster Surveys (MICS) utilized the overlap in birth histories across the surveys, and produced trends of childhood mortality rates (neonatal, infant, and under-5 mortality) based on the cumulated data, as opposed to trends based on a single survey. Accumulating birth histories across different surveys decreased the confidence intervals around the estimated mortality rates, minimized fluctuations in the time series for national and subnational mortality rates, and established more stable, reliable time trends.

In this paper, we examine another application of the accumulation technique in which we accumulate contraceptive calendars across different DHS surveys. During this process, we paid special attention to two aspects of the calendar data. First, unlike full birth histories, data for the contraceptive calendar are collected only for a bounded period, which is up to 7 years before the survey. Second, the consistency of the calendar data across different surveys might be questionable. Bradley et al. (2015) assessed the consistency of data collected in the contraceptive calendar by comparing retrospective CPR tabulated from the calendar with independently estimated CPR based on current status, which was collected in a prior survey for the same period. There was evidence of substantial under-reporting of retrospective contraceptive use in most calendars analyzed relative to the current use estimates.

These two aspects of the calendar data raised challenges to the accumulation techniques. The first imposes a restriction on surveys that can be accumulated, since only surveys with a short period in between can be accumulated, which is 5 years or less. The second aspect imposes another restriction in that only surveys with consistent calendar data can be accumulated. In this paper, we analyzed surveys from countries with a relatively long series of DHS surveys with short periods in between. We examined the consistency of the data collected in the contraceptive calendar by comparing the monthly contraceptive use across different surveys in the overlapping calendars. In addition, we examined the accumulated calendar data only with data that surpassed the data quality check, which included surveys with no significant differences in the estimated contraceptives usage when calculated for the same calendar month based on different surveys. In this paper, we aim to answer the following questions: 1) What are potential challenges for accumulating retrospective data when data are bounded in time? 2) Are the data collected in the calendar affected by recall bias? 3) When calendar data are consistent across surveys, what is the potential value-added of accumulating such data across surveys?

2 DATA AND METHODS

We analyzed DHS surveys that collected contraceptive calendars, where the time between the data collection date of any survey and its subsequent or predecessor is less than 5 years. Since the calendar collects approximately 6 years of data, the criterion we used for selecting the surveys allowed for surveys with overlapping calendars, in which calendar data for the same month were collected in two surveys or more. Based on this criterion, we analyzed 24 DHS datasets from Bangladesh, Egypt, Peru, and Senegal (Table 1). For each survey, the individual dataset (IR) was used in the data analysis. We restructured the calendar data to allow for calculating the CPR by month. We estimated contraceptive prevalence over time as described in the DHS Contraceptive Calendar Tutorial (DHS 2018). All datasets can be downloaded from the DHS (https://dhsprogram.com/).

Table 1 The surveys and number of women age 15-49 (n) by country

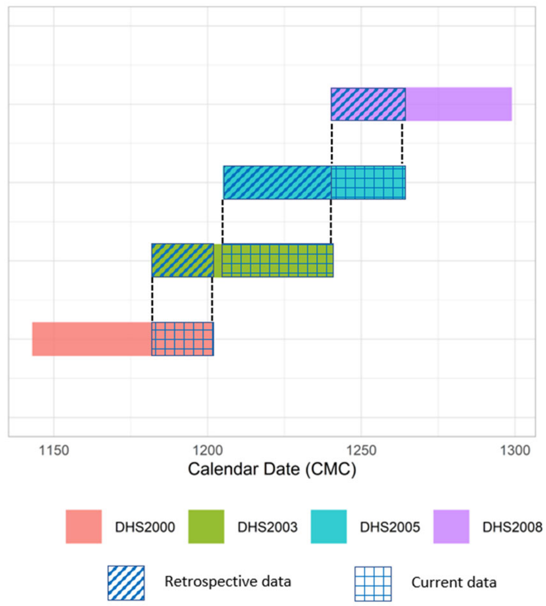
Country	Survey (n)	Survey (n)	Survey (n)	Survey (n)	Survey (n)	Survey (n)	Survey (n)	Survey (n)
Bangladesh*	DHS 2004 (11,440)	DHS 2007 (10,996)	DHS 2011 (17,842)	DHS 2014 (17,863)	DHS 2017-18 (20,127)			
Egypt*	DHS 2000 (15,573)	DHS 2003 (9,159)	DHS 2005 (19,474)	DHS 2008 (16,527)				
Peru	DHS 2000 (27,843)	DHS 2004-06 (19,090)	DHS 2007-08 (22,558)	DHS 2009 (24,212)	DHS 2010 (22,947)	DHS 2011 (22,517)	DHS 2012 (23,888)	
Senegal	DHS 2010-11 (15,688)	DHS 2012-13 (8,636)	DHS 2014 (8,488)	DHS 2015 (8,851)	DHS 2016 (8,865)	DHS 2017 (16,787)	DHS 2018 (9,414)	DHS 2019 (8,649)

*ever-married women surveys

The analysis is limited to women age 15-43 to avoid any bias due to the non-coverage of women age 50 or older who were in the age cohort of 44-49 during the survey calendar period. To calculate monthly contraceptive usage among women age 15-43, we excluded months before women's 15th birthday and after the end of their 43rd year. In Peru and Senegal, calendar data were collected from all women age 15-49, but in Bangladesh and Egypt, calendar data were collected only from ever-married women age 15-49. Therefore, results from each survey were based on the relevant target population, which was all women age 15-49 in Peru and Senegal, and ever-married women age 15-49 in Bangladesh and Egypt.

For any given month, calendar data might be available from one survey or from multiple surveys, which is known as overlapping calendars. Within any overlapping calendar period, the data at any given month are considered either current, with data on months at the end of the calendar, or retrospective, with data on months from the beginning of the calendar. For example, as indicated in Figure 1, there are three overlapping calendars between the four surveys conducted in Egypt. Each overlapping calendar contains current and retrospective data. Between the DHS surveys of 2000 and 2003, calendar data from the 2000 DHS are current relative to data from the 2003 DHS, while data from the 2003 DHS are retrospective relative to data from the 2000 DHS. The same applies to the other two overlapping calendars, where data from the 2003 DHS and 2005 DHS are current relative to data from the 2005 DHS and 2008 DHS, respectively, while data from the 2005 DHS and 2008 DHS are retrospective relative to data from the 2003 DHS and 2005 DHS, respectively. For any given month within the overlapping calendars, we assume that the current data are more accurate than the retrospective data.

Figure 1 Overlap between calendar months in four DHS surveys in Egypt



Since the data of current calendars are not prone to recall bias, we assume that estimates based on these data are not biased, or at least not affected by the recall bias that can affect the data of retrospective calendars. To compare current and retrospective calendar data, we plotted the monthly total CPR for women age 15-43 throughout the calendar months of each survey measured in century month code (CMC). Data for each successive survey were plotted in one graph. In each graph, the monthly prevalence was presented as a line over time, while 95% confidence intervals were presented around the prevalence line. In the appendix, we added additional figures with the prevalence for different contraceptive methods. For each country, we only present results for the most prevalent methods that include pills, IUDs, injections, implants, male condoms, or periodic abstinence. Lists of the most common methods by countries are presented in Table 2.

Table 2 List of methods analyzed for each country

Methods	Bangladesh	Egypt	Peru	Senegal
Pill	✓	✓		✓
IUD		✓	✓	
Injections	✓	✓	✓	✓
Implants				✓
Male condom	✓		✓	
Periodic abstinence	✓		✓	

All analyses were conducted with Stata 14, and the graphs were created with R. All estimates are weighted using the final survey weight for women (v005), while sampling errors and confidence intervals were estimated after accounting for sampling clusters and strata.

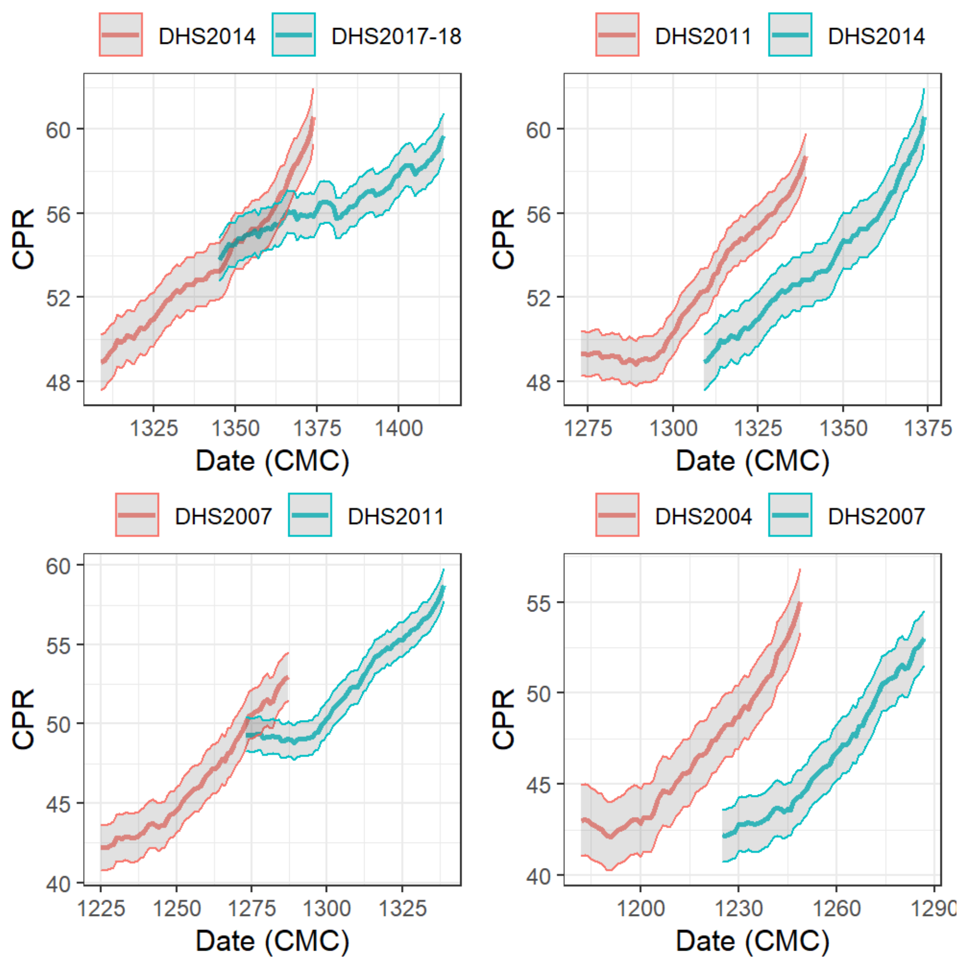
3 RESULTS

3.1 Calendar Data Consistency

In this section, we compare the monthly CPR among women age 15-43 using calendar data from each set of consecutive surveys listed in Table 1. We discuss the results by country and present the total CPR in this section and the method-specific CPR in the appendices. For all figures, any overlap in the confidence intervals indicates a nonsignificant difference in the estimates based on the two data sources. No overlap indicates that the differences are significant and implies some data quality issues and/or bias.

3.1.1 Bangladesh

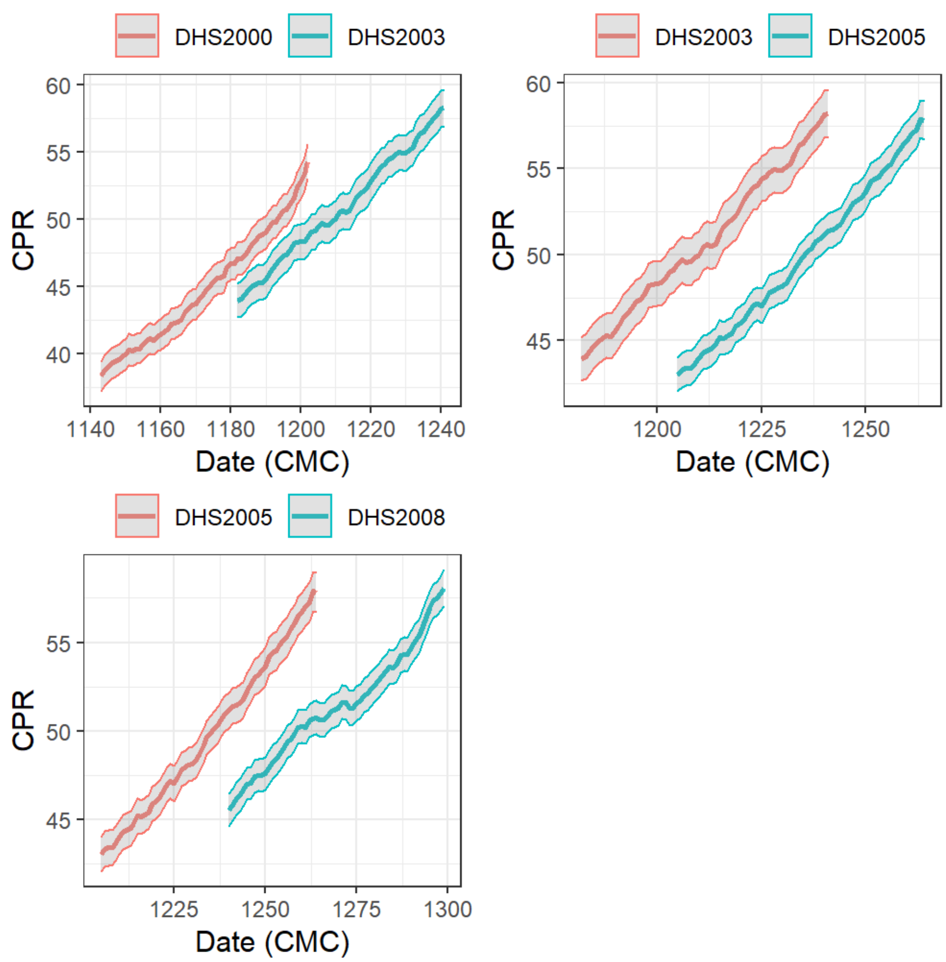
Figure 2 Total contraceptive prevalence rate among women age 15-43, Bangladesh



As indicated in Figure 2, there is a relatively consistent pattern of underestimated contraceptive use according to the retrospective calendar data relative to the contraceptive use according to the current calendar data. The largest differences exist between calendars from 2004 and 2007, and 2011 and 2014. In both cases, all differences are significant where confidence intervals do not overlap. There is a mix of significant and insignificant differences between contraceptive use according to current data and retrospective data from 2014 and 2017-18 and from 2007 and 2011. The insignificant differences can be observed by the overlapping periods for the CPR estimates. We observe more overlap between the 2014 and 2017-18 data than between the 2007 and 2011 data. It is possible, however, that these insignificant differences are due to chance, especially with the nontraditional slope of the 2017-18 and 2011 data in comparison with other surveys, in which there were stalling trends at the beginning of the calendar years. Similar patterns can be observed when we examined the usage of different methods, as indicated in Figures A.1 to A.4 in the appendix, where the usage prevalence is underestimated when measured with retrospective calendars. However, most of the differences were not significant (with no overlap). For some methods, such as male condoms and periodic abstinence, there were significant differences in the usage when it was measured with the retrospective calendar as opposed to when it was measured with current calendars, especially in 2004 vs. 2007 and 2007 vs. 2011.

3.1.2 Egypt

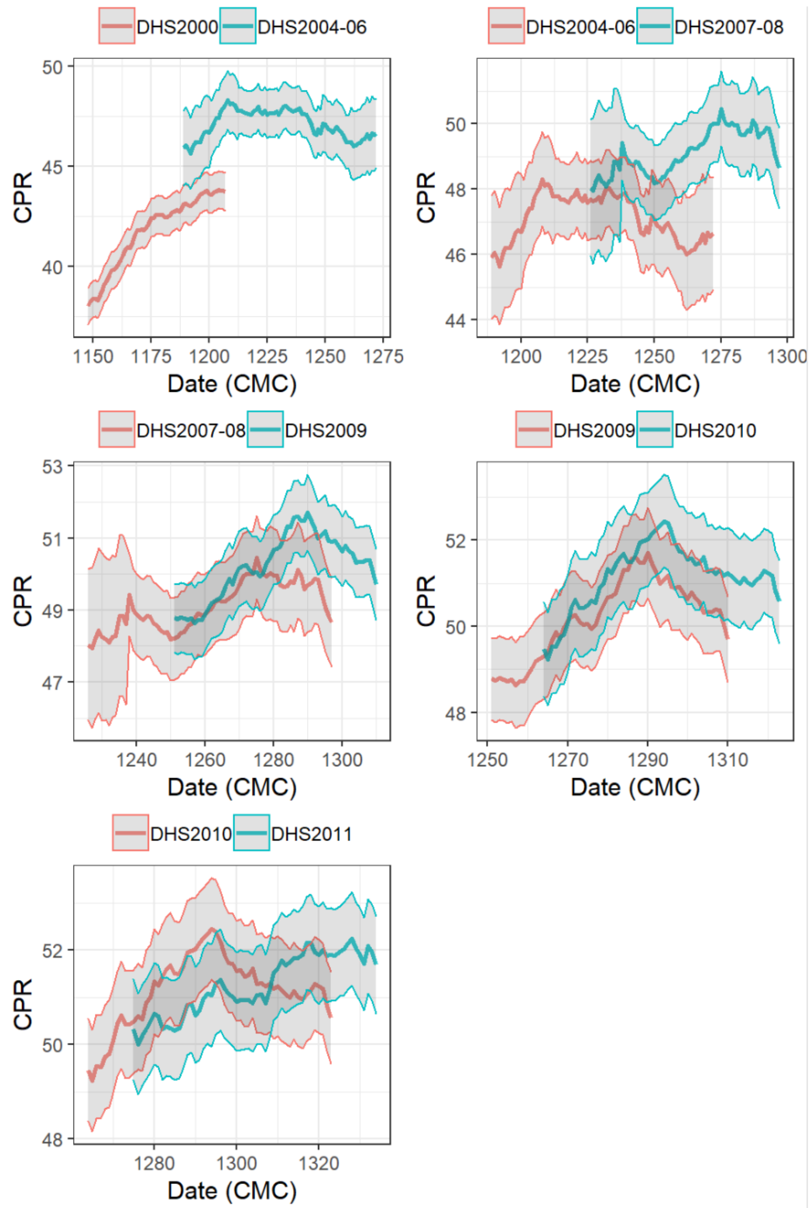
Figure 3 Total contraceptive prevalence rate among women age 15-43, Egypt



As shown in Figure 3, there is a consistent pattern of underestimated contraceptive use according to the retrospective calendar data relative to contraceptive use according to the current calendar data. The largest differences exist between calendars from 2003 and 2005, and the smallest between calendars from 2000 and 2003. All differences are significant in all comparisons when the confidence intervals do not overlap at any point. As shown in Figure A.6, these differences seem to be driven by significant differences in using IUDs, the most common method in Egypt, when calculated based on retrospective calendars as opposed to when calculated based on current calendars. Two other contraceptive methods, the pill and injections, were examined. The differences were not significant for injections, although there are both significant and insignificant differences for pills, especially in the comparison between calendars from 2005 vs. 2003 and 2008. The comparisons for different methods are presented in Figures A.5 to A.7 in the appendix.

3.1.3 Peru

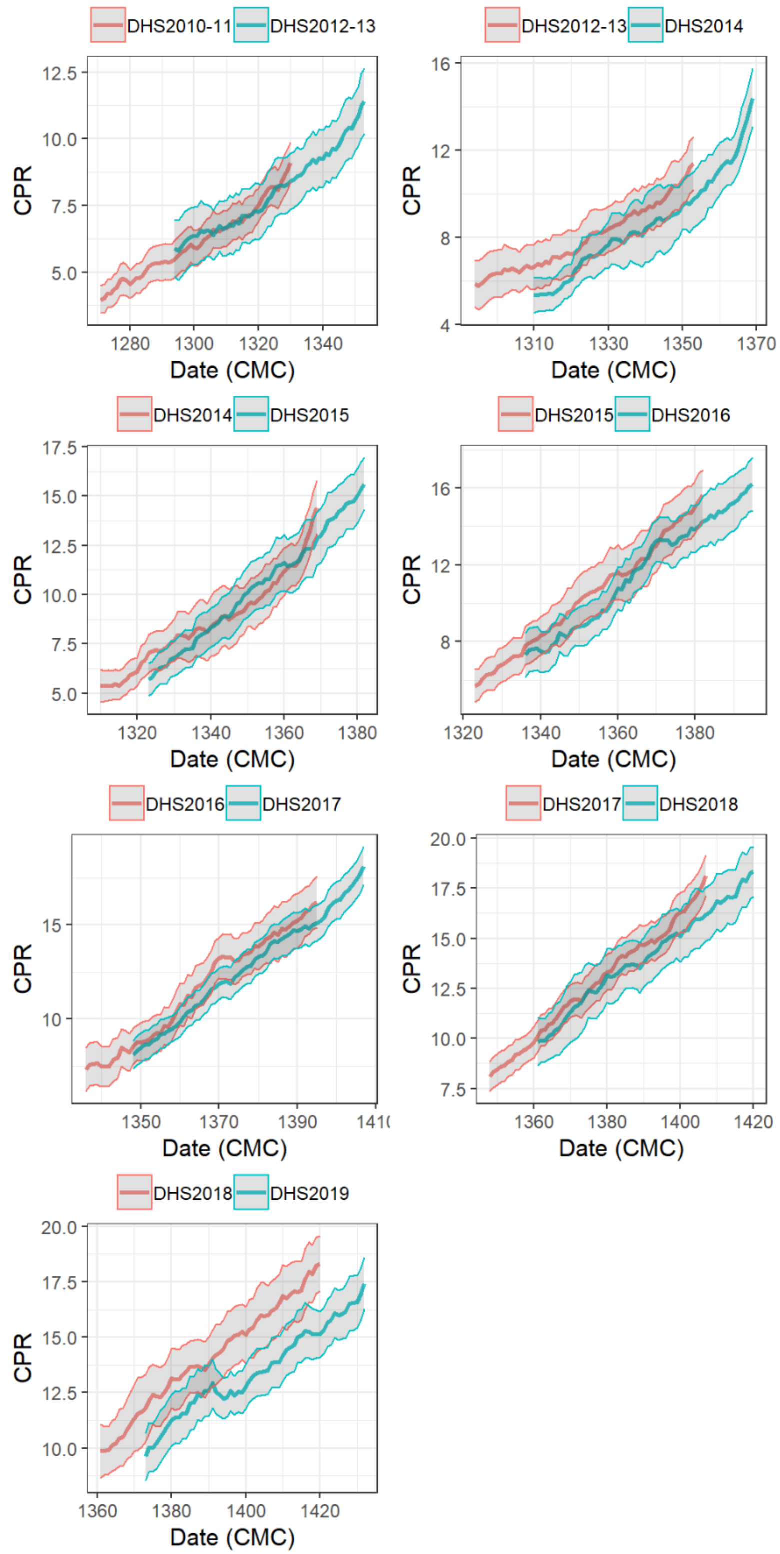
Figure 4 Total contraceptive prevalence rate among women age 15-43, Peru



For Peru, as shown in Figure 4, there is greater overlap between the retrospective calendar data and the current use data, except for the comparisons between 2000 and 2004-06. Between those two surveys, we observed an overestimation of contraceptive use according to the retrospective calendar compared to the current calendar data. This appears to be driven by the periodic abstinence method between these two surveys, as shown in Appendix Figure A.11, and to a lesser degree by male condom use, as indicated in Figure A.10.

3.1.4 Senegal

Figure 5 Total contraceptive prevalence rate among women age 15-43, Senegal



As indicated in Figure 5, there was an almost perfect overlap between contraceptive use according to the retrospective calendar data and according to the current calendar data. The only exception exists in the comparison between 2018 and 2019, where there are larger but insignificant differences between contraceptive use based on the retrospective and current calendars. The differences between these two surveys appear to be largely due to reporting on the pills method. We also observe largely overlapping calendars for all other prevalent methods, as shown in Figures A.12 to A.14 in the appendix.

3.2 Accumulating Calendar Data

In this section, we accumulate calendar data across the surveys of Peru and Senegal. These are countries with fewer inconsistencies in calendar data based on comparisons in the previous section.

3.2.1 Peru

Figure 6 depicts trends of monthly CPR. Trends were calculated with separate survey datasets and a cumulated dataset. Trends from the separate datasets show an increase in CPR in several surveys, but also a stall or reversal in others. Cumulated data moderated some fluctuations in the trends of the separate datasets and show a definite pattern that suggested an increase in CPR, followed by a brief stall, and then a continued increase. We also see a sudden increase in CPR near the middle of the trend. This is probably due to the significant differences in CPR based on data from 2000 and 2004-06, as shown in the first panel of Figure 4. It is important to note that cumulated data yielded trends with more narrow confidence intervals as opposed to the trends in the separate datasets, especially in months where the calendar data overlap.

3.2.2 Senegal

Figure 7 depicts trends of monthly CPR in Senegal. Trends were calculated with separate survey datasets and a cumulated dataset. Trends from the separate datasets show a clear trend of increasing CPR. Cumulated data also showed a consistently increased trend in CPR, but with a sudden drop toward the end of the study period. This was due to the difference between the calendar data from 2018 and 2019, as indicated in Figure 5. Cumulated data yielded a trend with more narrow confidence intervals as opposed to the trends in the separate datasets, especially in months where the calendar data overlap.

Figure 6 **Total CPR among women age 15-43 based on cumulated and separate datasets, Peru**

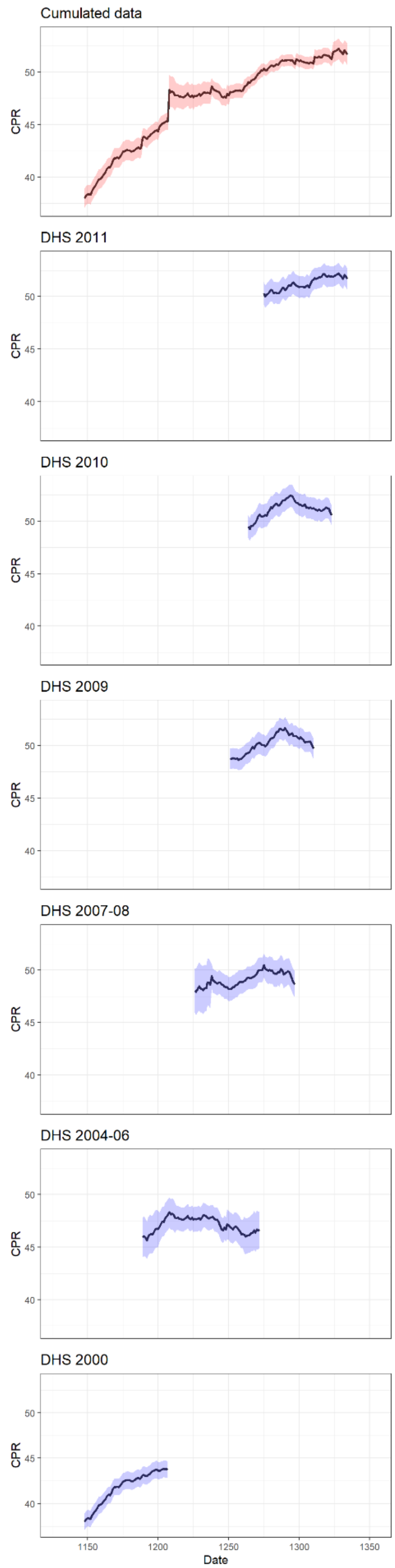
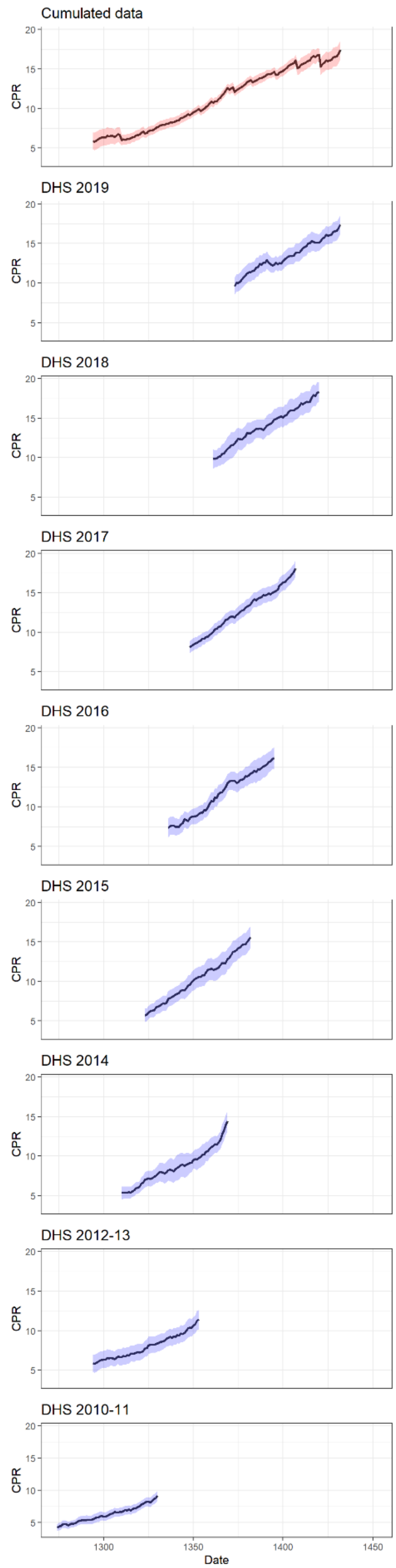


Figure 7 Total CPR among women age 15-43 based on cumulated and separate datasets, Senegal



4 DISCUSSION

This paper uses data from the contraceptive calendars of consecutive DHS surveys to examine the potential of accumulating retrospective data in DHS surveys. Another application of the birth history data was examined previously in Working Paper 177, in which the accumulation approach was presented in detail. The fact that calendar data are collected only for 6 years before the survey and concerns about data quality and consistency encouraged us to conduct the current analyses.

Our goal was to answer the following questions: 1) What are potential challenges for accumulating retrospective data when the data are bounded in time? 2) Are the data collected in the calendar affected by recall bias? 3) When calendar data are consistent across surveys, what is the potential value-added of accumulating such data across surveys?

The challenges of accumulating calendar data were obvious in the early stage of our analysis. We identified only a limited number of surveys that could be analyzed. The fact that data for the contraceptive calendar are collected only for a bounded period, which is up to 7 years prior to the survey, imposed a restriction on the surveys that could be accumulated. Ideally, we would prefer surveys with a short period in between so that there would be large overlap in the calendar data. In addition, given the concerns about quality of the calendar data, we needed to examine the consistency of the calendar data across surveys.

We found some indication of recall bias in Bangladesh and Egypt, where we observed an underestimation of CPR based on retrospective data between most surveys. In Senegal and Peru, we found more consistent estimates between the two data sources, especially for Senegal. This implies that the contraceptive calendar data for Senegal and Peru had better data quality and less bias. With Senegal, the overall consistency in the data between each set of consecutive surveys may be a result of the fact that Senegal's data are based on continuous surveys with approximately 1 year in between.

Method-specific estimates were also produced. This allowed us to explore whether methods might be affecting any inconsistent estimates. The use of injections appeared to provide the most consistent estimates in all countries. This was the case in Bangladesh and Egypt where we observed some underestimation in the overall CPR based on the retrospective data. Periodic abstinence was one of the main drivers of the inconsistent estimates in Bangladesh and Peru, and for Egypt, it was IUDs. The male condom was another influence on the inconsistent estimates in Bangladesh. This is not surprising since it would be difficult for a woman to recall every occurrence of periodic abstinence and condom use during the 5 years before the survey. The same could be said for IUDs because women may not recall exactly when they receive or remove an IUD. However, since injections typically have a regular schedule such as every 1-3 months, it would be easier for a woman to recall injections in the calendar.

With calendar data that were consistent across surveys in Peru and Senegal, we produced trends of CPR based on the accumulated data. The accumulated data moderated some fluctuations in the trends of the separate datasets and showed definite patterns. However, the accumulated trends were affected by any inconsistency in the data, such as the significant differences in CPR based on calendar data from different surveys. As expected, the accumulated data yielded trends with more narrow confidence intervals as opposed to the trends in the separate datasets, especially in the months where calendar data overlap.

However, the application on calendar data did not show promising potential similar to the application on birth histories as found by Schmidt and Elkasabi (2020).

The results of this analysis show that calendar data is affected by recall bias and that this bias varies with specific methods. This suggests that there may be questionable data quality in countries where these specific methods (traditional methods or male condoms) are more prevalent. From the Senegal example, we can see that shorter periods between surveys improve data quality. While this may not be possible for many countries, the results suggest that having a shorter calendar data period (3 years instead of 5) might improve data quality. With countries that have good data quality, the accumulation of the calendar data that would provide a longer period of monthly CPR estimates can be very useful for monitoring and evaluating family planning methods.

Our conclusions are limited because we were unable to perform the comparisons on more surveys due to the strict criteria for selecting data for analysis. With more surveys, we would have been able to define more patterns in the data and identify more factors that might contribute to the recall bias. Our analysis was also limited by the type of indicators that can be calculated from the calendar data. In this paper, we examined monthly CPR estimates. It may have been more useful to examine other indicators that are calculated on reference periods before the survey. With such indicators, the potential of the accumulation technique becomes more apparent, as indicated by Schmidt and Elkasabi (2020).

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APPENDIX

Figure A.1 Injections usage among women age 15-43, Bangladesh

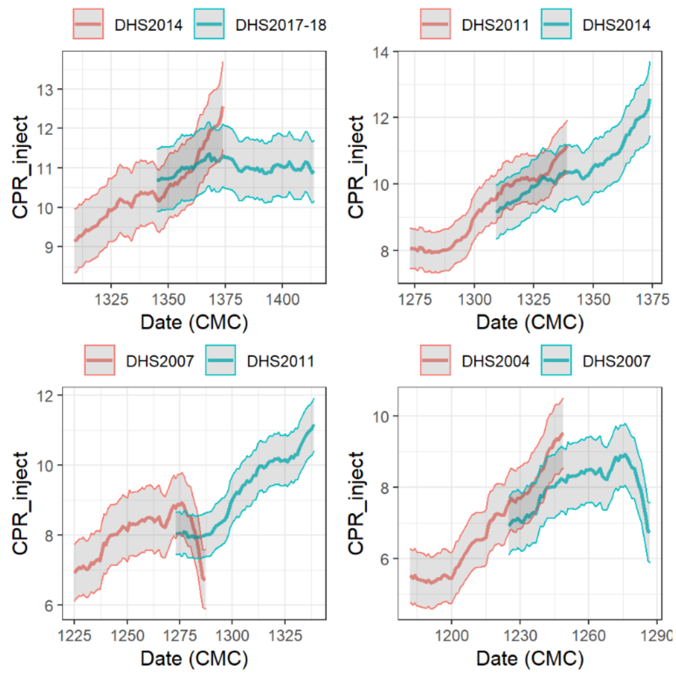

Figure A.2 Male condoms usage among women age 15-43, Bangladesh

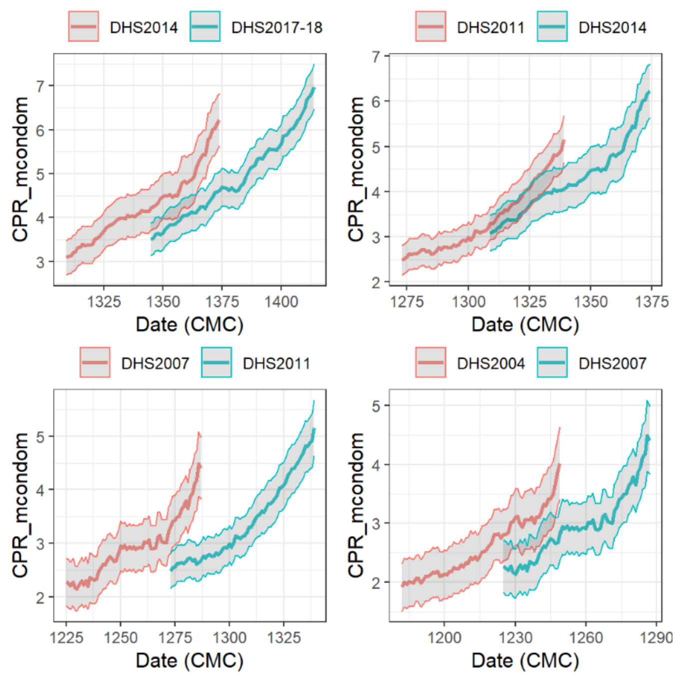

Figure A.3 Periodic abstinence usage among women age 15-43, Bangladesh

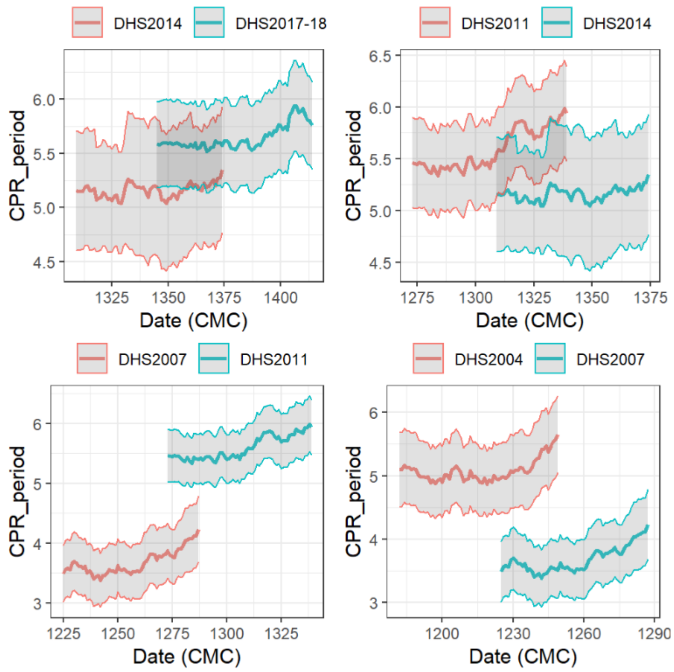

Figure A.4 Pills usage among women age 15-43, Bangladesh

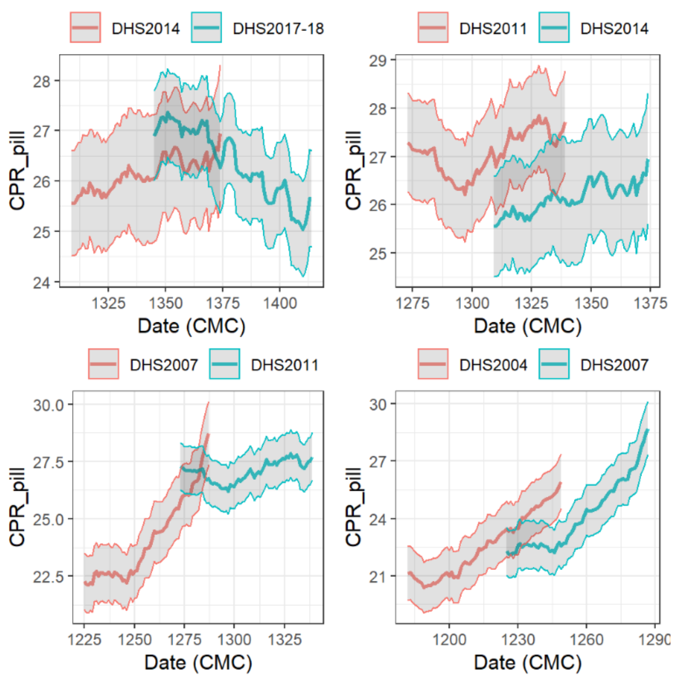

Figure A.5 Injectables usage among women age 15-43, Egypt

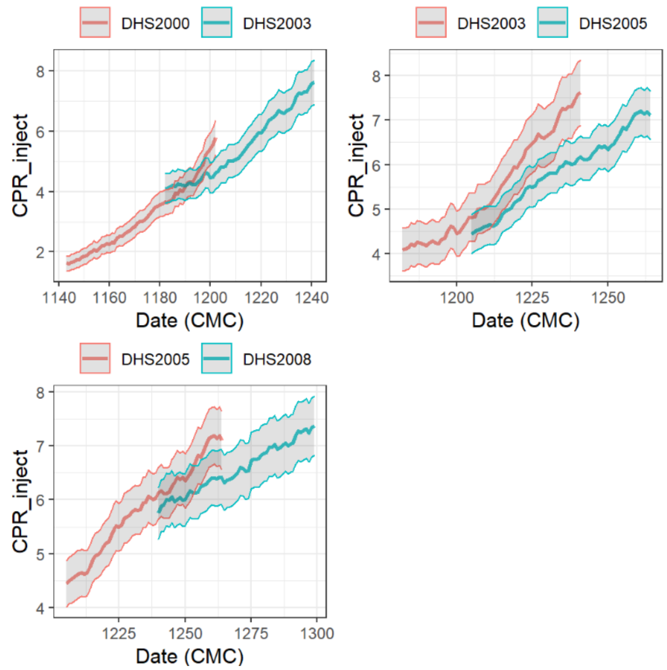

Figure A.6 IUD usage among women age 15-43, Egypt

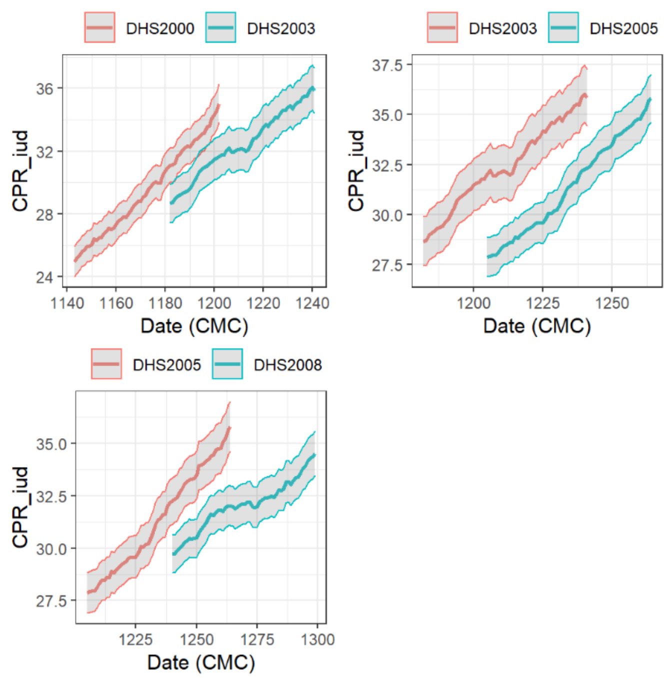

Figure A.7 Pills usage among women age 15-43, Egypt

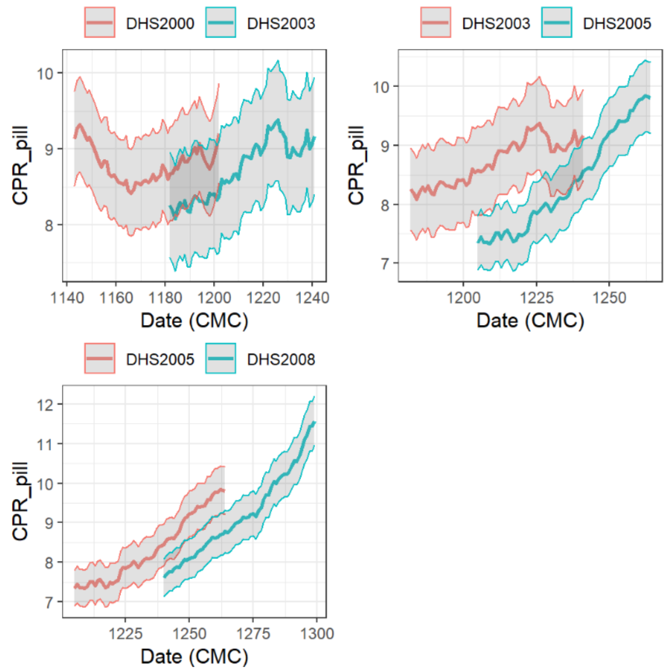

Figure A.8 Injections usage among women age 15-43, Peru

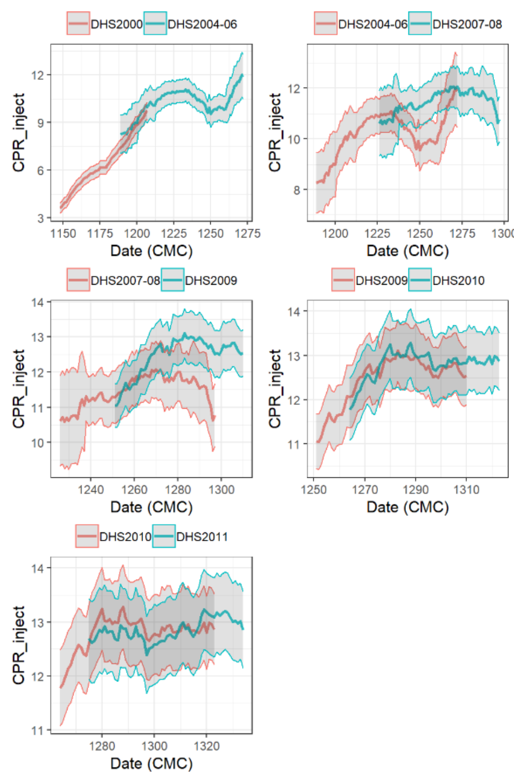

Figure A.9 IUD usage among women age 15-43, Peru

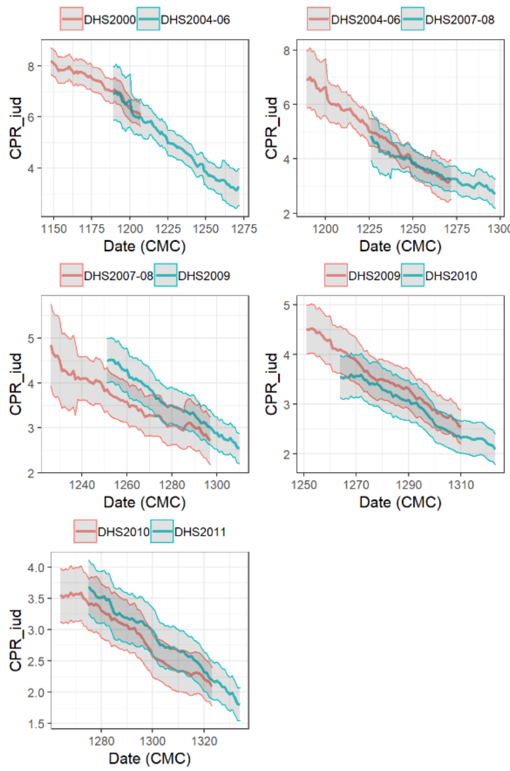

Figure A.10 Male condoms usage among women age 15-43, Peru

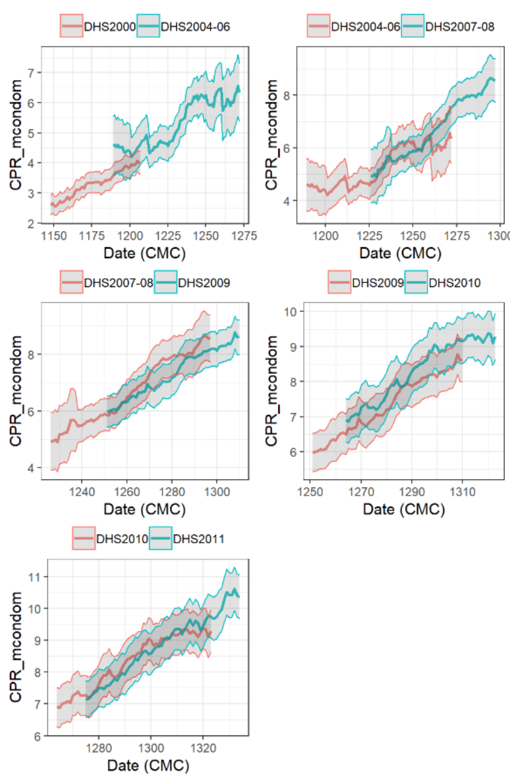

Figure A.11 Periodic abstinence usage among women age 15-43, Peru

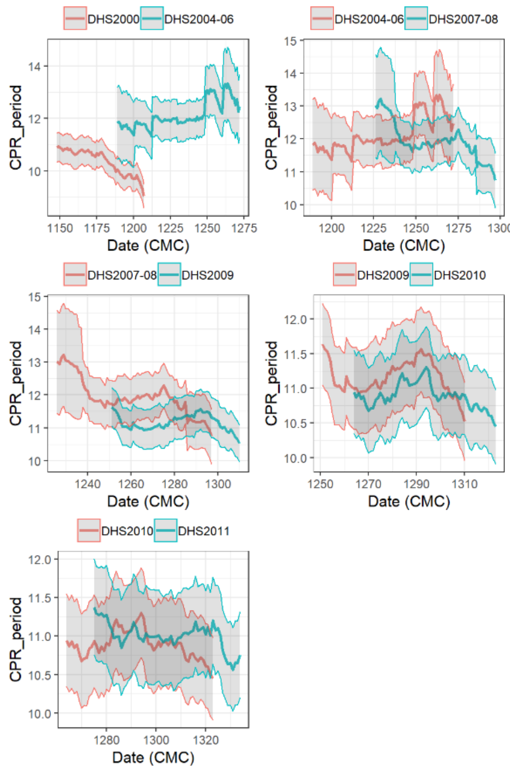

Figure A.12 Implants usage among women age 15-43, Senegal

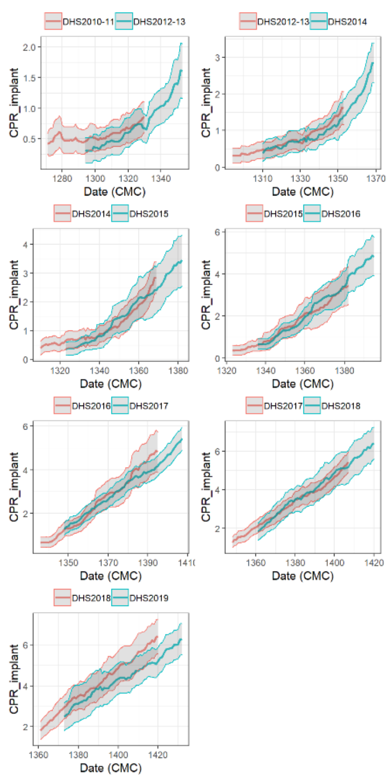

Figure A.13 Injections usage among women age 15-43, Senegal

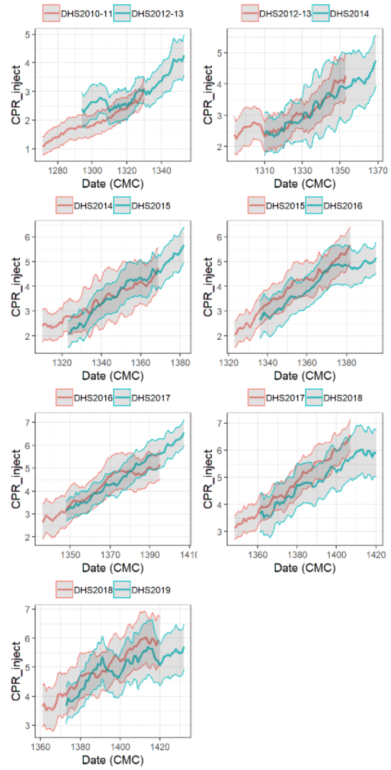

Figure A.14 Pills usage among women age 15-43, Senegal