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Fertility and Family Planning Characteristics of Contraceptive Clusters in Burundi

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Fertility and Family Planning Characteristics of Contraceptive Clusters in Burundi

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ABSTRACT

This study sought to identify discrete subpopulations of women in Burundi based on patterns in their contraceptive and pregnancy experience. Toward this aim, we do not use typical cross-sectional measures, but instead put to new use retrospective, longitudinal data from Demographic and Health Surveys (DHS) contraceptive calendars. Specifically, we apply sequence and cluster analysis of these longitudinal data to identify discrete clusters that characterize women's dynamic contraceptive and pregnancy behaviors over the previous 5 years. We further supplement the sequence data of the clusters with additional demographic, fertility, and family planning data from elsewhere in the survey and use multivariate logistic regression analysis to create rich descriptions of women in these clusters.

We identify six clusters, with three clusters (85% of women) characterized by no use of contraception and three clusters (16%) characterized by contraceptive use. The six clusters are: (1) Quiet Calendar (42%), characterized by women who do not experience pregnancy or use any methods of contraception; (2) Family Builder 1 (25%) and (3) Family Builder 2 (18%), which are both characterized by women who did not use any method and experienced two pregnancies; (4) Modern Mother (8%), which is characterized by women who adopted short-term modern methods toward the end of year 2 after a period of non-use and one pregnancy; (5) Consistently Covered Mother (6%), characterized by women who adopted long-acting reversible contraception or permanent methods after a period of non-use and one pregnancy; and (6) Traditional Mother (2%), characterized by those who adopted traditional methods at the end of year 2 after non-use and one pregnancy.

Factors most consistently associated with cluster membership are need for family planning, lifetime experience of contraceptive use, marital status, pregnancy experience, and age. The number of children ever born at the start of a woman's calendar sequence is associated with membership in only half of the clusters: Quiet Calendar, Modern Mother, and Consistently Covered Mother. Cluster membership is seldom differentiated by socio-economic variables.

The Quiet Calendar cluster stands apart from the other clusters: Along with no use of contraception over the past 5 years, Quiet Calendar women are unmarried and have no children or pregnancies, no need for family planning, and no history of contraceptive use. The Family Builder 1 and Family Builder 2 clusters, which appear similar, deviate from one another in terms of levels of unmet need and lifetime experience with contraception.

Key words: clusters, contraceptive calendar, fertility, family planning, Burundi

ACRONYMS AND ABBREVIATIONS

DHS	Demographic and Health Survey
EC	emergency contraception
IUD	intra-uterine (contraceptive) device
LAM	lactational amenorrhea method
LAPM	long-acting and permanent methods
LARC	long-acting, reversible contraception
OR	odds ratio
PAM	partitioning around medoids
PSU	primary sampling units
SBC	social and behavior change
SDM	standard days method
UNFPA	United Nations Population Fund
USAID	United States Agency for International Development

1 INTRODUCTION

Fertility remains high in Burundi, having only gradually declined from 6.9 children per woman in 1987 to 5.5 children per woman in 2016-17 (Ministère à la Présidence chargé de la Bonne Gouvernance et du Plan - MPBGP et al. 2017). Almost a quarter (23%) of married women ages 15-49 use a modern method—a small and gradual increase from 18% in 2010. Similarly, the demand for family planning has modestly increased from 54% in 2010 to 58% in 2016-17. The modern contraceptive method mix is dominated by injectables (49%) and implants (26%) (Avenir Health 2018). Burundi is one of 69 priority countries that has made commitments toward FP2020 (Brown et al. 2014), but sluggish growth in contraceptive use suggests that more effort is needed to meet the country’s goals for increased contraceptive prevalence and reduced unmet need.

The Demographic and Health Surveys (DHS) Program administers a contraceptive calendar as a part of most surveys. These contraceptive calendars are a rich source of data on contraceptive behavior and pregnancy experience covering the 5 years preceding the survey (Croft, Bradley, and Allen 2018). Calendar data have become the basis for much research on fertility behavior, including the calculation of discontinuation rates and other contraceptive dynamics (Ali, Cleland, and Shah 2012; Curtis and Hammerslough 1995), postpartum family planning adoption (Moore et al. 2015), the analysis of birth intervals (Bascieri and Hinde 2007; Moultrie, Sayi, and Timæus 2012), and perinatal mortality and pregnancy terminations (Bradley, Winfrey, and Croft 2015; MacQuarrie et al. 2018). These data also provide a comprehensive view of women’s journeys with contraceptive use over time.

Market segmentation researchers have tried to make cross-sectional data useful to reproductive health programs by identifying distinct, homogenous groups within a population (i.e., market segments) that have different needs and inclinations to use contraceptive services. The aim of market segmentation is to help tailor messages and services to distinct groups of potential and existing family planning clients who have different motivations to use or avoid services. Segmentation methods use latent class analysis approaches on *current* status from cross-sectional data and tend to prioritize *attitudes* over behavior. For example, several studies have found trust, whether in health systems or in peers (Dabney et al. 2019; Dalglish et al. 2018), to be a motivating factor, while others form segments based on positive views of contraception or gender attitudes (Camber Collective 2014, 2015; Dalglish et al. 2018; Trasi 2018; Wang et al. 2009).

Underutilized behavioral data on reproductive experiences can complement such attitudinal data. Longitudinal data, such as those in DHS calendars, provide more insight on the nuances of contraceptive behavior and dynamics over time than current status measures can (Curtis and Hammerslough 1995; Finnegan 2019; MacQuarrie, Mallick, and Kishor 2016; MacQuarrie et al. 2014). Although latent class analysis and similar statistical techniques typically used in market segmentation are usually ill-suited to longitudinal data, other statistical methods can be used to identify patterns and subgroups using longitudinal, behavioral data (Abbott 1995; Aisenbrey and Fasang 2010; Dias and Willekens 2005; Feldman, Masyn, and Conger 2009), due to the availability of new statistical packages (Dias and Cortinhal 2008; Furnas 2016; Gabadinho, Ritschard, Mueller, et al. 2011; Gemmill 2019; Genolini et al. 2015; Studer 2013). We apply these methods to calendar data in Burundi.

This study identifies discrete subpopulations of women in Burundi based on patterns in their contraceptive and pregnancy experience. Toward this aim, we do not use typical cross-sectional measures, but instead put to new use retrospective, longitudinal data from DHS contraceptive calendar. Specifically, we apply sequence and cluster analysis of longitudinal data to identify discrete clusters that characterize women's dynamic contraceptive and pregnancy behaviors over the previous 5 years. We supplement the sequence data of the clusters with additional demographic, fertility, and family planning data that were collected elsewhere in the survey to create a rich description of women in these clusters. This is believed to be the first such application of these methods to nationally representative longitudinal contraceptive data.

2 DATA AND METHODS

2.1 Data

This study uses contraceptive calendar data from the 2016-17 Burundi DHS survey. The Burundi DHS, like other DHS surveys, is a household survey collecting data on numerous health and demographic indicators and is representative at the national and subnational levels. Households are selected through a multi-stage, clustered sampling process in which primary sampling units (PSUs) are selected based on probability proportional to size and households are randomly selected within the selected PSUs. All eligible women in each household are selected for interview. Additional details on the design of the survey can be found in the survey final report (Ministère à la Présidence chargé de la Bonne Gouvernance et du Plan - MPBGP et al. 2017). The 2016-17 Burundi DHS survey achieved a response rate of 98.8% among eligible women.

The contraceptive calendar is a retrospective history of more than 5 years in which monthly event data including pregnancies, births, terminations, episodes of contraceptive use, and non-use of contraception are recorded (Croft, Bradley, and Allen 2018). These data were collected for all women of reproductive age (age 15-49) in the 2016-17 Burundi DHS (n=17,269). We placed three restrictions on the data, namely restrictions on the period of observation, the number of states (see explanation of states below), and the age of the women in the sample.

First, we omit the month of the interview and the two prior months, since some women who recently became pregnant may not yet have recognized that they were pregnant. We also omit months at the beginning of the calendar so that we observe exactly 59 months of data for each woman in her calendar sequence, with month 1 being the earliest point in the woman's calendar (approximately 5 years before the interview) and month 59 being the most recent month (three months before the interview).

Next, we condense the state codes in the calendar sequence into five possible states:

1. No use of contraception
2. Use of a short-term modern method of contraception
3. Use of a long-acting or permanent method (LAPM) of contraception
4. Use of a traditional method of contraception
5. Pregnancy, birth, or termination.

Short-term modern methods are pills, injectables, condoms, the lactational amenorrhea method (LAM), emergency contraception (EC), and the Standard Days Method (SDM). LAPM consist of two long-acting, reversible (LARC) methods—intrauterine devices (IUDs) and implants—plus two permanent methods—female and male sterilization. Traditional methods include periodic abstinence/rhythm, withdrawal, and other traditional or folkloric methods.

Third, we exclude women who were younger than age 15 at the start of their calendar sequences. Prior research indicates that girls this age are neither sexually active nor biologically fecund and seldom use contraception (MacQuarrie, Mallick, and Allen 2017; Pullum, Croft, and MacQuarrie 2018), so their calendar sequences would not have included the states most of interest to this analysis. These restrictions provide us with a weighted analytic sample of 13,293 women in Burundi.

2.2 Sequence and Cluster Analysis

In the first stage of analysis, we use sequence and cluster analysis to identify primary clusters of contraceptive use. We conduct sequence and cluster analysis in R using the TraMineR and WeightedCluster packages (Gabadinho, Ritschard, Mueller, et al. 2011; Gabadinho, Ritschard, Studer, et al. 2011; Studer 2013). All analyses are weighted to account for sampling probability, non-response, and the complex sampling design.

Briefly, we use Optimal Matching to calculate distances in our dissimilarity matrix, which (unlike Hamming distance-matching procedures) allows for states to be inserted and deleted as well as substituted in computing distances, or differences between pairs of sequences. This flexibility allows us to better account for the sporadic timing of pregnancies in the sequences by potentially aligning these events over time. To measure pairwise distances between sequences, we use a constant cost matrix that assumes uniform costs for all substitutions, insertions, or deletions. Constant costs assume that the costs of each transition between states, for example from using a short-term method to discontinuing it or from not using a method to becoming pregnant, are equal. Finally, we conduct cluster analysis on the dissimilarity matrix to group together women whose calendar sequences exhibit similar patterns of contraceptive use and pregnancy experience using a k-medoid (i.e., a partitioning around medoids, or PAM) clustering algorithm. These parameters and the number of clusters in the final solution were guided by scores on a series of six quality metrics (Gemmill 2019; Studer 2013).

These quality metrics led us to a final solution with six clusters in Burundi. These clusters grouped women solely on the basis of the contraceptive behaviors and pregnancy experiences observed in their 59-month calendar sequences. We use medoid plots and sequence index plots to visually describe the sequences in each cluster. Further methodological details have been described previously (MacQuarrie et al. 2019).

2.3 Regression Analyses

In the second stage of our analysis, we estimated multivariable logistic regression models separately for each of the six clusters to further elaborate on the demographic, fertility, and family planning experiences of women in those clusters. These covariates, collected elsewhere in the survey, complement the data contained in the calendar sequences upon which the clusters are identified. These covariates describe a combination of experiences preceding, during, and immediately following the calendar sequence (at the time of the survey). No causal direction is implied. Regression models are used to identify associated features only. Models also include socio-economic controls.

Regression analyses are conducted in Stata ME 16. All analyses are weighted to account for sampling probability, and non-response and *svyset* commands are used to account for the complex sampling design.

2.3.1 Demographic, fertility, and family planning covariates

The covariates in the regression models are age, marital status, number of children, experience of unintended pregnancy, need status, and lifetime use of family planning.

Age at the start of the calendar sequence is expressed in completed years and then grouped into six five-year age groups: age 15-19, 20-24, 25-29, 30-34, 35-39, and 40-44. Age 30-34 serves as the reference category.

Marital status is a current status measure categorized on the basis of marital status at the time of interview because a complete marital history is not collected for all women in DHS surveys. Marriage includes both formal and informal unions as reported in response to the question, “Are you married or living with a man as if married?” This variable has three categories: never in union, currently in union, and formerly in union (i.e., divorced, separated, or widowed). Never in union serves as the reference category.

Number of children is the number of children ever born (whether currently alive or not) at the start of the calendar sequence. This variable precedes the contraceptive and pregnancy experiences that define the cluster, so for certain clusters characterized by pregnancies and births, the number of children ever born at the time of the survey could exceed the value on this variable. After testing for sensitivity of the variable expressed as a continuous or categorical variable, we opted to express number of children as a categorical variable to ease interpretation. Women with 1-2 children, 3-4 children, or 5 or more children are compared with the reference category (i.e., women with no children at the start of the calendar sequence).

Experience of unintended pregnancy describes women’s experience at any point during the 5-year calendar or in the three months between the end of the calendar sequence and the time of the interview. Pregnancies are categorized as well-timed (i.e., wanted then), mistimed (i.e., wanted later), or unwanted (i.e., did not want any more) and are compared against the reference category of women who did not experience a pregnancy during this time period.

Need for family planning is a current status measure describing, at the time of the survey, whether women have no need, met need, or unmet need for family planning. Use of either traditional or modern methods constitutes met need. This formulation of need for family planning follows the revised algorithm now standard for DHS surveys (Bradley et al. 2012). No need serves as the reference category.

Lifetime experience of contraceptive use is a dichotomous variable expressing whether women report having ever used family planning. Women who are currently or have ever used a modern or traditional method of family planning are compared with women who have never used family planning.

2.3.2 Socio-economic control factors

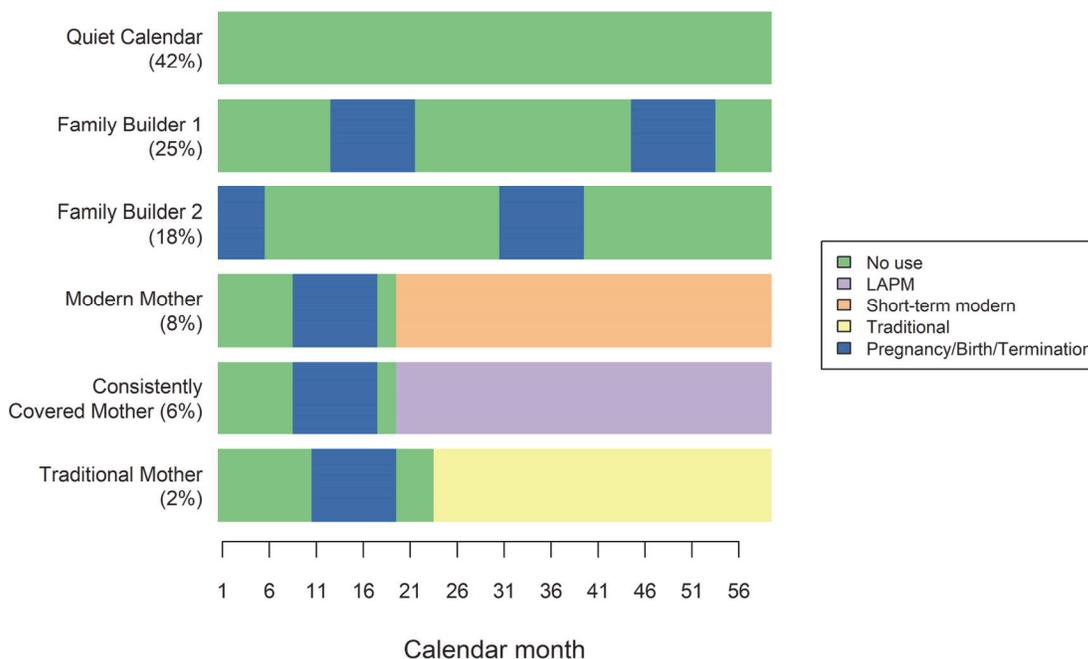
Regression models also include a common set of socio-economic variables as controls. These are rural/urban residence, educational attainment (i.e., none, primary, and secondary or higher), and household wealth quintile (based on an inventory of assets and housing materials in the household’s possession at the time of the survey).

3 RESULTS

3.1 Identifying Discrete Contraceptive Clusters

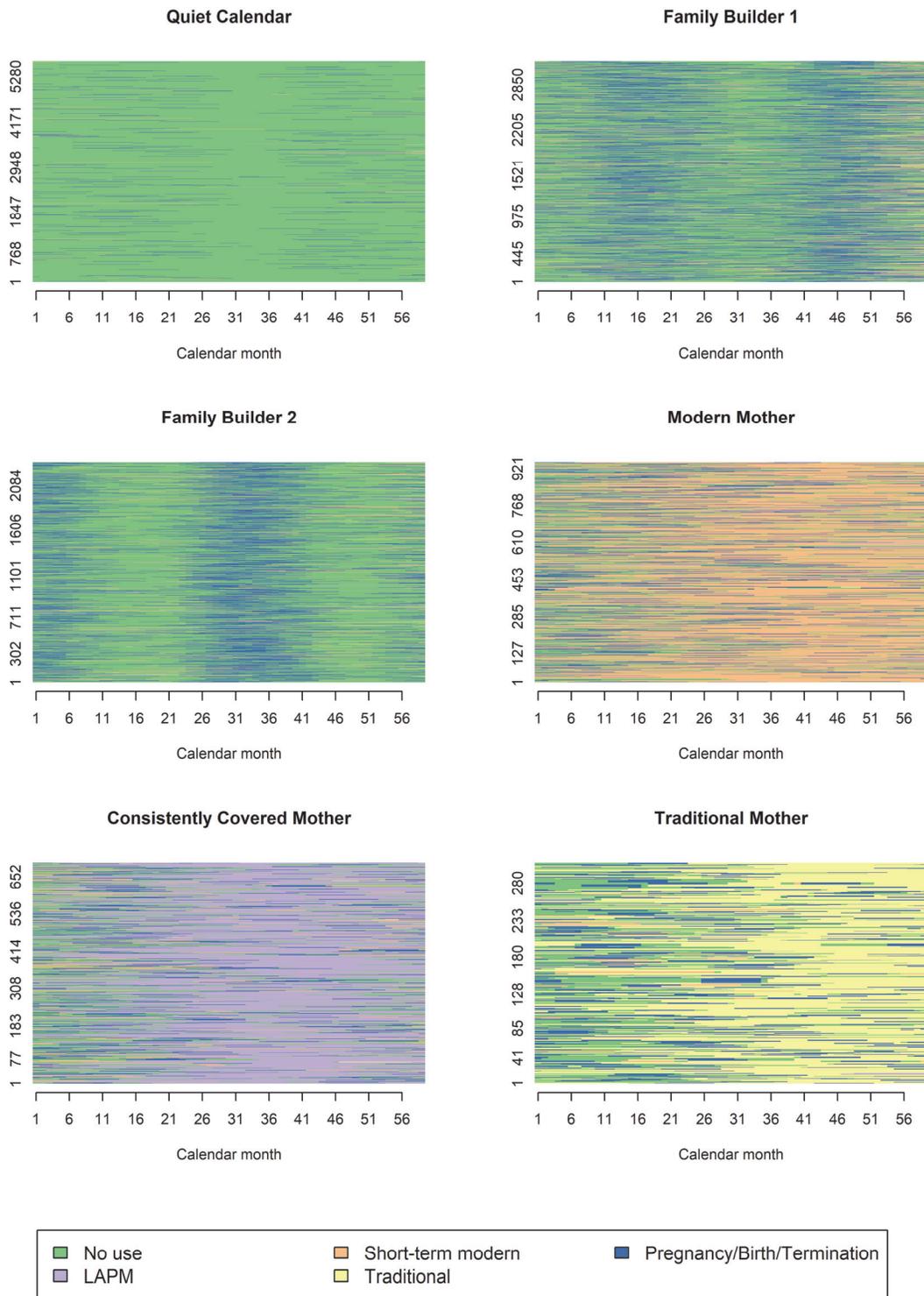
We identify six distinct clusters, illustrated by their medoid—the most illustrative sequence for each cluster (Figure 1). The three most common clusters, including 85% of women, are characterized by no use of contraception while the remaining three clusters are characterized by contraceptive use. The six clusters are: (1) Quiet Calendar (42%), characterized by women who did not experience pregnancy or use any methods of contraception; (2) Family Builder 1 (25%) and (3) Family Builder 2 (18%), which are both characterized by women who did not use any method and experienced two pregnancies, but vary in terms of timing during the calendar sequence; (4) Modern Mother (8%), characterized by women who adopted short-term modern methods toward the end of year 2 after a period of non-use and one pregnancy; (5) Consistently Covered Mother (6%), characterized by women who adopted LAPMs after a period of non-use and one pregnancy; and (6) Traditional Mother (2%), characterized by those who adopted traditional methods at the end of year 2 after non-use and one pregnancy.

Figure 1 Representative sequence (medoid) and proportion of women in each Burundi contraceptive cluster



Sequence index plots show the individual sequences for every woman in each cluster. The sequence index plots in Figure 2 show little deviation in sequences among members in each cluster when compared with the medoids presented in Figure 1. In aggregate, Quiet Calendar women spent an average of 56 months of the 59 months in a non-use state, only 2.5 months in a state of pregnancy, and less than 1 month using short-term modern methods, LAPMs, or traditional methods.

Figure 2 Sequence index plots of each Burundi contraceptive cluster



Women in the Family Builder 1 cluster spent an average of 37 months not using contraception and nearly 16.5 months in a state of pregnancy. Similarly, women in the Family Building 2 cluster spent an average of 42 months and 14 months in these respective states. In both of these clusters, contraceptive use of any kind, combined, spanned less than six months on average.

This contrasts sharply with the three clusters characterized by contraceptive use. A total of 36 months, on average, was spent using short-term modern methods in the Modern Mother cluster, 38 months using LAPMs in the Consistently Covered Mother cluster, and 34 months using traditional methods in the Traditional Mother cluster. The average time spent using no contraception in these three clusters ranges from 11 months (Consistently Covered Mother) to 13.5 months (Traditional Mother), and the average time in pregnancy ranges from 7 months to 10 months, respectively, with the remaining time spent using other contraceptive methods.

3.2 Sample Description

Table 1 presents the characteristics of women in the analytic sample, in terms of the factors in the regression models. The sample is relatively young, with the highest proportion (24%) age 15-19 and the lowest proportion (9%) age 40-44 at the start of the calendar sequence.

Most women are currently married (72%). About one-third of the sample had no children at the start of their calendars (34%). The remaining two-thirds are more or less evenly distributed (19% to 24%) across the other categories of 1-2, 3-4, or 5 or more children.

Women have most commonly experienced a well-timed pregnancy (43%) during or since their calendar sequences, followed by experiencing no pregnancy (33%). Less common is experiencing an unintended pregnancy, with mistimed pregnancies (17%) exceeding unwanted pregnancies (8%). About half of the sample currently has no need for family planning, and one-quarter each experiences unmet need and met need for family planning. The majority (56%) has never used family planning.

The sample is largely rural (88%) and has either no education (45%) or primary education only (37%). The sample is evenly distributed across household wealth quintiles.

Table 1 Analytic sample profile

	Percentage	Weighted n
Contraceptive cluster		
Quiet Calendar	41.5	5,521
Family Builder 1	24.9	3,308
Family Builder 2	18.1	2,400
Modern Mother	7.6	1,007
Consistently Covered Mother	5.6	750
Traditional Mother	2.3	308
Age at the start of calendar sequence		
15-19	24.2	3,219
20-24	22.6	3,006
25-29	18.3	2,431
30-34	14.6	1,941
35-39	11.5	1,533
40-44	8.8	1,165
Marital status at time of survey		
Never in union	17.3	2,293
Currently in union	71.6	9,512
Formerly in union	11.2	1,487
Number of children at start of calendar sequence		
0	34.3	4,563
1-2	23.9	3,172
3-4	19.2	2,555
5+	22.6	3,003
Experienced unintended pregnancy during or since calendar sequence		
No pregnancy	33.1	4,395
Well-timed pregnancy	42.6	5,661
Mistimed pregnancy	16.7	2,221
Unwanted pregnancy	7.6	1,016
Need for family planning at time of survey		
No need	54.9	7,292
Unmet need	22.9	3,040
Met need	22.3	2,960
Ever used family planning		
No	55.9	7,429
Yes	44.1	5,864
Residence		
Urban	12.5	1,666
Rural	87.5	11,627
Highest education level		
No education	44.8	5,955
Primary	36.8	4,896
Secondary or higher	18.4	2,441
Household wealth quintile		
Poorest	20.3	2,696
Poorer	20.2	2,688
Middle	20.1	2,671
Richer	18.9	2,513
Richest	20.5	2,725
Total	100.0	13,293

3.3 Demographic, Fertility, and Family Planning Attributes of Clusters

The sequence and cluster analysis defined the six clusters described above on the basis of contraceptive use and pregnancy experience in women's 59-month calendar sequences, alone. Table 2 presents the results of separate logistic regression models, which further elaborate on the demographic, fertility, and family planning experiences associated with membership in each of the six clusters.

Ever use of family planning is included in the regression models for the first three clusters only. It is omitted from the last three cluster models (those characterized by contraceptive use) because ever use of family planning is, by definition, a characteristic of membership in these clusters.

Table 2 Demographic, fertility, and family planning factors associated with cluster membership. Odds ratios from logistic regressions

	Quiet Calendar (42%)		Family Builder 1 (25%)		Family Builder 2 (18%)		Modern Mother (8%)		Consistently Covered Mother (6%)		Traditional Mother (2%)	
	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value
Age at the start of calendar sequence (ref: 30-34)												
15-19	0.86	0.282	1.35	0.011	0.85	0.182	0.98	0.907	1.70	0.022	0.21	0.000
20-24	0.54	0.000	1.32	0.006	0.95	0.635	1.08	0.667	1.97	0.000	0.63	0.082
25-29	0.65	0.000	1.24	0.015	1.02	0.796	0.99	0.943	1.30	0.071	0.77	0.209
35-39	1.48	0.001	0.85	0.103	0.98	0.866	0.74	0.037	0.84	0.288	0.85	0.477
40-44	4.20	0.000	0.24	0.000	0.84	0.314	0.51	0.001	0.45	0.000	1.25	0.426
Marital status (ref: never in union)												
Currently in union	0.12	0.000	6.09	0.000	1.07	0.745	3.20	0.000	7.14	0.000	7.02	0.001
Formerly in union	0.39	0.000	3.10	0.000	1.01	0.975	2.39	0.005	4.17	0.001	0.70	0.677
Number of children at start of calendar sequence (ref: none)												
1-2	0.54	0.000	1.03	0.765	1.09	0.267	1.55	0.008	4.05	0.000	0.84	0.535
3-4	0.58	0.000	1.09	0.409	0.87	0.181	1.53	0.027	5.83	0.000	0.89	0.704
5+	0.53	0.000	1.09	0.457	0.93	0.578	1.70	0.011	6.12	0.000	1.04	0.905
Experience of unintended pregnancy during or since calendar sequence (ref: no pregnancy)												
Well-timed pregnancy	0.06	0.000	60.52	0.000	89.93	0.000	0.88	0.364	0.48	0.000	0.86	0.453
Mistimed pregnancy	0.02	0.000	105.80	0.000	94.58	0.000	0.55	0.001	0.40	0.000	1.35	0.215
Unwanted pregnancy	0.03	0.000	101.30	0.000	84.08	0.000	0.67	0.041	0.38	0.000	1.19	0.506
Need for family planning at time of survey (ref: no need)												
Unmet need	0.91	0.294	0.81	0.002	1.65	0.000	1.32	0.087	0.72	0.110	0.98	0.962
Met need	0.10	0.000	0.79	0.002	0.58	0.000	9.68	0.000	6.78	0.000	10.24	0.000
Ever used family planning (ref: no)												
Yes	0.20	0.000	1.37	0.000	0.73	0.000						
Residence (ref: urban)												
Rural	1.15	0.241	1.25	0.007	0.85	0.133	0.62	0.001	1.19	0.320	0.77	0.239
Education (ref: none)												
Primary	1.03	0.703	1.03	0.680	1.04	0.460	0.92	0.414	0.87	0.214	1.40	0.072
Secondary or higher	1.82	0.000	1.03	0.810	0.68	0.005	0.75	0.067	0.87	0.544	1.80	0.012
Household wealth index (ref: poorest)												
Poorer	0.91	0.328	1.10	0.239	1.07	0.436	0.84	0.170	1.01	0.925	1.14	0.657
Middle	0.86	0.112	1.05	0.558	1.03	0.746	0.79	0.073	1.48	0.007	1.08	0.780
Richer	0.92	0.379	0.99	0.842	1.09	0.305	0.72	0.011	1.29	0.111	1.89	0.008
Richest	1.21	0.104	0.89	0.240	0.83	0.106	1.10	0.536	1.27	0.257	1.74	0.038
Observations	13,293		13,293		13,293		13,293		13,293		13,293	

3.3.1 Quiet Calendar

Women in the Quiet Calendar cluster are typically not in their 20s at the start of their calendar sequences; rather they are either adolescents (age 15-19) or older than age 35, are never married, and have no children.

After controlling for socio-economic variables such as residence, education, and wealth, currently and formerly married women have 88% and 61% lower odds ($p < 0.001$), respectively, of being a member of the Quiet Calendar cluster than do never married women (Table 2). In other words, never married women have higher odds of belonging to the Quiet Calendar cluster. This pattern contrasts with that in most other profiles, in which either currently or formerly married women have higher odds of membership.

Women with any number of children at the start of their calendar sequences are significantly less likely to belong to the Quiet Calendar cluster than are women with no children, with similarly lower odds (42% to 47% lower odds, $p < 0.001$) across each category. As with marital status, this pattern is unique to the Quiet Calendar cluster.

Women who have experienced any pregnancy during or following their calendar sequences, whether mistimed/unwanted or well-timed, have significantly lower odds of belonging to the Quiet Calendar cluster (94% to 98% lower odds, $p < 0.001$). Quiet Calendar women are likely to have no need for family planning, as evidenced by 90% lower odds ($p < 0.001$) of membership among women with met need and no significantly different odds among women with unmet need. Similarly, women who have never used family planning in their lifetimes have 80% lower odds of being in the Quiet Calendar cluster than do women who have used family planning ($p < 0.001$).

Quiet Calendar membership is associated with having at least a secondary education; however, neither residence nor wealth appear to be an indicator of membership in this cluster.

In sum, the Quiet Calendar cluster lives up to its name, with constituent women having few reproductive experiences and no use of or need for family planning.

3.3.2 Family Builder 1 and Family Builder 2

Family Builder 1 and 2 resemble one another in that their representative sequences are characterized by no use of contraception and the experience of two pregnancies. They differ only in terms of the timing of the pregnancies within their sequences: Women in Family Builder 1 had their pregnancies more recently than Family Builder 2 women. In spite of their similarities, women in these clusters differ along several other dimensions (Table 2).

The Family Builder 1 cluster consists of young women. The odds of membership are 24% to 35% higher for those younger than age 30 ($p < 0.05$) and 76% lower for those age 40-44 ($p < 0.001$) compared with the middle age group. Currently married women have six times the odds and formerly married women have three times the odds of belonging to the Family Builder 1 cluster compared with never married women ($p < 0.001$). Neither age nor marital status is associated with membership in the Family Builder 2 cluster.

Women in the Family Builder 1 cluster are likely to have experienced unintended pregnancies during or since their calendar sequence. The odds ratio of being a member of this cluster is between 101 and 106 times higher ($p < 0.001$) for women with an unintended pregnancy than for women with no pregnancy and

60.5 times higher ($p < 0.001$) for those with a well-timed pregnancy. Similar to women in Family Builder 1, women in Family Builder 2 are more likely to have experienced a well-timed or unintended pregnancy. However, the differences in timing are not as stark. Women who experienced well-timed pregnancies have 90 times the odds ($p < 0.001$) of belonging to the Family Builder 2 cluster when compared with women with no pregnancy; this is similar to women who experienced an unintended pregnancy, whose odds of membership range from 84 to 95 times higher ($p < 0.001$), depending on whether the pregnancy was mistimed or unwanted.

The Family Builder 1 cluster further consists of women who have no current need for family planning, as indicated by about 20% lower odds ($p < 0.01$) of cluster membership than women with either met or unmet need. In contrast, the odds of belonging to the Family Builder 2 cluster are lower ($OR = 0.58$, $p < 0.001$) among women with met need but 65% higher ($p < 0.001$) among those with unmet need (compared with those with no need). Women who have used contraception at some point in their lifetimes have 37% higher odds ($p < 0.001$) of being in the Family Building 1 cluster and 27% lower odds ($p < 0.001$) of being in the Family Builder 2 cluster.

Rural residents have increased odds ($OR = 1.25$, $p < 0.01$) of Family Builder 1 membership compared with urban residents, while women with secondary or higher education have reduced odds ($OR = 0.68$, $p < 0.01$) of Family Builder 2 membership compared with women with less education. For both Family Builder clusters, membership appears to be unrelated to the number of children women had at the start of their calendar sequences.

Need for family planning, use of family planning, and experience of unintended pregnancies are the clearest dimensions by which membership in the Family Builder 1 and 2 clusters differ from one another.

3.3.3 Modern Mother

In general, the Modern Mother cluster consists of women who were unlikely to be older at the start of their calendar sequences and are likely to reside in urban areas, be currently or formerly married, and have had children at the start of their calendar sequences. Women are unlikely to be in this cluster if they had experienced an unintended pregnancy and have currently met their need for family planning.

Women older than age 35 have reduced odds ($p < 0.05$) of being in the Modern Mother cluster compared with women age 30-34. Meanwhile, currently married women have more than three times the odds ($p < 0.001$) of belonging to the Modern Mother cluster and formerly married women nearly two and a half times the odds ($p < 0.01$) compared with never married women.

A pregnancy recorded in a Modern Mother's calendar sequence is typically not her first. Women with either 1-2 children or 3-4 children at the start of their calendar sequences have about 1.5 times the odds ($p < 0.05$) of belonging to the Modern Mother cluster and women with 5 or more children have 1.7 times the odds ($p < 0.05$) of being in this cluster, compared with women with no children. Women who have experienced a mistimed or unwanted pregnancy since the start of their calendar sequences (but not a well-timed one) have 33% to 45% lower odds ($p < 0.05$) of being in the Modern Mother cluster than women with no pregnancy in the past five years. Although having met need is associated with lower odds of membership in the Quiet Calendar and both Family Builder clusters, women with met need have 9.7 times the odds ($p < 0.001$) of being in the Modern Mother cluster when compared with their counterparts with no need. Women with

rural residence have lower odds ($p < 0.001$) of Modern Mother cluster membership than women with urban residence—the only socio-economic control to show an association with cluster membership.

3.3.4 Consistently Covered Mother

Overall, the Consistently Covered Mother cluster consists of currently and, to a lesser extent, formerly married women who have several children, have not experienced a well-timed or unintended pregnancy during or since their calendar sequence, and have had their current family planning needs met.

Compared with women age 30-34, women younger than age 24 have increased odds ($p < 0.05$) of membership in the Consistently Covered Mother cluster and women older than age 40 have reduced odds ($p < 0.001$) of cluster membership. Currently and formerly married women have between four and seven times the odds ($p < 0.001$) of cluster membership compared with never married women. The odds of membership in the Consistently Covered Mother cluster increases steadily with the number of children born, ranging from four times higher among women with 1-2 children to more than six times higher among those with 5 or more ($p < 0.001$) children, when compared with women with no children.

Although LAPM use followed a pregnancy in the representative sequence for this cluster, women who had experienced any pregnancy, whether mistimed/unwanted or well-timed, have 52% to 62% lower odds ($p < 0.001$) of belonging to the Consistently Covered cluster than women with no pregnancy, when controlling for other factors in the model.

Having met need at the time of the survey is associated with 6.8 times higher odds ($p < 0.001$) of membership in the Consistently Covered Mother cluster than was having no need, although women with unmet need do not differ significantly from women with no need regarding cluster membership. With the exception of being in the middle wealth quintile, residence, education, and wealth are not indicative of cluster membership.

3.3.5 Traditional Mother

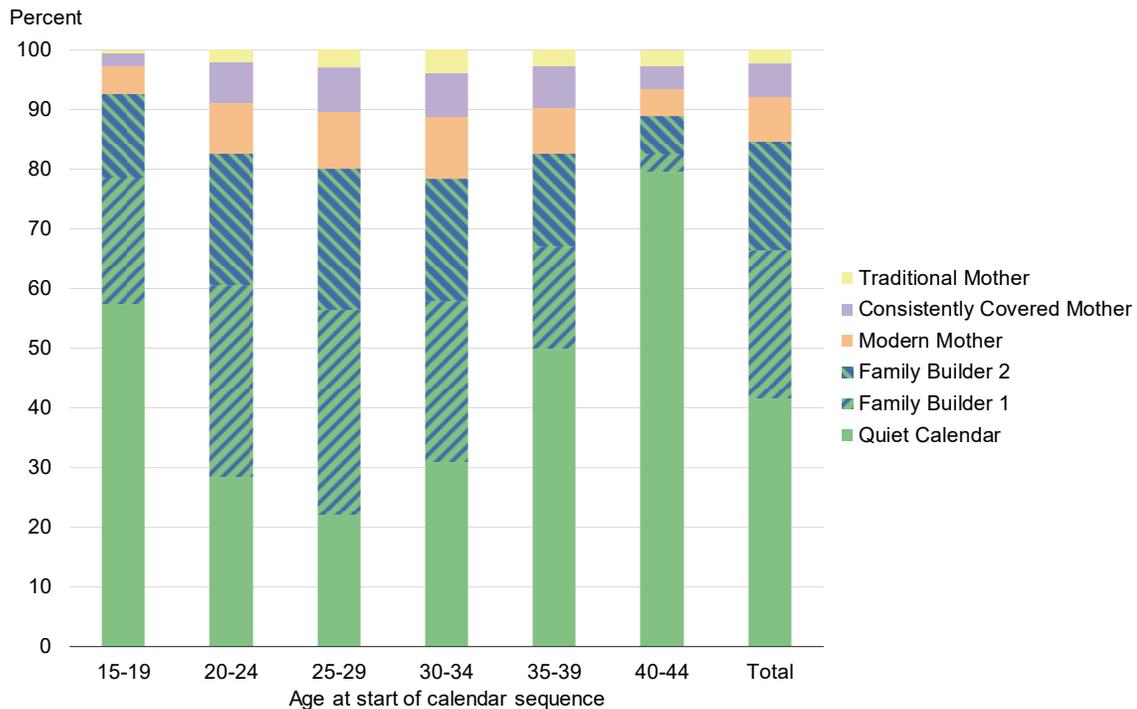
In general, the Traditional Mother cluster consists of non-adolescent women who are currently married and whose need for family planning is being met. Adolescent women age 15-19 have 79% lower odds ($p < 0.001$) of membership in the Traditional Mother cluster than do women in the middle age group. Currently married women have seven times the odds of belonging to the Traditional Mother cluster compared with never married women, though no association is detected for formerly married women. The odds of belonging to the Traditional Mother cluster are 10.2 times higher ($p < 0.001$) for women with a met need for family planning than for those who have no need.

As with the Family Builder clusters, membership in the Traditional Mother cluster does not appear to differ noticeably among women with no children, few children, or many children. Cluster membership is also not associated with experience of unintended pregnancy, and Traditional Mother is the only cluster for which no association is found with this variable. With the exception of being in the richer wealth quintile, socio-economic controls also show no relationship with cluster membership.

3.4 Age, Unmet Need, and Cluster Membership

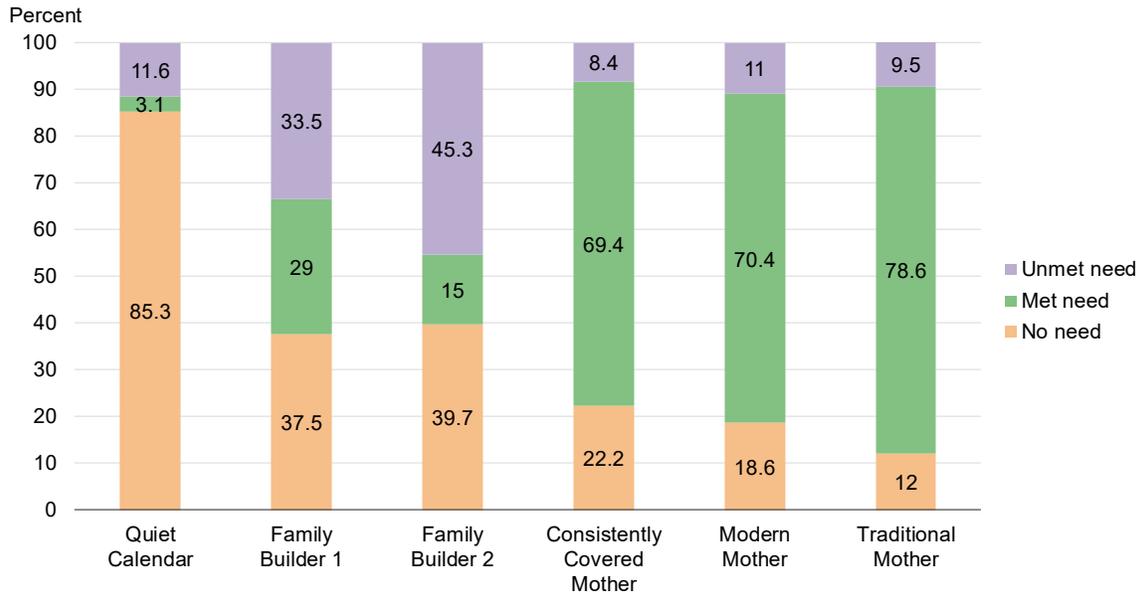
As shown in Table 2, the Quiet Calendar cluster has a distinctive age pattern when compared with other clusters. The bivariate distribution of clusters across age groups, presented in Figure 3, further illustrates this finding. It shows that the Quiet Calendar cluster is commonly experienced by both adolescent and older women. In contrast, in the Family Building clusters and those characterized by contraceptive use, the prevalence of membership increases with age until it begins to decrease again in a middle (Family Builder) or older (all three contraceptive clusters) age group.

Figure 3 Prevalence (percent distribution) of contraceptive clusters by age at start of the calendar sequences



Unmet need is a significant factor for predicting membership in each cluster, as shown in Table 2. The results of bivariate analysis of need status, distributed across the six clusters (Figure 4), complements the results of the multivariate analysis presented in Table 2. They reiterate that women with no need for family planning are concentrated in the Quiet Calendar cluster and are least likely to belong to the clusters characterized by contraceptive use. Unmet need is highest in the two Family Builder clusters, while met need is most prevalent in the three contraception clusters. Although total levels of need are similar in the two Family Builder clusters, unmet need is substantially greater in the Family Builder 2 cluster than in the Family Building 1 cluster.

Figure 4 Prevalence (percent distribution) of current need for family planning among women in each contraceptive cluster



4 CONCLUSIONS

This study identified six clusters of reproductive behavior in Burundi, three of which are characterized by contraceptive use and three of which are characterized by the absence of contraceptive use. This study further identified demographic, fertility, and family planning factors associated with membership in these clusters.

A large majority of women (85%) belong to one of the non-contraception clusters, with a minority (16%) belonging to one of the three contraceptive clusters. These findings are consistent with estimates of current contraceptive use in other studies (Avenir Health 2018; Ba et al. 2019; Cahill et al. 2018). Factors most consistently associated with cluster membership are need for family planning, lifetime experience of contraceptive use, marital status, pregnancy experience, and age. The number of children ever born at the start of a woman's calendar sequence is associated with membership in only half of the clusters: Quiet Calendar, Modern Mother, and Consistently Covered Mother. Cluster membership is seldom differentiated by socio-economic variables.

The Quiet Calendar stands apart from the other clusters in many ways: Along with no use of contraception over the past 5 years, Quiet Calendar women are unmarried, have no children or pregnancies, no need for family planning, and no history of contraceptive use. The size of this cluster (42%) may be a surprise in a high fertility setting such as Burundi. Although we understand that fertility desires and associated behavioral patterns are dynamic (e.g., Bernardi, Mynarska, and Rossier 2015; Speizer and Lance 2015)—and this study's own data indicate both dynamism within most clusters and that women likely move between clusters at different points in their lives—the Quiet Calendar cluster is an exception. The steady lack of activity over an extended period of time (five years) is striking. It suggests that health programs may need to reconsider ways to reach women with no imminent need for family planning or maternal health services to make sure they still have the access they need for general preventive and curative health care.

Two of the non-contraception clusters are characterized by family building, defined as the use of no contraception and the experience of two pregnancies. The Family Builder 1 and 2 clusters appear at first glance to be nearly identical, differing only by the timing of the pregnancies. This similarity raises the question as to whether their identification as separate clusters is an anomaly of the statistical procedures used and based on sampling variance in the times at which women were interviewed relative to their pregnancies, or whether they are indeed programmatically meaningful, distinct groups of women. The results of regression analyses in this study support the latter conclusion.

Women in Family Builder 1—the cluster in which the experience of two pregnancies is more recent—experience unintended pregnancies to a greater extent than women in Family Builder 2. They also tend to have no unmet need for family planning and have lifetime experience using contraception. In contrast, Family Builder 2 women generally experience unmet need and have never used contraception. Family Builder 2 is characterized by women who have less experience with contraception, either are not using or do not intend to use contraception, and have current unmet need for family planning. These findings comport with those of additional analyses indicating that Family Builder 1 women articulate more clearly defined fertility intentions than do Family Builder 2 women (MacQuarrie, Juan, and Gemmill 2020) and are more likely than Family Builder 2 women to participate in joint contraceptive decision making (Juan,

Allen, and MacQuarrie 2020). In sum, Family Builder 1 women are inclined to use contraception at points in their lives when they need it but are presently focused on having children, although they have struggled with planning the timing of childbearing.

The three contraceptive clusters are each characterized by the type of contraception used—short-term modern methods, LAPMs, or traditional methods. Interestingly, women in these clusters are not segmented based on other dimensions of contraceptive behavior, such as discontinuation, experimentation or switching among methods, timing of method adoption, or interruptions in or continuity of use.

In all three contraceptive clusters, contraceptive use follows the experience of pregnancy. This reiterates findings from another study indicating that women’s pregnancy experiences predict contraceptive behavior in Burundi (Bakibinga et al. 2016). The degree of pregnancies in these clusters and the two Family Builder clusters both reflects the high fertility in Burundi (Gerland, Biddlecom, and Kantorová 2017; Ministère à la Présidence chargé de la Bonne Gouvernance et du Plan - MPBGP et al. 2017) and highlights the potential of maternal health services and postpartum family planning (Rutaremwya and Kabagenyi 2018; Track20 2018).

Women in these three contraceptive clusters are currently meeting their need for family planning and (particularly for women in the Modern Mother and Consistently Covered Mother clusters) are unlikely to have experienced an unintended pregnancy. Although Modern Mother and Consistently Covered Mother women have had children prior to their calendar sequences (especially Consistently Covered Mothers), this is not so for Traditional Mothers, suggesting that life course factors also differentiate membership in contraceptive clusters (CT Innovation Lab 2018; Wang et al. 2009).

This study took an innovative approach to segmenting women, not based on current contraceptive status and attitudes, but based on their contraceptive and pregnancy behaviors over the past five years. This represents a new use of DHS calendar data. This study also elaborated on the demographic, family planning, and fertility attributes associated with women in each of six discrete clusters of women in Burundi, providing reproductive health programs with unique insights on the clientele they seek to serve.

REFERENCES

Abbott, A. 1995. "Sequence Analysis: New Methods for Old Ideas." *Annual Review of Sociology* 21 (1): 93-113. <https://doi.org/10.1146/annurev.so.21.080195.000521>.

Aisenbrey, S., and A. E. Fasang. 2010. "New Life for Old Ideas: The "Second Wave" of Sequence Analysis Bringing the "Course" Back into the Life Course." *Sociological Methods & Research* 38 (3): 420-462. <https://doi.org/10.1177/0049124109357532>.

Ali, M. M., J. G. Cleland, and I. H. Shah. 2012. *Causes and Consequences of Contraceptive Discontinuation: Evidence from 60 Demographic and Health Surveys*. Geneva, Switzerland and Egypt: World Health Organization.

Avenir Health. 2018. "Burundi FP2020 Core Indicator Summary Sheet: 2017-2018 Annual Progress Report." Glastonbury, CT: Avenir Health.

Ba, D. M., P. Ssentongo, E. Agbese, and K. H. Kjerulff. 2019. "Prevalence and Predictors of Contraceptive Use among Women of Reproductive Age in 17 Sub-Saharan African Countries: A Large Population-Based Study." *Sexual & Reproductive Healthcare* 21: 26-32. <https://doi.org/10.1016/j.srhc.2019.06.002>.

Bakibinga, P., D. J. Matanda, R. Ayiko, J. Rujumba, C. Muiruri, D. Amendah, and M. Atela. 2016. "Pregnancy History and Current Use of Contraception among Women of Reproductive Age in Burundi, Kenya, Rwanda, Tanzania and Uganda: Analysis of Demographic and Health Survey Data." *BMJ Open* 6 (3). <http://dx.doi.org/10.1136/bmjopen-2015-009991>.

Baschieri, A., and A. Hinde. 2007. "The Proximate Determinants of Fertility and Birth Intervals in Egypt: An Application of Calendar Data." *Demographic Research* 16 (3): 59-96. <https://doi.org/10.4054/DemRes.2007.16.3>.

Bernardi, L., M. Mynarska, and C. Rossier. 2015. "Uncertain, Changing and Situated Fertility Intentions." In *Reproductive Decision-Making in a Macro-Micro Perspective*, 113-139. Dordrecht, Netherlands: Springer.

Bradley, S. E., T. N. Croft, J. D. Fishel, and C. F. Westoff. 2012. *Revising Unmet Need for Family Planning*, DHS Analytical Studies No. 25. Calverton, MD: ICF International.

Bradley, S. E. K., W. Winfrey, and T. N. Croft. 2015. *Contraceptive Use and Perinatal Mortality in the Dhs: An Assessment of the Quality and Consistency of Calendars and Histories*. DHS Methodological Reports No. 17. Rockville, Maryland, USA: ICF International. <http://dhsprogram.com/pubs/pdf/MR17/MR17.pdf>.

Brown, W., N. Druce, J. Bunting, S. Radloff, D. Koroma, S. Gupta, B. Siems, et al. 2014. "Developing the "120 by 20" Goal for the Global FP2020 Initiative." *Studies in Family Planning* 45 (1): 73-84. <https://doi.org/10.1111/j.1728-4465.2014.00377.x>.

Cahill, N., E. Sonneveldt, J. Stover, M. Weinberger, J. Williamson, C. Wei, W. Brown, and L. Alkema. 2018. "Modern Contraceptive Use, Unmet Need, and Demand Satisfied among Women of Reproductive Age Who Are Married or in a Union in the Focus Countries of the Family Planning 2020 Initiative: A Systematic Analysis Using the Family Planning Estimation Tool." *The Lancet* 391 (10123): 870-882. [https://doi.org/10.1016/S0140-6736\(17\)33104-5](https://doi.org/10.1016/S0140-6736(17)33104-5).

Camber Collective. 2014. *Qualitative Insights and Strategic Narratives in Niger: A Report of Findings, Insights and Ideas*. Seattle, WA: Camber Collective.

Camber Collective. 2015. *Increasing Contraceptive Use in Niger: Final Report*. Seattle, WA: Camber Collective.

Croft, T., S. E. K. Bradley, and C. Allen. 2018. *DHS Contraceptive Calendar Tutorial* Rockville, MD: ICF.

CT Innovation Lab. 2018. *Imagining the Future of Women's Contraception: Project Report*. Seattle, WA: The Bill and Melinda Gates Foundation.

Curtis, S. L., and C. R. Hammerslough. 1995. *Model Further Analysis Plan: Contraceptive Use Dynamics*. DHS Further Analysis Reports No. 59. Calverton, Maryland, USA: Macro International. <http://dhsprogram.com/pubs/pdf/FA59/FA59.pdf>.

Dabney, N., J. Smith, Z. Congo, F. T. Mendy, and F. Aucur. 2019. "Adolescent Girls as Agents of Change: Behavioral Design to Increase Family Planning Uptake in Senegal, Burkina Faso, and Uganda." Paper presented at the *Francophone Africa Social and Behavior Change Summit, Abidjan, Cote d'Ivoire, 25-27 February 2019*.

Dalglish, S. L., J. Vandermark, C. Rossier, A. Kemou, and H. Neighbor. 2018. "Using Marketing Science to Understand Contraceptive Demand in High-Fertility Niger." *Studies in Family Planning* 49 (4): 367-383. <https://doi.org/10.1111/sifp.12078>.

Dias, J. G., and M. J. Cortinhal. 2008. "The Skm Algorithm: A K-Means Algorithm for Clustering Sequential Data." In *Ibero-American Conference on Artificial Intelligence*, 173-182. Springer.

Dias, J. G., and F. Willekens. 2005. "Model-Based Clustering of Sequential Data with an Application to Contraceptive Use Dynamics." *Mathematical Population Studies* 12 (3): 135-157.

Feldman, B. J., K. E. Masyn, and R. D. Conger. 2009. "New Approaches to Studying Problem Behaviors: A Comparison of Methods for Modeling Longitudinal, Categorical Adolescent Drinking Data." *Developmental Psychology* 45 (3): 652-676. <https://doi.org/10.1037/a0014851>.

Finnegan, A. 2019. "Visualizing Contraceptive Use Trajectories in Kenya." Paper presented at the *Annual Meeting of the Population Association of America, Austin, TX, April 10-13*.

Furnas, H. E. 2016. "Capturing Complexities of Relationship-Level Family Planning Trajectories in Malawi." *Studies in Family Planning* 47 (3): 205-221. <https://doi.org/10.1111/j.1728-4465.2016.00064.x>.

- Gabardinho, A., G. Ritschard, N. S. Mueller, and M. Studer. 2011. "Analyzing and Visualizing State Sequences in R with Traminer." *Journal of Statistical Software* 40 (4): 1-37. <https://doi.org/10.18637/jss.v040.i04>.
- Gabardinho, A., G. Ritschard, M. Studer, and N. Müller. 2011. *Mining Sequence Data in R with the Traminer Package: A User's Guide*. Geneva, Switzerland: University of Geneva.
- Gemmill, A. 2019. "From Some to None? Fertility Expectation Dynamics of Permanently Childless Women." *Demography* 56 (1): 129-149. <https://doi.org/10.1007/s13524-018-0739-7>.
- Genolini, C., X. Alacoque, M. Sentenac, and C. Arnaud. 2015. "Kml and Kml3d: R Packages to Cluster Longitudinal Data." *Journal of Statistical Software* 65 (4): 1-34.
- Gerland, P., A. Biddlecom, and V. Kantorová. 2017. "Patterns of Fertility Decline and the Impact of Alternative Scenarios of Future Fertility Change in Sub-Saharan Africa." *Population and Development Review* 43: 21-38. <https://doi.org/10.1111/padr.12011>.
- Juan, C., C. Allen, and K. L. D. MacQuarrie. 2020. *Associations between Women's Current Contraceptive Method Decision Making and Their Contraceptive Histories in Burundi*. DHS Working Paper No. 172. Rockville, MD: ICF.
- MacQuarrie, K. L. D., S. E. K. Bradley, A. Gemmill, and S. Staveteig. 2014. *Contraceptive Dynamics Following Hiv Testing*. DHS Analytical Studies No. 47. Rockville, Maryland, USA: ICF International. <http://dhsprogram.com/pubs/pdf/AS47/AS47.pdf>.
- MacQuarrie, K. L. D., C. Juan, C. Allen, S. Zweimueller, and A. Gemmill. 2019. *Women's Contraceptive Profiles Throughout the Life Course in Burundi and Nepal*. DHS Analytical Studies No. 72. Rockville, Maryland, USA: ICF. <https://dhsprogram.com/pubs/pdf/AS72/AS72.pdf>.
- MacQuarrie, K. L. D., C. Juan, and A. Gemmill. 2020. *Attributes Associated with Contraceptive Profiles in Burundi: Attitudes, Media, and Health Services Interactions*. DHS Working Paper No. 173. Rockville, MD: ICF.
- MacQuarrie, K. L. D., L. Mallick, and C. Allen. 2017. *Sexual and Reproductive Health in Early and Later Adolescence: Dhs Data on Youth Age 10-19*. DHS Comparative Reports No. 45. Rockville, Maryland, USA: ICF. <http://dhsprogram.com/pubs/pdf/CR45/CR45.pdf>.
- MacQuarrie, K. L. D., L. Mallick, and S. Kishor. 2016. *Intimate Partner Violence and Interruption to Contraceptive Use*. DHS Analytical Studies No. 57. Rockville, Maryland, USA: ICF International. <http://dhsprogram.com/pubs/pdf/AS57/AS57.pdf>.
- MacQuarrie, K. L. D., W. Winfrey, J. Meijer-Irons, and A. R. Morse. 2018. *Consistency of Reporting of Terminated Pregnancies in Dhs Calendars*. DHS Methodological Reports No. 25. Rockville, Maryland, USA: ICF. <http://dhsprogram.com/pubs/pdf/MR25/MR25.pdf>.

Ministère à la Présidence chargé de la Bonne Gouvernance et du Plan - MPBGP, Ministère de la Santé Publique et de la Lutte contre le Sida - MSPLS, Institut de Statistiques et d'Études Économiques du Burundi - ISTEEBU, and ICF. 2017. *Burundi Troisième Enquête Démographique Et De Santé 2016-2017*. Bujumbura, Burundi: MPBGP, MSPLS, ISTEEBU, and ICF. <http://dhsprogram.com/pubs/pdf/FR335/FR335.pdf>.

Moore, Z., A. Pfitzer, R. Gubin, E. Charurat, L. Elliott, and T. Croft. 2015. "Missed Opportunities for Family Planning: An Analysis of Pregnancy Risk and Contraceptive Method Use among Postpartum Women in 21 Low-and Middle-Income Countries." *Contraception* 92 (1): 31-39. <https://doi.org/10.1016/j.contraception.2015.03.007>.

Moultrie, T. A., T. S. Sayi, and I. M. Timæus. 2012. "Birth Intervals, Postponement, and Fertility Decline in Africa: A New Type of Transition?" *Population studies* 66 (3): 241-258. <https://doi.org/10.1080/00324728.2012.701660>.

Pullum, T., T. Croft, and K. L. D. MacQuarrie. 2018. *Methods to Estimate under-15 Fertility Using Demographic and Health Surveys Data*. DHS Methodological Reports No. 23. Rockville, Maryland, USA: ICF. <http://dhsprogram.com/pubs/pdf/MR23/MR23.pdf>.

Rutaremwya, G., and A. Kabagenyi. 2018. "Postpartum Family Planning Utilization in Burundi and Rwanda: A Comparative Analysis of Population Based Cross-Sectional Data." *Pan African Medical Journal* 30 (1). <https://doi.org/10.11604/pamj.2018.30.303.15105>.

Speizer, I. S., and P. Lance. 2015. "Fertility Desires, Family Planning Use and Pregnancy Experience: Longitudinal Examination of Urban Areas in Three African Countries." *BMC Pregnancy and Childbirth* 15 (1): 294.

Studer, M. 2013. *Weightedcluster Library Manual: A Practical Guide to Creating Typologies of Trajectories in the Social Sciences with R, Lives Working Papers, 24, 1-32*. Geneva, Switzerland: University of Geneva.

Track20. 2018. *Exploring Opportunities for Mcpr Growth in Burundi*. Glastonbury, CT: Avenir Health. <http://www.track20.org/download/pdf/2018%20Opportunity%20Briefs/english/Burundi%20FP%20Opportunity%20Brief.pdf>.

Trasi, R. 2018. "Old Problems, New Solutions: Using Cross-Disciplinary Methods to Address Contraceptive Non-Use in Burkina Faso, Ethiopia, and Bangladesh." Paper presented at the *International Conference on Family Planning, Kigali, Rwanda, 12-15 November 2018*.

Wang, W., R. Patsika, R. Berg, S. Sulzbach, and G. OSullivan. 2009. *From Young Rural Intenders to Ready-to-Limit Pragmatists: Segmenting the Family Planning Market to Improve Behavior Change Interventions in the Philippines*. Bethesda, MD: Private Sector Partnerships-One project, Abt Associates Inc.