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Trajectories into First-time Contraceptive Use Among Adolescents: A Comparison of Data from Burundi, Colombia, and Nepal

Kerry L.D. MacQuarrie

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ABSTRACT

This study sought to identify and understand different trajectories adolescents take to their first use of contraception. It applied sequence and cluster analysis to contraceptive calendar data from Demographic and Health Surveys in Burundi, Colombia, and Nepal. Unique clusters—each representing a type of trajectory into first contraceptive use—were identified and described, comparisons and contrasts were drawn across countries, and associations were identified between adolescent characteristics and membership in each cluster. The study identified four unique clusters in Burundi, five in Colombia, and four in Nepal. More commonalities were found between the trajectories in Burundi and Nepal than between the trajectories in these two countries and those in Colombia. In Burundi and Nepal, adolescents typically adopted a method of contraception only after experiencing at least one pregnancy, and the four trajectories were differentiated primarily by number and timing of pregnancies and secondarily by method of contraception. In Colombia, by contrast, the five trajectories were differentiated primarily by the contraceptive method used. This study was a first attempt to apply new methods for segmenting longitudinal, behavioral data on adolescents. The results demonstrate that this analytical approach can be applied in a diverse range of settings in which contraceptive calendar data are available.

Key words: adolescent sexual and reproductive health, Burundi, cluster analysis, Columbia, contraception, contraceptive calendar, Nepal, sequence analysis

ACRONYMS AND ABBREVIATIONS

DHS	Demographic and Health Surveys
IUD	intrauterine device
LAPM	long-acting and permanent method
NDHS	Nepal Demographic and Health Survey
PBT	pregnancy, birth, or termination
STI	sexually transmitted infection
USAID	United States Agency for International Development

1 BACKGROUND

In the Family Planning 2020 Initiative (now FP2030), much emphasis has been placed on meeting the needs of adolescents, as well as on their potential contribution to the initiative's goals of additional (contraceptive) users and reducing unmet need for family planning. This attention on adolescents requires a closer examination of their diverse needs, behaviors, and motivations, including how they come to use contraception for the first time. However, typical cross-sectional data sources collect data only from women age 15–49, excluding the earliest adolescent experiences.

Demographic and Health Surveys (DHS) often include contraceptive calendars that provide monthly recorded data on events such as pregnancies, births, terminations, episodes of contraceptive use, and non-use of contraception in the 5 or more years preceding the survey.[1] Previous analyses have shown the potential of these retrospective contraceptive calendars to capture contraceptive experiences throughout the adolescent period, in particular the first use of contraception, even when that occurs during early adolescence.[2] Recently, new methods of sequence and cluster analyses of longitudinal data have been applied to DHS contraceptive calendars—analytical approaches that capture the complex, dynamic nature of contraceptive use and reproductive events over time in ways that static, current methods cannot.[3] These approaches are particularly useful for studying patterns or paths—trajectories—that lead to states related to childlessness, relationships, and family planning use.[4,5]

In the present study, we applied new analytical approaches to identify the trajectories adolescents took to their first use of contraception in Burundi, Colombia, and Nepal.

2 METHODS

Data for this study came from contraceptive calendars from the most recent Demographic and Health Surveys (DHS surveys) in three geographically disparate countries: the 2016–17 Burundi DHS, 2015 Colombia DHS, and 2016 Nepal DHS. For each adolescent woman, we analyzed the 59-month calendar sequences occurring in months 3–63 preceding the interview. We restricted the analytic sample to women who met three criteria: (1) age 9–19 at the start of the calendar sequence (that is, age 15–25 at the time of the interview), (2) were not using any method of contraception in the first month of the calendar sequence, and (3) used a method of contraception in at least 1 of the 59 months in the sequence. These restrictions yielded a weighted analytic sample of n=828 in Burundi, n=4,505 in Colombia, and n=995 in Nepal.

Upon these samples of calendar sequences, we conducted sequence and cluster analyses in R using the TraMineR and WeightedCluster packages.[6–8] These methods are ideal for longitudinal sequences with repeated measures (like states of contraceptive use or non-use) over time. Specifically, we used a k-medoid (partitioning around medoids, or PAM) clustering algorithm with optimal matching to calculate distances in the dissimilarity matrix and a transition rate-based cost matrix. Scores on a series of six quality metrics guided the number of clusters in the optimum solution.[5,8]

Each identified cluster represented a unique type of trajectory, or a distinct pathway, that a group of adolescent women took to arrive at their first use of contraception. We applied a descriptive label to each cluster to explain the trajectory, and we visualized the identified clusters with medoid sequence plots, sequence index plots, density plots, and mean time plots.

Finally, we developed cross-tabulations of cluster membership across a range of adolescent characteristics (that is, covariates) to better understand who followed each trajectory type. The characteristics consisted of life course factors (age and marital status at the start of the sequence), fertility and family planning factors (unmet need for family planning and ideal number of children), attitudes toward refusing sex or insisting on condom use, and socioeconomic factors (residence, highest education level, and household wealth quintile), age at first sex, and (if married) whether a respondent's husband was living with her. A p value $\leq$ .05 corresponding to a chi-square test of independence indicated a significant association between the adolescent characteristicand membership in the cluster. In the future, we will estimatemultivariable logistic regression models to identify the covariates associated with adolescents' membership in each of the clusters—an approach has been adopted to identify attributes of cluster membership in similar studies.[5,9,10]

These analyses were conducted in Stata MP 16.1. All analyses were weighted, and we used *svyset* commands to account for sampling probability and non-response and for the complex sampling design.

3 RESULTS

3.1 Description of the Analytical Sample

Table 1 describes the full analytic sample before adolescents were grouped into clusters based on their types of trajectories to first contraceptive use.

Table 1 Full analytic sample by country and adolescent characteristics

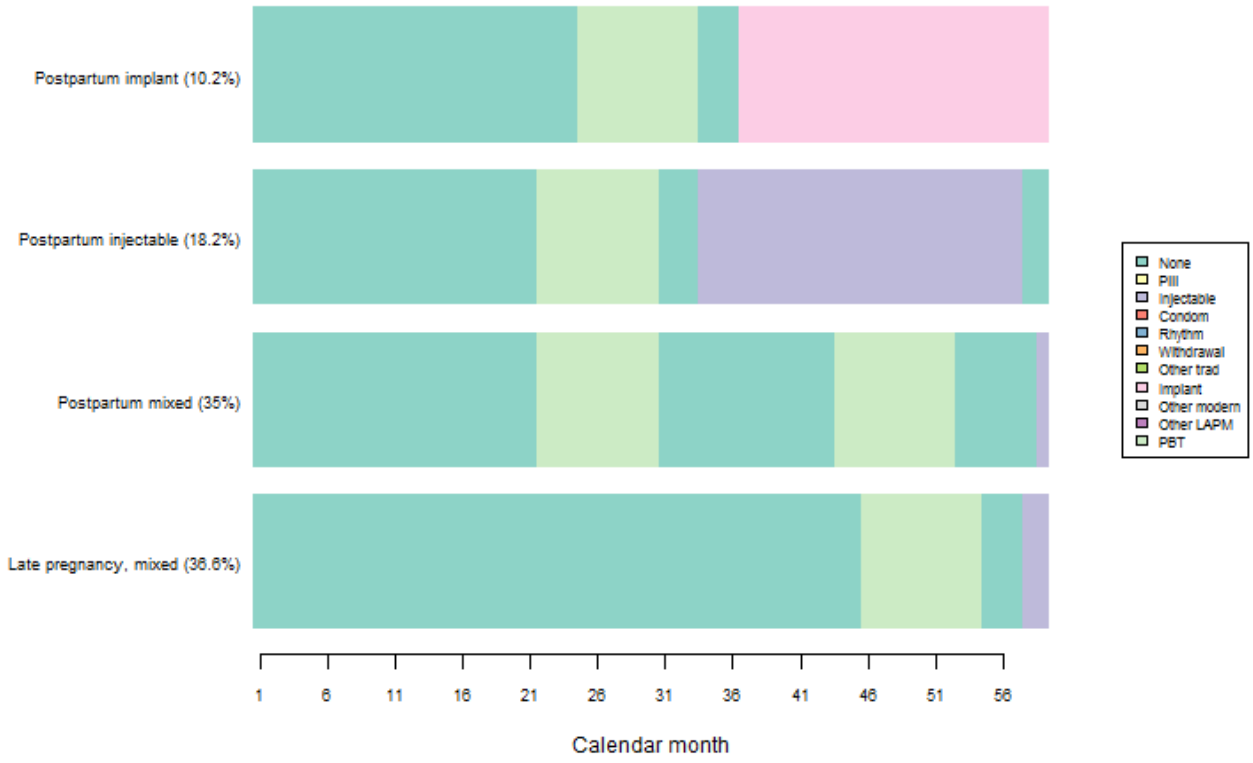
	Burundi (n = 828)		Colombia (n = 4,505)		Nepal (n = 996)	
Characteristic	%	n	%	n	%	n
Age at start of sequence						
10–12	4.2	35	25.2	1,135	7.6	76
13–14	13.5	111	24.7	1,115	17.1	170
15–17	44.3	367	34.4	1,549	41.8	416
18–19	38.1	315	15.7	705	33.5	334
Marital status						
Married at start of sequence	21.6	179	5.9	267	24.7	246
Married during sequence	62.2	515	27.5	1,238	74.4	740
Never married/married after sequence ended	16.2	134	66.6	3,000	1.0	10
Age at first sex						
<15	5.2	43	19.2	863	8.5	85
15–18	62.7	519	68.4	3,080	61.6	613
≥19 or never had sex	32.1	266	12.5	562	29.9	298
Husband living with her						
No	34.4	285	75.9	3,417	38.6	385
Yes	65.6	543	24.1	1,088	61.4	611
Ideal number of children						
0	1.4	11	6.7	303	1.2	12
1	0.9	7	17.1	771	19.0	189
2–3	58.2	482	73.1	3,291	77.8	774
4+	39.6	328	3.1	140	2.0	20
Unmet need						
No need	24.1	199	23.2	1,045	20.3	202
Unmet need	11.0	91	9.0	407	27.0	268
Met need	64.9	538	67.7	3,052	52.7	525
Wife justified asking husband to use condom if he has STI						
No	18.5	153	2.3	101	4.6	45
Yes	81.5	675	97.7	4,403	95.4	950
Wife can refuse sex if husband has sex with other women						
No	39.0	323	3.3	150	12.0	119
Yes	61.0	505	96.7	4,355	88.0	876
Residence						
Urban	14.9	123	80.4	3,620	59.1	588
Rural	85.1	705	19.6	885	40.9	407
Highest education level						
No education	25.4	210	0.2	10	10.2	102
Primary	50.7	420	5.2	236	17.0	169
Secondary+	23.9	198	94.6	4,259	72.8	724
Household wealth quintile						
Poorest	21.5	178	16.3	735	17.4	174
Poorer	21.1	175	22.1	998	24.7	246
Middle	22.1	183	22.5	1,015	21.6	215
Richer	15.8	131	20.5	924	21.5	214
Richest	19.5	161	18.5	833	14.7	146

STI = sexually transmitted infection

3.2 Descriptive Features of Trajectories in Burundi

This study identified four unique clusters representing distinct types of trajectories into contraceptive use among adolescents in Burundi. The most common cluster was the late pregnancy, mixed contraception cluster (37% of women), followed by the postpartum mixed contraception (35%), postpartum injectable (18%), and postpartum implant (10%) clusters (Figure 1).

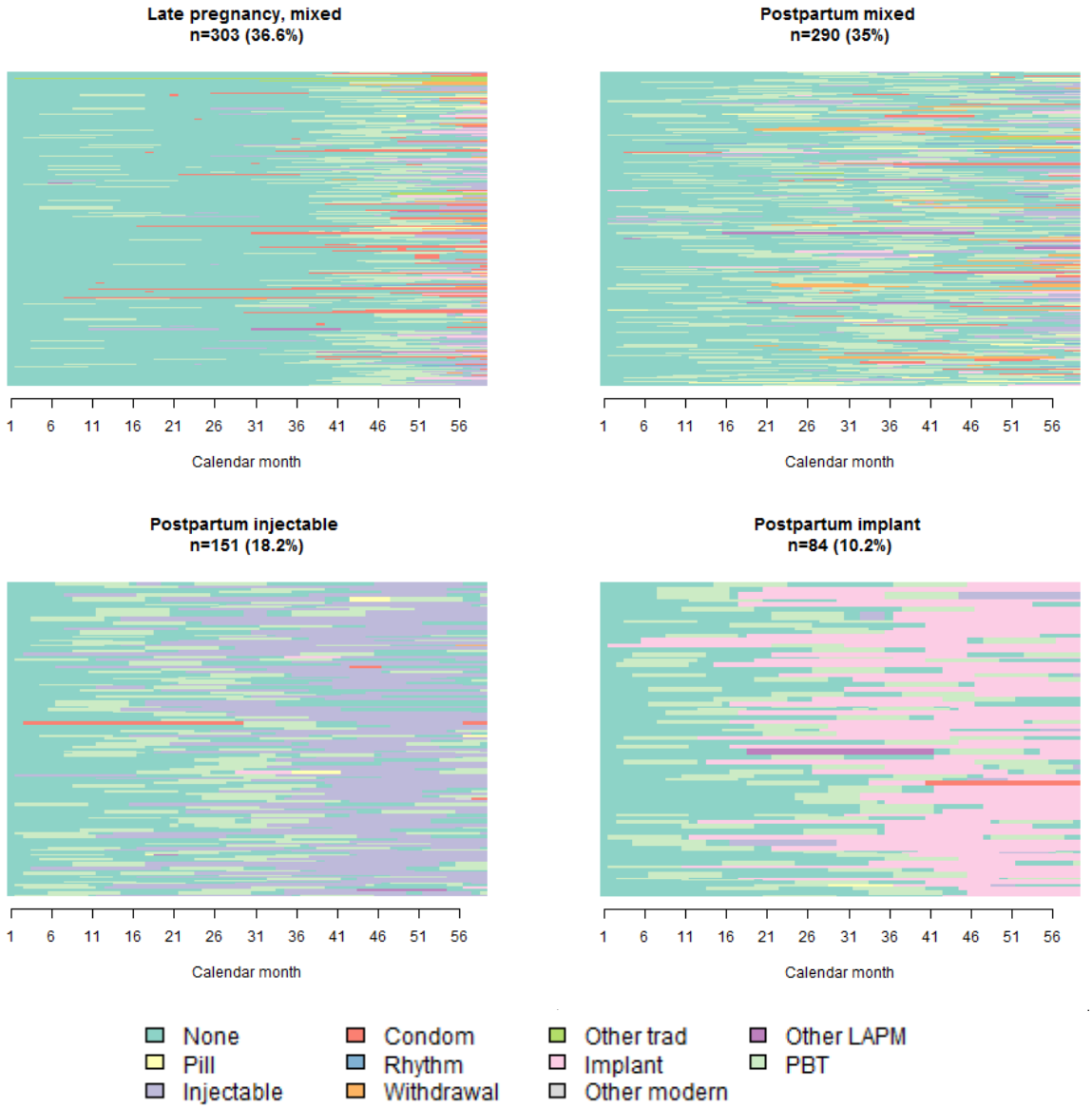
Figure 1 Representative medoid sequence plots for each cluster (type of trajectory into contraceptive use) in Burundi, 2016–17 Burundi DHS



LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

The medoid sequence (the central or most representative sequence in a cluster) showed that adolescents adopted injectables as a contraceptive method in both the late pregnancy, mixed contraception and the postpartum mixed contraception clusters (see Figure 1). However, the sequence index plots, which showed the sequences of every adolescent in these clusters, confirmed that these adolescents adopted a variety of methods (Figure 2). In the postpartum mixed cluster, mean time plots indicated that, on average, adolescents spent more time using injectables and condoms than using other methods; in the late pregnancy, mixed cluster, they spent more time using injectables, withdrawal, pills, and condoms than other methods (Figure 3).

Figure 2 **Sequence index plots for each cluster (showing all trajectories into contraceptive use in the clusters) in Burundi, 2016–17 Burundi DHS**

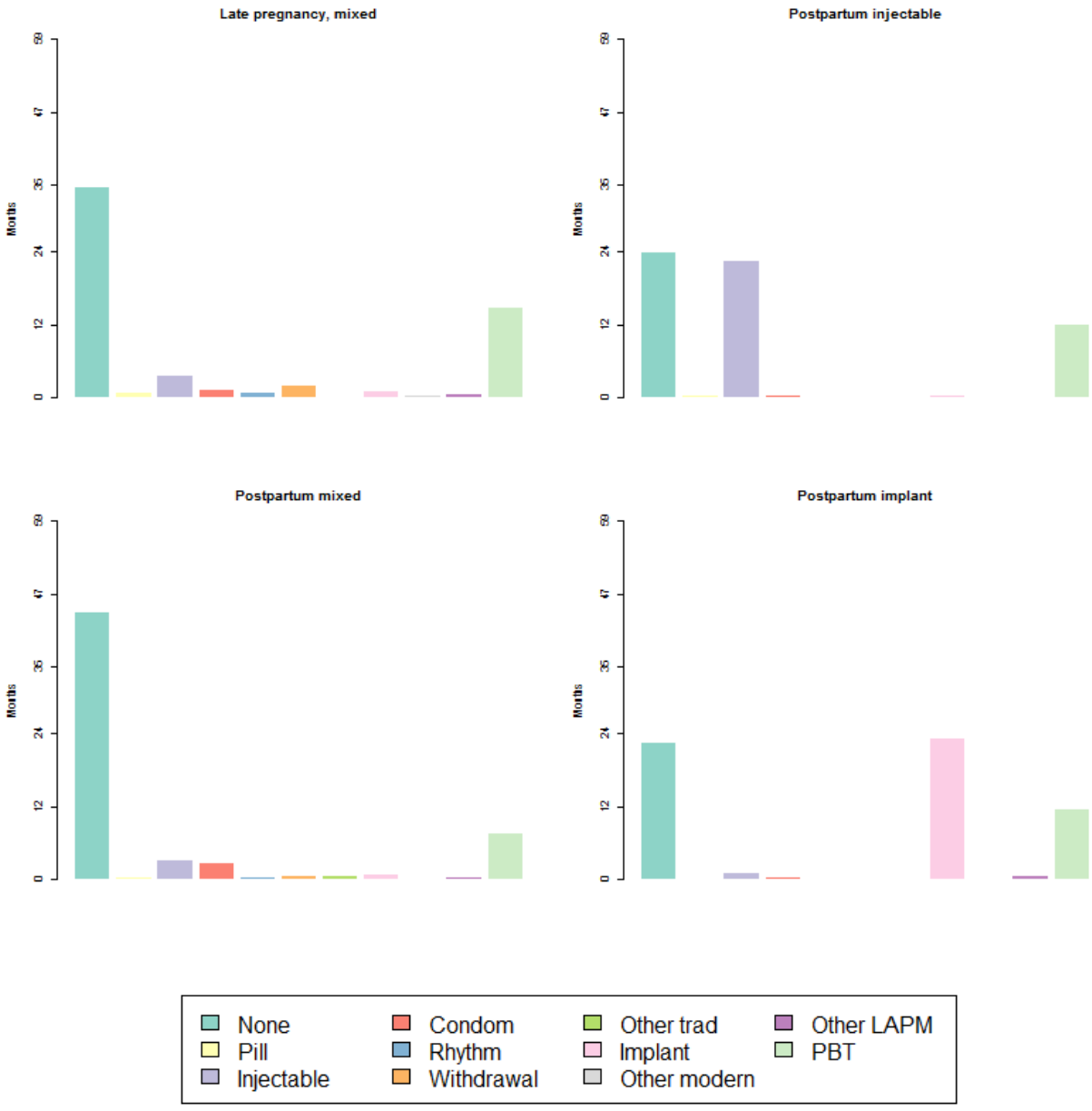


LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

One feature of all clusters in Burundi was that contraceptive use followed, rather than preceded, a pregnancy (as represented by the pale green in Figure 1). The third and fourth clusters were distinguished from one another by the method of contraception that was adopted following a pregnancy: injectables for the third cluster and implants for the fourth. This was evident in both the medoid sequence (see Figure 1) and the sequence index plots (see Figure 2), which showed these methods dominating in their respective clusters. While Figure 3 shows the mean time spent in each state, Figure 4 displays the density plot for each cluster—the distribution of states in each month of the 59-month sequence. According to these plots, adolescents in the postpartum injectable and postpartum implant clusters spent similar amounts of time in pregnancy (10 months), not using contraception (23 and 22 months, respectively), and using their characteristic method (22 and 24 months, respectively).

In contrast, the first and second clusters were distinguished from one another not by the method of contraception, but by the number of pregnancies experienced in the calendar sequence. Adolescents in the late pregnancy, mixed cluster typically experienced a single pregnancy (often late in the 59-month sequence) before adopting contraception from a mixture of methods (condoms, other traditional methods, implants, injectables, withdrawal, pills, or intrauterine devices), whereas those in the postpartum mixed cluster typically experienced two pregnancies before adopting one of these methods (see Figures 1 and 2). Adolescents in the postpartum mixed cluster spent about twice as much time in a state of pregnancy than those in the late pregnancy, mixed cluster (14 versus 7 months) and substantially less time in a state of contraceptive non-use (36 versus 45 months) (Figures 3 and 4).

Figure 3 Mean time spent in each state for each cluster (type of trajectory into contraceptive use) in Burundi, 2016–17 Burundi DHS



LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

Figure 4 **Density plots for each cluster (showing all trajectories into contraceptive use in the clusters) in Burundi, 2016–17 Burundi DHS**

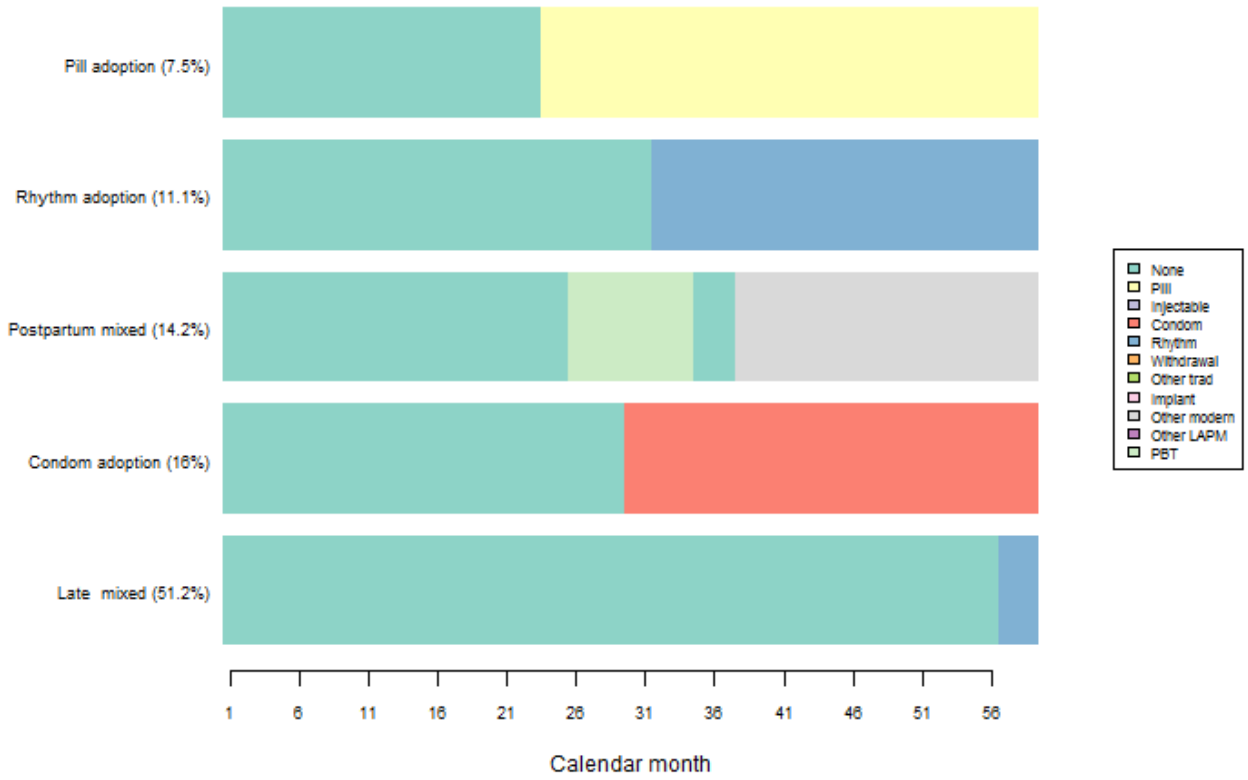
LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

3.3 Descriptive Features of Trajectories in Colombia

Five unique clusters representing distinct types of trajectories into contraceptive use were identified among adolescents in Colombia. In contrast to Burundi, pregnancy preceding adoption of contraception was characteristic of only one cluster in Colombia—the third most common cluster, labeled postpartum mixed (14%). The medoid sequence plot showed use of other modern methods of contraception as the most representative sequence in this cluster (Figure 5). However, the sequence index plot (Figure 6) showed that adolescents in this cluster adopted a variety of both modern and traditional methods, thus giving this cluster its name. Compared with comparable clusters in Burundi (postpartum mixed and late pregnancy mixed),

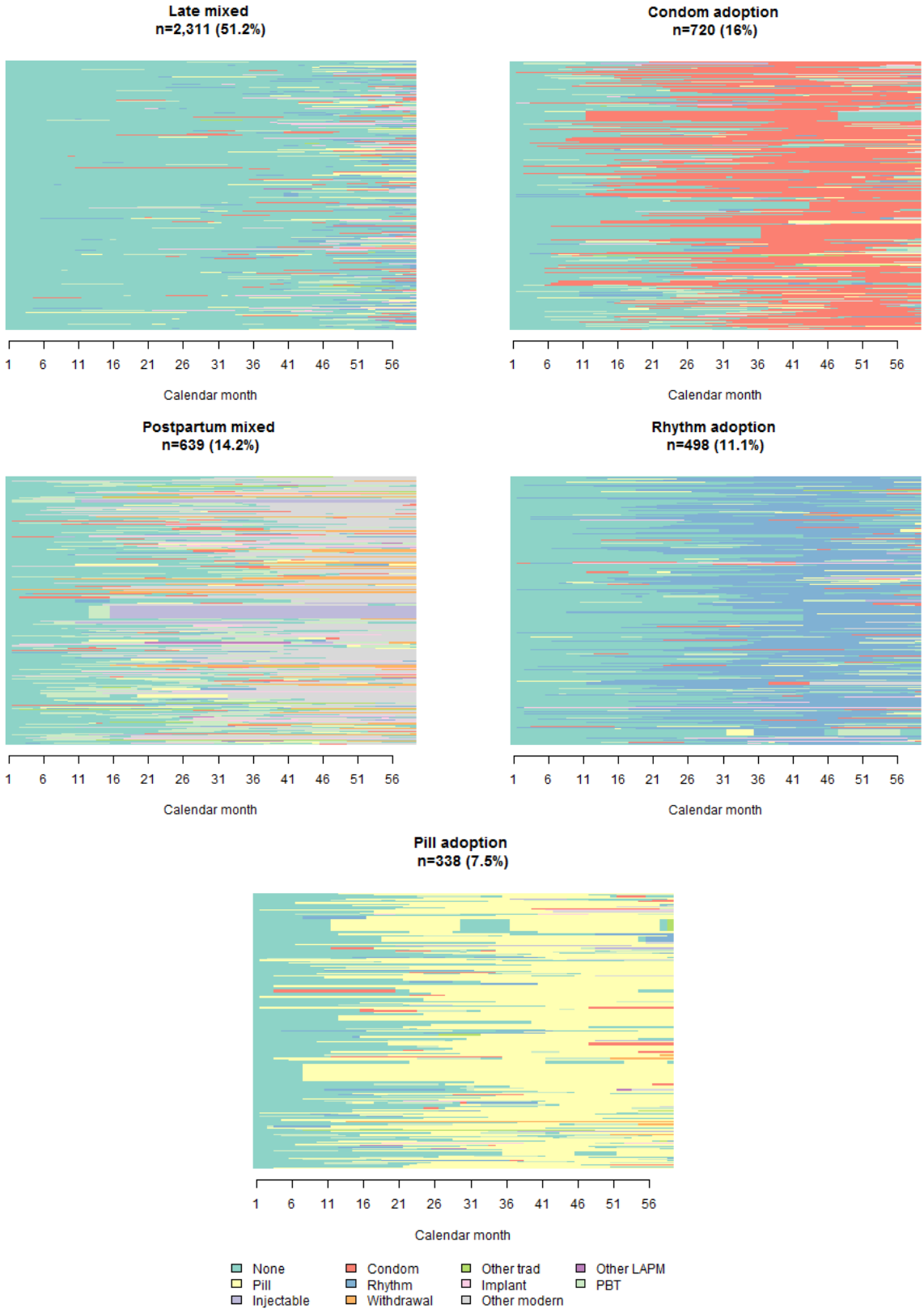
both pregnancy and the adoption of contraception occurred earlier in the sequence for the postpartum mixed cluster in Colombia (Figures 5 and 6). Adolescents in Colombia also spent more time in a state of contraceptive use (29 months) and less in a state of pregnancy (8 months) or non-use (22 months) than did their counterparts in Burundi (Figures 7 and 8).

Figure 5 Representative medoid sequence plots for each cluster (type of trajectory into contraceptive use) in Colombia, 2015 Colombia DHS



LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

Figure 6 **Sequence index plots for each cluster (showing all trajectories into contraceptive use in the clusters) in Colombia, 2015 Colombia DHS**



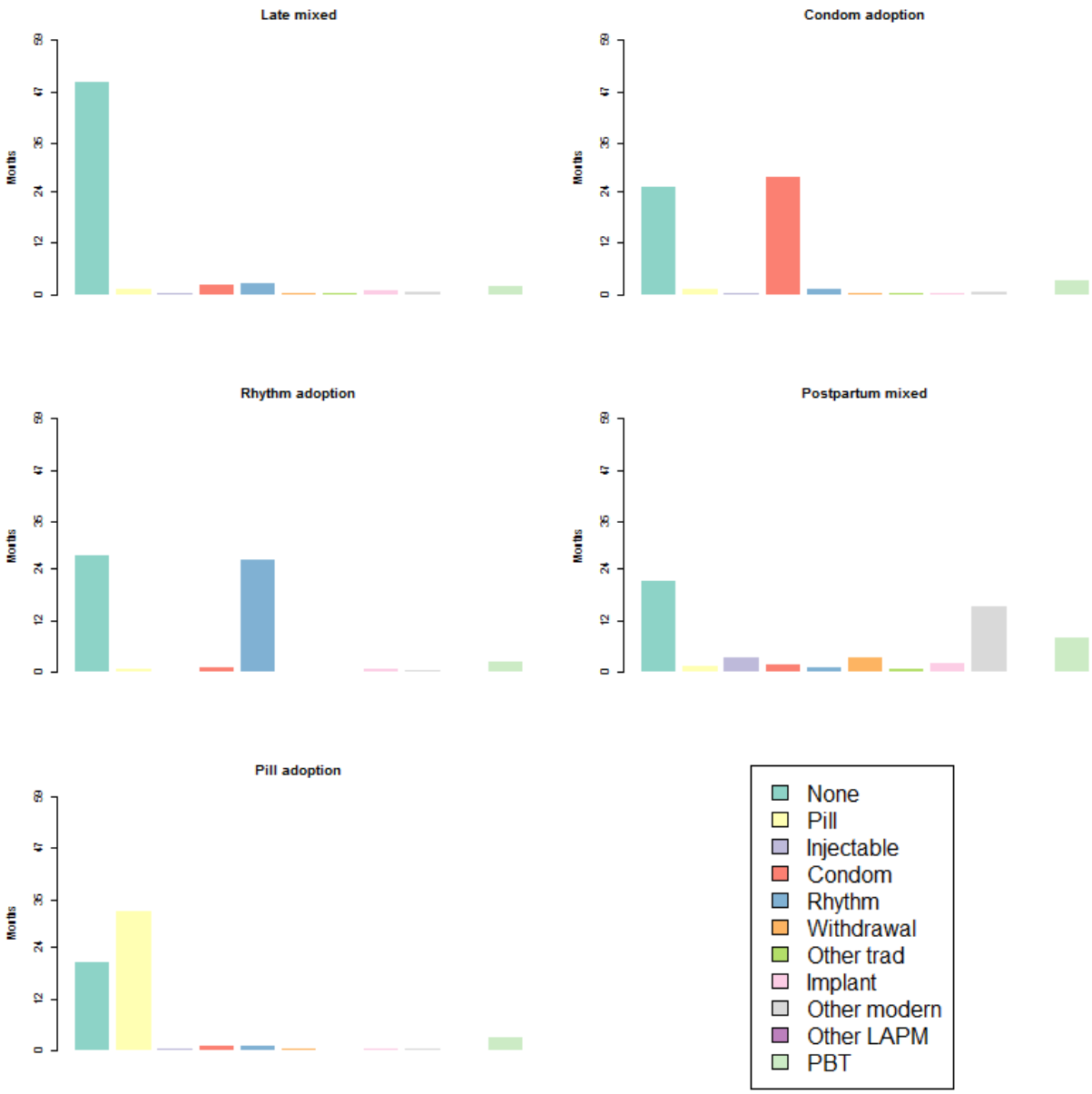
LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

None of the other four clusters were denoted by a pregnancy in the trajectory to contraceptive use, or even a pregnancy following contraceptive use in the sequence. The sequence index plots likewise showed few pregnancies in these clusters (see Figure 6).

The most common cluster, comprising 51% of the sample in Colombia, was the late mixed cluster, in which women adopted one of a variety of methods after a prolonged period of non-use (see Figure 5 and 6). The method mix was similar to that in the postpartum mixed cluster (see Figure 6), although it was represented by the rhythm method in the medoid plot (see Figure 5).

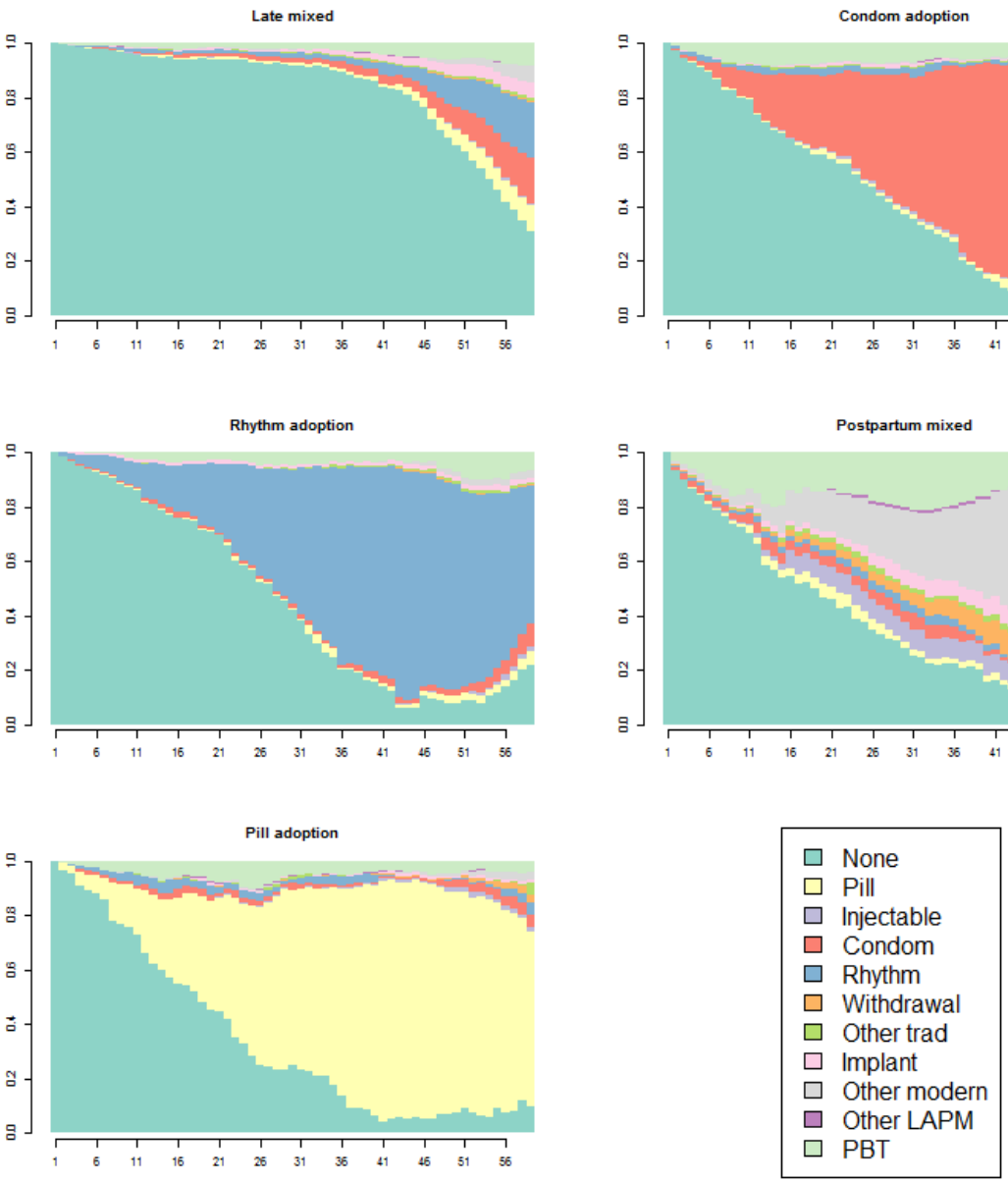
The remaining three clusters were distinguished by the method of contraception adopted: condoms (16%), rhythm/periodic abstinence (11%), and pills (8%). Figures 7 and 8 confirm that women in these clusters spent relatively little time in a state of pregnancy (less than 3 months) compared with women in the postpartum mixed cluster (8 months) and relatively little time in a state of non-use (22–26 months) compared with women in the late mixed cluster (48 months).

Figure 7 **Mean time spent in each state for each cluster (type of trajectory into contraceptive use) in Colombia, 2015 Colombia DHS**



LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

Figure 8 **Density plots for each cluster (showing all trajectories into contraceptive use in the clusters) in Colombia, 2015 Colombia DHS**

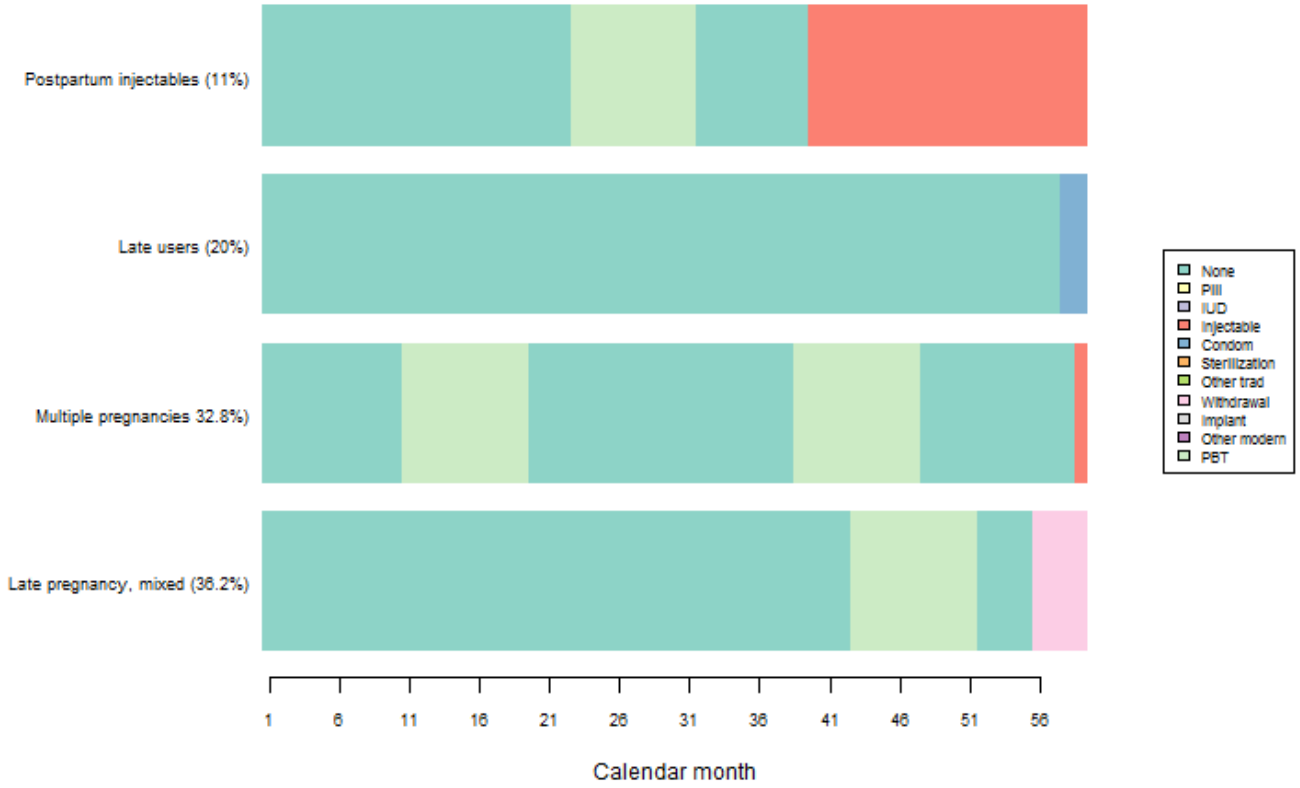


LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

3.4 Descriptive Features of Trajectories in Nepal

In Nepal, the most common cluster was the late pregnancy, mixed cluster (36%), which shared some features with its counterpart in Burundi (Figure 9). In the medoid sequence, withdrawal was the first method adopted after a pregnancy late in the sequence. The sequence index plot showed that the methods of contraception adolescents adopted following pregnancy included withdrawal, injectables, condoms, pills, sterilization, other traditional methods, and implants (Figure 10). The sequence index plot also confirmed the presence of a pregnancy in most adolescents' trajectories and that this pregnancy was typically late in the sequence. According to the sequence index plot, a very small minority of adolescents in this cluster used condoms or withdrawal before a pregnancy.

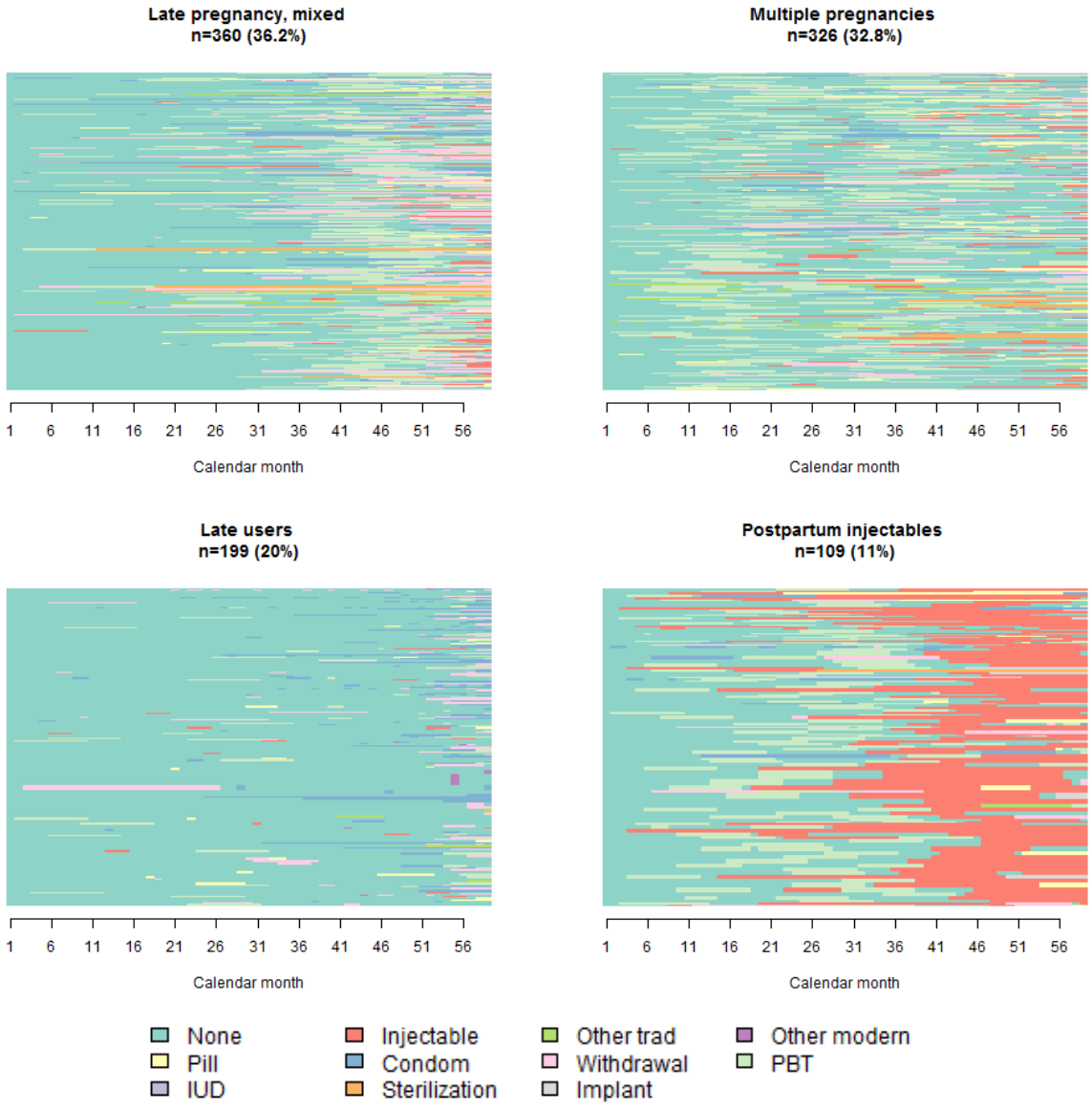
Figure 9 Representative medoid sequence plots for each cluster (type of trajectory into contraceptive use) in Nepal, 2016 NDHS



IUD = intrauterine device; LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

The second most common cluster, comprising 33% of adolescents, was the multiple pregnancies cluster, which was defined by two pregnancies before adoption of contraception (Figure 9). The sequence index plot (Figure 10) indicated that adolescents in this cluster typically experienced both pregnancies before adopting any of a variety of methods (as expressed by the medoid). However, in rare instances, some adolescents adopted contraception (particularly withdrawal, injectables, condoms, or pills) between their pregnancies.

Figure 10 Sequence index plots for each cluster (showing all trajectories into contraceptive use in the clusters) in Nepal, 2016 NDHS



IUD = intrauterine device; LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

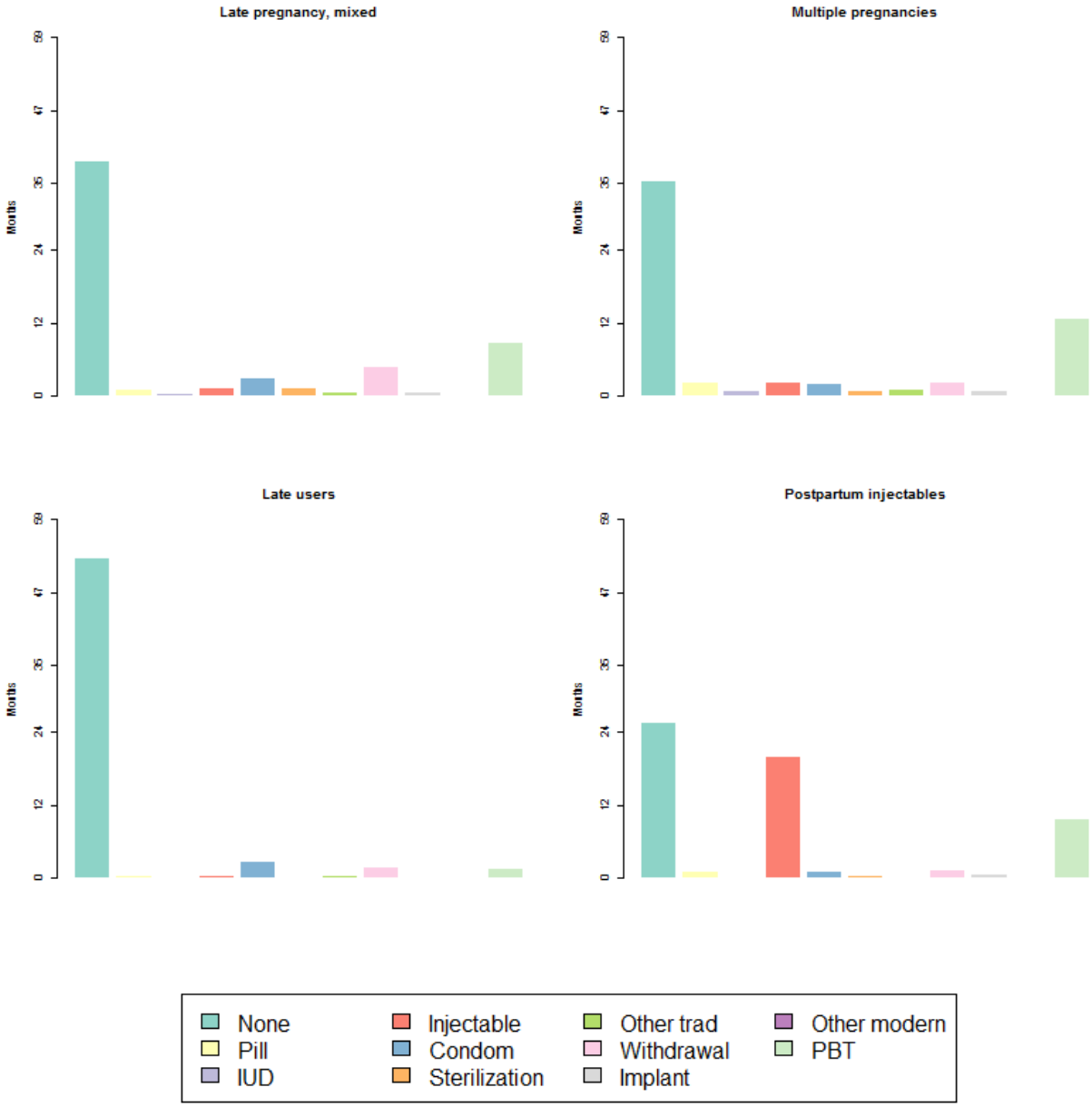
Less common clusters were late users (20%) and postpartum injectables (11%). Women in the late user cluster did not necessarily experience pregnancy before adopting one of a mixture of methods. The medoid sequence plot (see Figure 9) indicated that adoption occurred toward the end of the 59-month sequence, but the sequence index plot (see Figure 10) indicated that some women in this cluster adopted and discontinued contraception after a short episode of use in the middle of the sequence.

The density plots (Figure 11) and mean time plots (Figure 12) confirmed that less time was spent using contraception in the late user cluster (53 months of non-use) than in other clusters (25–38 months of non-use). The postpartum injectables cluster, as its label implies, was characterized by adoption of injectables following a pregnancy (see Figures 9 and 10). Women in this cluster, on average, spent less time in a state

of non-use (25 months) than women in the other three clusters, and contraceptive use was dominated by injectables (22 months) (Figure 11).

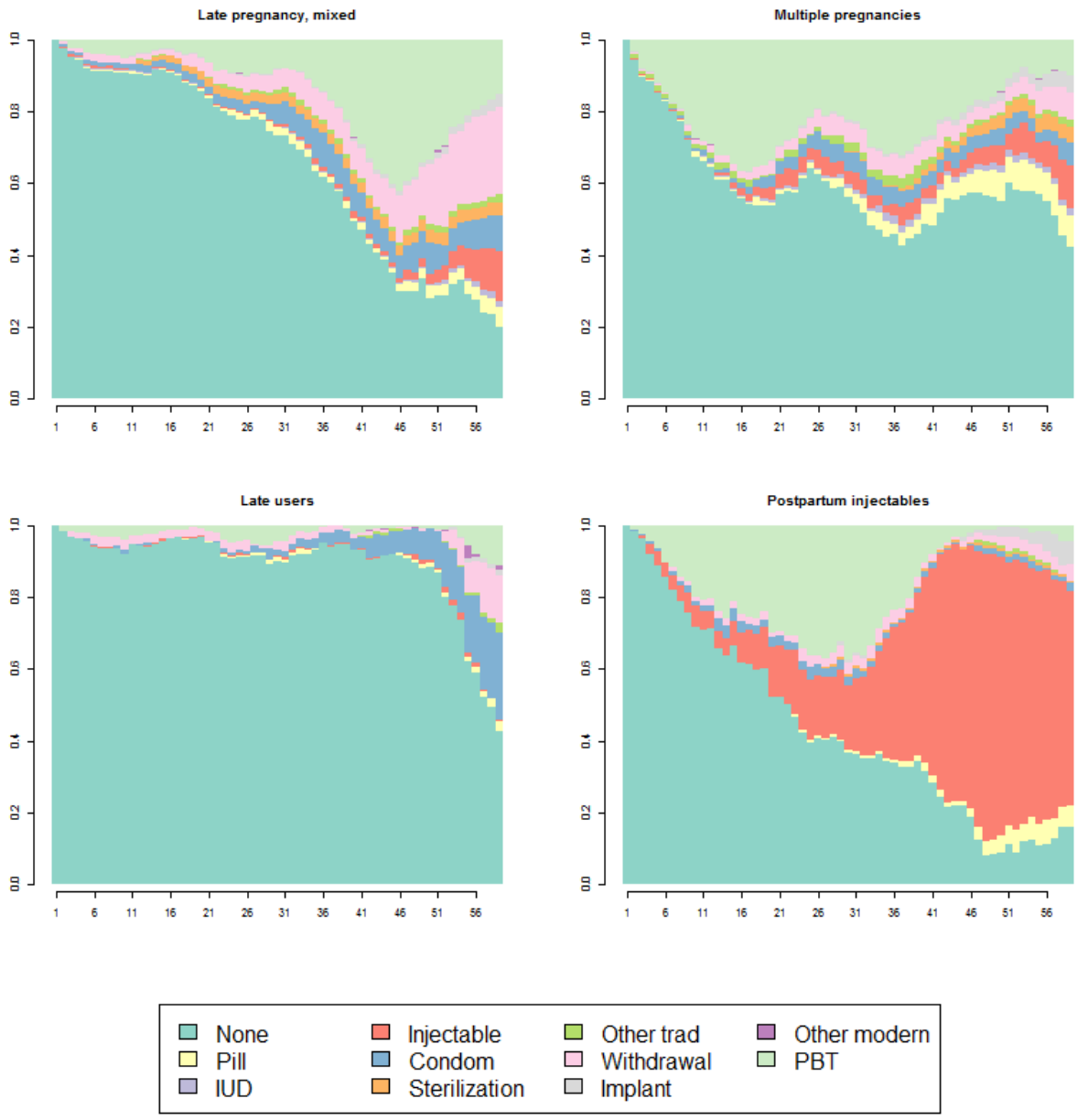
The average time spent in a state of pregnancy was highest in the multiple pregnancies cluster (13 months), followed by the late pregnancy, mixed methods and the postpartum injectables clusters (8–9 months), and lowest in the late users cluster (less than 2 months) (Figures 11 and 12).

Figure 11 Mean time spent in each state for each cluster (type of trajectory into contraceptive use) in Nepal, 2016 NDHS



IUD = intrauterine device; LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

Figure 12 Density plots for each cluster (showing all trajectories into contraceptive use in the clusters) in Nepal, 2016 NDHS



IUD = intrauterine device; LAPM = long-acting and permanent method; PBT = pregnancy, birth, or termination

3.5 Constituents of Trajectory Clusters in Burundi

Table 2 shows the distribution of the four clusters in Burundi across characteristics of adolescents in the sample (describing who comprised the types of trajectories to first contraceptive use). A *p* value from a chi-square test of independence suggested whether an association was found between cluster membership and each characteristic.

Table 2 Distribution of adolescents according to clusters (types of trajectories to contraceptive use) and characteristics in Burundi (N=828)

		Late pregnancy, mixed (36.6%)		Postpartum mixed (35%)		Postpartum injectables (18.2%)		Postpartum implants (10.2%)	
Characteristic	**n**	**%**	***p* value**	**%**	***p* value**	**%**	***p* value**	**%**	***p* value**
Age at start of sequence									
10–12	35	97.9	**0.000**	0.0	**0.000**	2.1	**0.007**	0.0	0.105
13–14	111	57.3		25.3		11.4		6.1	
15–17	367	36.1		36.1		17.4		10.4	
18–19	315	23.3		41.0		23.3		12.4	
Marital status									
Married at start of sequence	179	14.1	**0.000**	44.4	**0.000**	26.1	**0.000**	15.4	**0.022**
Married during sequence	515	33.4		37.8		18.9		9.8	
Never married/married after sequence ended	134	79.0		11.8		4.7		4.6	
Age at first sex									
<15	43	40.1	**0.007**	31.2	0.116	22.0	0.215	6.6	0.729
15–18	519	32.3		37.9		19.7		10.0	
≥19 or never had sex	266	44.5		30.0		14.5		11.0	
Husband living with her									
No	285	52.7	**0.000**	24.7	**0.000**	13.5	0.056	9.0	0.490
Yes	543	28.2		40.4		20.6		10.8	
Ideal number of children									
0	11	25.7	**0.040**	25.8	**0.020**	18.5	0.784	29.9	**0.042**
1	7	13.0		33.0		29.2		24.9	
2–3	482	40.9		30.4		17.0		11.6	
4+	328	31.2		42.1		19.6		7.1	
Unmet need									
No need	199	27.9	**0.000**	37.5	**0.000**	27.6	**0.002**	7.0	0.189
Unmet need	91	13.1		59.2		19.5		8.1	
Met need	538	43.9		30.0		14.4		11.7	
Wife justified asking husband to use condom if he has STI									
No	153	32.9	0.317	31.1	0.360	25.2	**0.027**	10.9	0.800
Yes	675	37.5		35.9		16.6		10.0	
Wife can refuse sex if husband has sex with other women									
No	323	38.6	0.463	33.4	0.496	18.7	0.798	9.4	0.605
Yes	505	35.4		36.1		17.9		10.7	
Residence									
Urban	123	53.0	**0.000**	26.3	**0.027**	16.3	0.566	4.4	**0.016**
Rural	705	33.8		36.5		18.5		11.2	
Highest education level									
No education	210	29.0	**0.000**	35.9	**0.000**	24.8	**0.003**	10.3	0.512
Primary	420	28.4		41.5		18.8		11.2	
Secondary+	198	62.3		20.1		9.8		7.8	
Household wealth quintile									
Poorest	178	29.0	**0.001**	34.1	**0.026**	25.3	0.113	11.6	0.611
Poorer	175	37.6		31.2		18.9		12.3	
Middle	183	29.7		43.2		16.7		10.4	
Richer	131	36.2		40.6		13.7		9.4	
Richest	161	52.3		26.2		14.8		6.7	

Note: Statistically significant *p* values are in bold.
STI = sexually transmitted infection

Life course factors figured prominently in cluster membership in Burundi, particularly with regards to the late pregnancy, mixed cluster (Table 2). Age and marital status were both significantly associated with cluster membership in three of four clusters, not controlling for other factors. Age at first sex was significantly associated only with membership in the late pregnancy, mixed cluster.

Compared with other clusters, the late pregnancy, mixed cluster disproportionately included adolescents early in their life course. Accounting for 37% of the overall sample, this cluster included 98% of those age 10–12, 57% of those age 13–14, 79% of unmarried adolescents, and 45% of adolescents who had never had sex or did not have sex until they were at least 19 years old. One-third of adolescents who married during the sequence also belonged to this cluster.

In contrast, almost no adolescents age 10–12 were in any of the three clusters with trajectories defined by postpartum method use. A higher proportion of older adolescents age 18–19 were members of the postpartum mixed cluster (41%) than of the other clusters. The postpartum cluster had the highest portion of adolescents who were already married at the start of their sequence (44%) or who married during the sequence (38%). The postpartum mixed cluster was also the most common cluster for adolescent women who were currently residing with their husbands (40%). Older adolescents and those already married at the start of the sequence were more likely to be in the smaller postpartum injectables and postpartum implants clusters.

On attitudinal measures, membership in the late pregnancy, mixed method cluster was highest (41%) among those who preferred to have two or three children, although a substantial proportion (31%) of those preferring four or more children were also in this cluster. These percentages were nearly reversed for the postpartum mixed cluster, suggesting that this cluster was composed of adolescents who preferred larger families. In contrast, a preference for small families seemed to dominate the postpartum implant cluster. The clusters did not seem to be well differentiated from one another in terms of attitudes regarding sexual health self-efficacy. In general, self-efficacy attitudes were not significantly associated with membership in any cluster. However, membership in the postpartum injectables cluster was lower among those who thought a woman was justified in insisting on condom use if her husband had symptoms of a sexually transmitted infection (17%) than among those who thought this was not justified (25%).

Membership in the late pregnancy, mixed method cluster was disproportionately high among urban adolescents (53%), among those with secondary or higher education (62%), and among those in the richest wealth quintile (52%). Meanwhile, membership in the postpartum mixed cluster was higher among rural residents (37%), those with primary education (42%), and those in the middle (43%) or richer (41%) quintile. Membership in the postpartum injectables cluster was higher among adolescents with no education (25%) than among those with primary education or with secondary or higher education. Membership in the postpartum implants cluster was concentrated among rural as opposed to urban residents (11% versus 4%).

3.6 Constituents of Trajectory Clusters in Colombia

Table 3 indicates that life course factors figured prominently in trajectories to first contraceptive use in Colombia as well. As with the late pregnancy, mixed cluster in Burundi, the late pregnancy, mixed cluster in Colombia included greater proportions of young adolescents (75% of those age 10–12), adolescents who were unmarried during their sequence (58%), and adolescents who did not reside with their husbands (58%). Similarly, this cluster included smaller proportions of older adolescents (33% of those age 18–19) and adolescents who were already married at the start of the sequence (24%).

Table 3 Distribution of adolescents according to clusters (types of trajectories to first contraceptive use) and characteristics in Colombia (N=4,505)

		Late mixed (51.3%)		Condom adoption (16%)		Postpartum mixed (14.2%)		Postpartum implants (11.1%)		Pill adoption (7.5%)	
Characteristic	**n**	**%**	***p* value**	**%**	***p* value**	**%**	***p* value**	**%**	***p* value**	**%**	***p* value**
Age at start of sequence											
10–12	1,135	75.0	**0.000**	9.4	**0.005**	9.4	**0.011**	4.7	0.000	1.5	0.000
13–14	1,115	50.6		17.1		17.1		9.4		5.8	
15–17	1,549	43.0		17.0		15.0		14.0		11.0	
18–19	705	32.5		22.5		15.5		17.6		12.0	
Marital status											
Married at start of sequence	267	23.9	**0.000**	23.7	**0.001**	3.1	**0.001**	42.8	0.000	6.5	0.838
Married during sequence	1,238	40.0		20.2		12.2		19.8		7.8	
Never married/married after sequence ended	3,000	58.4		13.6		16.0		4.6		7.4	
Age at first sex											
<15	863	49.7	0.116	18.4	0.531	10.5	0.140	14.4	0.000	7.0	0.713
15–18	3,080	50.2		15.8		15.2		11.4		7.3	
≥19 or never had sex	562	59.6		13.3		13.9		4.1		9.1	
Husband living with her											
No	3,417	55.7	**0.000**	14.0	**0.000**	15.6	**0.001**	7.3	0.000	7.4	0.755
Yes	1,088	37.4		22.3		9.8		22.7		7.8	
Ideal number of children											
0	303	44.7	0.510	17.6	0.638	15.1	0.563	16.2	0.369	6.4	0.483
1	771	50.2		18.8		12.2		10.7		8.1	
2–3	3,291	52.1		15.2		14.7		10.5		7.6	
4+	140	53.6		15.8		11.6		15.8		3.3	
Unmet need											
No need	1,045	69.5	**0.000**	11.5	**0.037**	13.5	0.829	2.7	0.000	2.8	0.000
Unmet need	407	59.4		12.7		15.0		8.3		4.5	
Met need	3,052	44.0		18.0		14.3		14.3		9.5	
Wife justified asking husband to use condom if he has STI											
No	101	53.2	0.745	22.7	0.122	2.9	**0.000**	14.0	0.448	7.2	0.927
Yes	4,403	51.3		15.8		14.4		11.0		7.5	
Wife can refuse sex if husband has sex with other women											
No	150	55.0	0.454	13.3	0.424	10.8	0.384	14.8	0.168	6.1	0.561
Yes	4,355	51.2		16.1		14.3		10.9		7.5	
Residence											
Urban	3,620	50.7	0.274	16.2	0.573	14.8	0.108	10.4	0.039	7.9	0.143
Rural	885	53.6		15.0		11.8		13.9		5.8	
Highest education level											
No education	10	41.4	0.777	8.5	0.766	0.0	**0.018**	50.0	0.000	0.0	0.033
Primary	236	53.0		16.3		7.7		19.7		3.4	
Secondary+	4,259	51.2		16.0		14.6		10.5		7.7	
Household wealth quintile											
Poorest	735	53.3	0.374	15.5	0.409	10.1	0.102	16.0	0.006	5.2	0.125
Poorer	998	52.2		13.1		14.9		13.8		5.9	
Middle	1,015	46.7		19.0		16.4		10.4		7.5	
Richer	924	51.9		15.0		15.9		9.4		7.9	
Richest	833	53.4		17.3		12.3		6.1		10.9	

Note: Statistically significant *p* values are in bold.
STI = sexually transmitted infection

In contrast, the condom adoption and postpartum implants clusters were disproportionately more common among older adolescents age 18–19 (23% and 18%, respectively) and among those who were already married (24% and 43%) or who married during the trajectory (both 20%) than among their younger, unmarried counterparts. Membership in the pill adoption cluster also varied by age, with a higher percentage of adolescents over age 15 than of younger adolescents belonging to this cluster. Differences by marital status and by coresidence with husbands were most striking with regard to the postpartum implants cluster; 43% of those who were already married compared with just 5% of those who remained unmarried belonged to this cluster, and 23% of those with a coresident husband compared with 7% without a coresident husband belonged. These findings suggested that implant use may be reserved for mature, stable relationships.

Sexual debut was not associated with cluster membership except for in the postpartum implants cluster. Membership in this cluster was much higher among adolescent women who had their first sexual experience before age 15 (14%) than among those who had their sexual debut at age 19 or older (4%).

In contrast to these three clusters, membership in the postpartum mixed cluster was higher among adolescents age 13–14 (17%) or older (≥15%) than among those age 10–12 (9%), among those who remained unmarried (16%) than among those who were already married (3%) or who married during their trajectory (12%), and among those who did not have a husband or were not coresiding with their husbands (16%) than among those with a coresident husband (10%).

In general, cluster membership did not vary substantially with regard to attitudinal factors like ideal number of children or support for sexual health self-efficacy. The exception was the postpartum mixed method cluster, in which membership was higher among those supporting a wife's ability to insist on condoms if her husband had a sexually transmitted infection (14% versus 3%).

Socioeconomic characteristics were sporadically associated with cluster membership. The postpartum implants cluster was largely composed of rural adolescents (14%), those with no education (50%), and those in the poorest (16%) and poorer (14%) wealth quintiles compared with their urban, more educated, and richer counterparts.

3.7 Constituents of Trajectory Clusters in Nepal

Table 4 shows that, in Nepal, the late pregnancy, mixed method cluster and the late users clusters were both more common among younger adolescents than older adolescents; membership rates were separated by 14 percentage points between the youngest and oldest age groups in the mixed method cluster, and by nearly 35 percentage points in the later users cluster.

Table 4 Distribution of adolescents according to clusters (types of trajectories to contraceptive use) and characteristics in Nepal (N=995)

		Late pregnancy, mixed (36.2%)		Multiple pregnancies (32.8%)		Late users (20%)		Postpartum injectables (11%)	
Characteristic	**n**	**%**	***p* value**	**%**	***p* value**	**%**	***p* value**	**%**	***p* value**
Age at start of sequence									
10–12	76	40.8	**0.000**	9.0	**0.000**	48.1	**0.000**	2.1	0.041
13–14	170	49.3		13.7		23.8		13.2	
15–17	416	37.5		33.3		18.9		10.3	
18–19	334	26.8		47.3		13.2		12.7	
Marital status									
Married at start of sequence	246	22.3	**0.002**	53.3	**0.000**	7.6	**0.000**	16.7	0.024
Married over course of sequence	740	40.8		26.4		23.5		9.2	
Never married/married after sequence ended	10	34.0		0.0		66.0		0.0	
Age at first sex									
Age <15	85	26.7	0.250	48.6	**0.004**	10.1	**0.000**	14.7	0.029
15–18	613	37.0		33.5		17.1		12.4	
≥19 or never had sex	298	37.2		26.9		29.0		7.0	
Husband living with her									
No	385	30.0	**0.004**	39.6	**0.001**	24.5	**0.014**	5.8	0.000
Yes	611	40.1		28.5		17.2		14.3	
Ideal number of children									
0	12	67.7	0.250	15.4	0.391	0.0	0.541	16.9	0.685
1	189	38.4		28.4		20.1		13.1	
2–3	774	35.4		34.0		20.3		10.3	
4+	20	26.0		38.0		19.9		16.1	
Unmet need									
No need	202	32.1	**0.000**	26.3	**0.000**	34.6	**0.000**	6.9	0.000
Unmet need	268	27.3		48.9		19.3		4.4	
Met need	525	42.3		27.0		14.8		15.9	
Wife justified asking husband to use condom if he has STI									
No	45	30.3	0.447	38.6	0.433	11.4	0.218	19.6	0.135
Yes	950	36.5		32.5		20.4		10.6	
Wife can refuse sex if husband has sex with other women									
No	119	33.8	0.629	32.1	0.881	26.3	0.185	7.8	0.279
Yes	876	36.5		32.9		19.2		11.4	
Residence									
Urban	588	36.3	0.926	30.0	**0.049**	23.2	**0.006**	10.5	0.592
Rural	407	36.0		36.9		15.4		11.7	
Highest education level									
No education	102	33.9	**0.037**	49.8	**0.000**	4.4	**0.000**	11.9	0.000
Primary	169	27.5		43.7		8.9		19.9	
Secondary+	724	38.5		27.8		24.8		8.8	
Household wealth quintile									
Poorest	174	31.6	**0.036**	42.4	**0.022**	14.5	**0.000**	11.5	0.202
Poorer	246	38.2		34.9		13.1		13.8	
Middle	215	38.2		32.3		16.9		12.6	
Richer	214	41.9		27.8		21.2		9.1	
Richest	146	27.0		25.8		41.1		6.1	

Note: Statistically significant *p* values are in bold.
STI = sexually transmitted infection

Membership in both of these clusters was particularly common among those who married during their sequence. Membership in the late users cluster was particularly uncommon (8%) among adolescents who were already married at the start of their sequence. Late pregnancy, mixed method cluster membership was higher among women who were living with their husbands (40% versus 30%), whereas the reverse was true for late users cluster membership (17% versus 25%).

In contrast to those two clusters, membership in the multiple pregnancies cluster (the second most common cluster overall) increased with age and was higher among those who were already married than among those who married during the sequence (53% versus 26%). Membership increased with earlier age at first sex and was higher among those who lived with their husbands than among those who did not (40% versus 29%).

Similar to membership in the multiple pregnancies cluster, membership in the postpartum injectables cluster was also higher (though the relationship was non-linear) among older adolescents than younger ones, among adolescents already married than those married during the sequence (17% vs 9%), and among those with earlier age at first sex. However, unlike membership in the multiple pregnancies cluster, membership in the postpartum injectables cluster was higher among women with coresident husbands than among those without (14% versus 6%).

As with Burundi and Colombia, attitudinal measures in Nepal appeared to be independent of cluster membership. However, cluster membership was differentiated by socioeconomic factors.

Membership in the late pregnancy, mixed method cluster was higher among those with secondary or higher education and among those in the richer (but not richest) wealth quintile. Membership in the late users cluster was similarly concentrated among those with secondary or higher education and increased with household wealth. Membership was also higher among urban than rural residents (23% versus 15%).

Meanwhile, membership in the multiple pregnancies cluster was higher among rural residents, those with no education or primary education, and those in the poorest and poorer wealth quintiles than among their counterparts. A higher proportion of women with primary education (20%), than of those with no education (12%) or with secondary or higher education (9%), were members of the postpartum injectables cluster.

4 DISCUSSION

Several commonalities were found among the four clusters—or types of trajectories to contraceptive use—identified in Burundi and the four identified in Nepal. Fewer similarities were found between the clusters in these two countries and the five clusters identified in Colombia. In Burundi and Nepal, adolescents typically adopted a method of contraception only after experiencing at least one pregnancy. The four types of trajectories in these two countries were differentiated primarily by number and timing of pregnancies and secondarily by method of contraception. In Colombia, by contrast, the five trajectory types were differentiated primarily by the contraceptive method used.

The most common clusters in Burundi and Nepal were late pregnancy before adoption of a mixture of methods (37% of women in Burundi and 36% of women in Nepal), followed by a cluster with adolescent women experiencing two pregnancies before adoption of a mix of methods (35% and 33%, respectively). Less common trajectories were pregnancies followed by injectable use (Burundi and Nepal) or implant use (Burundi only). In Colombia, a majority of adolescents (51%) had an extended period of no use of any method followed by adoption of a mixture of methods late in the sequence. The remaining trajectories were differentiated by adoption of condoms, periodic abstinence/rhythm, or pills and, for one cluster, experience of a pregnancy before adopting one of a mixture of methods.

In all the clusters in Colombia and all but the multiple pregnancies cluster in Burundi and Nepal, once adolescents adopted a method of contraception, they typically continued using it through the remainder of the sequence. Although their sequences were censored at the time of the interviews, particularly for late adopters, these findings suggest that adolescents in most clusters become long-term users of the methods they adopt. Future analysis of discontinuation rates and reasons for discontinuation in this population would be worthwhile to inform how service providers can better support adolescents in their family planning goals and reduce discontinuation while still in need.

Descriptive analyses of the characteristics of members of each cluster indicated that life course factors may be closely associated with trajectory type. In all three countries, membership in any of the "late" clusters was predominantly among the youngest adolescents and among unmarried adolescents. Marriage was more consistently associated with cluster membership than was age at first sex. The development of sexual relationships and their social context may dictate the trajectory adolescents take to first contraceptive use. Subsequent analysis should more carefully overlay the timings of first sex and marriage with states in adolescents' contraceptive trajectories.[4]

Surprisingly, attitudinal factors were not strongly associated with the composition of the clusters in any country. This finding contrasts with other segmentation work[11] that has differentiated types of contraceptive users using cross-sectional data and found that attitudes differ among groups. However, like much of that work, this study did find compositional differences based on socioeconomic factors. Investigation of these factors, within the context of segmentation and possibly with the application of other behavioral analysis tools, may provide reproductive health program managers with information to better target programs to heterogenous populations of adolescents with differing needs.

This study was a first attempt to apply new methods of segmentation for longitudinal, behavioral data on adolescents. This approach provides a new perspective on the question of how adolescents come to use contraception for the first time. Although much more can and should be done to elaborate on these findings and turn them into programmatic insights, the results of this study demonstrate that this analytical approach can be applied in a diverse range of settings in which contraceptive calendar data are available.

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