Unmet Need for Family Planning and Fertility in Nepal: Levels, Trends, and Determinants

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Additional information about the 2016 NDHS may be obtained from the Ministry of Health and Population, Ramshahpath, Kathmandu; telephone: +977-1-4262543/4262802; internet: http://www.mohp.gov.np; and New ERA, Rudramati Marg, Kathmandu, P.O. Box 722, Kathmandu 44600, Nepal; telephone: +977-1-4413603; email: info@newera.com.np; internet: http://www.newera.com.np.

The DHS Program assists countries worldwide in the collection and use of data to monitor and evaluate population, health, and nutrition programs. Additional information about The DHS Program can be obtained from ICF, 530 Gaither Road, Suite 500, Rockville, MD 20850 USA; telephone: +1 301-407-6500, fax: +1 301-407-6501, email: info@DHSprogram.com, internet: www.DHSprogram.com.

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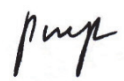
FOREWORD

The 2016 Nepal Demographic and Health Survey (NDHS) is the fifth nationally representative comprehensive survey conducted as part of the worldwide Demographic and Health Surveys (DHS) Program in the country. The survey was implemented by New ERA under the aegis of the Ministry of Health and Population (MoHP). Technical support for this survey was provided by ICF with financial support from the United States Agency for International Development (USAID) through its mission in Nepal and support for report production from the United Nations Population Fund (UNFPA).

The standard format of the survey final report included only a descriptive presentation of findings and trends, and did not include analytical methods that can ascertain the significance of change and association among variables. Although largely sufficient, the final report is limited, particularly in providing answers to "why" – answers that are essential in reshaping important policies and programs. After the dissemination of the NDHS 2016, the MoHP and its partners convened and agreed on key areas that are necessary for assessing progress, gaps, and determinants in high-priority public health programs being implemented by the MoHP. In this context, seven further analysis studies have been conducted by technical professionals from the MoHP and its partners who work directly on the given areas, with technical support and facilitation from research agencies.

The primary objective of the further analysis of the 2016 NDHS is to provide more in-depth knowledge and insights into key issues that emerged from the survey. This information provides guidance for planning, implementing, refocusing, monitoring, and evaluating health programs in Nepal. The long-term objective of the further analysis is to strengthen the technical capacity of local institutions and individuals for analyzing and using data from complex national population and health surveys to better understand specific issues related to country need.

The further analysis of the 2016 NDHS is the concerted effort of many individuals and institutions, and it is with great pleasure that I acknowledge the work involved in producing this useful document. The participation and cooperation of the members of the Technical Advisory Committee in the different phases of the survey are highly valued. I would like to extend my appreciation to USAID/Nepal for providing financial support for the further analyses. I would also like to acknowledge ICF for its technical assistance at all stages. My sincere thanks also go to the New ERA team for the overall management and coordination of the entire process. I would also like to thank the Public Health Administration Monitoring and Evaluation Division, as well as the Policy Planning and Monitoring Division, MoHP, for their efforts and dedication to the completion of this further analysis of the 2016 NDHS.



Dr. Pushpa Chaudhary
Secretary
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ABSTRACT

This study examined the levels, trends, socioeconomic determinants of and changes in the unmet need, demand for family planning, and demand satisfied for family planning using the pooled NDHS 2006 and 2016 data as a part of the further analysis of the follow-up to the 2016 NDHS. This study also explores changes in the total fertility rate through the proximate determinants of fertility, with the addition of a spousal separation index to take into account Nepal's high level of migration.

The analysis reveals that unmet need in Nepal has declined from 24.7% in 2006 to 23.7% in 2016. During that time, demand for modern family planning satisfied decreased from 61% to 56%, a scenario the reverse of the one expected. This may be attributable to the poor commodity supply and limited method choices across the country.

Differences in unmet need and demand for family planning satisfaction were clearly evident among subgroups of population classified by age, education, wealth quintile, and child loss experience among women.

Spousal separation was found to be the most important proximate determinants to explain the decline in fertility observed between 2006 and 2016. This was followed by changing marriage pattern, abortion, and contraception.

Increased family planning commodity supply and services, intended to increase access to family planning methods and user choices, may improve the unmet need situation in Nepal, which ultimately may contribute to further decline in fertility in the country.

KEY WORDS: Proximate determinants, unmet need, demand for family planning, demand for family planning satisfied, contraceptives, fertility

ACRONYMS AND ABBREVIATIONS

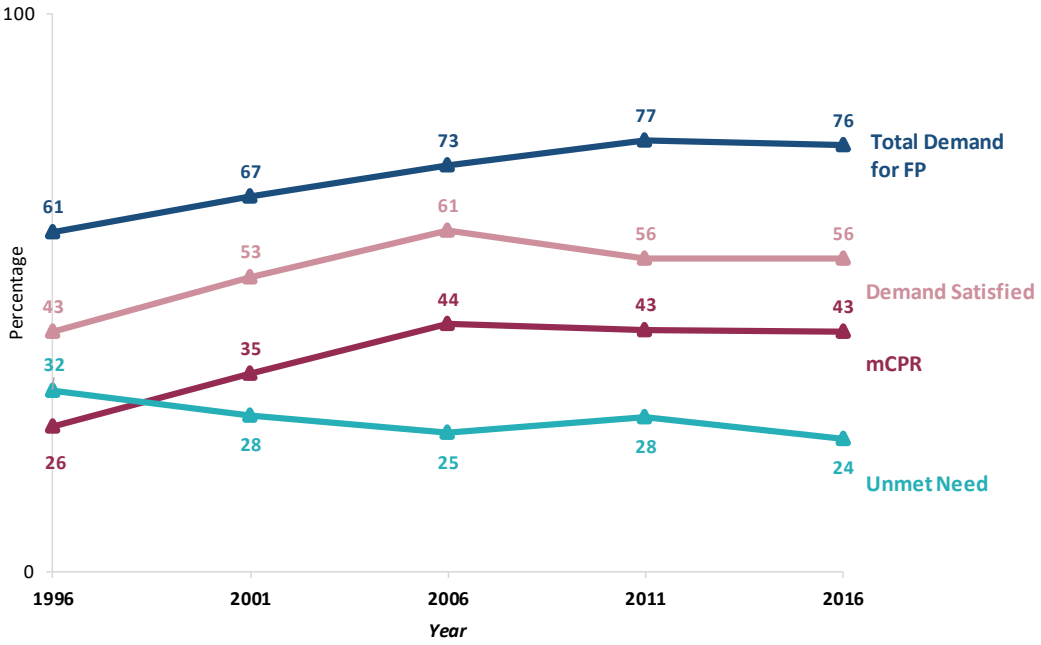
C_a	index of induced abortion
C_c	index of contraception
C_i	index of postpartum infecundability
C_m	index of non-marriage
C_{sep}	spousal separation
CIP	costed implementation plan
CPR	contraceptive prevalence rate
DHS	Demographic Health Survey
DoHS	Department of Health Service
FP	family planning
FS	female sterilization
GoN	Government of Nepal
IUD	intrauterine device
LAM	lactational amenorrhea method
MoH	Ministry of Health
MoHP	Ministry of Health and Population
MS	male sterilization
NDHS	Nepal Demographic and Health Survey
NHFS	Nepal Health Facility Survey
NPC	National Planning Commission
SDG	Sustainable Development Goals
TAR	total abortion rate
TF	total fecundity
TFR	total fertility rate
TMFR	total marital fertility rate
TRAD	traditional method

1 INTRODUCTION

Family planning (FP) is one of the important components of Nepal's national health system. The government has made commitments in several development plans and strategies since 1968 (MOHP 2007, 2010, 2015a, 2015b). Family planning services are offered in all district-level hospitals, primary health care centers, health posts, urban health centers, 88% of the zonal and above hospitals of the government, and in 70% of the private hospitals (MOH et al. 2017b). The major aim of the FP program is to increase equitable access to voluntary FP services based on informed choices by individuals and couples so that they may plan and accomplish their desired number of children, have pregnancy spacing, and reduce the incidence of unintended pregnancies, unsafe abortions, and maternal deaths (DoHS 2018, MOHP 2015a, 2015b, GON 2017).

The five Nepal Demographic and Health Surveys (DHS) conducted in the county between 1996 and 2016 have shown the progress accomplished by the family planning program in Nepal. The modern contraceptive prevalence rate increased from 26% in 1996 to 43% in 2016. During the same period, the unmet need for family planning decreased from 32% to 24%, and the demand for family planning satisfied increased from 43% to 56% (Figure 1). The median female age at marriage (women 25-49) increased from 16 years to 18 years. All of these contributed to the decline in total fertility from 4.6 in 1996 to 2.3 in 2016 (Pradhan et al. 1997; MOH, New ERA, and ORC Macro 2002; MOHP, New ERA, and ICF International 2007, 2012; MOH, New ERA, and ICF 2017).

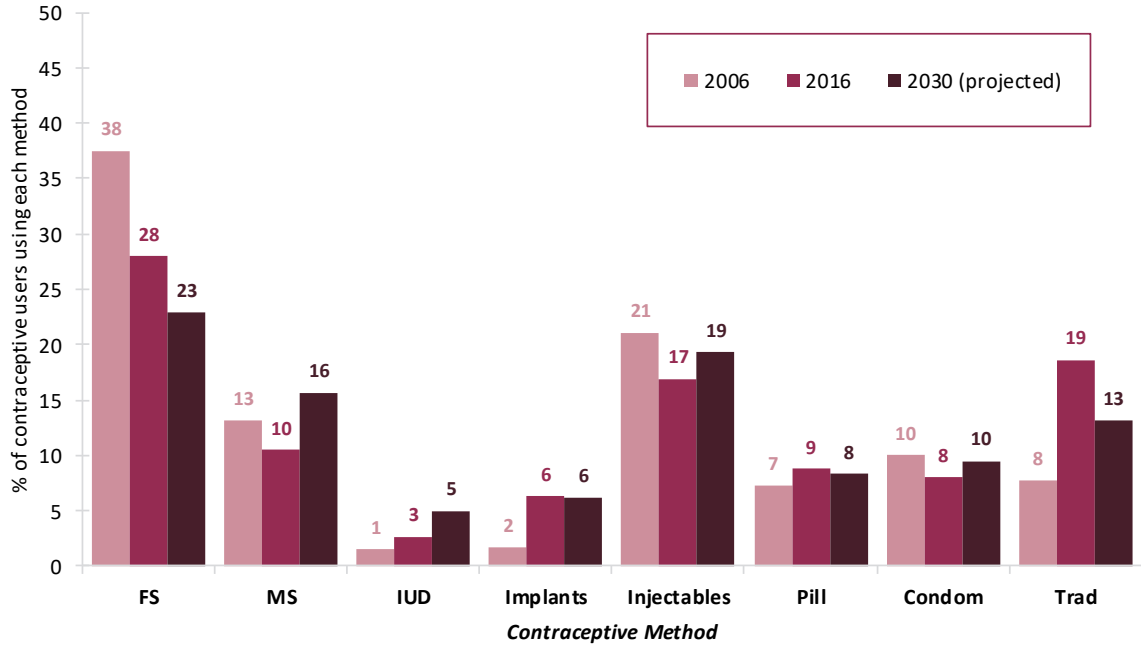
Figure 1 Trends in selected family planning indicators, Nepal DHS 1996-2016



FP = Family planning; mCPR = modern contraceptive prevalence rate

The method-mix patterns observed between DHS 1996 and 2016 in Nepal (Figure 2) show a changing pattern of choices of methods among users. In 2006, sterilization accounted for 38% of all methods used, but declined to 28% in 2016. Similarly, male sterilization during the same time declined from 13% to 10%. Other methods increased in popularity over time, including implants, pills, and traditional methods (Pradhan et al. 1997; MOH, New ERA, and ORC Macro 2002; MOHP, New ERA, and ICF International 2007, 2012; MOH, New ERA, and ICF 2017, MOHP 2015a).

Figure 2 Contraceptive method mix, Nepal DHS 2006-2016 and projection for 2030



FS = female sterilization; MS = male sterilization

Table 1 Fertility planning, wanted fertility, and excess birth due to unwanted pregnancy among women, Nepal DHS 1996-2016

Categories	DHS Survey Year				
	1996	2001	2006	2011	2016
Fertility planning status (%)					
Wanted then	61.9	64.1	69.2	74.4	81.2
Wanted later	19.2	13.8	14.4	12.4	11.5
Wanted no more	18.1	21.6	16.4	13.3	7.2
Wanted fertility (per woman)	2.9	2.5	2.0	1.8	1.7
Difference between TFR and wanted fertility (per woman)	1.7	1.6	1.1	0.8	0.6
Percentage of excess births due to unwanted pregnancy	59	64	55	44	35

Source: Pradhan et.al., 1997; MOH, New ERA, and ORC Macro 2002; MOHP, New ERA, and ICF International 2007, 2012; MOH, New ERA, and ICF 2017.

The fertility planning status of women who reported wanting to have a child then increased from 62% in 1996 to 81% in 2016. This figure shows an increase in desired and correctly timed births. The incidence of mistimed births declined from 37% in 1996 to 19% in 2016. The difference between the wanted fertility and the actual fertility (TFR) over the 1996 and 2016 period has also narrowed from 1.7 to 0.6 children per women. At the same time, the excess births due to unwanted pregnancy in Nepal has also declined from 59% in 1996 to 35% in 2016 (Table 1).

1.1 Family Planning Program in Nepal

The major objectives of the national family planning program are to ensure that individuals and couples have equitable access to voluntary FP services based on informed choice, and they are able to fulfill their reproductive needs by using appropriate family planning methods. The program envisages that increased use of FP will reduce unmet need for family planning, ultimately contributing to reduced incidences of unintended pregnancy, improved maternal and child health, and increased empowerment for women, and lead to economic growth by expanding the healthy and skillful labor force. All of these improve the Nepali quality life (DoHS 2018).

The program also perceives that increases in FP use can be achieved by increasing access to quality services, especially increasing access among the hard-to-reach rural, poor, Dalit, other marginalized people, and those with high unmet need for the service. Additionally, the program aims to increase the demand for FP services by implementing behavior change communication activities (DoHS 2018).

The government of Nepal has committed to maintaining and sustaining all efforts initiated through the implementation of the FP2020 commitments by focusing on reaching the unreached and increasing the government budget in FP by 7% each year up to 2020, in order to increase additional FP users to about 1 million by 2020 and increase the demand satisfied by modern methods to 71% by 2020 (NPC 2017, MOHP 2015b).

The selected target indicators fixed by the Government of Nepal to ensure universal access to sexual and reproductive health care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programs by 2030, are shown in Table 3. According to the sustainable development goals of the Nepali government, the demand satisfied with modern methods aims to reach 75% among married women, the adolescent fertility will decline to 30 per 1,000 women, the TFR will reach two children per woman, and unmet need for family planning will decline from 25% in 2014 to 10% in 2030. Similarly, demand satisfied for FP will increase from 66% in 2014 to 80% in 2030 (Table 2).

Table 2 Targets with selected family planning and fertility indicators, current status, and future projections, Nepal 2014-2030

Targets and Indicators		Reference Year				
		2015	2019	2022	2025	2030
3.7.1 a	Contraceptive prevalence rate (modern methods) (%)	47.1	52.0	53.0	56.0	60.0
3.7.2	Adolescent fertility rate (births per 1,000 women age 15-19 years)	71	56	51	43	30
3.7.6	Unmet need for family planning (%)	23.0	21.4	18.3	15.2	10.0
3.7.1	Proportion of demand satisfied for family planning (%)	66.0	71.0	74.0	76.0	80.0
3.7.1 b	Total fertility rate (TFR) (births per women)	2.3	2.1	2.1	2.1	2.1
3.7.8	Households within 30 minutes travel time to a health facility (%)	61.8	69.3	75.0	80.6	90.0

Source: NPC 2017

1.2 Issues and Challenges of Family Planning Program in Nepal

The Costed Implementation Plan (CIP) of MoHP focuses on five strategic areas: enabling environment, demand generation, service delivery, capacity building, and research and innovation, to address the existing challenges and opportunities for scaling up rights-based FP in the country. The expected outcomes from these approaches are to increase demand satisfied for modern contraceptives, increase the contraceptive prevalence rate (CPR) for modern methods, reduce unmet need, and diminish the adolescent fertility rate, as well as total fertility rate, as targeted by the plan. The strategy also expects to see changes in the method mix over time. The other focused area of the program includes enhancing quality of FP service delivery, increasing capacity of service providers, improving contraceptive commodities and logistics, strengthening FP service-seeking behavior, and advocacy for family planning, management, monitoring, and evaluation (MOHP 2015a).

This study examines the levels, trends, and determinants of unmet need for family planning; demand for family planning; demand satisfied; and fertility. The outcomes of this study will inform the government of Nepal in its plans to formulate and polish upcoming programs and policies for improved quality of reproductive life of mothers in the country. The further analysis of contraceptive use is not included in this study because the use of modern methods between 2006 and 2016 was constant.

2 METHODS

This paper examines the levels, trends, and determinants of unmet need for family planning, demand for family planning, family planning demand satisfied, and fertility in Nepal, and explores factors that have contributed to changes between the 10-year period from 2006 to 2016. The data for this study come from the 2006 and the 2016 Nepal DHS. The study examines the levels, trends, and determinants by selected socioeconomic and demographic characteristics of married women age 15-49 covered in the surveys (Appendix Table A1). The final reports of the respective surveys provide detailed descriptions of the survey methodology.

The bivariate cross-tabulation analysis tables show the levels and trends of unmet need, demand for family planning, and family planning demands satisfied according to the selected background characteristics of the respondents. Additionally, the effect of each characteristic of the respondents on the three outcomes is measured by multivariate logistic regression – holding the effect of other characteristics constant – to substantiate the bivariate results. Binary logistic regression analyses use the 2006 and 2016 NDHS pooled data to examine which factors contribute to the observed changes in outcome variables between 2006 and 2016 (New ERA and ICF International 2007; MOH, New ERA, and ICF 2017).

The outcome measures – unmet need, demand for family planning, and family planning demand satisfied – are the probabilities that a woman will have that particular outcome. For unmet need, the categories are: unmet need versus other (no need, using, infecund/menopausal); for demand for FP, the categories are: those who have demand for FP (those using or with unmet need) versus no demand for FP (no need); and for demand satisfied, among those who had demand for family planning, demand satisfied versus demand not satisfied with a modern method. The predictor variables of interest include age, education, husband's education, ethnicity, whether a husband is present or living outside the home, number of household members, province, exposure to mass media messaging about family planning, wealth of the household, number of living sons, number of living daughters,[1] and if any children have died.

Data analysis was performed using Stata 15. Descriptive statistics (number, percentage, mean, range, and standard deviation) and inferential statistics, using *t*-test, Chi-square test, and Fisher's exact test were applied. P-value less than 0.05 was considered statistically significant.

To examine the changes in the total fertility rate, we examined the proximate determinants of fertility (using the Bongaarts (1978) model) and then decomposed each contribution on the change in fertility between 2006 and 2016.

[1] We choose to separate the number of living sons and daughters in order to investigate if son preference influences contraceptive use and demand.

3 CPR, UNMET NEED, DEMAND SATISFIED, TOTAL DEMAND

Unmet need for contraception includes all nonpregnant or nonpostpartum amenorrheic fecund married women age 15-49 who want to postpone their next birth for 2 or more years or stop childbearing altogether but are not using a contraceptive method, or have a mistimed or unwanted current pregnancy, or postpartum amenorrheic women whose most recent birth in the last 2 years was mistimed or unwanted (MOH, New ERA, and ICF 2017).

Unmet need for family planning in NDHS 2016 was calculated using the definition of unmet need, described in Bradley et al. (2012). In order to compare the results from the NDHS 2006 with the results from 2016, the unmet need for 2006 presented in this study has been recalculated using the revised definition and may differ slightly from numbers published in the NDHS 2006 report[2] (MOHP, New ERA, and ICF International 2007).

The analysis reveals that unmet need in Nepal remained statistically unchanged from 24.7% in 2006 to 23.7% in 2016.

Looking at unmet need across different subgroups shows significant variation in both years. Focusing on 2016, younger women have higher levels of unmet need compared to older women, and by educational status, women with secondary schooling have the highest unmet need. When looking at the wives of migrants (34% of married women did not reside with their husbands in 2016), almost half of women whose husband has been away for under a year are classified as having unmet need, while the number is over 50% when husband's absence is over a year. This may not be true unmet need, but an assumption in the definition of unmet need is that all married women are sexually active and exposed to the risk of pregnancy.

The decline in the unmet need between 2006 and 2016 was also observed to be statistically significant for selected characteristics of respondents at many disaggregation levels. For example, significant change in the unmet need between the 2006 and 2016 period was observed among those in the 35-39 age group, respondents who have no education, women whose husbands/partners are never away, those who live in Province 4, and those who fall in the poorest wealth quintile. Similarly, the decline in unmet need between the same period was also observed among those who had two or more daughters and those who had experienced one or more child losses. The analysis so far describes the unmet need at unadjusted level (Table 3).

[2] Stata code to calculate the 2012 version of unmet need in older surveys is available from the DHS website: https://dhsprogram.com/topics/unmet-need.cfm.

Table 3 **Distribution of unmet need by selected characteristics among currently married women age 15-49, Nepal DHS 2006-2016**

Characteristics of respondents	NDHS 2006		NDHS 2016		Difference between 2016 and 2006 (% change)	
Age of respondents						
15-19	37.8		34.9		-7.7	
20-24	33.2		32.6		-1.9	
25-29	26.7		30.0		12.3	
30-34	21.6	***	24.6	***	14.0	
35-39	22.1		17.1		-22.6	*
40-44	15.9		13.6		-14.9	
45-49	10.0		10.3		3.0	
Respondent's education						
No education	21.7		17.9		-17.2	*
Primary	27.7	***	26.4	***	-4.4	
Secondary	32.2		30.2		-6.1	
Higher	24.4		23.2		-4.9	
Husband/partner's education						
No education	19.4		17.4		-10.4	
Primary	26.1	***	21.8	***	-16.4	*
Secondary	27.7		28.0		1.2	
Higher	22.6		21.4		-5.4	
Caste/ethnicity						
Brahmin/Chhetri	26.2		25.1		-4.1	
Terai caste	18.0		19.6		8.5	
Dalits	27.7	**	27.7	**	-0.1	
Janajati	23.6		22.9		-3.2	
Others	31.1		25.8		-17.0	
Spousal separation						
Never away	16.4		10.4		-36.3	***
Away for less than one year	44.0	***	47.5	***	8.1	
Away for one year and more	58.9		51.7		-12.2	*
Number of household members						
1 to 5	24.1		24.4		1.2	
More than 5 members	25.3		22.8		-10.0	
Province						
Province 1	25.1		24.9		-0.6	
Province 2	21.3		20.6		-3.3	
Province 3	22.4		19.8		-11.6	
Province 4	37.1	**	30.0	***	-19.0	*
Province 5	26.1		27.9		6.6	
Province 6	26.1		25.7		-1.5	
Province 7	20.5		21.3		4.1	
Heard FP message on media (radio, TV or newspaper)						
No	23.2		23.7		2.0	
Yes, at least in one of the media	25.3		23.8		-5.8	
Wealth quintile						
Poorest	32.2		27.0		-16.0	*
Poorer	26.8		23.7		-11.5	
Middle	22.7	***	24.3	**	6.7	
Richer	23.3		23.8		1.8	
Richest	19.2		20.5		6.7	
Number of living sons						
None	26.8		25.7		-4.0	
One	28.6	***	27.9	***	-2.5	
Two or more	20.0		17.0		-15.1	
Number of living daughters						
None	24.9		24.7		-1.2	
One	25.2		25.4	***	0.9	
Two or more	24.1		20.5		-14.7	*
Number of child loss						
None	26.1	***	25.0	***	-4.2	
One or more	20.4		16.2		-20.3	*
Total	**24.7**		**23.7**		**-3.9**	
Total N	***8,257***		***9,875***			

*** p < 0.001, ** p < 0.01, * p < 0.05

3.1 Demand for Family Planning

Demand for family planning is a straightforward concept where demand indicates the sum of unmet need for family planning and the total contraceptive use (any method) (MOHP, New ERA, and ICF International 2007), the women not included in this measure are those who want to have a child soon, are pregnant/amenorrheic with a wanted pregnancy, or are menopausal/infecund. The distribution of the demand for family planning by selected characteristics of the respondents from both the NDHS 2006 and the NDHS 2016 is shown in Table 4. The table also shows the changes in the demand for family planning across the surveys by the characteristics of the respondents covered in the table.

The data in Table 4 show that the total demand for family planning in Nepal between 2006 and 2016 has increased by 5.1 percent, and this change is statistically significant. The disaggregated demand for family planning by selected characteristics of the respondents across surveys shows that almost all had significantly differing levels of demand for family planning across subgroup.

With respect to the percent change between 2006 and 2016, at least one category of each variable in Table 4 shows a significant increase in the demand for family planning in Nepal between 2006 and 2016. The highest increase was observed among woman age 45-49 (35%) followed by a moderate increase among those who belong to the poorest wealth quintile (17%). Like results for unmet need presented previously, the demand for family planning in Nepal between 2006 and 2016 in Table 4 portrays the results at the unadjusted level.

Table 4 **Distribution of demand for family planning by selected characteristics among currently married women age 15-49, Nepal DHS 2006-2016**

Characteristics of respondents	NDHS 2006		NDHS 2016		Difference between 2016 and 2006 (% change)	
Age of respondents						
15-19	53.8		58.0		7.9	
20-24	63.8		64.6		1.2	
25-29	75.1		75.9		1.0	
30-34	84.7	***	83.2	***	-1.7	
35-39	86.9		85.6		-1.5	
40-44	79.2		83.0		4.8	
45-49	55.9		75.7		35.4	***
Respondent's education						
No education	70.9		76.2		7.4	**
Primary	73.1	**	76.8		5.0	
Secondary	77.5		77.0		-0.5	
Higher	75.9		74.4		-1.9	
Husband/partner's education						
No education	66.6		73.3		9.9	**
Primary	73.0	***	77.5		6.3	*
Secondary	74.4		76.9		3.4	
Higher	81.9		76.3		-6.8	*
Caste/ethnicity						
Brahmin/Chhetri	75.0		79.3		5.7	**
Terai caste	64.9		71.1		9.7	*
Dalits	70.1	***	75.2	***	7.3	
Janajati	75.8		79.8		5.3	*
Others	61.6		58.2		-5.5	
Spousal separation						
Never away	73.5		78.0		6.2	**
Away for less than one year	69.7	*	72.5	***	4.0	
Away for one year and more	71.7		73.6		2.6	
Number of household members						
1 to 5	71.5		77.8	***	8.8	***
More than 5 members	73.7		74.1		0.6	
Province						
Province 1	77.6		80.0		3.2	
Province 2	63.6		68.3		7.4	
Province 3	78.2		80.5		2.9	
Province 4	75.6	**	78.5	***	3.9	
Province 5	71.8		75.9		5.7	
Province 6	68.7		76.8		11.9	*
Province 7	72.2		78.7		8.9	
Heard FP message on media (radio, TV or newspaper)						
No	64.2	***	72.9	***	13.6	***
Yes, at least in one of the media	75.9		79.9		5.2	**
Wealth quintile						
Poorest	65.0		76.1		17.1	***
Poorer	69.4		77.2		11.1	***
Middle	71.9	***	73.9	***	2.7	
Richer	76.2		73.9		-3.0	
Richest	80.1		80.8		0.9	
Number of living sons						
None	48.1		54.1		12.3	**
One	76.7	***	81.8	***	6.5	**
Two or more	84.1		87.6		4.2	**
Number of living daughters						
None	63.5		67.6		6.4	*
One	77.6	***	81.6	***	5.1	**
Two or more	76.2		79.9		4.8	*
Number of child loss						
None	73.6	**	76.4		3.7	*
One or more	69.6		76.3		9.6	**
Total	**72.7**		**76.4**		**5.1**	**
N	***8,257***		***9,875***			

*** p < 0.001, ** p < 0.01, * p < 0.05

3.2 Demand Satisfied for Family Planning with Modern Contraception

When there is a demand for family planning, the department of health services will want to know what proportion of the demand has been fulfilled with modern contraceptive methods. Demand satisfied in this study is categorized as a binary variable where those who are currently using a modern contraceptive method are coded as 1, which explains the family planning demand satisfied, and those who are using a traditional method or are not using a method of contraceptive and do not want to become pregnant are coded as 0, which explains the family planning demand not satisfied among those who had demand for family planning (also included in this group are pregnant and amenorrheic women classified as having an unmet need). Modem family planning methods include female sterilization, male sterilization, pill, intrauterine devices (IUD), injectables, implants, male condom, emergency contraception, lactational amenorrhea method (LAM), and other modern methods.

Table 5 shows that age, education of both women and their husbands, ethnicity, location, exposure to mass media, parity, and experience of child loss are all associated with demand satisfied for family planning in the 2016 survey. The table also reveals that the demand satisfied in Nepal has declined 8%, from 60.9%in 2006 to 56.1% in 2016. The largest increases in demand satisfied are seen among those whose husbands were away from more than 1 year and women in the poorest wealth quintile. Many groups saw decreases in demand satisfied between 2006 and 2016; the largest decreases were among women in the highest wealth quintile and women age 25-29.

Overall, between 2006 and 2016, we see a statistically significant increase in total demand, a statistically significant decrease in demand satisfied with modern methods among married women, and no change in unmet need in Nepal.

Table 5 **Trends in the distribution of demand for family planning satisfied among currently married women age 15-49 who have demand by survey year, Nepal DHS 2006-2016**

Characteristics of respondents	NDHS 2006		NDHS 2016		Difference between 2016 and 2006 (% change)	
Age of respondents						
15-19	25.7		25.0		-2.8	
20-24	43.6		37.0		-15.0	*
25-29	60.4		48.8		-19.2	**
30-34	68.7	***	57.0	***	-17.0	***
35-39	69.1		67.1		-3.0	
40-44	73.2		70.4		-3.8	
45-49	76.0		73.4		-3.4	
Respondent's education						
No education	65.5		67.9		3.8	
Primary	57.3	***	55.2	***	-3.7	
Secondary	50.8		44.7		-12.0	*
Higher	53.9		44.8		-16.9	
Husband/partner's education						
No education	67.1		69.7		3.9	
Primary	60.6	**	62.6	***	3.3	
Secondary	57.8		50.6		-12.6	**
Higher	58.9		49.7		-15.6	**
Caste/ethnicity						
Brahmin/Chhetri	57.7		51.1		-11.4	**
Terai caste	70.8		61.1		-13.7	**
Dalits	57.8	*	56.7	***	-1.9	
Janajati	63.5		58.7		-7.6	
Others	45.4		47.1		3.8	
Spousal separation						
Never away	71.3		68.9		-3.3	
Away for less than one year	34.9	***	31.3	***	-10.3	
Away for one year and more	17.9		27.2		52.2	*
Number of household members						
1 to 5	60.9		55.8		-8.4	**
More than 5 members	60.8		56.5		-7.1	
Province						
Province 1	59.4		50.1		-15.7	*
Province 2	63.8		61.8		-3.1	
Province 3	65.0		61.2		-5.9	
Province 4	45.7		47.5	***	3.9	
Province 5	58.4		51.3		-12.2	*
Province 6	58.3		57.9		-0.7	
Province 7	68.6		61.1		-10.9	
Heard FP message on media (radio, TV or newspaper)						
No	61.6		57.8	*	-6.2	
Yes, at least in one of the media	60.6		54.4		-10.2	**
Wealth quintile						
Poorest	46.6		55.0		18.0	*
Poorer	58.4		58.1		-0.6	
Middle	65.1	***	57.7		-11.4	
Richer	63.3		56.4		-10.9	**
Richest	67.3		53.2		-20.9	***
Number of living sons						
None	38.5		34.5		-10.3	
One	56.9	***	51.9	***	-8.7	
Two or more	71.8		71.5		-0.5	
Number of living daughters						
None	55.2		49.7		-9.9	
One	62.4	**	56.3	***	-9.9	**
Two or more	63.6		62.0		-2.5	
Number of child loss						
None	59.2	***	54.1	***	-8.6	*
One or more	66.2		67.6		2.1	
Total	**60.9**		**56.1**		**-7.9**	*
N	***5,999***		***7,539***			

*** p < 0.001, ** p < 0.01, * p < 0.05

3.3 Determinants of Unmet Need, Demand, and Demand Satisfied

Table 6 shows the adjusted levels, trends, and determinants of unmet need for family planning in Nepal. Columns one and two show the adjusted determinants of unmet need for family planning, and column three shows the differences in unmet need for family planning derived from the pooled logistic regression. The first category of each of the variables is the reference category.

The data shows that unmet need for family planning in both periods declines with the increase in the age of women. Unmet need for family planning was also found to increase with level of education, except among the higher education groups, in 2016. Husband's education shows a significant difference between none and primary education in 2006. The unmet need for family planning was found to be lowest among those belonging to the Terai caste ethnic group in 2006 and was significantly different from the reference category (Brahmin/Chhetri).

Spousal separation is found to be a highly significant factor in influencing the unmet need for family planning. The data shows that unmet need for family planning increases with the increase in the duration of spousal separation, which makes sense as women whose husbands have been gone for longer periods are less likely to continue using a method. Family size influenced unmet need for family planning only in the NDHS 2006. Unmet need for family planning was lowest in Province 7 and highest in Province 4 in 2006. Women in Provinces 7 and 2 had the lowest percentage of unmet need in 2016, controlling for other variables.

Unmet need for family planning and wealth quintile in 2006 shows a negative pattern, declining with the increase in wealth. In 2016, unmet need was highest among those belonging to thepoorest quintile, but there is not a statistically significant difference from the other wealth categories.

The number of living daughters and unmet need for family planning in both 2006 and 2016 shows a clear positive association. A similar pattern is observed in the NDHS 2006 for those who have lost a child compared to those who have not lost any of their children (Table 6).

Between 2006 and 2016, older women experienced more change in unmet need than younger women, which is clearly evident after controlling for the effects of other variables. Similarly, increased unmet need for family planning between the two periods was also found among those whose husband was away for less than one year compared to those whose husband was present at the time of the survey. Middle, richer, and richest wealth quintiles experienced greater changes in unmet need than the lowest quintile. The results show that unmet need for family planning in Nepal between 2006 and 2016 among certain groups of population is significantly changed, and some subgroups are changing faster than others.

Table 6 **Trends and adjusted effects of selected characteristics among currently married women age 15-49 on unmet need for family planning, Nepal DHS 2006-2016**

Characteristics of respondents	NDHS 2006 Odds Ratio	NDHS 2016 Odds Ratio	Difference between 2016 and 2006 Odds Ratio
Age of respondents			
15-19	Ref	Ref	Ref
20-24	0.5***	0.6***	1.3
25-29	0.3***	0.5***	1.8*
30-34	0.2***	0.4***	1.9*
35-39	0.2***	0.3***	1.3
40-44	0.1***	0.3***	1.8*
45-49	0.1***	0.2***	2.4*
Respondent's education			
No education	Ref	Ref	Ref
Primary	1.0	1.2*	1.2
Secondary	1.5***	1.5***	1.0
Higher	1.7*	1.2	0.7
Husband/partner's education			
No education	Ref	Ref	Ref
Primary	1.2*	1.1	0.9
Secondary	1.1	1.3*	1.1
Higher	1.2	1.1	0.9
Caste/ethnicity			
Brahmin/Chhetri	Ref	Ref	Ref
Terai caste	0.7*	0.8	1.2
Dalits	0.9	1.1	1.2
Janajati	0.9	0.9	1
Others	1.3	1.2	0.9
Spousal separation			
Never away	Ref	Ref	Ref
Away for less than one year	3.7***	7.2***	1.9***
Away for one year and more	7.6***	9.5***	1.2
Number of household members			
1 to 5	Ref	Ref	Ref
More than 5 members	1.2**	1.1	0.9
Province			
Province 1	Ref	Ref	Ref
Province 2	0.7	0.6**	0.9
Province 3	1	0.9	0.9
Province 4	1.4***	1.1	0.7
Province 5	0.9	1.1	1.2
Province 6	0.8	0.9	1.1
Province 7	0.6**	0.6**	1.1
Heard FP message on media (radio/ TV/newspaper)			
No	Ref	Ref	Ref
Yes, at least in one of the media	1	0.9	0.9
Wealth quintile			
Poorest	Ref	Ref	Ref
Poorer	0.7*	0.8*	1.1
Middle	0.5***	0.8*	1.4*
Richer	0.5***	0.8*	1.5*
Richest	0.4***	0.9	2.4***
Number of living sons			
None	Ref	Ref	Ref
One	1.8***	1.8***	1.0
Two or more	1.9***	1.5***	0.8
Number of living daughters			
None	Ref	Ref	Ref
One	1.4***	1.4***	1.0
Two or more	2.3***	1.7***	0.8
Number of child loss			
None	Ref	Ref	Ref
One or more	1.2*	0.9	0.8*
Intercept	0.4***	0.3***	0.4***

*** p < 0.001, ** p < 0.01, * p < 0.05; Ref: Reference Category

Table 7 **Trends and adjusted effects of selected characteristics among currently married women age 15-49 on demand for family planning, Nepal DHS 2006-2016**

Characteristics of respondents	NDHS 2006 Odds Ratio	NDHS 2016 Odds Ratio	Difference between 2016 and 2006 Odds Ratio
Age of respondents			
15-19	Ref	Ref	Ref
20-24	0.5***	1.7***	1.1
25-29	0.5***	1.8***	1.0
30-34	0.7***	0.6***	0.9
35-39	0.8***	0.6***	0.9
40-44	0.4***	2.2***	1.1
45-49	0.1***	0.2***	2.0**
Respondent's education			
No education	Ref	Ref	Ref
Primary	1.2*	1.2	1
Secondary	1.5**	1.6***	1.1
Higher	1.3	1.7***	1.3
Husband/partner's education			
No education	Ref	Ref	Ref
Primary	1.3*	1.2	0.9
Secondary	1.4**	1.3*	0.9
Higher	2.2***	1.3	0.6*
Caste/ethnicity			
Brahmin/Chhetri	Ref	Ref	Ref
Terai caste	0.7*	1.2	1.1
Dalits	1.1	1.1	1
Janajati	1.2	1.3***	1.1
Others	0.6*	2.6***	0.6
Spousal separation			
Never away	Ref	Ref	Ref
Away for less than one year	0.9	1.1	1.0
Away for one year and more	0.8	1.2**	1.0
Number of household members			
1 to 5	Ref	Ref	Ref
More than 5 members	1.0	1.1	0.9
Province			
Province 1	Ref	Ref	Ref
Province 2	0.7***	1.8***	0.9
Province 3	1.1	1.1	0.9
Province 4	0.9	1.3*	0.9
Province 5	0.7**	1.3	1.1
Province 6	0.7*	1.3	1.1
Province 7	0.9	0.8*	0.9
Heard FP message on media (radio/ TV/newspaper)			
No	Ref	Ref	Ref
Yes, at least in one of the media	1.4***	1.3***	0.9
Wealth quintile			
Poorest	Ref	Ref	Ref
Poorer	1.4**	1.3**	0.9
Middle	1.7***	1.3**	0.8
Richer	1.9***	1.3*	0.7**
Richest	2.0***	1.7***	0.9
Number of living sons			
None	Ref	Ref	Ref
One	4.5***	5.2***	1.2
Two or more	13.8***	15.5***	1.1
Number of living daughters			
None	Ref	Ref	Ref
One	2.5***	2.9***	1.1
Two or more	3.2***	3.5***	1.1
Number of child loss			
None	Ref	Ref	Ref
One or more	0.7**	1.2	1.1

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; Ref: Reference Category

Table 7 shows the association between selected characteristics of respondents from the NDHS 2006 and 2016 and demand for family planning, and the changes between these two periods after controlling for the effects of other variables considered in the table. Columns one and two in Table 7 show the adjusted determinants of demand for family planning, and column three shows the differences in demand for family planning between 2006 and 2016 derived from the pooled logistic regression. The first category of each of the variables is the reference category.

Looking at the age pattern of demand for family planning, controlling for other variables, in 2006 all age groups had significantly lower odds of having demand for family planning compared to women 15-19, while in 2016, women age 20-29 and 40-44 had significantly higher odds of demand for family planning compared to the youngest age group.

In general, the demand for family planning is higher for women with any education compared to those with no education in both years. For example, the demand for family planning in 2006 was highest among those with a secondary level of education followed by those who had a primary level of education, while in 2016, the demand for family planning was highest among those who had a higher level of education followed by those who had a secondary level of education. The demand for family planning among women in 2006 shows a positive correlation with husband/partner's education, while this pattern was not consistent among women in 2016 because only those who had a partner/husband with a secondary level of education had significantly higher odds of demand for family planning compared to women whose husbands had no education.

The demand for family planning by caste ethnicity in 2006 shows lower demand among those who belonged to Terai caste and other caste groups compared to Brahmin/Chhetris. In 2016, the highest demand for family planning was found among those who belonged to others and the Janajati group compared to Brahmin/Chhetris. In 2016, demand for family planning by spousal separation category finds demand for family planning is significantly higher among those whose husband/partner was away for one year and more compared to those whose husband was not away. This could be an artifact of the way demand is measured – women may not be able to have a child in the near future if their husband is not present.

The provincial level data shows that demand for family planning in Provinces 2, 5 and 6 in 2006 was statistically lower than in Province 1. In contrast, in 2016, the demand for family planning in Provinces 2 and 4 was statistically higher than in Province 1. This shows that the pattern of increased demand for family planning across provinces in 2006 and 2016 was not uniform.

Demand for family planning is statistically higher in both surveys among those who were exposed to family planning media messages compared to those not exposed. Statistically higher demand is seen for higher wealth groups compared to the poorest group. Higher demand with the increased number of living sons as well as number of daughters is clearly evident in both the 2006 and 2016 surveys. With respect to child loss experience, the demand is significantly lower among those who have lost their child compared to those who have not lost their child in 2006, but in 2016 there is not a significant difference.

The demand for family planning between 2006 and 2016 has significantly increased more rapidly for women age 45-49 compared to the change experienced by women 15-19. The demand for family planning during the same span of time has changed more slowly among those whose husbands/partners had a higher level of education compared to those whose husbands had no education. The richer wealth quintiles saw statistically less change than the poorest wealth quintile.

Table 8 shows the adjusted associations between selected characteristics of respondents from the NDHS 2006 and 2016 and demand for family planning satisfied, and the change in family planning demand satisfied between 2006 and 2016. Columns one and two in Table 8 show the adjusted determinants of demand satisfied, and column 3 shows the differences in demand satisfied between 2006 and 2016 derived from the pooled logistic regression. The first category of each of the variables is the reference category.

The analysis reveals that demand satisfied is significantly higher in older women compared to women 15-19, in both the NDHS 2006 and NDHS 2016. The change in demand satisfied among women age 25-34 compared to women 15-19 is significantly lower over the 10 years. Furthermore, the demand satisfied was lower among those whose husband/partner had secondary and higher education in 2016 compared to those who were not educated.

Demand satisfied among women belonging to Terai caste, Dalits, and Janajatis, in both the 2006 and 2016 surveys, was higher compared to Brahmin/Chhetri, though only significant in 2016 among the Janajatis. In contrast, demand satisfied among other groups was lower than Brahmin/Chhetri in 2016. The spousal separation variable shows that demand for family planning satisfied among those whose husband was away was lower than among those whose husband was not away in both years. Compared to Province 1 in 2006, demand satisfied in Province 4 was lower while it was higher in Province 7. In contrast, demand satisfied in all provinces in 2016 was higher compared to Province 1, with significant differences in Provinces 2, 3, 6, and 7.

Table 8 Trends and adjusted effects of selected characteristics among currently married women age 15-49 on family planning demand satisfaction, Nepal DHS 2006-2016

Characteristics of respondents	NDHS 2006 Odds Ratio	NDHS 2016 Odds Ratio	Difference between 2016 and 2006 Odds Ratio
Age of respondents			
15-19	Ref	Ref	Ref
20-24	2.1***	1.5*	0.7
25-29	3.5***	1.9**	0.5*
30-34	4.7***	2.2***	0.5*
35-39	4.2***	2.8***	0.7
40-44	4.7***	2.5***	0.5
45-49	4.7***	2.4***	0.5
Respondent's education			
No education	Ref	Ref	Ref
Primary	1.2	0.9	0.8
Secondary	1.0	0.8	0.8
Higher	0.8	0.8	1.0
Husband/partner's education			
No education	Ref	Ref	Ref
Primary	0.9	0.9	1.0
Secondary	0.9	0.7**	0.8
Higher	0.8	0.7*	0.9
Caste/ethnicity			
Brahmin/Chhetri	Ref	Ref	Ref
Terai caste	1.6*	1.1	0.7
Dalits	1.4*	1.2	0.8
Janajati	1.4*	1.5***	1.1
Others	0.6	0.6*	1.0
Spousal separation			
Never away	Ref	Ref	Ref
Away for less than one year	0.2***	0.2***	1.0
Away for one year and more	0.1***	0.2***	1.9**
Number of household members			
1 to 5	Ref	Ref	Ref
More than 5 members	0.7**	0.9	1.2
Province			
Province 1	Ref	Ref	Ref
Province 2	1.3	1.7***	1.4
Province 3	1.2	1.7***	1.4
Province 4	0.7*	1.1	1.5
Province 5	1.1	1.1	1.0
Province 6	1.5	1.7***	1.1
Province 7	2.3**	1.8**	0.8
Heard FP message on media (radio/ TV/newspaper)			
No	Ref	Ref	Ref
Yes, at least in one of the media	1.0	1.1	1.1
Wealth quintile			
Poorest	Ref	Ref	Ref
Poorer	2.1***	1.4**	0.7*
Middle	3.2***	1.5**	0.5**
Richer	3.3***	1.5**	0.5***
Richest	3.9***	1.1	0.3***
Number of living sons			
None	Ref	Ref	Ref
One	1.6**	1.6***	1.0
Two or more	2.5***	3.3***	1.3
Number of living daughters			
None	Ref	Ref	Ref
One	1.2	1.3**	1.1
Two or more	1.0	1.2	1.2
Number of child loss			
None	Ref	Ref	Ref
One or more	0.8**	1.0	1.2

*** p < 0.001, ** p < 0.01, * p < 0.05; Ref: Reference Category

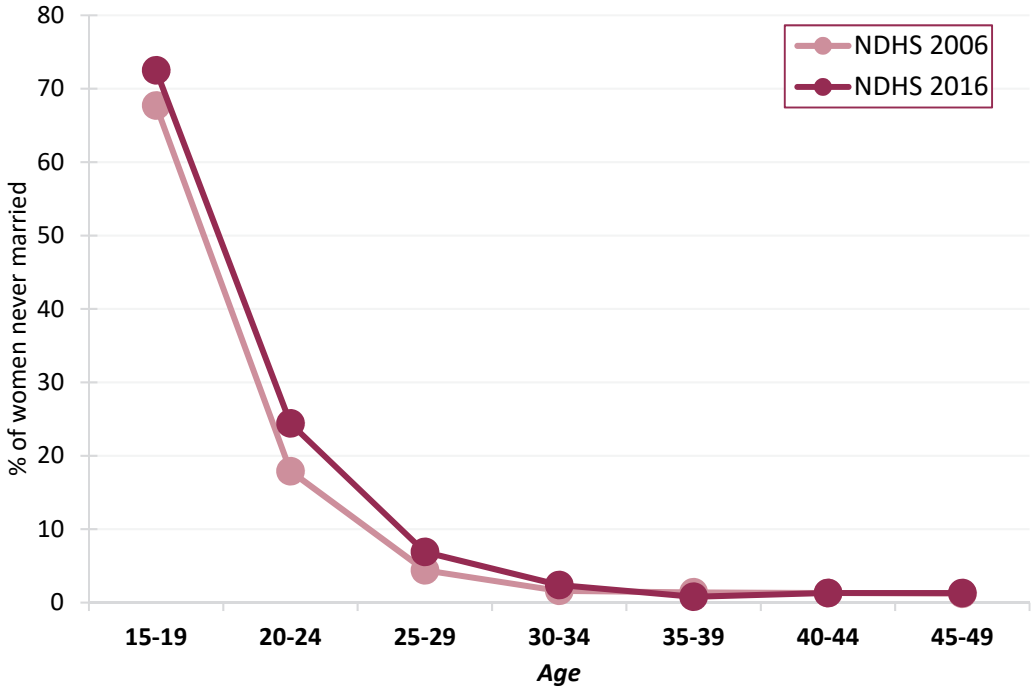
Wealth quintile and demand satisfaction show a positive association. For example, demand satisfaction in both surveys, except for the richest group in 2016, increases with the increase in the level of wealth quintile compared to the poorest group. Demand satisfied was also positively associated with the number of living sons in both surveys. Demand satisfied among those who have lost a child in 2006 was found to be lower than among those who have not lost a child.

Between 2006 and 2016, demand satisfied was found to have changed significantly less among women age 25-29 and 30-34 compared to the change among women 15-19. Women whose husband/partner was away for more than one year saw a larger change in demand satisfied compared to women whose husbands were not away.

4 PROXIMATE DETERMINANTS OF FERTILITY

Fertility is one of the three major components of population dynamics (along with mortality and migration) and has a major role in determining the size, structure, and composition of a population. The total fertility rate (TFR) is the number of live births per woman if the woman has the current age-specific fertility rates through her childbearing years (age 15-49). Fertility in Nepal between 2006 and 2016 has declined from 3.1 to 2.3, a decline of almost one child per women. What factors led the decline in fertility between 2006 and 2016 is a matter of interest among policy makers and decision makers. During the period, modern contraceptive use was almost stagnant (44% in 2006 and 43% in 2016). The median age at marriage for women age 25-49 increased from 17 to 19.9. The proportion of those who were never married in 2016 has increased since 2006, except among those age 35-44, for whom marriage is near universal (Figure 3).

Figure 3 Proportion of never married women by age, Nepal DHS 2006-2016



4.1 The Model

The proximate determinants of fertility were first suggested by Davis and Blake (1956) to understand the biological and behavioral factors through which social, economic, and environmental variables affect fertility. The Bongaarts (1978) framework proposed a model incorporating only seven variables termed the "proximate determinants of fertility". Of the seven variables, Bongaarts and Potter (1983) found that 96% of the variation in the total fertility of 41 countries studied was explained by four principal proximate determinants: marriage (C_m), contraception (C_c), induced abortion (C_a) and postpartum infecundability (C_i).

The proximate determinants model suggested by Bongaarts (1978) explains the relationship between the total fertility rate and the proximate determinants of fertility. The model assumes that the natural reproductive capacity of all fecund women (total fecundity) is nearly the same for all women, which in

actual life is altered by proximate determinants. The fertility effects of the proximate determinants in the model is expressed as:

$$TFR = C_m \times C_c \times C_a \times C_i \times TF$$

Where

TFR = total fertility rate
TF = total fecundity
C_m = index of non-marriage
C_c = index of contraception
C_i = index of postpartum infecundability
C_a = index of induced abortion

In this study the index of spousal separation (C_{sep}) is added to examine the effect of Nepal's large amount of spousal separation due to male migration on fertility (MoLE 2018, Sijapati and Limbu 2013, Sijapati, Bhattarai, and Pathak 2015), and the model is modified as:

$$TFR = TF * C_m \times C_c \times C_i \times C_a \times C_{sep}$$

4.1.1 Total Fecundity (TF)

Total fecundity (TF) is the total fertility rate in the absence of the fertility-inhibiting effects of the proximate determinants. Bongaarts estimates the TF of most populations falls within the range of 13 to 17 births per woman, with an average of about 15.3 (Bongaarts 1978). In this study the Bongaarts average TF value is used.

4.1.2 Total Fertility Rate (TFR)

TFR is the observed total fertility rate interpreted as the average number of children a woman would have during age 15-49 if she survived that age range, and follows the current age-specific fertility rates. It is calculated using the birth history data collected by the DHS, and includes births and exposure time of women over the 3 years preceding the survey.

4.1.3 Index of Marriage (C_m)

C_m shows the reduced exposure to the risk of conception due to non-marriage between the ages of 15 and 49 (Bongaarts 1978). C_m is the ratio of the TFR to the total marital fertility rate (TMFR), that is (C_m = TFR/TMFR), where TMFR equals the number of births a woman would have at the end of her reproductive years if she survives the reproductive span of life and remains married following the current fertility schedule. The index of marriage C_m equals 1 if all women of reproductive age are married, and equals 0 in the absence of marriage. In summary, most births in Nepal occur within marriage, and therefore marriage marks the beginning of a woman's exposure to the risk of childbearing. The index of marriage measures the effect of non-marriage on reducing fertility, and women delaying marriage and thus delaying childbearing.

4.1.4 Index of Contraception (C_c)

C_c shows the reduced exposure to the risk of conception; contraception equals 1 in the absence of any use of contraception, and 0 if all fecund married women use 100% effective contraception. The effects of contraception depend on use effectiveness (e) of contraception, which measures the protection from unintended pregnancy of contraception as practiced by individual users. The index is calculated by

weighting age-specific, method-specific prevalence rates by the effectiveness of each method. C_c is derived from the equation developed by Bongaarts (1978): [C_c = 1–1.08 * u * e], where u is the overall proportion of married women currently practicing contraception; e is the weighted average of contraceptive use effectiveness using the proportions of current contraceptive users of each method as weights; 1.08 is a sterility correction factor (some women in a population know they are unable to become pregnant and therefore do not use contraception). The index measures the proportionate reduction in marital fertility due to contraceptive use within marriage.

For contraceptive use efficacy, Aisch and Marsh (2014) calculated the probabilities of pregnancy while using each method, alone, for up to 10 years. In this study, since the fertility rate is calculated based on the births in the 3 years preceding the survey, the contraceptive use efficacy applied corresponds to the second year probabilities suggested by Aisch and Marsh (2014).

4.1.5 Index of Postpartum Infecundability (C_i)

C_i shows the reduced exposure to the risk of conception due to postpartum infecundability, referred to as postpartum insusceptibility in this paper. This index equals 1 in the absence of breastfeeding; it is smaller with longer breastfeeding and postpartum abstinence. This index describes the reduced risk of exposure to conception because of extended breastfeeding. Bongaarts (1978) quantified this effect with the formula [C_i = 20/18.5 +i], where i is the mean duration of postpartum insusceptibility.

4.1.6 Index of Abortion (C_a)

C_a shows the reduced exposure to the risk of birth due to abortion. This index equals 1 in the absence of abortion and 0 if all pregnancies are aborted. In many countries, abortion is illegal or legal only in certain cases, making it difficult to obtain reliable and valid data on induced abortion. NDHS is unique in that it asks women in the reproductive calendar if terminations or pregnancies were intended or unintended, thus making it possible to calculate the total abortion rate (TAR) in the same manner that TFR is calculated.

C_a is calculated as

$$C_a = \frac{TFR}{TFR + 0.4(1+u)TAR}$$

where in the absence of contraceptive use an abortion averts 0.4 births, but averts more births with increased contraceptive use following abortion and effective methods (U).

4.1.7 Index of Separation (C_{sep})

One of the interests of this paper is to examine the effect of spousal separation (the proportion of married women whose husbands are not living with them) on fertility, as these women may have different exposure to pregnancy compared with women who are living with their husbands. To examine the effect of spousal separation on fertility, this study has calculated the index of exposure, denoted as C_{sep} described by Blanc (2004):

> *It is the ratio of the TMFR to a fertility rate that excludes births and exposure to conception among women who are not currently residing with their spouses. It represents the hypothetical number of children that women would have if all married women lived with their spouses continuously and had children at the same rate as women who were currently living with their spouses. The index provides a measure of the potential fertility-reducing effect of married couples living apart. One note is that the TFR is calculated over the 3-year period before the survey, but the information on migration is at the time of*

the survey (if the spouse is gone and how long they have been away). Therefore, we are not able to directly measure when a husband was away over the 3-year observation window but has since returned.

In this calculation, women whose husbands were away for less than 1 year are considered a husband not away because these women are assumed to be equally exposed to fertility as women whose husbands are not away.

4.1.8 Residual factor

Johnson et al. (2011) argue that, if unmeasured components of the model are dropped (assumed to be 1), they are implicitly consolidated with TFR, making it harder to interpret TFR. In their study (Johnson et al. 2011) they modified the formula to express the fact that the observed TFR and the calculated C values may not be consistent with a fixed TF, as TF is set at an arbitrary but plausible value, 15.3. As the authors suggest, a residual adjustment, R, can be calculated as follows:

$$R = TFR/(15.3 \times C_m \times C_c \times C_i \times C_a \times C_{sep})$$

It can be interpreted as a multiplicative adjustment to TF = 15.3 that would be required to achieve internal consistency of the model.

4.1.9 Total fertility-inhibiting effect accounted for proximate determinants

The difference between the TF, taken as 15.3 in NDHS 2006 and NDHS 2016, and the estimated TFR of the respective surveys is attributed to the result of the inhibitory effect of each variable in the respective surveys. The total inhibiting effect is derived by the proportion of the logarithm of each index to the sum of logarithm of all indices (Wang et al. 1987).

Effect of marriage = $[TF - TFR\ (estimated)] \times \log_e C_m \ / \ \log_e C_m + \log_e C_c + \log_e C_i + \log_e C_a + \log_e C_{sep}$

Effect of Contraception = $[TF - TFR\ (estimated)] \times \log_e C_c \ / \ \log_e C_m + \log_e C_c + \log_e C_i + \log_e C_a + \log_e C_{sep}$

Effect of Postpartum Infecundability = $[TF - TFR\ (estimated)] \times \log_e C_i \ / \ \log_e C_m + \log_e C_c + \log_e C_i + \log_e C_a + \log_e C_{sep}$

Effect of abortions = $[TF - TFR\ (estimated)] \times \log_e C_a \ / \ \log_e C_m + \log_e C_c + \log_e C_i + \log_e C_a + \log_e C_{sep}$

Effect of spousal separation = $[TF - TFR\ (estimated)] \times \log_e C_{sep} \ / \ \log_e C_m + \log_e C_c + \log_e C_i + \log_e C_a + \log_e C_{sep}$

TFR (estimated) = $15.30 * C_m \times C_c \times C_i \times C_a \times C_{sep}$

4.1.10 Decomposition of the changes in fertility

The NDHS 2006 and 2016 representative samples of women of reproductive age have similar methods and coverage, and permit the construction of comparable variables that can be used to study changes and determinants of fertility between the two surveys. The decomposition equation given below allows us to quantify the contribution of each of the proximate determinants of fertility to the observed change in fertility between two timepoints.

$$P_f = P_m + P_c + P_i + P_a + P_{sep} + P_r + I$$

where P represents proportional change in the TFR due to change in marriage patterns (P_m), contraception (P_c), postpartum infecundability (P_i), abortion (P_a), spousal separation (P_{sep}), residual

(other proximate determinants) (P_r), and the I or an interaction term (Bongaarts and Potter 1983). The P values are computed from the indices of the proximate determinants of fertility as follows:

$P_f = (TFR_{2016} / TFR_{2006}) - 1$: proportional change in TFR between 2006 and 2016.
$P_m = (Cm_{2016}/Cm_{2006}) - 1$: proportional change in TFR due to change in the index of marriage.
$P_c = (Cc_{2016}/Cc_{2006}) - 1$: proportional change in TFR due to change in the index of contraception.
$P_i = (Ci_{2016}/Ci_{2006}) - 1$: proportional change in TFR due to change in the index of postpartum infecundability.
$P_a = (Ca_{2016}/Ca_{2006}) -1$: proportional change in TFR due to change in the index of abortion.
$P_{sep} = (Csep_{2016}/Csep_{2006}) -1$: proportional change in TFR due to change in the index of spousal separation.
$P_r = (Cr_{2016}/Cr_{2006})- 1$: proportional change due to changes in the remaining proximate variables—natural fecundability, spontaneous intra-uterine mortality.

4.1.11 Proximate determinants of fertility in Nepal DHS 2006-2016

Table 9 shows the indices of the proximate determinants of fertility from the Bongaarts indices: the index of non-marriage; the index of contraception; the index of postpartum insusceptibility; the index of abortion; the index of separation; and the product of the five, along with the residual adjustment R described above as a consolidation of unmeasured proximate determinants. The lower the estimated value of the indices, the larger the fertility reduction effect. The predicted fertility rate before the residual factor is included to compare with the observed TFR for the 3 years prior to the survey.

Table 9 Trends in the estimates of different indices of fertility, Nepal DHS 2006-2016

Survey year	2006	2016
Observed fertility (TFR)	3.14	2.35
TF	15.30	15.30
C_m	0.75	0.67
C_c	0.54	0.51
C_i	0.65	0.66
C_a	0.98	0.92
C_{sep}	0.93	0.83
$C_m*C_c*C_i*C_a*C_{sep}$	0.24	0.18
Predicted Fertility Rate	3.63	2.69
Residual	0.86	0.87
TF-TFR Estimated	11.67	12.61

TFR: Total fertility rate (observed), TF: Total Fecundity, C_m: Index of proportion married, C_c: Index of non-contraception, C_a: Index of induced abortion, C_i: index of postpartum infecundability, C_{sep}: index of spousal separation.

Table 9 shows the trends in the estimates of different indices of fertility where smaller values indicate greater effects. The analysis shows that the observed TFR in Nepal declined from 3.14 births per women in 2006 to 2.35 in 2016, a decline of 25%. The index value of all except C_i (index postpartum insusceptibility) has declined in 2016 compared to 2006, indicating that the decline has contributed to the reduction in fertility from 2006 to 2016. The index value of C_i (postpartum insusceptibility), in contrast, shows a small, negative influence in the fertility decline observed between the 2006 and 2016. With respect to the effect of spousal separation, the index value declined substantially between 2006 and 2016, which indicates that spousal separation had a major influence in the observed decline in fertility between 2006 and 2016.

Between surveys, the postpartum infecundability (the period of time during which a woman is considered not at risk of pregnancy because she is postpartum amenorrheic and/or abstaining from sexual intercourse) declined from 12.3 months in 2006 to 11.6 months in 2016. Correspondently, C_i index in 2006 and 2016 has respectively increased only slightly from 0.65 to 0.66. Accordingly, C_i has little contribution to the change in fertility in Nepal between 2006 and 2016. In contrast, the index values of other proximate determinants – C_m, C_c, C_a, and C_{sep} – have declined from 0.75 to 0.67, 0.54 to

0.51, 0.98 to 0.92, and 0.93 to 0.83, making them the major contributors to the decline in the fertility between 2006 and 2016.

4.1.12 Fertility-inhibiting effects of the proximate determinants

To estimate the fertility-inhibiting effects of the proximate determinants: marriage, contraception, induced abortion, postpartum infecundability, and spousal separation, the formulas described in earlier sections are applied. The summary measures, which are needed for the application of the model, are presented in Table 10. The second column shows the trend for each proximate variable of fertility for the periods of 2006 and 2016. The results indicate that an estimated 11.67 births per woman were inhibited in the 2006 data: 2.32 were due to the effect of delayed marriage, 5.02 to the use of contraception, 3.50 to postpartum infecundability, 0.20 to abortion, and 0.62 to the effect of spousal separation. Similarly, in 2016, 12.61 births were inhibited, of which 2.88 were due to later marriage, 4.81 to contraception, 2.96 to postpartum infecundability, 0.57 to abortion, and 1.39 to the effect of spousal separation (Table 10).

Table 10 Fertility-inhibiting effect, births per women, and percent distribution of fertility-inhibiting effect, Nepal DHS 2006-2016

Proximate determinants	Fertility-inhibiting effect		Births per women		Percent distribution of fertility-inhibiting effect	
Survey Year	*2006*	*2016*	*2006*	*2016*	*2006*	*2016*
C_m	0.20	0.23	2.32	2.88	19.9	22.8
C_c	0.43	0.38	5.02	4.81	43.0	38.2
C_i	0.30	0.24	3.50	2.96	30.0	23.5
C_a	0.02	0.05	0.20	0.57	1.7	4.5
C_{sep}	0.05	0.11	0.62	1.39	5.3	11.0
TF-TFR Estimated			11.67	12.61	100	100

TFR: Total fertility rate (observed), TF: Total Fecundity, C_m: Index of proportion married, C_c: Index of non-contraception, C_a: Index of induced abortion, C_i: index of postpartum infecundability, C_{sep}: index of spousal separation.

The percent distribution of the fertility-inhibiting effect in Table 10 indicates that in 2006 13.6% of births were inhibited by marriage pattern, 38.8% by contraception, 20.6% by breastfeeding and postpartum abstinence, 8.1 by abortion, and 18.9 by spousal separation. Similarly, in 2016, 15.5% were inhibited by marriage pattern, 35.5% by contraception, 16.0% by breastfeeding and postpartum abstinence, 11.8% by abortion, and 21.2% by spousal separation.

Table 11 Decomposition of changes in total fertility rate, Nepal DHS 2006-2016

Changing indices	2006-2016	Remarks
P_f	-25.08	Change in total fertility rate
P_m	-10.55	Change due to marriage
P_c	-4.40	Change due to contraception
P_i	2.33	Change due to breastfeeding
P_a	-5.21	Change due to abortion
P_{sep}	-10.84	Change due to spousal separation
P_r	-1.30	Change due to other factors not included in the model
P_{int}	4.89	Change due to interaction

Table 11 shows the decomposition of change of all indices in TFR between 2006 and 2016. The TFR in Nepal between 2006 and 2016 has declined from 3.14 to 2.35, a decline of 25.1% or 0.79 births. The table also reveals that of the total decline in fertility between 2006 and 2016, 10.8% was due to spousal separation, 10.6% to change in marriage, 5.2% to abortions, and 4.4% to contraception. Breastfeeding mitigated the decline in TFR, and in the absence of other proximate determinates would have contributed to an increase in TFR by 2.3%. The residual proximate determinants together contribute about 1.3% of the decline in TFR.

In summary, after adjusting for differences in marriage, contraceptive use, infecundability, and abortion between the two survey rounds, the data indicate that the change in spousal separation factor, as defined by Blanc (2004), played a major role in the observed decline in fertility in Nepal between 2006 and 2016. The marriage index was second in importance, and abortion index was third, followed by contraception. Breastfeeding showed no effect on the decline in fertility in Nepal between 2006 and 2016.

5 DISCUSSION

This paper has examined the levels, trends, determinants of unmet need for family planning, FP demand and demand satisfied, and their changes between 2006 and 2016 by selected socioeconomic and demographic characteristics of the respondents as a part of the further analysis of the follow-up to the 2016 Nepal Demographic Health Survey. The major aim of the analysis was to explore factors associated in explaining the changes in unmet need for FP, demand for FP, and FP demand satisfied to inform the Government of Nepal in its plans to formulate and polish upcoming programs and policies to improve the quality of reproductive life of mothers in the country. Furthermore, the study also explores the proximate determinants of fertility in Nepal that explain the decline in fertility in the country between 2006 and 2016.

5.1 Trends in Unmet Need and Demand for Family Planning Satisfied

The unmet need for family planning in this study was calculated using the definition of unmet need described in Bradley et al. (2012). The data show that unmet need in Nepal has not changed significantly between 2006 and 2016. During the same span of time the demand for modern family planning satisfied has decreased from 61% to 56%, a scenario the reverse of that expected. Unmet need levels of 25% or more are considered very high, and this could sometimes indicate a lack of access to contraceptive supplies and services in developing countries (Sedgh et al. 2016). One reason for the lack of change in unmet need is the high rate of spousal separation. By definition, unmet need assumes married women are exposed to the risk of pregnancy. If many women in a population are not using contraception because their husbands are away, and because of this separation also intend to wait several years before their next birth, they can be recorded as having an unmet need, even if they are not actually in need due to lack of exposure to pregnancy.

The recent nationally representative Nepal Health Facility Survey (NHFS) (MoH et al, 2017b) found that although all facilities providing FP services in Nepal were able to provide male condoms, oral contraceptives, and injectables to clients at the facility, only about one in five were providing IUDs and implants at the facility. Furthermore, the NHFS also reveals that health facilities in the Terai region were less likely to receive family planning commodities on time than facilities in the hill and mountain regions despite the fact that road networks and transportation facilities in Terai are better compared to other regions. This indicates that unmet need for FP can be reduced in the country by strengthening the timely supply of required FP commodities in the facilities in different corners of the country, and increasing the choice of FP methods.

5.2 Factors Associated with Unmet Need, Demand for Family Planning (FP), and Demand for FP Satisfied

The cross-sectional data analysis show that almost all of the explanatory variables in the 2006 and 2016 studies were significantly associated with unmet need for family planning, demand for family planning, and demand for family planning satisfied.

The unmet need for family planning among women in age groups 25-29, 30-34, 40-44, and 45-49 between 2006 and 2016 has significantly increased, and this result is the reverse of what was expected. At the same time the demand satisfied among women aged 25-29 and 30-34 has significantly decreased, which is again the opposite of what was expected. The NDHS 2016 provides the reasons for discontinuing a FP method. The data revealed that three out of every five women who began using a

contraceptive method in the 5 years before the survey discontinued the method within 12 months due to the husband being away (47%), followed by side effects or health concerns (18%) and the desire to become pregnant (13%) (MOH, New ERA, and ICF 2017). A study of multiple DHS surveys between 2005 and 2014 from 52 countries (Sedgh et al. 2016) also revealed that the most common reasons a married woman cited for not using contraception despite wanting to avoid a pregnancy were concerns about contraceptive side effects and health risks, followed by infrequent sex, and family member opposition. Therefore, the increase in the unmet need among these groups of women could largely be due to inability to reach them, or inability to provide their choice of methods, reflected in the declining FP demand satisfied indicator between 2006 and 2016, as well as assuming all married women have a need for contraception, which may not be the case if their husband is away.

The analysis also reveals an increase in the unmet need for family planning between 2006 and 2016 among those whose spouse was away for less than 1 year compared to women whose husbands are present: [Odds: 3.7–7.2]. It is a well-known phenomenon that those husbands who are away for less than 1 year are likely to return home time and again, and, in such a situation, they may not have access to the quick family planning services, leading to an increase risk of pregnancy. This phenomenon persists despite the fact that the demand satisfied among these groups of people between the same span of time has increased compared to women whose husbands are present [Odds: 0.1–2.0]. This again could be due to the FP service or commodity supply problem.

Unmet need for family planning between 2006 and 2016 was also found to have declined among those who have lost one or more children compared to those who had not lost a child [Odds: 1.2–0.9]. This decline could be because those whose child has died may want to have another child, resulting in no need for family planning. The 2016 NDHS (MOH, New ERA, and ICF 2017) shows that 13% of those who were using a method discontinued due to a desire to become pregnant.

In 2006 and 2016, women in the poorest wealth quintile had the highest risk of unmet need, though in 2016 the odds ratios were closer to 1 (suggesting a reduced difference between the groups). The odds ratios for demand satisfied are high in 2006, showing higher odds of demand satisfied for wealthier women compared to the poorest quintile. In 2016, the odds ratios were statistically significant for the three middle quartiles, compared to the lowest quartile. These results could be the indication of persistent, but reduced inequality by wealth.

5.3 Fertility

The analysis shows that the observed TFR in Nepal declined from 3.14 births per women in 2006 to 2.35 in 2016, a decline of 25.1% or 0.79 births. Of the total decline in fertility between 2006 and 2016, 10.84% was due to spousal separation, 10.55% was due to marriage, 5.21% was due to abortions and 4.40% was due to contraception. Breastfeeding mitigated the decline in TFR, and in the absence of other proximate determinates would have contributed to an increase in TFR by 2.3%. The residual proximate determinants together contribute about a 1.3% decline in TFR. Therefore, spousal separation seems to have played a major role in the observed decline in fertility in Nepal between 2006 and 2016, followed by changing marriage patterns, abortion, and contraception.

5.4 Recommendations

Based on the research findings, this study provides the following recommendations to achieve the desired outcomes on unmet need, demand for FP and FP demand satisfied, and fertility.

- Increase FP commodity supply and services to increase access to FP methods and choices for users. This can increase the demand for FP satisfied as well as reduce the level of unmet need for family planning.

- Improve counseling on method-specific side effects and method choice. The 2016 NDHS shows that in the last 5 years 18% of the women discontinued contraceptive use because of side effects, 5.9% were searching for a more effective method, and 0.7 lacked access. More counseling can help these women choose an appropriate method and understand the risks of side effects.

- Exposure to family planning messages in the media was not effective in influencing the change in unmet need between 2006 and 2016. Identify new and diverse means of communications should be identified to target individuals with information on family planning.

- Increase educational access for women, which could increase the use of contraceptives and decrease unmet need for family planning.

- Increase access for underserved groups through targeted campaigns and community health workers.

- Increase contraceptive use and promote later marriage to reduce unintended pregnancies and births.

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APPENDIX

Appendix Table A1 Percent distribution of study population by their selected sociodemographic characteristics, Nepal DHS 2006-2016

Characteristics of respondents	NDHS 2006	NDHS 2016
Age of respondents		
15-19	9.5	7.1
20-24	19.4	17.1
25-29	20.1	19.8
30-34	15.3	17.5
35-39	13.7	15.3
40-44	12.3	13
45-49	9.5	10.2
Respondent's education		
No education	61.9	40.3
Primary	17.0	18.8
Secondary	18.4	29.3
Higher	2.7	11.6
Husband/partner's education		
No education	25.5	16.2
Primary	27.7	21.9
Secondary	38.4	43.9
Higher	8.4	18
Caste/ethnicity		
Brahmin/Chhetri	31.2	29.4
Terai caste	12.5	17.8
Dalits	12.6	12.8
Janajati	37.8	34.5
Others	5.9	5.4
Spousal separation		
Never away	73.6	66
Away for less than one year	19.4	17.2
Away for one year and more	6.9	16.7
Number of household members		
1 to 5	48.8	60.2
More than 5 members	51.2	39.8
Province		
Province 1	16.3	16.8
Province 2	19.3	22
Province 3	18.8	19.4
Province 4	10.7	9.6
Province 5	15.1	17.7
Province 6	5.3	5.9
Province 7	14.4	8.6
Heard FP message on media (radio, TV or newspaper)		
No	27.9	50.7
Yes, at least in one of the media	72.1	49.3
Wealth quintile		
Poorest	18.6	17.1
Poorer	19.9	19.7
Middle	21.2	21.1
Richer	19.9	21.3
Richest	20.5	20.7
Number of living sons		
None	24.6	26.5
One	34.9	40.6
Two or more	40.4	32.9
Number of living daughters		
None	31.7	34
One	32.3	37.1
Two or more	36.0	28.9
Number of child loss		
None	75.2	85.4
One or more	24.8	14.6
Total *N*	***8,257***	***9,875***