University of Southampton

Faculty of Social Statistics and Demography

School of Economic, Social and Political Sciences

Isolation and Social Change:

Assessing the Nature and Determinants of Fertility Change in Myanmar

by

Anne Corbit Blauvelt Schuster

Master of Public Health

Thesis for the degree of Doctor of Philosophy

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Abstract

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Historic fertility declines across Asia suggest that significant social change and the institutional provision of family planning are necessary preconditions for reducing fertility, but Myanmar's fertility decline took place during a time of authoritarian control and conflict, and prior to the introduction of government family planning programs. This thesis integrates classical demographic methods with geospatial measures of physical and social remoteness and conflict exposure to understand how these factors interact with and potentially influence sexual and reproductive decision making and fertility outcomes in Myanmar. Using newly released census and Demographic Health Survey data, this thesis begins by presenting methods for estimating fertility in Myanmar at several administrative levels, including the introduction of a Myanmar-specific standard fertility schedule. The associations between district level social and demographic characteristics and total fertility are assessed, demonstrating the importance of social and physical remoteness on fertility. Next, factors associated with fertility are examined using the proximate determinants of fertility framework. The social and economic factors associated with entry into marriage are then explored. Finally, the thesis combines individual level reproductive health and fertility data with geolocated conflict-event data to further examine the relationships between conflict exposure and fertility. Ultimately, it is through these processes that this thesis describes fertility changes across Myanmar, contributing to a deeper understanding of how classical demographic theory can be understood and applied to fragile states.

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Research Thesis: Declaration of Authorship

Print name:	Anne Corbit Blauvelt Schuster

Title of thesis:	Isolation and Social Change: Assessing the Nature and Determinants of Fertility Change in Myanmar

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
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Schuster, A., Hinde, A. and Padmadas, S. (2019) The geography of changing fertility in Myanmar, *Demographic Research*, 41, pp. 37-52.

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Schuster A, Padmadas S, Hinde PRA. Missing marriage? Changing marriage patterns in the context of rapid fertility decline in Myanmar. Oral presentation: Marriage & fertility patterns in less developed countries. 2018 British Society for Population Studies Annual Conference, Winchester, UK.

Schuster A, Padmadas S, Hinde PRA. Mapping the divergence and dynamics of fertility transition in Myanmar using census and population survey data. Oral Presentation: Methods using limited, deficient, and defective data. 2017 XXVIII IUSSP International Population Conference, Cape Town, South Africa.

Signature:		Date:	

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Abbreviations

ACLED	Armed Conflict Location and Event Data
ASFR	Age-Specific Fertility Rate
ASMR	Age-Specific Mortality Rate
CDR	Crude Death Rate
CPR	Contraceptive Prevalence Rate
DHS	Demographic Health Survey
DMPA	Depomedroxyprogesterone Acetate
FRHS	Fertility and Reproductive Health Survey
GDP	Gross Domestic Product
IDP	Internally Displaced Person
IUD	Intrauterine Device
IMR	Infant Mortality Rate
IOM	International Organization for Migration
iTFR	Implied Total Fertility Rate
IUSSP	International Union for the Scientific Study of Population
MICS	Multi-Indicator Cluster Survey
MIMU	Myanmar Information Management Unit
NGO	Non-Governmental Organization
PAC	Post-Abortion Care
PCFS	Population Changes and Fertility Survey
P/F	Parity/Fertility
RHSP	Reproductive Health Strategic Plan
SAA	Self-Administered Area
SMAM	Singulate Mean Age at Marriage
TAR	Total Abortion Rate
TF	Total Fecundity Rate
TFR	Total Fertility Rate
TMFR	Total Marital Fertility Rate
TNM	Total Natural Marital Fertility Rate
U5M	Under-5 Mortality Rate
UACD	Uppsala Armed Conflict Dataset
UCDP	Uppsala Conflict Data Project
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commission on Refugees
UNICEF	United Nations Children's Fund
UNODC	United Nations Office on Drugs and Crime

Chapter 1 Background and Introduction to Research

1.1 Introduction

Myanmar recently conducted its first population survey in more than 30 years, releasing sub-national level data on population, social and housing conditions across the country. Initial examination of these data shows that the country has nearly reached replacement fertility, with a total fertility rate (TFR) of 2.2. This represents a substantial fertility decline between to two most recent censuses, with the 1983 Census reporting a TFR of 4.73.

Fertility declines for a multitude of reasons, which are different for every country or setting. However, when fertility approaches replacement there are normally high rates of family planning use, substantial improvements in socioeconomic indicators, and changes in marriage patterns (Bongaarts and Potter, 1983; Easterlin and Crimmins, 1985). Many of the countries with fertility around 2.1 are socioeconomic and political leaders. At first glance, Myanmar appears to fall outside of this pattern and differs from neighbouring countries like Thailand, Malaysia and Indonesia, where fertility decline was achieved through rapid social and economic development, effective national family planning programmes and other cultural shifts including women's empowerment and a weakening of intergenerational influences on reproductive decisions (Jones, 2007).

Myanmar stands out for its rapid and pronounced fertility decline without early institutionalization of family planning. Fertility decline in the country likely began in the 1970s with a drop in the TFR from 5.96 in 1970 to 3.58 in 1989 and 3.04 in 1995 (Maung, 1986; Myint, 1991; Tint, 1991; Spoorenberg, 2013; World Bank, 2019). Three quarters of the decline in the TFR appear to have taken place before 1992, when there was no or limited state provision of family planning and during a period when Myanmar was experiencing conflict, civil unrest and political instability (Figure 1-1). Furthermore, although education rates in Myanmar are high and the age of marriage is consistent with other low-fertility countries, the country's health indicators are poor and great regional and ethnic disparities exist. As a result, the mechanisms through which Myanmar achieved a reduction in fertility remain unclear.

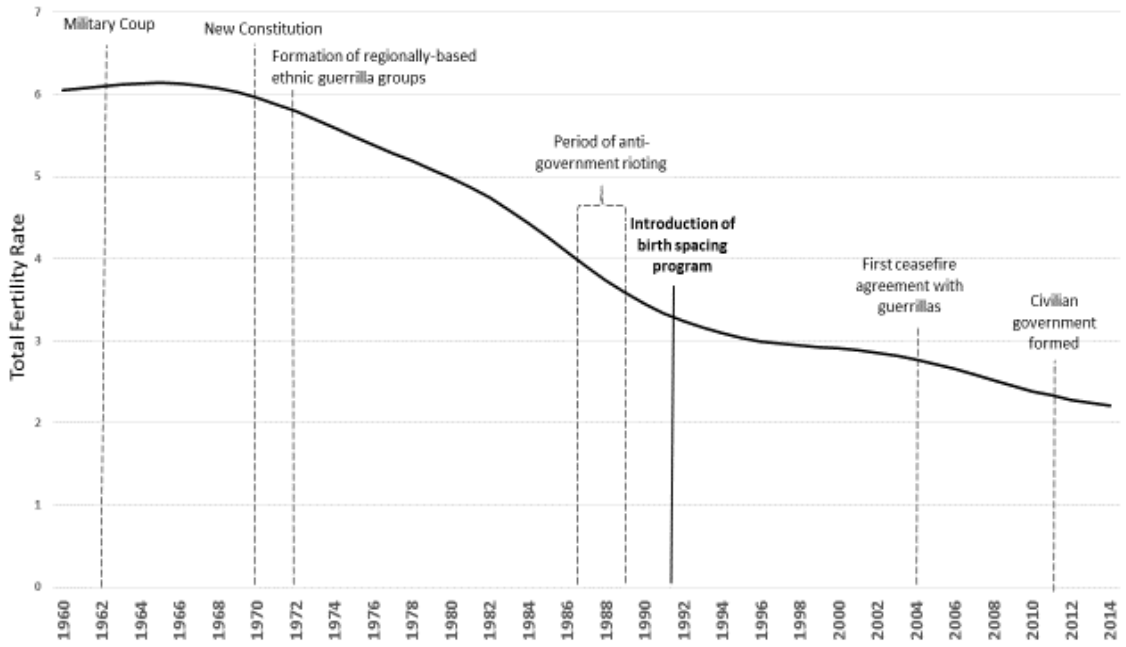


Figure 1-1. Timeline of major events and fertility change
Sources: TFR Projections (World Bank, 2019) with key events in recent history added by author (Smith, 1991; Myanmar Profile – Timeline, 2019)

Considering the social and health situation in Myanmar, the country's fertility decline was likely driven by improvements in female education, changing marriage patterns, and increasing urbanisation and social connectivity. However, internal disparities are widening across Myanmar, with economic and social development severely affected by ongoing armed conflict in remote, peripheral areas. In addition to hindering the diffusion of fertility limiting ideas and behaviours to these areas, conflict may influence how individuals and communities view fertility, changing the way couples make decisions about childbearing. Using data from the 1983 and 2014 Censuses, and Myanmar's Demographic Health Survey, this thesis identifies regional and demographic trends in fertility before describing the social and political changes taking place in the country that can be linked to fertility differentials across time and space within Myanmar. Ultimately, it is through these processes that this thesis presents options for applying traditional demographic theory to fragile states with the aim of expanding global understanding of the mechanisms influencing fertility in the absence of family planning.

1.2 Country overview

1.2.1 Geography

Myanmar in located in Southeast Asia, bordered to the east by Thailand, Lao and China, and to the west by India and Bangladesh. Border relations differ widely, allowing for an especially porous border along the east (Grundy-Warr & Wong, 2002), while movement across international borders to the west remains more challenging. Only land border crossings between Myanmar and Thailand remain accessible to foreigners on a regular basis and borders between Myanmar and its international neighbours are often closed to all migrants. However, these restrictive borders actually represent an opening of trade and migration between Myanmar and its neighbours. For example, the IOM estimates that the number of emigrants from Myanmar to Thailand has increased by around 90% over the past twenty-five years (International Organization for Migration, 2016). More recently, the military junta leading the country for much of its existence began to step back, allowing for "free" elections and a loosening on policies restricting international business and trade (Myanmar Profile – Timeline, 2018). However, borders remain restricted and movement within and outside of the country remains limited when compared to neighbouring countries.

Within Myanmar, there are 21 administrative sub-divisions; seven regions (also known as divisions, depending on the period) and seven states, one union territory (Nay Pyi Taw), and six self-administered areas (SAAs). Regions and states are a part of the same administrative level and are subdivided into 73 districts and 330 townships (Map 1-1) (General Administrative Department, 2018). These administrative areas have evolved over the last several decades. In 2008, a constitutional reform established a new capital of Nay Pyi Taw, and the six ethnicity-based SAAs, which combined ethnic majority townships into semi-autonomous areas. Five SAAs are in Shan state, while the last lies along the Indian border in northern Sagaing. SAAs have their own local governments, similar to those found at the district level in the rest of the country (Republic or the Union of Myanmar, 2008). Although ostensibly managed by the central government and its local representatives, the local administration and non-government stakeholders (for example armed groups may have more power in SAAs) play a role in managing each of these different administrative areas.

Map 1-1. States/regions and townships of Myanmar
Source: Myanmar Information Management Unit, 2007

Regions/divisions and states tend to differ in topography and culture. The states of Chin, Shan and Kachin have mountainous terrain and few major roads connecting remote areas to major urban areas. Tanintharyi, in the country's far south, has a completely different climate with relatively low elevation and substantial rainfall - nearly four times more rain fell annually on average in Tanintharyi than in Chin from 2000-2009 (Central Statistical Organization, 2010). In the central regions spanning from Yangon to Mandalay, elevation is low and neither temperatures nor annual rainfall represent national extremes.

The vast differences in topography and climates have resulted in substantial cultural variety across the country. The 1931 Indian census notes natural geologic divisions, which fostered the growth of a variety of tribes, now 135 officially recognized by the Burmese government, confined to small geographic areas. The census report described the Chin group of the western frontier as living sparsely, with the "wild nature" of the region effectively isolating the group from the rest of the nation (Bennison, 1933). An ethnography of highland culture conducted in the early 1900s emphasized the variation of ethnic groups and the rift between highland and lowland societies. Anthropologist E.R. Leach (1964) found an absence of lingual connections between the two broad groups (highland areas now being states and lowlands being modern regions) that explained differences in everything from cooking supplies to farming methods and ritual behaviour. Beyond the bigger differences between highland and lowland groups, Leach noted small but significant differences among individual highland groups (Leach, 1964).

There is evidence that some of these differences remain, with the gaps widening between traditional communities and rapidly modernizing urbanites. One example is the dramatic differences in housing conditions reported in the 2014 Census across the country. More than 45% of households in Kayin state indicated that they used candles as their main source of lighting, compared to only 7% in Yangon (Department of Population, 2015). Additionally, 57% of households in Chin and 55% in Rakhine lacked access to any form of digital communication in the home. This compares to only 17% of households in Yangon (Department of Population, 2015).

1.2.2 Population changes

Since establishing its current borders in the early 1940s, the population of Myanmar has nearly tripled. Trends suggest that population growth gained momentum following independence (annual growth rate over 10%), but has more recently begun to stabilize, reaching a population of just over 50 million in 2014. This pattern runs counter to previous government estimates, which

assumed greater population momentum and a growth to between 45 and 64 million by 2003 (Myint, 1991; Tint, 1991) and to approximately 60 million people by 2010 (Spoorenberg, 2013).

According to the 2014 Census, around one-third of the country's residents live in the urban regions of Yangon, Mandalay and Nay Pyi Taw. Chin state has the fewest residents, less than 500,000 people or approximately 1% of the country's total population. However, other border areas are more populous, with 12% of the population (approximately 5.8 million people) living in Shan state (Department of Population, 2015). Population growth in Yangon has led the country's overall growth: the population of Yangon grew by 86% from 4.0 million in 1983 to 7.4 million people in 2014. However, the two states/regions with the second greatest population growth are peripheral states. The population of Kayah increased from 1.7 million in 1983 to 2.9 million in 2014, and Shan's population grew from 3.7 million to 5.8 million people over the same period (Immigration and Manpower Department, 1986; Department of Population, 2015). The growing populations in these peripheral areas highlight the importance of identifying strategies for reaching communities in these areas, which are often remote and have poorer health and social outcomes.

Although the population increased by more than 80% between the 1983 and 2014 censuses, population growth has been slower than projected by the government and past researchers. The reasons behind this deceleration of population growth are explored in more detail in Chapter 3, but likely include a combination of rapidly declining fertility, persistently high mortality rates, and increasing emigration out of Myanmar to neighbouring countries.

1.2.3 Health system

Although centrally managed by the Department of Health, local administration has a great deal of power regulating Myanmar's health system (Figure 1-2). At the township level, township hospitals serve catchment areas of between 100,000-300,000 people and are overseen by a township health authority (Grundy *et al.*, 2014). At the village level, each township is expected to have four

or five sub-rural health centres where a midwife oversees the work of volunteer health workers, including auxiliary midwives and community health workers (Myanmar Ministry of Health, 2010).

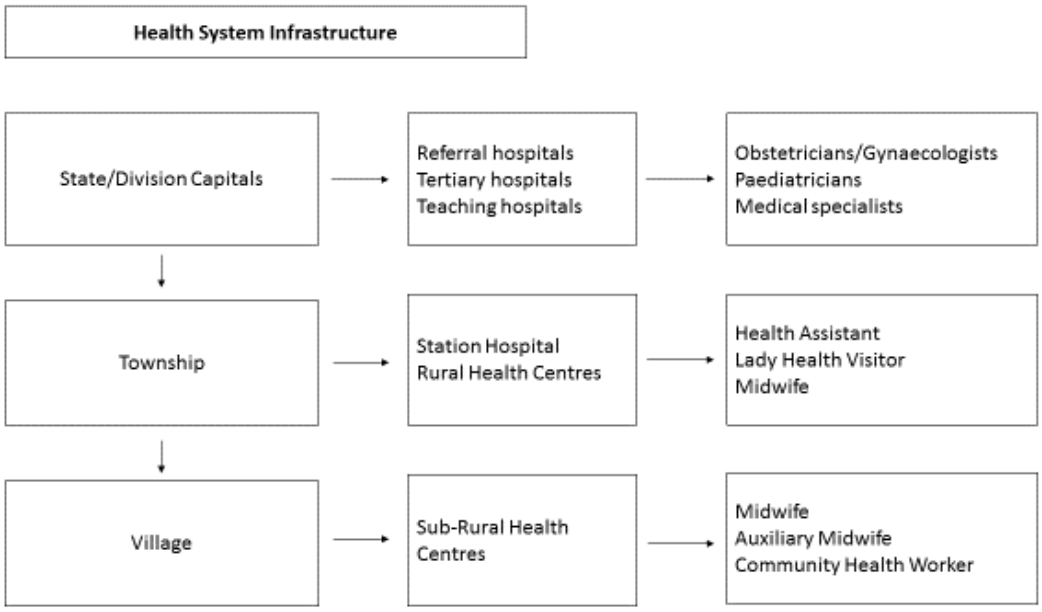


Figure 1-2. Overview of health system
Source: Adapted by the author from information in Grundy *et al.* (2014) and Myanmar Ministry of Health, 2010

The actual number of facilities and beds varies across the country. For example, Ayeyarwady Region had the lowest bed to population ratio in 2014 of 0.51 bed per 1,000 population, while Chin State, which usually shows some of the lowest health indicators, has the highest bed to population ratio of 2.07 beds per 1,000 (Myanmar Statistical Information Service, 2015). While this indicator provides basic information on the presumed availability of services, it does not account for quality or level of care at facilities. While beds may be available in Chin, data from the most recent multiple indicator cluster survey (MICS) showed low utilization of health services: only 38.9% of women delivered with the help of skilled provider and only 49.4% of children received all three rounds of the diphtheria, pertussis and tetanus vaccine (Ministry of National Planning and Economic Development and UNICEF, 2011).

Additionally, the majority of health facilities offering maternal and reproductive health services in Chin, northern Shan, and eastern Shan are more than 21 miles from the closest medical depot (Department of Medical Research and UNFPA, 2016), severely limiting access to supplies and essential medicines. Possibly as a result of stock outs, the nation saw a significant fall in the number of health facilities providing life-saving maternal and reproductive health medicines, such

as magnesium sulphate and oxytocin, between 2014 and 2015 (Department of Medical Research and UNFPA, 2016).

With the help of international consultants and organizations, the Department of Health has made efforts over the past few decades to strengthen the health system. For example, the government recently committed to a transition to decentralizing control and removing some military power over state decision making and to providing universal health coverage (Grundy *et al.*, 2014). The government's efforts to decentralize may lead to improvements in health outcomes if ethnic minorities are able to engage in local politics and lead efforts to reform health systems in their communities, and if the country can transition from a donor-funded, project-based approach to a systems-based approach to health care delivery. However, if local governments in ethnic-minority and rural areas are led by members of the Burmese elite, or if local governments are not able to take on the management of health systems in areas where international aid agencies provide care through targeted programs, devolution may further marginalize poor and hard to reach communities.

1.2.4 Conflict history

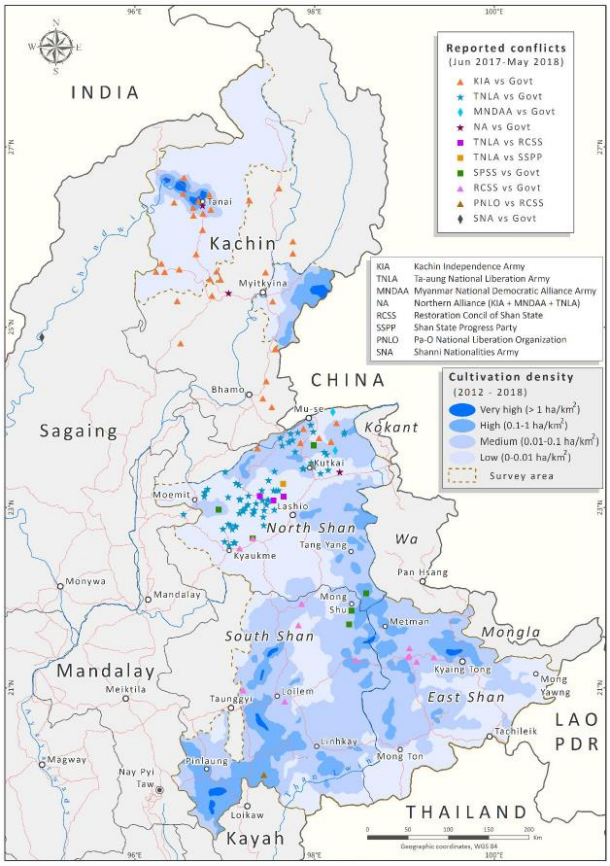
In the 1950s, Myanmar gained its independence from the United Kingdom and established itself as an independent nation state. Ethnic Burmese, who made up the majority of the population and resided in the central, more economically stable plains, ran the government. Clashes between the Burmese government and traditional community and tribal leaders in the highlands began almost immediately following independence. The clashes between groups were legitimized by the government's *Pya Ley Pya (Four Cuts)* campaign, introduced in the 1960s and still in effect today. Under *Four Cuts*, the country was divided into nine military zones, with each zone given a colour: black for entirely insurgent-controlled areas; brown for disputed areas; and white for conflict free areas (Smith, 1991).

In Black Zones, soldiers are empowered to do harm, having the right to shoot opposition forces on sight (Footer *et al*., 2014). This is a decision that often includes the targeting of aid workers and medical personnel attempting to bring supplies to villages in disputed zones (Footer *et al.*, 2014). Household surveys conducted in disputed zones found widespread reports of killings, torture, rape, false imprisonment, disappearances and other persecution based on race or ethnicity (Sollom *et al.*, 2011). Even in Chin, in eastern Myanmar where conflict is generally less extreme, researchers found that more than one-third of all households reported a least one human rights

violation in the past year. These primarily include destruction or seizure of food, livestock and crops. The researchers found significant associations between forced labour and higher infant, under-five and crude mortality rates. They also linked higher prevalence of moderate to severe acute malnutrition among children to displacement (Parmar *et al.*, 2014).

These poor health outcomes may be due to the limitations on the availability of basic health services during times of conflict. Health workers from Kachin and Kayin have described a "general climate of insecurity and fear" for civilians and health care providers alike (Footer *et al.*, 2014). They face a number of risks, including: demands for bribes, confiscation of medications and medical supplies, arrest and attack or interference at clinics and have indicated that trauma and acute care demands limit their ability to provide preventative care (Footer *et al.*, 2014).

The recent distribution of armed conflict events is explored in greater detail in Chapter 7, but data on conflict in Myanmar show that despite ceasefires, armed clashes continue to take place throughout border states, and in areas of higher elevation (Burke *et al.*, 2017). Peacekeeping efforts are further hampered by the country's drug trade. Myanmar is one of the largest producers of opiates in the world, second only behind Afghanistan. The government and the United Nations Office on Drugs and Crime (UNODC) estimate that organized crime, most of which relates to the production and sale of illegal drugs, generates approximately $12.6 billion per year with the opiate economy alone contributing between 1.5%-3.3% of the country's annual gross domestic product (United Nations Office on Drugs and Crime, 2018). Most production (around 90% in 2018) takes place in Shan state, which remains engaged in armed conflict despite ceasefire agreements (Map 1-2). A UNODC survey investigating the characteristics of poppy growing villages in 2015 found that



Map 1-2. Locations of armed conflict events and opiate cultivation, 2012-2018
Source: United Nations Office on Drugs and Crime, 2018

these villages were almost twice as likely to report nearby militia activity as non-poppy growing villages (United Nations Office on Drugs and Crime, 2015). The presence of opium production in conflict areas undoubtedly contributes to the continued insecurity in the region, as well as being associated with higher utilization of illicit drugs and the associated health risks.

As a result of the ongoing conflict, humanitarian groups estimate that as of early 2016 there were between 375,000-644,000 internally displaced persons (IDPs) living in six IDP camps in eastern Myanmar (United Nations High Commission for Refugees, 2019; Internal Displacement Monitoring Centre, 2019; Thailand Burma Border Consortium, 2016). In addition to the support from IDP camps in the region, a 2012 ceasefire between the government and 10 of the 11 main insurgent groups in the region has led to reports of a fragile and gradual improvement in conditions in eastern Myanmar (Footer *et al.*, 2014). However, renewed violence against Rohingyas living in Rakhine State in western Myanmar threatens to disrupt the peace process. The Rohingyas are a predominantly Muslim group ethnically similar to the population of neighbouring Bangladesh. While Rohingya's are estimated to make up more than 90% of the population of Rakhine, they are often discriminated against and undercounted due to their citizenship status. Rohingyas are not one of the 135 ethnic groups officially recognized by the government of Myanmar and even families that have lived in Rakhine for generations may not automatically be granted citizenship (Arakan Project, 2012). As a result of renewed, extreme, violence in mid-2017 more than 700,000 Rohingyas were estimated to have fled Rakhine for pre-existing refugee camps in Bangladesh between August 2017 and April 2019, with more than 900,000 currently living in refugee camps along the Myanmar-Bangladesh border (International Organization for Migration, 2019). Although this creates an obvious humanitarian emergency, it is important to note that major events in and displacement from Rakhine began after all data for this thesis had been collected.

1.2.5 Women's Status

Throughout the nineteenth century, women's status in Burmese society was lauded as higher than, and more progressive than, the status of women in other societies throughout Asia. Western travellers to the region noted that Burmese women had more autonomy than others from nearby regions because of their freedom of movement outside of the home, access to education, occasional participation in market or field work and ability to divorce their spouses (Khaing, 1984; Ikeye, 2005/2006). The concept of the liberated Burmese woman persisted well

into the Twentieth Century. However, the relative freedoms experienced by women in Myanmar compared to the rest of Asia have become less clear as traditional roles remain intact amidst rapid social and economic development.

For the purposes of this thesis, special attention should be paid to traditional and contemporary marriage and household roles for women, including their access to education and workforce engagement. Unlike in neighbouring countries, women in Myanmar have traditionally held relative power in marital decision-making and were less likely to marry in childhood or early adolescence. For example, the 1931 Census for Burma notes that child marriage was effectively non-existent in Burma, but common amongst Indian and Bengali populations. The Census notes that for 14-16 year old females, 84% of Hindus in Bengal, 77% of Hindus in Bihar and Orissa states of India, and nearly 90% of Muslim females in Bengal were listed as married during the most recent census. This compared to less than 1% of Burmese females in the same age group (Bennison, 1933).

Although marriage is an expected life event for women and remaining unmarried carries negative social stigma, more recent research with women in Myanmar has found that most women expect to marry between the ages of 21 and 25, with arranged marriages an option but not an expectation (Belak, 2002). This is reflected in population surveys and census data, which have found that the mean age at marriage for women in Myanmar has been above 21 years old for at least the past fifty years (Maung, 1986).

Perhaps because women have married later in Myanmar than neighbouring countries, female education rates have increased in tandem with male education rates across the country. In 1973, 60.2% of men and 68.3% of women had no formal education (Maung, 1986). By 2014, this had fallen to 12.1% of men and 12.5% of women (Department of Population, 2015). However, a recent review of text books used for grades 1-7 found that the educational system may help perpetuate conflicting social norms for girls by depicting them helping with domestic work at home and studying, but not being active or serving as leaders (Thein, 2015). This is reflected in education and employment trends in the country. Census and population survey data show that since the turn of the 21st Century, women have been more likely than men to complete university but only half of all women aged 25-50 in 2014 were employed compared to around 90% of men (Department of Population, 2015).

These differences in education and employment status demonstrate a long-standing, traditional, set of gender roles within Myanmar, which contradict and create tension with the concept of "high status" women in the country in today's modernising society. More recent scholarship on gender and women's status in Myanmar highlights this tension and points to the ideological concept of *Hpon* (also referred to as *Pon*), an abstract concept derived from Theravada Buddhism that establishes the religious superiority of men, and often leads to an institutionalized belief in male superiority (Thein, 2015; Miedema, 2016). While this thesis does not include a deep exploration of gender relations and female empowerment in Myanmar, it acknowledges the conflict created by acceptance of concepts like *Hpon* and the efforts of the government to encourage and enable women equal access to education and promote relatively relaxed marriage and employment norms. The role of changing access to female education and employment in the absence of changing social norms on marriage and fertility is explored in more detail in Chapter 6, but a greater sociological research into gender roles and stereotypes in Myanmar would greatly contribute to our growing understanding of social change and fertility in the country.

1.3 Theoretical considerations

Classic demographic transition theory states that a country experiencing a demographic transition will begin in a pre-transitional state with both high mortality and high fertility. As the country industrializes, health will improve and mortality will decline. This leads to an initial surge in population as births outnumber deaths. In time, industrialization and urbanisation put pressure on families to provide food, housing and other services for their children at increasingly higher costs. This pressure, along with changing beliefs about ideal family size and the value of larger families, causes couples to limit their fertility, ultimately leading to a stabilization of population growth (Farooq and Simmons, 1985).

While early tests of the theory supported this pattern, assessments were generally limited to European and other western countries. The assumption was that modernization meant westernization and that fertility decline could not take place until this process had started. Some have harshly criticized these assumptions, arguing demographic change should be studied in a more subjective light, examining individual social, cultural and economic factors affecting fertility on a country or regional basis, rather than attempting to apply overarching theories to global shifts (Davis and Blake, 1956; Caldwell, 1976; van de Walle, 1992). Indeed, it does appear that the developing world follows a similar pattern on the whole (mortality declines first, followed by

fertility leading to population stabilization/decline), but there have been some exceptions. For example, the theory has been challenged by examples of rapid transition followed by stalls in decline in at least fourteen countries across geographic regions (Bongaarts, 2005) and by fertility decline below replacement across Western Europe and East Asia (Farooq and Simmons, 1985; Kirk, 1996).

The explanation for the mechanisms fuelling demographic transition, especially related to fertility change, vary. Explanations focus on changes to family structure and the nuclearization of families (Caldwell, 1976; Coale, 1983). Others point to the conceptualization of numeracy of children, arguing that a fertility decline cannot take place without a conscious decision being made by couples about limiting the children they have to a specific ideal family size, rather than a "few" children or as many children as come (Coale, 1983; van de Walle, 1992). Finally, some emphasize the importance of changing socioeconomic situations in a society on fertility outcomes. This school of thought examines fertility from a supply and demand perspective, arguing that increases and decreases in the costs, both psychic and market, of children determine a couple's likelihood of limiting or spacing pregnancies and childbirths (Easterlin and Crimmins, 1985).

Across theories, the key to testing and interpreting demographic change is the identification of determinants of fertility, both direct and indirect. Several frameworks for assessing determinants have been introduced. While the details of each framework differ, they collectively support examination of fertility through an assessment of risk of exposure to conception and pregnancy throughout a woman's reproductive lifespan (Davis and Blake, 1956; Bongaarts and Potter, 1983; Cleland and Hobcraft, 1985).

Direct determinants of fertility include societal and biological elements that limit exposure to intercourse and conception (for example, age at marriage, age at menarche, spousal separation) and elements determining timing and spacing of pregnancy (such as the use of contraception, postpartum amenorrhea, and spontaneous and induced abortion rates) (Davis & Blake, 1956; Bongaarts & Potter, 1983; Cleland & Hobcraft, 1985). In this thesis, direct determinants of fertility are considered in Chapter 5, primarily through the lens of the intermediate variables and proximate determinants frameworks, explained in more detail below.

The intermediate variables framework considers factors through which cultural conditions affect the reproductive processes of intercourse, conception and childbirth. Davis and Blake offer up eleven potential factors that may have additive or negative effects on total fertility over a

woman's life. Bongaarts takes a similar approach, but focuses on only four main indicators affecting exposure to conception and childbirth into which all other determinants can be grouped (Bongaarts, 1978; Bongaarts and Potter, 1983). The proximate determinants model is used extensively when discussing fertility change, in part because of the useful mathematical model provided by Bongaarts to empirically explore the relationships between the proximate determinants and fertility. However, the simplicity of Bongaarts' model loses some of the ability of the intermediate variables framework to explore variation in sexual and reproductive health behaviour across settings.

Both models focus on several direct determinants of fertility. These include societal and biological elements that limit exposure to intercourse and conception (for example, age at marriage) and elements determining timing and spacing of pregnancy (for example, use of contraception) (Davis and Blake, 1956; Bongaarts, 1978**;** Bongaarts and Potter, 1983; Cleland and Hobcraft, 1985). Bongaarts' model includes four factors only: age at marriage, contraceptive use, postpartum amenorrhea, and induced abortion rates. He argues that these four factors are the most important, and most easily measured, of those proposed by Davis and Blake, and presents a model to explain variation in total fertility in a given population using the measurement of these factors alone. While this model is useful, this thesis considers whether or not discussion of the additional seven variables presented by Davis and Blake (including: permanent celibacy, time between unions, voluntary and involuntary abstinence, voluntary and involuntary infecundity, and involuntary foetal mortality) add value to our understanding of fertility change in Myanmar.

Chapter 5 provides a deeper discussion of how each proximate determinant contributes to fertility, and describes intercensal changes in contraceptive use, average breastfeeding length, total abortion rates and marriage patterns. However, to better explain fertility change in Myanmar, this thesis builds upon the proximate determinants of fertility and the intermediate variables frameworks to derive a theoretical framework specific for the country. To do this, the thesis considers how each direct variable may also be acted upon by indirect determinants. Indirect determinants are understood to include socioeconomic, environmental, cultural, and other factors related to a couple's life. These determinants vary significantly by individual society, but tend to include female education and employment, urban/rural residency, wealth status and more. These characteristics have been linked to fertility, often acting to influence behaviour that directly determines fertility (Cleland and Hobcraft, 1985).

The main framework used for this thesis, explored in the next section, considers several indirect determinants of fertility. For example, improved access to education for girls and female workforce engagement have been cited as reasons for changing marriage and fertility patterns across Asia (Choe & Retherford, 2009; Jones, 2004; Ono, 2003) and may be contributing to similar change in Myanmar. Generally, there is a negative relationship between female education and fertility, with the number of children born decreasing as maternal education increases. However, there is some evidence of higher fertility among the wealthiest, best educated women. This finding supports home economic theories which argue that wealth can overcome the high opportunity cost and direct costs of childbearing (Cleland & Hobcraft, 1985).

Higher male education may indicate that the man is more likely to live at home (is not a seasonal migrant) and may therefore increase coital frequency. In contrast, greater female education may increase the likelihood that the mother works outside of the house which is often tied to lower fertility (Cleland & Hobcraft, 1985). These trends may also be linked to improved understanding and access to family planning methods and changes in individuals' professional or lifestyle goals, which may be unfavourable to children (Easterlin & Crimmins, 1985).

As discussed earlier in this chapter, female education rates in Myanmar have increased substantially over the past several decades. While employment rates have also increased, women are still less likely to work than men. Increases in female enrolment in higher education have followed a trajectory that is roughly inverse of fertility decline in the country. This suggests that female education, and possibly workforce engagement, is an important indirect determinant of fertility in Myanmar. A deeper examination of the role of changes in access to education as an indirect determinant of fertility are explored in more detail in Chapter 6, which focuses on the relationships between the indirect determinants of education and workforce engagement and the direct determinant of marriage.

Other commonly considered indirect determinants of fertility that may be relevant in Myanmar, but which are not explored in great detail in this thesis, include maternal nutrition and wealth. Malnutrition in particular has been found to be linked to the onset of menarche and may contribute to intrauterine mortality. However, the long-term impact of malnutrition on fertility may be limited, with subfecundity often quickly reversible with the introduction of nutritional supplements (Lindstrom & Berhanu, 1999; Holck & Cates, 1982; Bongaarts, 1980). Acute malnutrition on the other hand, caused by draught or famine has been shown to influence period fertility (Bongaarts, 1980; Lindstrom & Berhanu, 1999) by impacting maternal health, contributing

to higher rates of anaemia during pregnancy, and declines in child survival (Holck & Cates, 1982). Malnutrition appears prevalent across Myanmar, but data are primarily only available for child malnutrition. Due to the limited availability of data on maternal nutrition in Myanmar, this thesis does not explore how malnutrition contributes to fertility in the country.

Additionally, changes in personal wealth may affect fertility in Myanmar. There is evidence that fertility may remain high in pre-transitional or transitional societies because it is economically rational (Cain, 1980; Coale, 1983; Caldwell, 1976). For those subscribing to a home economics model of fertility, this means assigning a utility function to children. Couples take actions to ensure a maximum utility of children, considering the number and quality of children and their quantity of other goods (Farooq & Simmons, 1985). During socioeconomic development, the utility from having children remains constant but the cost of having children increases, leading to reduced cost/benefit of having another child. Demographers have further expanded on the rising costs of having children by including supply side inputs such as biology and culture, which may create different natural upper fertility limits for different groups (Easterlin & Crimmins, 1985), female education and employment, and economic security (Farooq & Simmons, 1985).

Compared to neighbouring countries, Myanmar has similar economic indicators. The Gross Domestic Product (GDP) in Myanmar in 2014 was $1,203.80 per person, compared to $1,581.5 in India, $1,203.80 in Cambodia, $1793.50 in Laos and $1,086.8 in Bangladesh. However, Myanmar's economy is outperformed by China ($7,590) and Thailand ($5,977.4) (World Bank, 2016). There is some evidence that Myanmar's economy has grown faster than those of similar countries in the region (Chan & Taylor, 2012). While this may have supported fertility decline to below replacement, the improvements in GDP may have started too recently to have contributed to the initial decline in fertility and scarce data on sub-national changes discourage more detailed examination of wealth as a driving force of fertility change in the country.

This thesis expands on these common determinants to create the Myanmar-specific framework by drawing on diffusion theories to consider how fertility decline spreads across the country. In order to understand how these theories intertwine in Myanmar, several non-traditional indirect determinants of fertility must first be discussed.

1.3.1 Remoteness

Although Myanmar's central regions have large urban centres, much of the country remains very remote. As explored in later chapters, populations living in especially remote areas exhibit the country's highest fertility rates, demonstrating the need to better understand how remoteness affects fertility in the country. In recent years, two different approaches to measuring remoteness have emerged. The first includes primarily spatial measures, for example distance from an urban centre. The other approach considers how socio-economic and behavioural characteristics of individuals and communities influence their ability to access goods and services (Information and Research Branch, 2001). Some argue that the later approach, which includes socio-economic characteristics, leads to difficulties in interpretation. However, examination of physical distance from urban centres alone may miss important relationships and predictors of remoteness. In Myanmar, for example, physical distance from other communities or urban centres is important, but understanding disparities, particularly in digital and social remoteness has become increasingly important (Copus, 2009). These definitions tie directly into ongoing discussions of the diffusion of fertility limiting behaviour as an innovation.

From Lesthaeghe's analysis of fertility change across Belgium to Watkins' research of fertility change across a multitude of European states and Kluesner *et al.*'s dissection of Swedish fertility data, analysis of sub-national fertility data have shown the importance of both physical and social remoteness to the fertility transition (Lesthaeghe, 1983; Watkins, 1991; Kluesner *et al*., 2016). In particular, Watkins' (1991) observation that provinces experiencing delayed fertility transition often lay along international borders or in mountainous areas, and typically did not share linguistic ties with the majority population of the country strongly illustrate the growing need to consider both physical and cultural barriers to the spread of fertility change. Recent analysis of fertility change in low and middle-income countries has shown similar patterns. For example, in India, urban and more economically prosperous areas experienced fertility decline first, with fertility decline spreading outwards over time (Guilmoto and Rajan, 2001). Examination of contraceptive use and fertility among the populations of Bangladesh and West Bengal, India found greater similarity between the populations living along the border between the two countries than with other areas of their own country (Amin *et al.*, 2002).

This thesis explores similar patterns emerging in Myanmar. These patterns may be the result of changes in transportation infrastructure and communication channels that reduced the physical

remoteness of individual townships during the intercensal period, providing improved access to new information about and access to family planning and other key health services. Alternatively, or in addition to these structural changes, Myanmar has experienced substantial social change over the past thirty years with improved education for both men and women, fewer women marrying, and increased emigration. Each of these changes, especially when considered from a geospatial perspective, are likely to help explain fertility change in the country.

1.3.2 Conflict

Although not a classic determinant of fertility, no examination of fertility in Myanmar would be complete without considering the role of security, both physical and economic, on demographic change. Cain (1980) suggested that individuals with greater inherent economic security may have lower fertility because there is less need for the economic protection provided by having a large family. Others have discussed the impact of spatial dislocation and uncertainty on decisions to delay childbearing, and on the impact of conflict on the health status of pregnant women.

Initial examination of fertility change in Myanmar points to a decline in fertility during a period of prolonged conflict, highlighting a multitude of potential influencers. An important fertility determinant during times of conflict is reduced coital frequency resulting from several reasons: spousal separation due to recruitment of men for fighting, death or morbidity of either spouse, or separation of families during forced migration (Lindstrom and Berhanu, 1999); and economic or psychosocial stress leading to a reduction in coital frequency (Lindstrom and Berhanu, 1999; McGinn, 2000). Couples who remain together during times of conflict may choose to postpone childbearing until they are in a more secure place, either having arrived in a safe environment or following a return to normalcy in their home area (Agadjanian *et al.*, 2008).

Access to health care also greatly impacts demographic changes in conflict areas. During times of conflict, health services can be severely limited, with an emphasis on emergency care rather than preventative services. This continues through forced migration, with a potential for dramatically improved access to health services upon arriving in a refugee camp or other final destination. This can often mean that access to family planning is compromised during times of conflict and displacement, resulting in higher rates of unwanted pregnancy. A 1994 assessment found a lack of comprehensive reproductive health services for refugees and displaced persons (McGinn, 2000), while an examination of data from Cambodian refugee camps in Thailand noted a delay in provision of reproductive health services while emergency cases were handled (Holck and Cates

Jr, 1982). Perhaps as a result, prolonged spatial, social, and political insulation has been shown to sustain high fertility in refugee communities despite situations which might otherwise encourage decline (McGinn, 2000; Agadjanian *et al.*, 2008).

1.4 Theoretical framework

This paper builds off existing frameworks used to quantify the effect of fertility behaviour on fertility outcomes, such as Bongaarts and Potter's (1983) proximate determinants and Davis and Blake's (1956) intermediate variables framework. These traditional determinants of fertility are thought to be important to fertility change in Myanmar, but are likely affected by their intersection with remoteness (both physical and social) and conflict. In particular, if diffusion theories are considered with the understanding that urbanisation facilitates the sharing of information about fertility limitation through formal and informal networks, then the role of restricted access to areas due to especially difficult terrain and physical and psychological barriers stemming from the presence of armed conflict in an area must also be considered. The theoretical framework below loosely depicts these intersections as they relate to the research presented in this thesis (Figure 1-3).

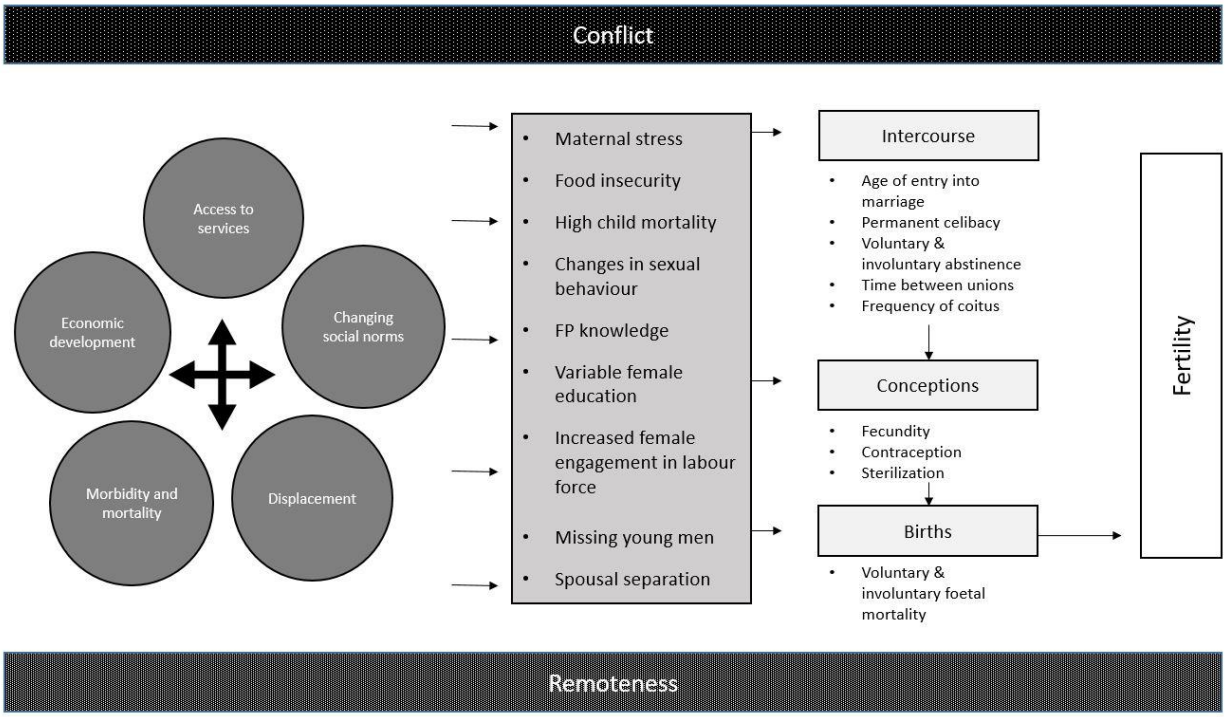


Figure 1-3. Theoretical framework

The framework allows for the discussion of both the direct and indirect determinants of fertility discussed above. This thesis focuses primarily on the direct determinants listed in the second column to the right in the framework above, along with a selection of indirect determinants of fertility, which fall under the broad categories depicted in the circles to the framework's far left. This thesis primarily focuses on education, workforce engagement and, to a lesser extent, changing social norms related to female autonomy. It also considers two overarching indirect determinants of fertility which are less studied: conflict and remoteness. Unlike education or workforce engagement, this thesis assumes that conflict and remoteness influence other indirect determinants and direct determinants alike.

The theoretical framework can be understood through several examples. In one instance, conflict may lead to excess male mortality, which may in turn lower a woman's likelihood of ever marrying, reducing the overall fertility for the population. In another example, male participation in armed combat, or the need to relocate away from conflict-affected areas for employment, may decrease a couple's coital frequency. Alternatively, frequent conflict events may limit the resources that a government puts into health or educational infrastructures in an area, especially if that area is also physically remote, limiting access to education or family planning. Another consideration is that both exposure to higher levels of conflict and lower levels of development may be associated with higher maternal stress, poor pre-natal and delivery services, and other factors associated with poor birth outcomes. Many other interpretations exist, some of which will be explored in more detail in this thesis, but ultimately the main benefit of this framework is to allow discussion and conceptualisation of how external forces, like armed conflict and remoteness, affect fertility behaviour both at an individual and geospatial level.

1.5 Study overview and thesis structure

Drawing on demographic theory and using data from the 2014 Census and 2015-16 Demographic and Health Survey (DHS), this thesis explores the potential reasons for fertility change in Myanmar. Methods used for this analysis include a review of population change and fertility decline across the country, an empirical analysis of the contribution of the proximate determinants of fertility to fertility decline, an assessment of how increased opportunities for female education and employment have affected entry into marriage, and an analysis of how exposure to and isolation due to prolonged armed conflict are associated with fertility and fertility-related behaviour. Ultimately, this research presents a theoretical model for

conceptualizing the determinants of fertility in Myanmar, reflecting a broader social, economic and political change.

1.5.1 Research objectives and questions

This research explores Myanmar's deviance from regional and assumed trends in fertility decline in order to contribute to existing understanding of fertility decline and to aid health and development efforts in the country. The research does so by exploring how social change and conflict may have affected fertility in Myanmar in the absence of robust, official family planning programming, and how family planning access has changed over time. Collectively, this analysis utilizes the previously presented framework to understand fertility decline in Myanmar and, potentially, in similarly fragile states emerging from periods of conflict and isolation. This will be achieved by answering the following interrelated research questions:

1) How has fertility in Myanmar evolved since 1983 over time and space and how does this change relate to population growth, mortality and migration changes?
2) What are the underlying social and demographic factors associated with fertility in Myanmar?
3) How does exposure to conflict affect fertility-related behaviour and outcomes in Myanmar?

This research hypothesises that, in the absence of effective family planning provision: (a) fertility differentials and changes in Myanmar can be primarily attributed to changes in social structure reflecting increases in female education and employment, age at marriage and changing migration patterns; and (b) the level and nature of political unrest and violent conflict, exacerbated by physical remoteness, affects the trends and levels of regional fertility.

1.5.2 Thesis structure

Answers to these research questions are presented in this thesis using the following format:

Chapter 2 provides an overview of the many data sources available for this analysis. Each data source is described before the quality of several key sources is explored in detail. Several data adjustments are discussed along with the limitations presented by working with data collected from conflict areas.

Chapter 3 presents an overview of population change in Myanmar, focusing on the intercensal period between 1983 and 2014. This chapter describes changes in the age composition and distribution of the population, migration patterns and changes in child and adult mortality. It also provides national and township level fertility estimates, explaining the adjustments of directly estimated total fertility rates along with several approaches to indirectly estimating fertility when data are limited or of poor quality. The chapter ends with a discussion of how falling fertility, improving mortality, and increasing migration combined to result in a slower than anticipated population growth in the country during the intercensal period.

Chapter 4 includes a more detailed geospatial exploration of changing fertility in the country and examines the associations between measures of physical and social remoteness and fertility at the district level in 2014. The chapter describes how both physical and social remoteness, along with female education rate, are associated with the district level total fertility rate and posits that this is the result of the diffusion of fertility limiting behaviour across social networks, which is potentially hampered by physical barriers, exemplified by poor road connectivity. A version of this chapter was published in *Demographic Research* (Schuster *et al*., 2019).

Chapter 5 describes changes in the proximate determinants of fertility in Myanmar during the intercensal period and decomposes the influence of each determinant on fertility change. The results show that family planning played an important role in fertility decline throughout the 1990s and early 2000s, but also highlight a need for a more detailed assessment of changing marriage patterns.

Chapter 6 includes a more in-depth exploration of changes in female education, workforce engagement and marriage patterns. Social change is described in greater detail using data from intercensal population surveys, and is compared to other countries in Asia. Survival analysis is then used to identify how various social characteristics (for example education and employment status) affect the hazard of entering into marriage for men and women separately. Individual age cohorts are also compared to demonstrate that higher education and employment status influence men's and women's chances of entering into marriage in opposite ways over the life course. A version of this chapter is under review with *Asian Population Studies*.

Chapter 7 examines the influence of conflict on fertility. The analysis in this chapter links geo-referenced conflict event data to individual demographic survey records to explore associations between conflict exposure and several variables used to measure sexual behaviour, contraceptive

use, and birth outcomes. The chapter also includes a critical assessment of the conflict event data and presents limitations for linking these data to survey data. Ultimately, the analysis presents preliminary evidence that exposure to conflict affects both sexual behaviour and contraceptive use, in turn leading to statistically significant differences in recent fertility outcomes.

Chapter 8 ties each of the previous chapters together, summarizes the key findings of the thesis and returns to a discussion of the theoretical framework presented in this chapter. Challenges, limitations and recommendations for future research are presented and discussed.

Chapter 2 Data Sources and Quality

Direct and indirect demographic estimation techniques were used to assess the validity and consistency of fertility estimates by region within Myanmar. The analyses are based on a range of data sources obtained from national and international institutions. Various regression analyses were used to investigate the association between social change, conflict, and fertility. Individual methods are described within each analytic chapter, while this chapter provides an overview of available data sources and the results of data quality assessments.

2.1 Data sources

Aggregate data from **sources 1-5** were combined to compare the characteristics, such as age structure, marriage patterns, socioeconomic status, maternal and child mortality and education, acting as the drivers of fertility changes from 1983 to 2014. Data from the two most recent surveys, **sources 6 and 7**, were used to identify the current determinants of fertility in Myanmar at the individual, community and regional levels. **Sources 8 and 9** were both considered to explore the role of conflict in fertility decline in Myanmar. Finally, **sources 10 and 11** are used throughout the thesis to create maps and link various quantitative data sources. Information about each data sources is outlined below. The University of Southampton provided ethical approval for use of these data sources through submission 23634.

2.1.1 Aggregate data

1. Data from the **1983 Population Census** are taken from the final report released by the Census Division of the Immigration and Manpower Department of Burma in 1986. In addition to providing written analysis of the data, the final report also includes complete population tables by geographic region. Data were manually extracted from these tables into Excel©. The 1983 Census data were collected by approximately 170,000 enumerators over the course of 1-5 April, 1983. Two questionnaires were administered, with 80% of the population receiving a short, 7-question survey, and another 20% answering additional questions. Data extracted from the tables includes estimates based on how the 20% answered. The available data does not include any individual-level data or any other information that may be used to identify participants. The national level report and tables are available from the Ministry of Population

and Immigration (www.dop.gov.mm**).** Reports from individual regions, which contain aggregate information at the township level, are also available online or from the British Library in London.

2. Data from the **1991 Population Changes and Fertility Survey (PCFS)** are similarly extracted from tables included in the final report**.** All ever-married women between the ages of 15-49 identified in the household survey were recruited to participate in the individual survey. Data were collected during January 1991 and preliminary results were reported in October 1992. The detailed report is available from the Ministry of Population and Immigration (www.dop.gov.mm**).** The available data do not include any individual-level data or any other information that may be used to identify participants.
3. The **1997 Fertility and Reproductive Health Survey (FRHS)** provides data on reproductive health, fertility, infant/child mortality and HIV/AIDS awareness. In 1997, the FRHS employed two types of questionnaires: a Household Questionnaire and an Individual Questionnaire. The Individual Questionnaire considered women to be eligible for participation if they were between the ages of 15-49 years and had ever been married. Aggregate data from both were extracted at the regional level from tables available in the Country Report available from the Ministry of Population and Immigration (www.dop.gov.mm**).** The available data do not include any individual-level data or any other information that may be used to identify participants.
4. The **2001 Fertility and Reproductive Health Survey (FRHS)** provides data on reproductive health, fertility, infant/child mortality and HIV/AIDS awareness. The 2001 FRHS followed similar procedures and included similar questions to the 1997 FRHS. The Individual Questionnaire considered women to be eligible for participation if they were between the ages of 15-49 years and had ever been married. Aggregate data were extracted at the regional level from tables available in the Country Report available from the Ministry of Population and Immigration (www.dop.gov.mm**).** The available data do not include any individual-level data or any other information that may be used to identify participants.
5. Data from the **2014 Myanmar Population and Housing Census** are available in Excel© files available for public download from the Ministry of Population and Immigration (www.dop.gov.mm). The 2014 Census used a single questionnaire to capture population and housing characteristics about the individuals living in Myanmar on the night of 29 March 2014. The questionnaire collected identifying information, such as individual names, but this is not available for public download and was not used for this analysis. The Ministry of Population and Immigration also released several thematic reports with additional data, including

estimates of fertility, mortality and migration for lower administrative units. These are also available from the Ministry's website and do not include any individual-level data or any other information that may be used to identify participants.

2.1.2 Individual data

6. The **2000 Myanmar Multi-Indicator Cluster Survey (MICS)** was implemented by the United Nations International Children's Emergency Fund (UNICEF) and was designed to include a nationally representative sample. A two stage sampling plan was used to randomly select 25,600 households from 627 village tracts and 173 urban wards across the country. Sample weights were applied for national level estimates. Sixteen data collection teams collected data between June and August 2000. De-identified individual data are available for public download from http://mics.unicef.org/surveys. Individual data were used to estimate breastfeeding rates by infant age in Chapter 5.
7. Data collection for the **2015-16 Demographic Health Survey (DHS)** took place from December 2015-May 2016. De-identified individual data are available upon request for public download from MEASURE DHS at http://dhsprogram.com/. The 2015-16 DHS was implemented in Myanmar in collaboration with the Department of Health. Like the MICS, the DHS is meant to provide a nationally representative sample of the total population and collected data on 12,750 individuals. Individual DHS data were used for descriptive analysis throughout the thesis, for survival analysis in Chapter 6 and for regression analysis in Chapter 7.

2.1.3 Conflict event data

8. The **Armed Conflict Location and Event Data Project (ACLED)** operates out of the Robert S Strauss Center at the University of Texas, Austin in collaboration with researchers at the University of Sussex. ACLED collects real-time data on conflicts in approximately 60 of the least developed counties, including Myanmar. ACLED researchers code events based on the date, location, agent, and event type. Each day of an individual conflict receives its own entry, as do multiple events taking place on the same day. Data for each entry are collected by researchers from a variety of government and non-government reports and media sources. Entries are checked by two separate reviewers before they are included in the dataset. Events are geo-referenced (including latitude and longitude) and categorised into one of nine categories: three types of battles, violence against civilians, remote violence, rioting (violent

demonstrations) and protesting (non-violent demonstrations) and three types of non-violent events (Raleigh et al 2010). Data are available for public download from ACLED's website (http://www.acleddata.com/asia-data/).

9. The **Uppsala Armed Conflict Dataset (UACD)** is compiled by the Uppsala Conflict Data Project (UCDP) at Uppsala Universitet, Sweden. UCDP provides several peace and conflict datasets, but this research only considered the UACD. UACD provides geo-referenced conflict event data linked to long-term conflicts (for example 150 individual events between the Government of Myanmar versus the Kachin Independence Organization), between 1989 and 2014. Each event is classified as one of three types of violence: state-based conflict, non-state conflict, or one-sided violence. Data are collected in a similar manner to ACLED, with review of news reports and secondary sources (for example reports from non-governmental organizations, field reports, books, etc.). However, unlike ACLED, the UACD does not include non-violent events (Sundberg & Melander 2013). Data are available for public download from the UACD website (http://www.pcr.uu.se/research/ucdp/datasets/).

2.1.4 Geographic data

10. This research uses **map shapefiles** downloaded from the Myanmar Information Management Unit (MIMU). MIMU consolidates data by geographic unit and prepares maps to strengthen management services and decision making within the humanitarian and development community. All data are available for public use, with attribution, from the MIMU website (http://themimu.info/). All maps presented in this thesis (unless otherwise noted) were developed by the author using the above listed data sources, MIMU shapefiles and ArcGIS 10.7.
11. **DHS cluster shapefiles** are available upon special request from MEASURE DHS. Permission to use the shapefiles, which include the offset latitude and longitude of each DHS cluster, was obtained by the author before use. Urban DHS cluster points contain between 0 and 2 kilometres of error, while location error for rural clusters may be intentionally set at up to 10 km in order to protect respondent identity (Perez-Heydrich *et al.*, 2013). More details about handling this error and using geolocational information are included in Chapter 7.

2.2 Assessment of data quality

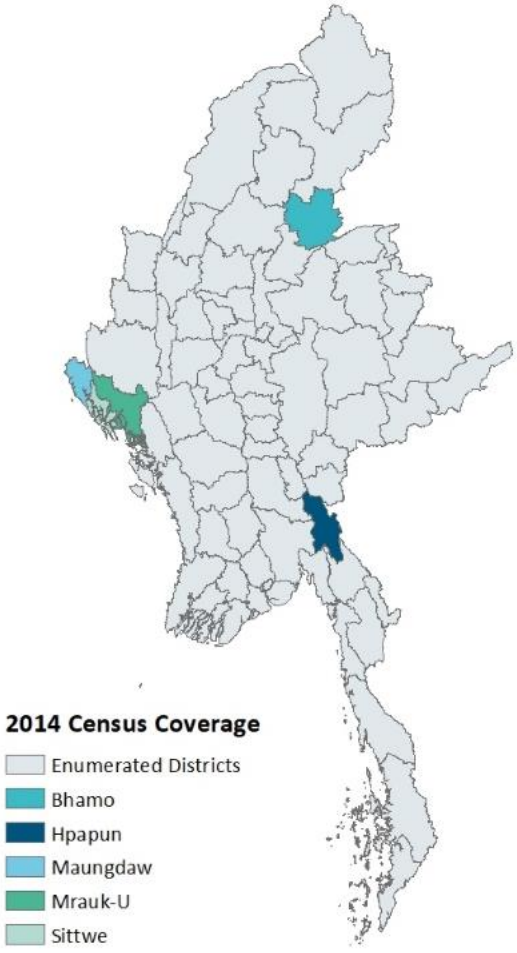
While this thesis considers several types of data, the majority of the analysis is done using either census or DHS data. Here, potential error is discussed by the type of data source.

2.2.1 Census data

In 1983, Myanmar had 314 townships across seven states and seven divisions. Census enumeration covered all townships, but only 12,814 of 13,756 village tracts within townships (93.1%) were enumerated (Immigration and Manpower Department, 1986). In 2014, Myanmar had 21 administrative sub-divisions; seven regions (replacing the divisions of 1983) and seven states, one union territory (Nay Pyi Taw), and six self-administered areas (SAAs). Although populations living in the SAAs were included in the census, they were not considered separately from the regions, states, and union territory in developing the census sampling frame. The regions, states and union territory are subdivided into 73 districts and 330 townships (General Administrative Department, 2018). In 2014, thirteen townships were either partially or completely non-enumerated. In all, 18 townships cannot be compared between the two censuses. Post-enumeration checks found that, in enumerated areas, more than 99% of identified households and individuals were counted (Immigration and Manpower Department, 1986; Department of Population, 2015).

The non-enumerated areas were home to an estimated 1.2 million people in similar geographic areas in both 1983 and 2014. Non-enumeration was primarily due to security concerns, the limitations of which are discussed in more detail at the end of this chapter. More than half (52%) of the partially or non-enumerated village tracts in 1983 were located in Shan state, but the largest estimated non-enumerated population was in Karen State, present day Kayin. Significant proportions of the populations of both states were estimated to have been non-enumerated: 40% in Kayin and 17% in Shan (Immigration and Population Department, 1995). In 2014, enumeration was restricted in Kachin, Kayin and Rakhine states. In addition to the exclusion of several village tracts from enumeration, not all people living in Rakhine were counted because they were not allowed to register names unrecognized by the government. Between 31-35% of the population of Rakhine state was not counted, over 1 million people (Department of Population, 2015). The census estimated that an additional 116,353 people were not counted in Kachin and Kayin states, for a total of 2.34% of the estimated population. Only the 2014 Census report lists districts and

townships with especially low coverage, shown in Map 2-1. These five highlighted districts represent areas where entire villages and towns were not enumerated due to security concerns. Other districts, especially those surrounding these five, may have been only partially enumerated as well, but this information is not available. At the national and state/region levels, the census estimated population figures for non-enumerated areas. However, detailed analysis, and the publicly available datasets, do not include estimates from non-enumerated areas. Therefore, the analysis throughout this thesis cannot consider the potentially different behaviours or contribution to fertility decline of the populations from non-enumerated areas.



Map 2-1. Districts with enumeration challenges, 2014
Data Sources: Management Unit, 2007; Ministry of Health and Sports and ICF, 2007

Despite these enumeration challenges, data verification and rectification efforts undertaken by WorldPop support district level analysis using the enumerated data set for all but Rakhine State. Working with the Myanmar Information Management Unit (MIMU), WorldPop reviewed

township level estimates and found data quality concerns consistent with the coverage limitation highlighted above (WorldPop, 2017). For their population estimates, WorldPop ultimately merged several townships in Kachin and Kayin states, but retained district level estimates. However, concerns over data quality led to the merging of three districts in Rakhine: Sittwe, Maungdaw and Mrauk-U. Unfortunately, merging these districts for district-level analysis for this thesis is not possible because much of the analysis relies on adjusted district-specific total fertility rates estimated for the *Thematic Report on Fertility and Nuptiality* which used enumerated data only (Department of Population, 2016a). However, as described in more detail in Chapter 4, this decision does not appear to dramatically alter findings.

Ultimately, several sources support the accuracy of state/region level data. District level data are also generally acceptable, with some exceptions in conflict areas. Although the issues suggest that findings from these areas be presented with caution, the presence of similar enumeration challenges during both censuses in similar areas suggests that comparisons of data from 1983 and 2014 can be reasonably made. A comparison of 2014 Census and 2015-16 DHS data presented later in this section provides further support for overall accuracy of the census data.

2.2.2 Myanmar Demographic and Health Survey data

The DHS has been conducted 294 times in 90 countries since 1985 (The DHS Program 2019). This experience has allowed for continuous refinement of survey methodologies and tools. The survey uses a multistage, probabilistic sampling approach to select a nationally representative sample of households and individuals within a country. This robust sampling methodology, along with the repeated implementation of the survey in many countries, allows for hierarchical and longitudinal analysis that is not typically possible using other survey data (Corsi *et al.,* 2012). Due to the global coverage of the DHS and the highly regarded implementation methods, data from the DHS are routinely used in national, regional and global analyses. This has also led to the development of standard methods for calculating fertility using DHS data (Schoumaker, 2014). This thesis draws on the high quality of the DHS data and previously established analytic approaches to assess the quality of census data and use both data sources to explore fertility dynamics in Myanmar.

The survey has been implemented only once in Myanmar, during the seventh round of global survey implementation. While the overall quality of data collection appears consistent with global expectations, some aspects of the sampling should be discussed. First, DHS implementation in Myanmar aimed to minimize non-enumeration limitations like those found in the 2014 Census.

The DHS used a sampling frame based on the 2014 Census, but included both census enumerated areas and those which were either partially or completely non-enumerated. An independent household listing activity was undertaken in areas which were partially or entirely non-enumerated during the 2014 Census. Furthermore, while the DHS sampling frame excluded institutionalized individuals it included those living in internally-displaced persons camps. However, despite these efforts, four clusters were eventually identified as being too insecure and were replaced with other clusters in the vicinity. One urban cluster was completely dropped due to growing insecurity during study implementation (Ministry of Health and Sports and ICF, 2017). For national and state/region level estimates of fertility, these changes are unlikely to affect results. Similarly, these sampling decisions should not affect the outcomes of individual-level analysis. However, the exclusion of some clusters due to their proximity to violent conflict may affect analysis of the effects of conflict on fertility, as discussed later in Chapter 7.

2.2.3 Comparison of census and DHS data

Given the generally high quality of the DHS data, the overall quality of census data and reliability of fertility estimates was assessed using birth history data from the 2015-2016 DHS. Age-specific and total fertility in the periods preceding the survey were estimated and compared to direct estimates from the census. Figure 2-1 shows DHS estimates as solid lines and direct census estimates as dashed lines.

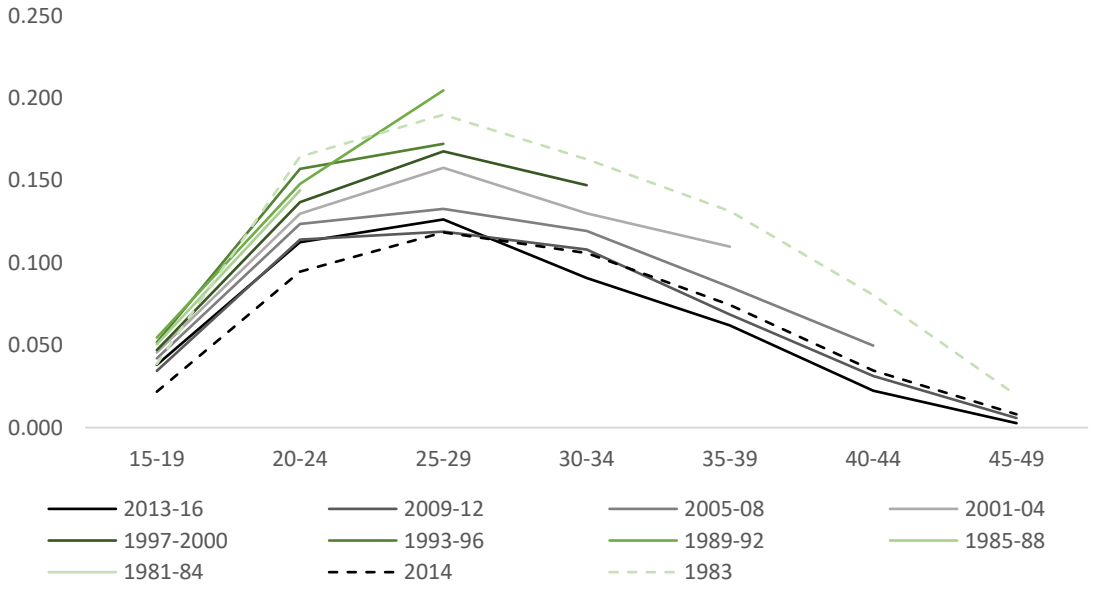


Figure 2-1. Weighted ASFR estimates, Myanmar 1981-2016 by age and period
Data Source: Ministry of Health and Sports and ICF, 2017; Department of Population, 2015

This assessment suggests that, relative to the DHS, fertility among younger women in Myanmar may have been under-reported in the 2014 Census and over-reported for older women. While the DHS estimates show a need to shift the shape of the ASFR curve, the data are less clear about the need to adjust the parity level.

Across all datasets, partial and non-enumeration disproportionately affects minority religious and ethnic groups. This is evidenced by the high non-enumeration of Shan, Kayin, Kachin and Rakhine during the censuses, the exclusion of large proportions of households in rural and conflict areas from the intercensal population survey sample frames, and the higher non-response in border states during the intercensal population surveys. Figure 2-2, below, shows that while weighted national level ASFR estimates from the DHS and 2014 Census had similar levels (see Figure 2-1), 2014 Census estimates of ASFR for areas with enumeration challenges may underestimate fertility, especially among younger women. This may be due to differences in fertility patterns among the excluded population. For example, it is likely that many of over one million non-enumerated individuals from Rakhine belonged to the Rohingya population. Little information is known about Rohingya-specific fertility, but their status as a Muslim minority group whose marriage, fertility and day-to-day lives are strictly monitored by the national government could mean that their fertility behaviours are different from the primarily Buddhist population living in the rest of the state. Similar differences in the fertility patterns between the enumerated and non-enumerated populations in other ethnic minority majority states could also help to explain the other discrepancies in DHS and census ASFR estimates.

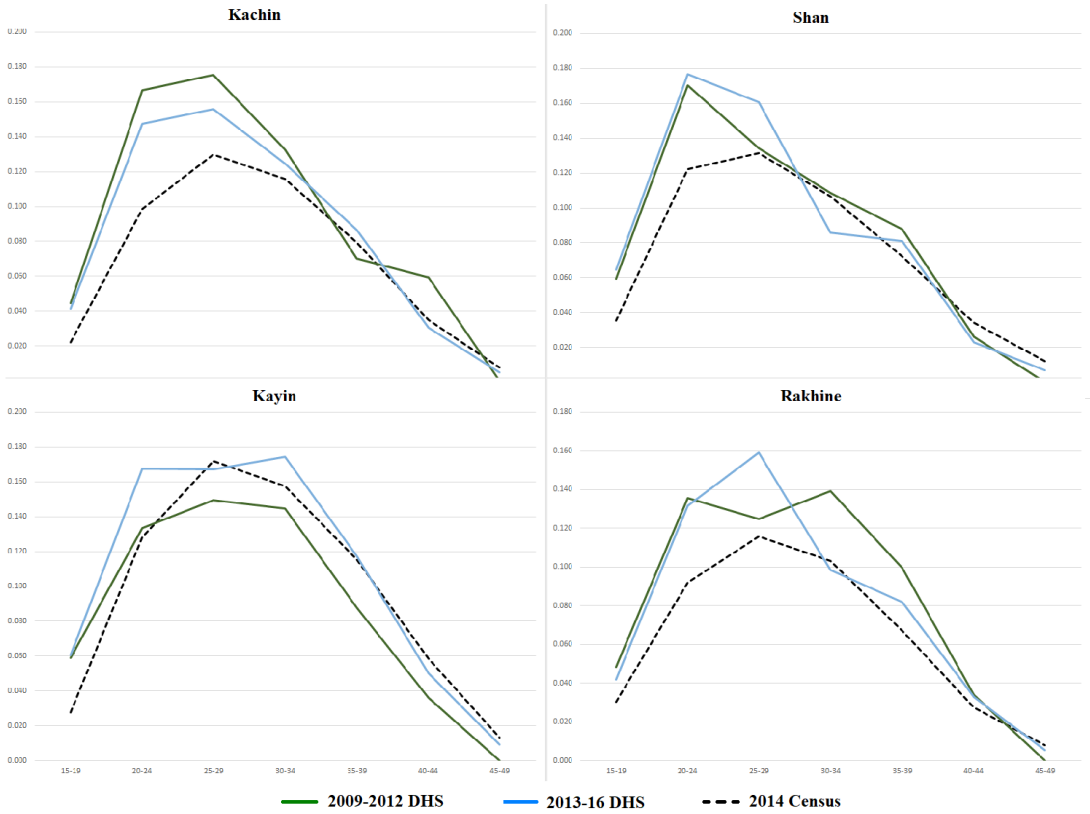


Figure 2-2. Comparison of recent ASFR for states with high levels of armed conflict
Data Sources: Ministry of Health and Sports and ICF, 2017; Ministry of Immigration and Population, 2015.

These results suggested that the state/region fertility estimates reported in the 2014 Census would need to be adjusted if analysis were to be completed at this level. Several methods for adjusting the direct estimates were considered, including the development of a new Myanmar-specific standard to replace the Booth Standard in the relational Gompertz model. This exercise is described in greater detail in Chapter 3. However, the comparison of DHS and census data above provide evidence of high data quality from the 2014 Census in nearly all states/regions of the country and at the national level.

2.2.4 Other population surveys

Although this thesis primarily uses census and DHS data, it also draws on other population level surveys conducted between 1983 and 2014 to describe intercensal trends. Access to individual level data was restricted, and several serious limitations in the sampling design and implementation were identified. The first of these surveys was the 1991 Population Changes and Fertility Survey (PCFS). The 1991 PCFS used a sampling frame based on the 1983 Census, but due to cost and safety concerns, estimates were only made for nine subnational areas. These

subnational areas combined: 1) Sagaing and Chin, 2) Mon, Tanintharyi and Kayin, and 3) Kayah, Shan and Kachin. In addition to this limitation, state and division officials were given the opportunity to exclude townships and villages from the sampling frame. As a result, substantial sections of Mon/Tanintharyi/Kayin (39% of households) and Kayah/Shan/Kachin (60% of households), almost entirely rural areas, were excluded from the sampling frame. Finally, plans to adjust the sample size following these exclusions were put aside, meaning that individuals from combined state/region groups were inappropriately sampled (Immigration and Population Department, 1995).

Similar problems persisted during design and implementation of the following population surveys. The 1997 Fertility and Reproductive Health Survey (FRHS) excluded 24 "inaccessible" border townships from the sampling frame, and again provided results for nine subnational areas. In the combined areas of Mon/Tanintharyi/Kayin and Kayah/Shan/Kachin, response rates were notably lower than other areas, at 89.5% and 87.6% respectively.

Low response rates in the combined domains continued through to 2001, when a 15% non-response rate was recorded in Mon/Tanintharyi/Kayin. The report for the 2001 FRHS attempts to justify the combination of the eight states/regions into three domains by stating that they were combined due to the "contiguity of their areas, homogeneity of their cultures and customs and for administrative and communication convenience" (Department of Population and UNFPA, 2004). As analysis in later sections demonstrates, these arguments likely do not hold, especially as justification for the combining of the increasingly diverging Chin State and Sagaing Region.

Ultimately, the sampling limitations, though slightly different for each survey, present less of an obstacle for trend analysis in the intercensal period because they are present in all surveys. However, the combination of eight states/regions into three domains, from 1991 until 2015-16, provides serious limitations to subnational analysis using these data and to comparisons with those surveys that present all states/regions separately (see Appendix A for a comparison of geographic areas available for each survey).

2.3 Overview of survey questions for estimation

2.3.1 Fertility

Both the 1983 and 2014 Censuses reported the number of births in the last twelve months based on several questions. Both surveys asked women to report the number of children ever born, the number of those children who were still living, and the date of a woman's last live birth. Additionally, they recorded the woman's age in completed years at the time of the survey (Immigration and Manpower Department, 1986; Department of Population, 2015). Although detailed information about the timing of last live birth was collected, this information, along with all microdata, is not available to the public. For these reasons, TFRs calculated by the author throughout this thesis are based on the number of live births in the last twelve months by current maternal age group, as reported in the two census reports. In the case of 2014, the additional *Thematic Report on Fertility and Nuptiality* (Department of Population, 2016a) includes TFR calculations at the district level calculated using data unavailable for this thesis. The *Report* uses a modification of Schmertmann *et al.*'s (2013) two-stage approach to modelling total fertility. When appropriate, these estimates are used instead of the author's as they were made based on more detailed data that could more accurately account for potential reporting error.

2.3.2 Mortality

The 2014 Census asked respondents to list the household members who had died in the last twelve months. The listing exercise asked for the name, sex and age of the deceased. For women of reproductive age, respondents were asked if the woman died during pregnancy, child birth, or in the first six weeks postpartum (Department of Population, 2015). Neither the microdata nor aggregate data collected through these questions are available for public use. Similar questions were not included in the 1983 Census. For these reasons, estimates used throughout this thesis, especially for smaller geographic areas, are taken from the *Thematic Report on Mortality* (Department of Population, 2016b).

When available, mortality data from intercensal surveys are also used for national level mortality estimates. Like the 2014 Census, the 1991 PCFS (Immigration and Population Department, 1995) and the 1997 FRHS (Population Department and UNFPA, 1999) included questions on deaths within the household in the previous twelve months. The questions captured the deceased's

name, sex and age. Reports from both surveys include Crude Death Rates (CDRs) and life expectancy for males, females and the total population. Less information is available from the 2001 FRHS, which only reports CDRs (Department of Population and UNFPA, 2004). Although urban-rural differentials are reported for each survey, sub-national estimates are only included in the *Thematic Report on Mortality* (Department of Population, 2016b).

2.4 General data limitations due to conflict

Armed conflict is known to disrupt survey implementation and most survey reports indicated that partial and non-enumeration occurred due to security concerns. Even in areas where data collection took place, conflict and insecurity may have affected response. An evaluation of household survey data quality during conflict in Nepal found that violent events, like bombings, decreased individual response rates during longitudinal research. Researchers provided several possible reasons for decreased response including migration out of the area and scepticism about surveyors during times of unrest (Axinn *et al.,* 2012). Higher non-response was found in border states, which generally have more conflict, during several of Myanmar's population surveys. Even when conflict areas were included in the sampling frame during the 2015-16 DHS, non-response was high in areas with frequent violent armed conflict like Shan state, which had a 15% non-response rate for women and a 25% non-response rate for men (Ministry of Health and Sports and ICF, 2017).

It should be noted that although vast sections of Rakhine were excluded from the census in 2014, armed conflict in the state was comparably low during census and DHS survey implementation. In 2014, events in Rakhine made up only around 6% of all ACLED events, although it contributed 27% of all violent events against civilians. These numbers were even lower during DHS implementation with Rakhine hosting 5.4% of all events and 18% of violent events against civilians. This can be compared to Kachin and Shan states, which were more completely enumerated and together accounted for 84% of conflict fatalities and hosted 72.5% of all conflict events and 68.5% of all violent events against civilians from 2014-2016. These proportions had changed by 2017 following increased violence and mass exodus from Rakhine, but this had not yet begun when either survey was implemented.

This thesis raises questions about the effect of conflict on fertility, and must acknowledge that answers to these questions may be limited by the exclusion of individuals with high exposure to

conflict. These limitations are considered throughout this thesis and addressed as they relate to each individual chapter, with a comprehensive review of the conflict data, its ability to be linked to survey data and the limitations of these methods in Chapter 7. For most analysis, comparisons of results from different surveys suggest that those data which were collected are accurate, with the main source of error coming from incomplete coverage of populations living in minority and high-conflict areas.

Chapter 3 Intercensal Population Change in Myanmar: 1983 - 2014

3.1 Introduction

Emerging population data from Myanmar suggest that the country experienced rapid population growth over the past century, more than tripling in size since establishing its current borders in the early 1940s. Trends suggest that population growth gained momentum following independence, but has more recently begun to stabilize, reaching a population of just over 50 million in 2014. This pattern runs counter to previous government estimates, which assumed more sustained growth to a population of approximately 60 million people in 2010, and to previous projections based on the 1983 Census data (Myint, 1991; Immigration and Population Department, 1995), including Tint's (1991) projection of a 2003 population of between 45 and 64 million.

In 2013, Thomas Spoorenberg retrospectively examined the country's population dynamics. Using reported changes in mortality and fertility in the country, Spoorenberg (2013) revised the population projections for Myanmar, suggesting a 2010 population of between 48.46 and 51.29 million people, depending on migration, estimates which were ultimately supported by the 2014 Census findings (Department of Population, 2015). Spoorenberg's estimates suggested a rapid fertility decline that was either unexpected or unacknowledged by the Government of Myanmar, and highlighted the importance of increasing emigration on population change in Myanmar.

In this chapter, data from the 2014 Census, unavailable at the time of Spoorenberg's estimations, are used to describe intercensal population changes. The analysis primarily relies on data collected from the 1983 and 2014 national censuses, but also looks to other nationally representative population surveys to help fill gaps and describe trends at the national and sub-national levels. This analysis highlights the importance of fertility decline (from a TFR of over 6.0 in the 1960s to near replacement level according to the 2014 Census) for the overarching population changes taking place in Myanmar over the past several decades, and establishes the need for further assessment of the drivers of fertility change in the country.

3.2 Data and methods

3.2.1 Population trends

Analysis begins with a comparison of population structures in the 1983 and 2014 censuses. Population pyramids were developed using data from both censuses and are presented along with a discussion of sub-national trends in population structure, with an emphasis on examining the distribution of the population across the country by sex. This is followed by a discussion of sub-national fertility estimates and a descriptive analysis of trends in mortality and migration during the intercensal period. Notably, the section explores changes in child and adult mortality patterns as well as internal and external migration. Unfortunately, the limited availability of data to explore these areas means that results are only descriptive. Nevertheless, understanding mortality and migration changes is crucial to understanding population and fertility changes and all publicly available data were explored to enhance discussion of these important areas. A more detailed description of the methods used for fertility adjustments follows, with further details available in Appendix B.

3.2.2 National and state/region fertility estimates for census years

As described in Chapter 2, the overall quality of the data and reliability of existing fertility estimates was assessed prior to any adjustment. This quality assessment suggested a need to shift the shape of the 2014 Census ASFR curve, but was less clear about the need to adjust the parity level. Age-specific Brass Parity/Fertility (P/F) ratios for each region were therefore also calculated for 1983 and 2014. P/F ratios compare average cumulative fertility to current period fertility for a given cohort of women, typically five-year age cohorts. Interpretation of P/F ratios can identify a need to adjust reported fertility levels due to misreporting births and can assist in the interpretation of fertility decline between the two periods (Moultrie *et al*., 2013). P/F ratios from 1983 show evidence of likely under-reporting of births across age groups, but especially for younger women. The 2014 data show less evidence of under-reporting in all states/regions except for Rakhine State. Graphs of the P/F ratios for each state/region and year are presented later in this chapter along with further interpretation. Collectively, the data quality assessments laid out here and in Chapter 2 suggested that both the level and shape of the ASFR curve needed to be adjusted for 1983, while only the shape of the 2014 curve required revision.

These adjustments were achieved using Moultrie et al.'s (2013) worksheet provided as a part of the International Union for the Scientific Study of Population's (IUSSP) *Tools for Demographic Estimation*. The worksheet uses the relational Gompertz model developed by the London School of Hygiene and Tropical Medicine and empirically tested by Booth (1984) to estimate age-specific and total fertility rates (Moultrie *et al*., 2013). However, using the worksheet without any revision led to alpha statistics, representing the alignment of the actual age distribution of childbearing with the distribution in the standard fertility schedule, that were consistently out of the accepted range of $-0.3 < \alpha < 0.3$. As Moultrie *et al*. (2013) note, this patterning suggested that the Booth Standard used as a default in the worksheet may not be appropriate for use in Myanmar. This may be due to the assumption of a high or medium fertility in Booth's standard, changes in fertility schedules over the thirty years since Booth calculated her standard (Booth's standard fits much better for the 1983 data than for the 2014 data), or some other way that Myanmar's fertility schedules deviate from fertility patterns in other low and middle-income countries. Therefore, efforts were made to develop a Myanmar-specific fertility standard to replace the Booth Standard in the IUSSP's worksheet.

Two methods for calculating a Myanmar-specific standard were considered. First, a Poisson regression was fit using birth history data to predict the age-specific fertility rate for each half-year in age from age 12 to 55 years old. The model included age, age-squared and age-cubed to assure appropriate model curve. A cubic spline using the same data was also considered. Statistics representing the Gompit for each age (Ys (X)) and the cumulated period fertility (Fs (X)) were calculated for both models. As Figure 3-1 shows, the standards developed through Poisson and cubic spline regression result in different shapes of the age-specific distribution of Gompits when compared to the Booth Standard.

The mean and variance of births over the past five years, as calculated using a Poisson model and the 2015-16 DHS data, were similar, indicating that the model could be used to develop the standard. However, the cubic spline was a better empirical fit to the observed DHS data (Figure 3-2), indicating that it was the preferred method for developing a new Myanmar-specific fertility standard to help smooth the shape of the census ASFR curves.

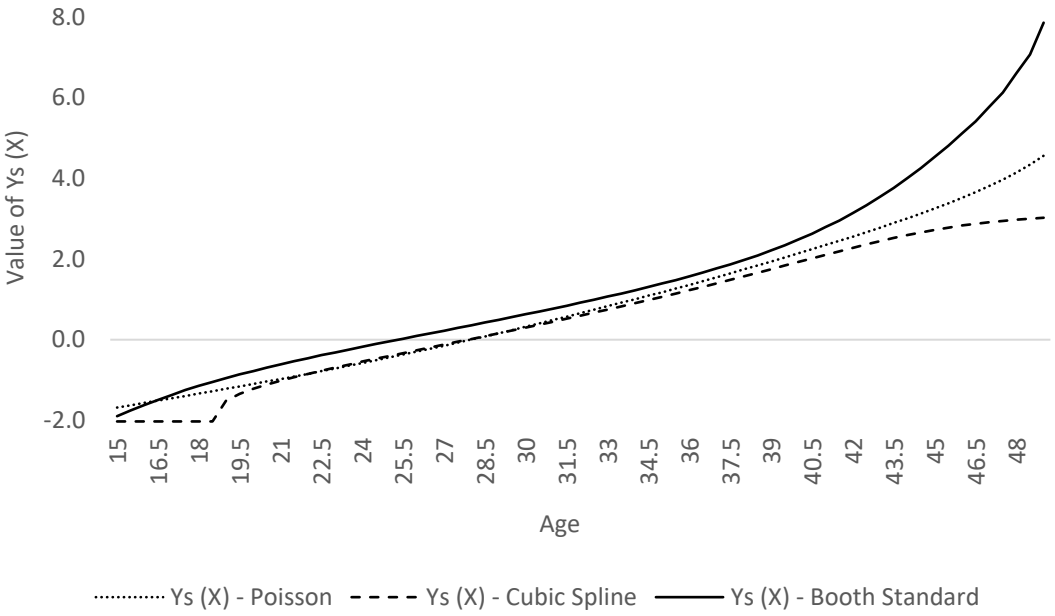


Figure 3-1. Comparison of Gompits from Booth, Poisson, and cubic spline standards
Data Sources: Ministry of Health and Sports and ICF, 2007

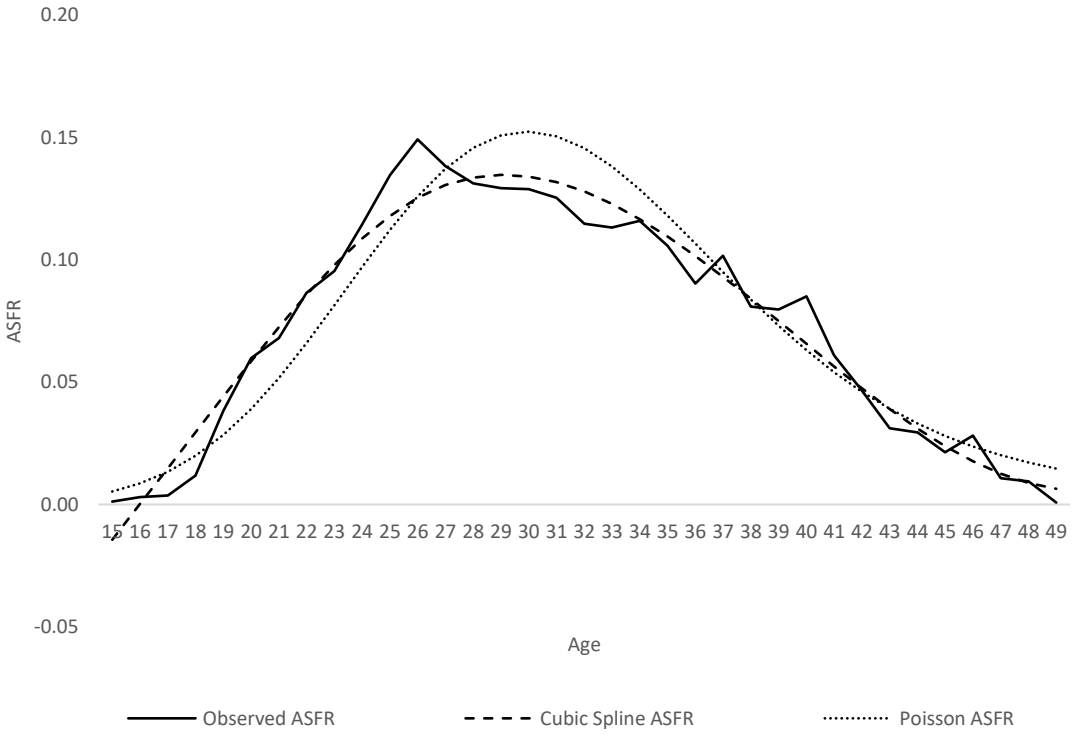


Figure 3-2. Comparison of observed and predicted ASFR curves
Data Sources: Ministry of Health and Sports and ICF, 2007

Once completed, the Booth Standard was replaced with the Myanmar-specific standard (see Appendix C for the complete standard) in the IUSSP worksheet. Using the worksheet, the shape and level of the 1983 national and state/region fertility rates were adjusted, while only the shape of the 2014 ASFR curves was corrected. Checks using the revised standard found that the Gompertz model now resulted in alpha statistics within the acceptable range with no other clear errors identified, and estimated TFRs aligned with those found in previous research (Myint, 1991; Spoorenberg, 2013).

3.2.3 National fertility estimates for intercensal years

Less data was available from intercensal populations surveys, meaning the same approaches could not be used to assess overall data quality or adjust fertility curves using the IUSSP's worksheet. However, as Chapter 2 explains, there is reason to suspect that the intercensal reports are inaccurate. To check the accuracy of intercensal fertility estimates and make needed adjustments, the 1983 Census population was projected forward to 2013 using the United Nations' general model life tables for men and women. Initial projections assumed no migration and used reported fertility rates (MEASURE Evaluation, no date; United Nations, 1982). These projections (Figure 3-3) appeared to underestimate the youth population and overestimate the population between 25 and 55 years old when compared to the enumerated data from the 2014 Census. This suggests that the initial population projections underestimated both external migration and fertility rates.

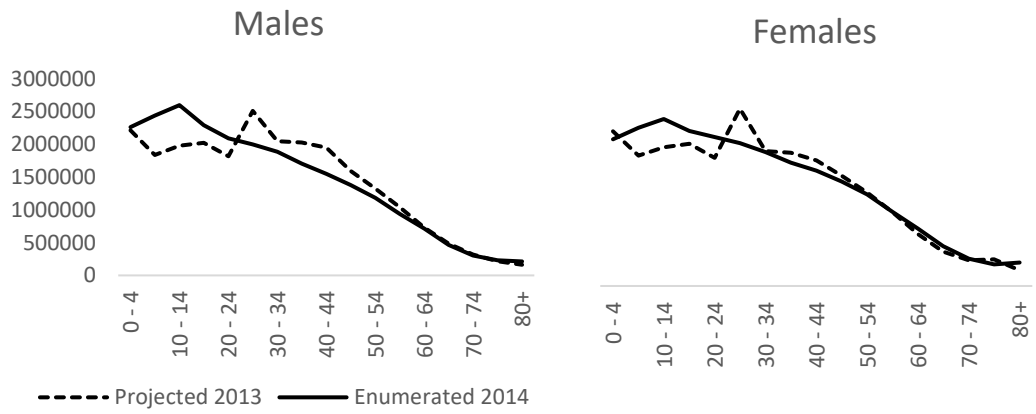


Figure 3-3. Comparison of projected and enumerated populations by sex, Myanmar 2013-14
Data Sources: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Department of Population, 2016b; Department of Population, 2016c; Immigration and Manpower Department, 1986

The population projections were improved by adding net-emigration estimates from the 2014 census (Department of Population, 2016c), but become most closely aligned with the enumerated population only once the total fertility rates for the intercensal periods were adjusted (Figure 3-4). Due to the lack of data from intercensal surveys, several approaches were used for the adjustments. The national Gompertz adjusted age-specific fertility rates were used for 1983 and 2014. Adjustments for 1998, 2003 and 2008 used the ASFRs for the closest year back-calculated using the DHS birth history data. The reported ASFR was used when DHS birth history estimates could not estimate the ASFR for all age groups. For 1988, an average of the reported 1991 ASFRs and the Gompertz estimated 1983 ASFRs was used as ASFRs could only be estimated with DHS data for three age groups. The 2014 *Thematic Report on Fertility and Nuptiality* included several modelled estimates of intercensal TFRs after 2000, which were higher than those reported in the population surveys (Department of Population, 2016a). These were considered for the population projections, but the results did not fit as well as the approaches described above.

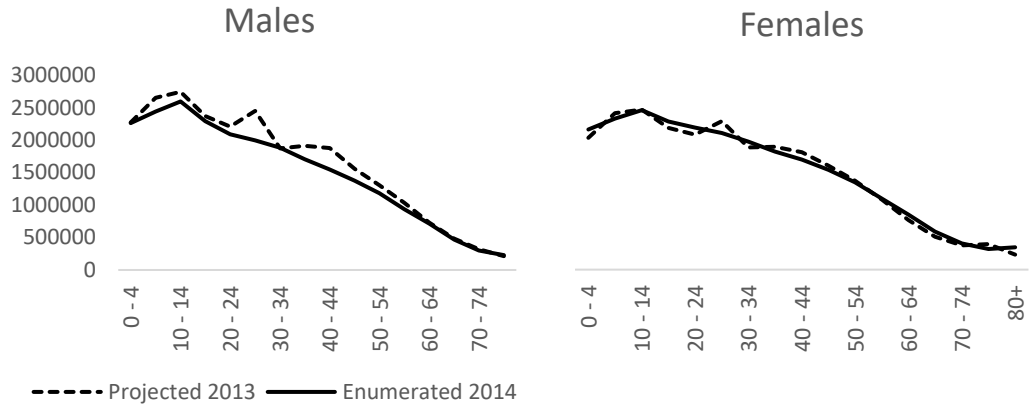


Figure 3-4. Comparison of adjusted projections and enumerated populations by sex, Myanmar 2013-14
Data Sources: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Department of Population, 2016b; Department of Population, 2016c; Immigration and Manpower Department, 1986

These intercensal TFR estimates are not presented as exact, but they do help highlight the likely data quality issues inherent in the intercensal surveys and raise questions about the representativeness of their results. The adjusted TFRs are presented to provide an alternative pathway for fertility decline in Myanmar between 1983 and 2014 that is internally consistent with more reliable independent sources of data. However, the projections still over-estimate the male population in certain age groups, suggesting that either the emigration or mortality estimates for these ages remain too low or underestimated.

3.2.4 Sub-national fertility estimates for census years

At the township level, the 1983 census does not provide data on births by maternal age. However, it does provide five-year population data by sex, which was used to calculate the implied total fertility rate (iTFR) for townships. While not a perfect measure, the iTFR has been demonstrated to be acceptably accurate in estimating TFR using limited data (Hauer *et al.*, 2013). The iTFR used in this thesis was further weighted by the estimated under-five mortality rate for 1983 of 1.2 (Department of Population, 2016b). The 2014 census does not provide age-specific population data for the township level so the iTFR for 1983 and 2014 could not be directly compared. However, the *2014 Census Thematic Report on Nuptiality and Fertility* provides adjusted township level TFR estimates (Department of Population, 2016a), which were used for this analysis.

For the purpose of the fertility assessment presented in this chapter, the 1983 iTFR and 2014 TFR were compared using a paired t-test. The analysis panel includes data from 304 townships compared across the two censuses. This analysis focused on assessing whether there was a significant decline in fertility between 1983 and 2014 across townships, and if this decline was different for states and regions. Historically, states are more disadvantaged, more isolated and less developed than regions, and this analysis lays the groundwork for additional sub-national fertility analysis presented in later chapters.

3.3 Results

3.3.1 Intercensal population changes

The population of Myanmar has nearly quintupled over the past one hundred years, from approximately 12 million people in 1911 to over 50 million in 2014. This growth is not unusual for the region, but is less than predicted by demographers following the last census in 1983 (Figure 3-5). However, in contrast to commentary following the 1983 census, which discussed improving mortality and increasing fertility rates as driving forces behind population change in Myanmar (Maung, 1986), a comparison of population pyramids from 1983 and 2014 suggest an aging population moving towards population decline.

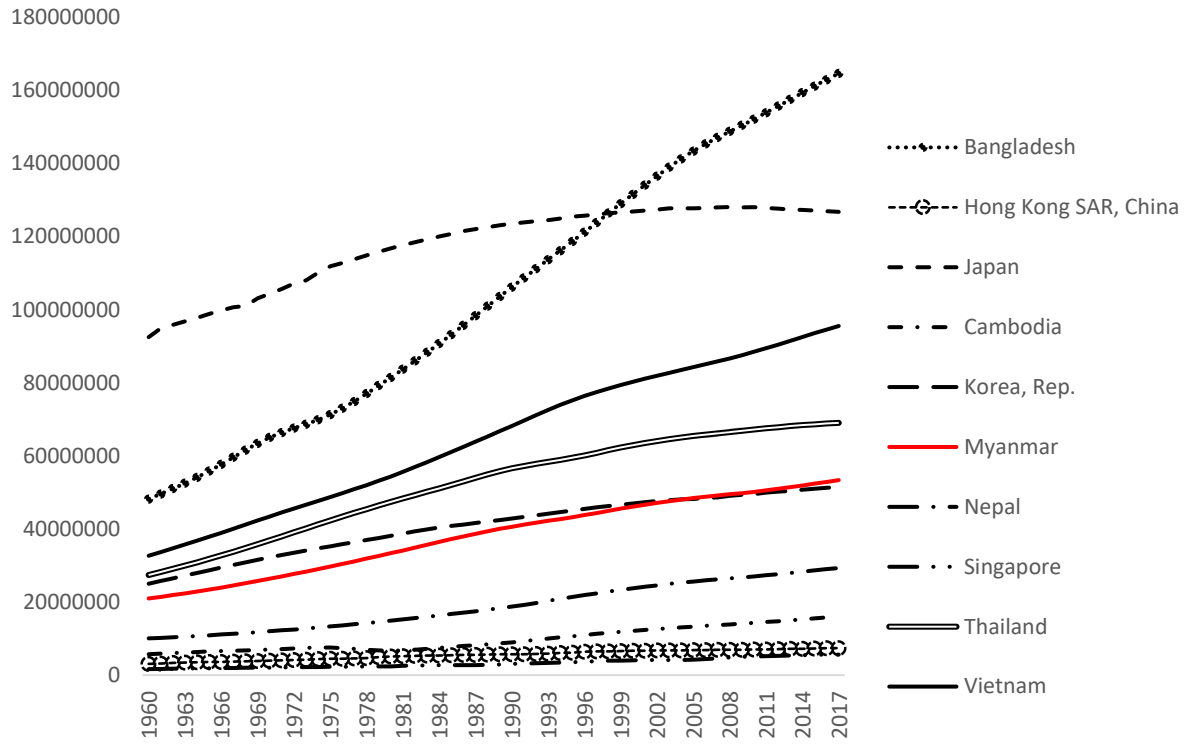
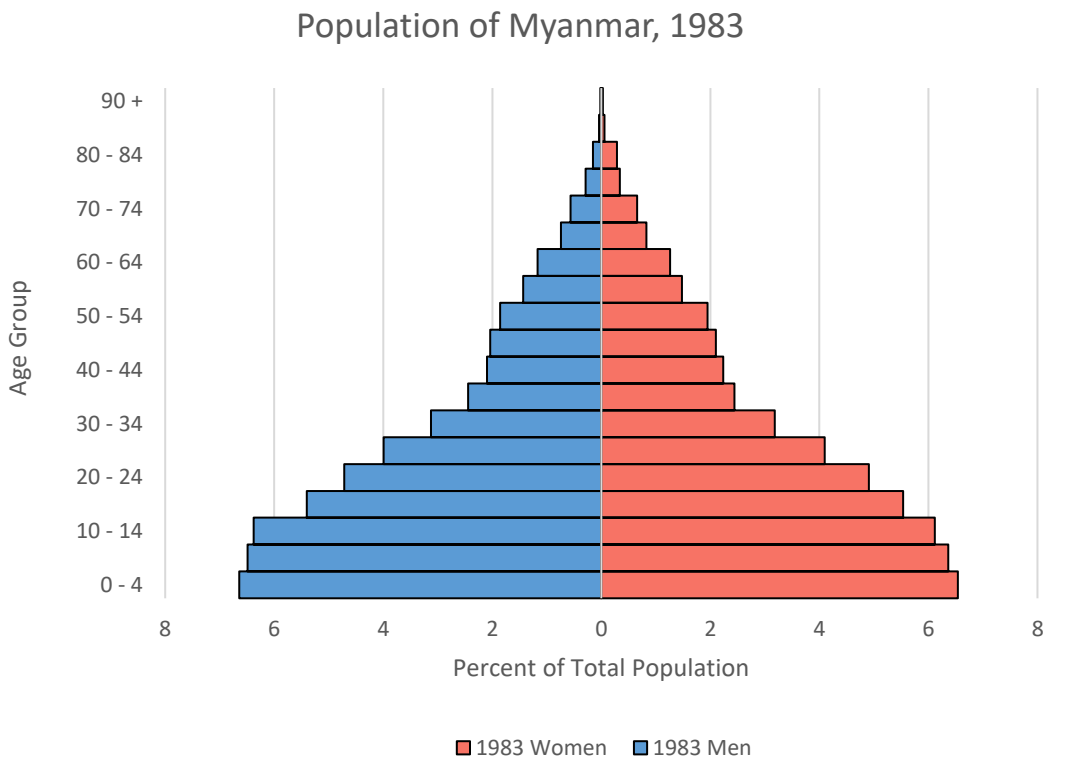


Figure 3-5. Population growth, select Asian countries 1960-2017
Data Source: World Bank, 2019

At the national level, the 1983 population pyramid (Figure 3-6) shows an increase in population around 30 years earlier, probably in the 1950s. At that time, the country had just gained independence and World War II had recently ended. The country appears to have experienced a population boom following these events. However, the beginning of a fertility decline is evident among the youngest generation. By 2014, a fertility decline is more clearly shown; there were fewer young children than there were adolescents.



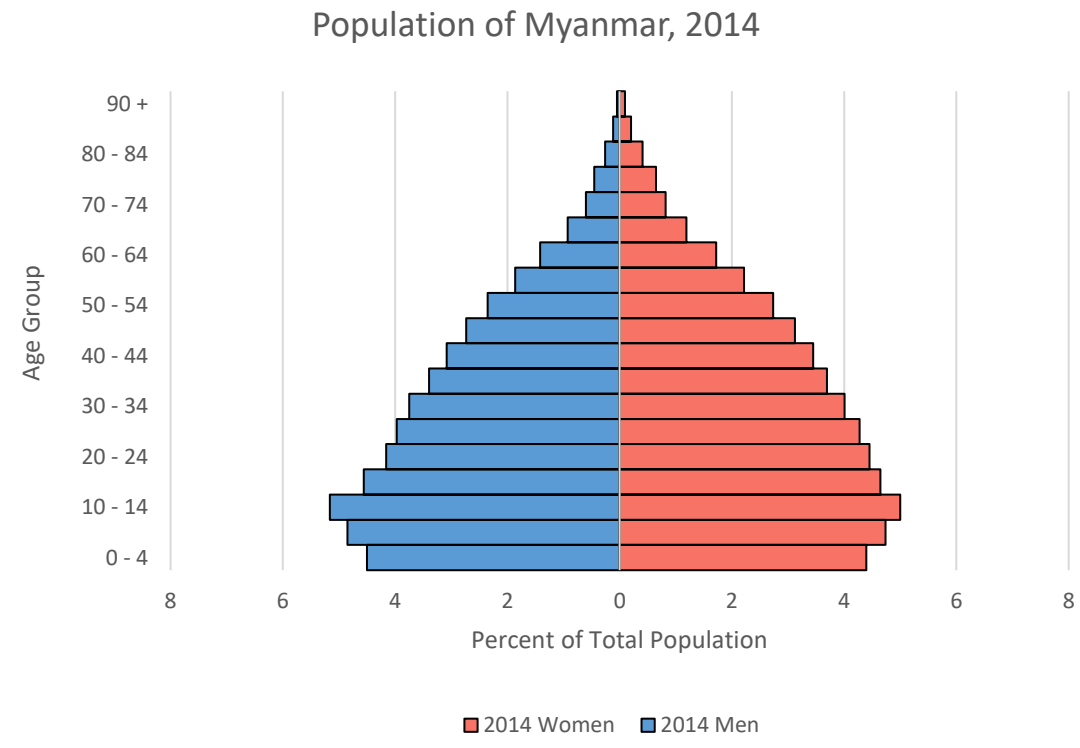
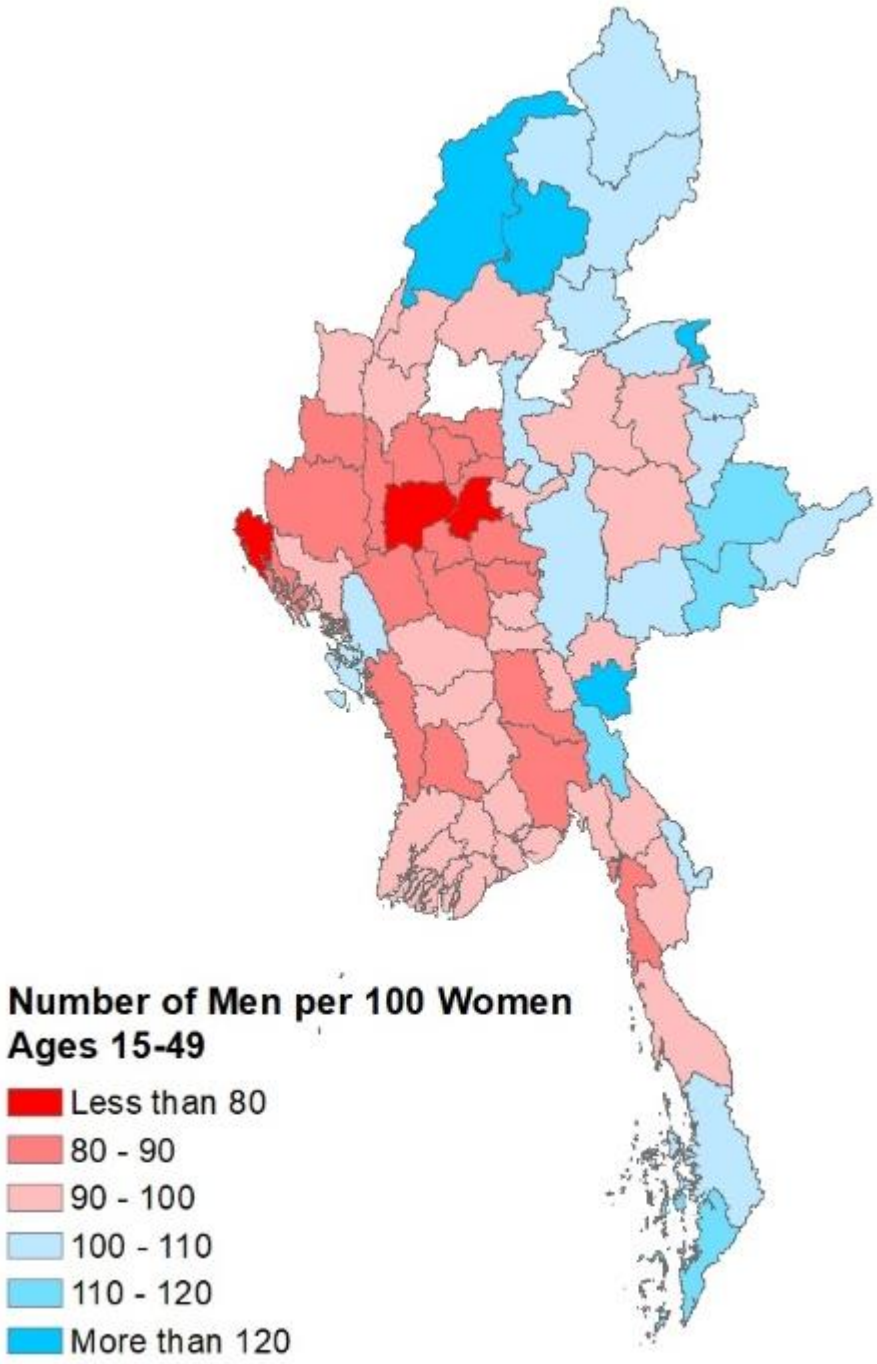


Figure 3-6. Population pyramids for 1983 and 2014
Data Source: Department of Population, 2015

All states and regions of Myanmar except for Yangon, the capital in 1983 and the largest city at the time of both censuses, show similar population distributions in 1983. By 2014, great variety is apparent across the country (Appendix D). However, several states and regions show notable differences. For example, population pyramids show little change in Chin between 1983 and 2014 and suggest that the state has high fertility and either high out-migration or mortality. While most states and regions show a small youth bulge, there are especially large youth populations in Kayin, Tanintharyi, Mon and Rakhine. This may be due to possible "baby booms" in the mid to late 1990s in these areas. However, after these initial increases, there is evidence that fertility is now declining.

Yangon shows a bulge in the population aged 15-25 in 2014, likely representing young men and women migrating into the city for work rather than a period of increased fertility. For similar migration reasons, Nay Pyi Taw, which became the country's capital in the early 2000s, has a disproportionately small 15-19 year old population. This may be due to migration patterns, with more children born to parents who moved to the city after its establishment as the nation's capital, who have yet to mature to early adulthood.

In 1983, the gender balance appears relatively even. However, by 2014 there are more adult women than adult men. At around age 20-24, the population sex ratio falls to 93.4 men per 100 women and continues to fall until there are nearly twice as many elderly women as there are elderly men. The greatest imbalances are seen in Magway, where there were only 83.7 men for every 100 women of reproductive age in 2014, and Kachin, one of the few areas with more men than women – 121.3 men for every woman of reproductive age in 2014 (Map 3-1). The unusual sex imbalance found in Magway region, and to a lesser extent Chin state, may be a result of high emigration from these areas, as explored later in this chapter, while Kachin state's high male to female ratio may be due to the high concentration of mining activities (LaJeunesse Connette *et al*., 2016).



Map 3-1. Sex-ratio by state/region, Myanmar 2014
Data Source: Department of Population, 2015

3.3.2 Fertility change

3.3.2.1 ***National level estimates***

At a national level, fertility declined in Myanmar between 1983 and 2014. However, the results of indirect population projections suggest that fertility did not decline as rapidly or as early as population surveys suggest. While national population surveys conducted in the intercensal period suggest a precipitous drop in fertility between 1983 and 1990, TFRs estimated from population projections adjusted for increasing emigration show a gradual decline over the last thirty years (Figure 3-7).

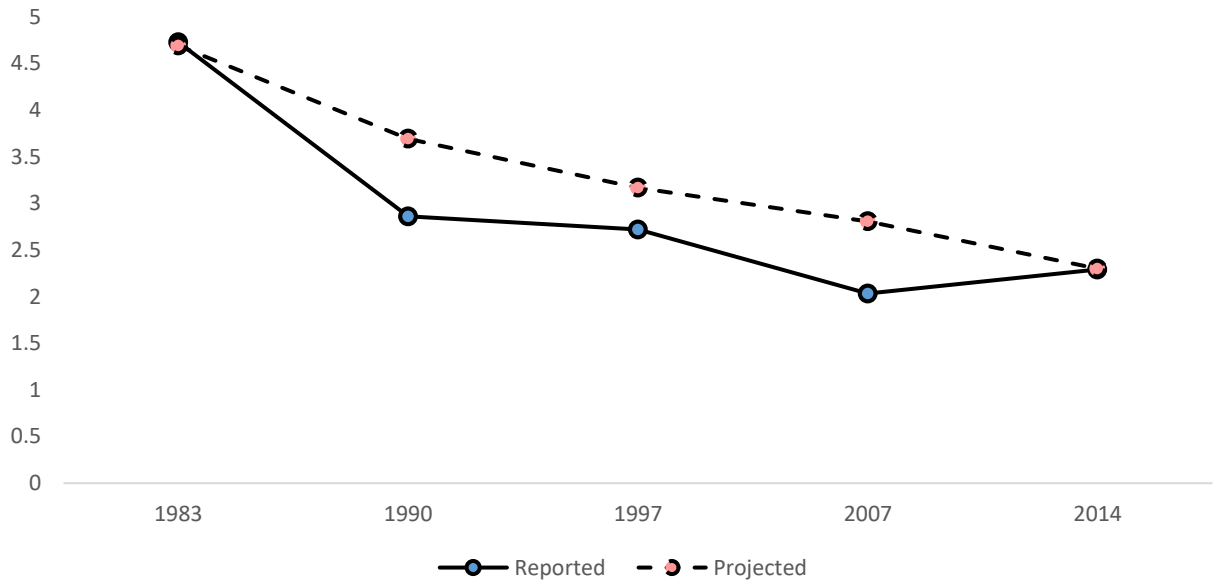


Figure 3-7. Reported vs projected total fertility rates, Myanmar 1983-2014
Data Source: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Department of Population, 2016b; Department of Population, 2016c; Immigration and Manpower Department, 1986

The predicted TFRs agree with those presented in Spoorenberg's (2013) paper, which also assumed a more gradual decline in fertility in the early 1990s based on reverse survival estimates using individual level data from several of national population surveys.

3.3.2.2 *State/Region Fertility Estimates*

As discussed in the methods section, P/F ratios were used to help determine if the level of fertility calculated using census data needed to be adjusted. As Figure 3-8 shows, only P/F ratios from Ayeyarwady and Magway were close to the expected value of 1.0, which would indicate constant fertility and accurate data. The P/F ratios from the other states/regions (Yangon and Tanintharyi in particular) were higher, supporting the decision to adjust the level of the ASFR curve for 1983. Figure 3-9 shows less variation across states/regions in 2014, except for Rakhine (blue line in Figures 3-8 and 3-9) whose P/F ratios suggest substantial under-reporting of births. This is not surprisingly given the policies limiting the number of children allowed to Rohingya couples and the under-enumeration of the state during 2014.

P/F ratios are also used to identify patterns suggesting fertility decline. If there has been constant fertility over time, the P/F ratios will be close to 1.0 for all age groups. However, gradual increases in P/F ratios by age group suggest falling fertility as the cumulated lifetime fertility for an age cohort begins to exceed the period fertility for that cohort. Figure 3-8 shows evidence of a slight recent fertility decline for the nation as a whole in 1983, but individual regions do not show a clear pattern of decline. In contrast, Figure 3-9 shows the gradual increase in P/F ratios by age cohort indicative of fertility decline. In 2014, decline is apparent at the national level and for nearly all states/regions. Only Chin state (red) stands out from all the others by not showing evidence of a recent fertility decline.

In addition to the evidence of declining fertility found in Figure 3-8, the P/F ratio patterns provide insight into where the decline was taking place within the age structure. The declining cohort P/F ratios from age cohorts 15-19 years and 30-34 years suggest both that fertility may be under-reported for the youngest age cohorts, and that fertility has been increasing among the middle age cohorts in recent years. This increasing fertility amongst women in middle age cohorts, especially the 24-29 and 30-34 year age cohorts, may be reflective of delays in marriage and childbearing, which in turn contributed to the country's fall in fertility in the absence of a national family planning program during this time period. The role of delayed marriage in the country's fertility decline, and the importance of never marriage, are explored further in Chapters 5 and 6.

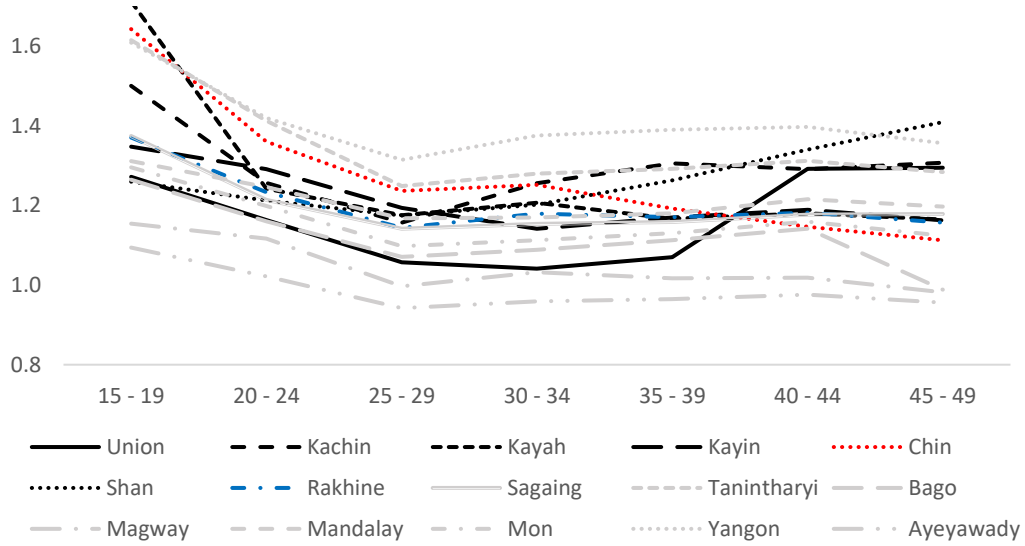


Figure 3-8. State/region P/F ratios, Myanmar 1983
Data Source: Immigration and Manpower Department, 1986

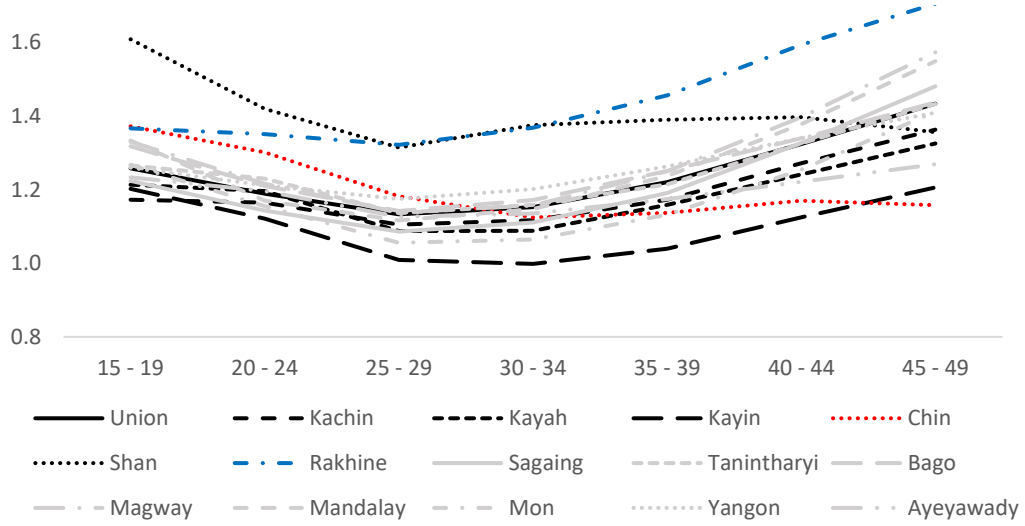
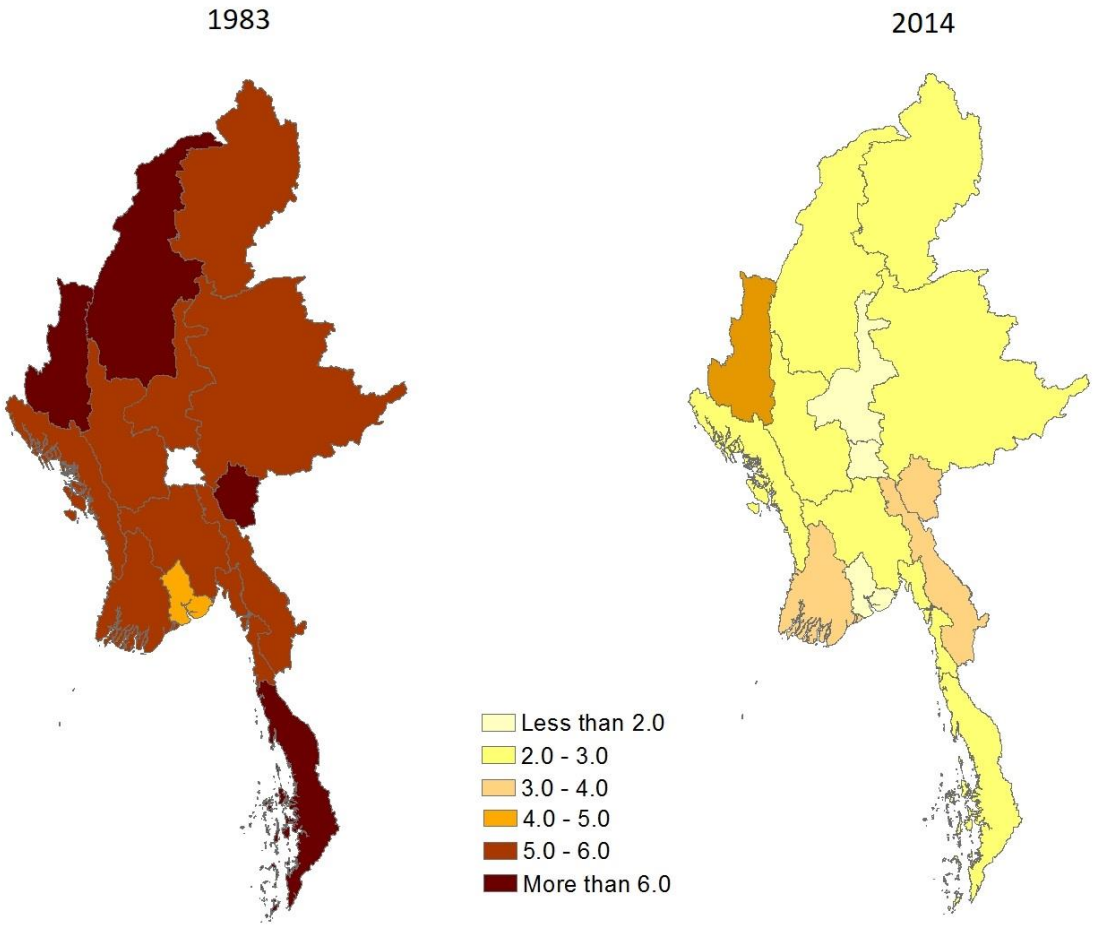


Figure 3-9. State/region P/F ratios, Myanmar 2014
Data Source: Department of Population, 2015

Following the previously described methods, the fertility estimates from the 1983 and 2014 censuses were adjusted. Comparison of these adjusted TFRs show that at the state/region level, every geographic area experienced an intercensal fertility decline (Table 3-1). Map 3-2 shows this change further, demonstrating how TFR declined across the country while leaving some areas behind. Disparities between neighbouring states/regions also appear to have increased. For example, the 2014 TFR in Chin state was 4.33, while it was down to 2.25 in neighbouring Sagaing Region. These areas had the smallest and largest intercensal fertility declines of 1.71 and 4.04, respectively. By 2014, urban areas were showing evidence of very low fertility. Yangon (1.62),

Mandalay (1.87) and Nay Pyi Taw (1.97), all urban areas, had TFRs below the replacement level of 2.1, the lowest of any states/regions in 2014. In contrast, border states, like Chin state (4.33) and Kayin state (3.37) had higher fertility rates.



Map 3-2. Gompertz adjusted state/region TFRs for 1983 and 2014
Data Source: Immigration and Manpower Department, 1986; Department of Population, 2015; Myanmar Information Management Unit, 2007

Table 3-1. Adjusted TFRs by State/Region in Myanmar, 1983 and 2014[1]

		1983			
Area	Unadjusted TFR	Adjusted TFR	Alpha	Beta	RMSE
Rakhine State	5.05	5.92	-0.0333	0.9178	0.121
Sagaing Region	5.32	6.29	-0.2917	0.8856	0.088

[1] ASFR curves were adjusted using materials provided in the IUSSP's *Tools for Demographic Estimation* (Moultrie et al., 2013) and a Myanmar-specific standard fertility schedule developed by the author for this thesis. For 1983, both the shape and level of the ASFR curve were adjusted. For 2014, only the shape of the curved was changed. More details on the methods used for these adjustments and the development of the standard can be found in the methods section of this chapter.

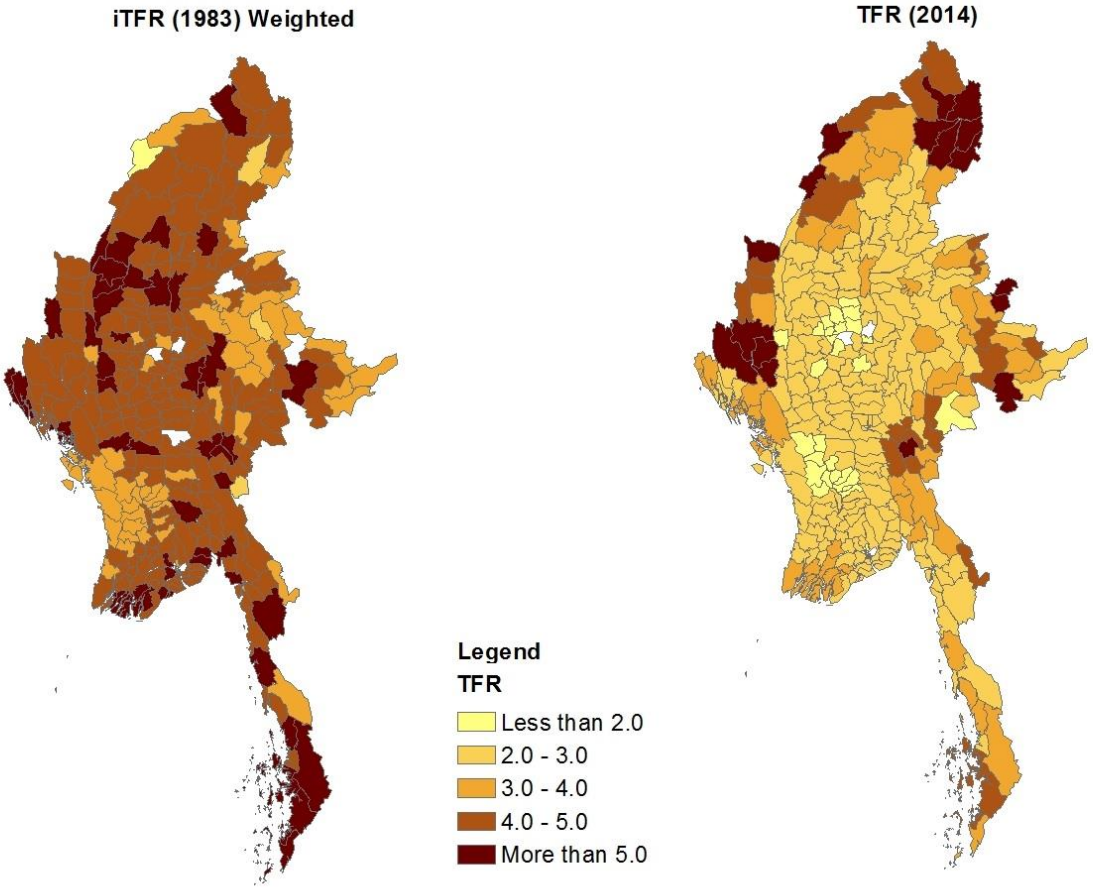
Shan State	3.68	5.04	-0.1926	0.8624	0.137
Tanintharyi Region	4.73	6.17	-0.2856	0.9077	0.119
Yangon Region	3.73	4.78	-0.1928	0.9179	0.130
Ayeyarwady Region	5.24	5.11	-0.1788	0.8860	0.093
Bago Region	4.70	5.24	-0.1256	1.0149	0.345
Chin State	5.12	6.04	-0.2525	0.9390	0.151
Kachin State	4.82	5.44	-0.0626	1.0630	0.638
Kayah State	5.07	6.08	-0.2059	0.8748	0.160
Kayin State	4.74	5.60	-0.2147	0.9488	0.123
Magway Region	5.37	5.50	-0.1732	0.9647	0.177
Mandalay Region	4.58	5.49	-0.2850	0.8954	0.095
Mon	4.99	5.71	-0.2511	0.8942	0.103
National	3.93	4.69	-0.3011	0.7968	0.251
		2014			
Area	Unadjusted TFR	Adjusted TFR	Alpha	Beta	RMSE
Nay Pyi Taw	1.97	1.97	-0.1163	0.9792	0.084
Rakhine State	2.21	2.22	-0.1069	0.9655	0.068
Sagaing Region	2.24	2.25	-0.1328	0.9994	0.064
Shan State	2.57	2.59	-0.0436	0.9014	0.121
Tanintharyi Region	2.91	2.93	-0.1979	0.9550	0.052
Yangon Region	1.62	1.62	-0.1812	1.0128	0.091
Ayeyarwady Region	3.15	3.20	-0.5632	0.5650	0.340
Bago Region	2.16	2.16	-0.1327	1.0114	0.065
Chin State	4.30	4.33	-0.2398	0.9473	0.055
Kachin State	2.44	2.45	-0.1187	1.0120	0.047
Kayah State	3.25	3.26	-0.2118	0.9583	0.061
Kayin State	3.36	3.37	-0.2007	0.9527	0.067
Magway Region	2.07	2.08	-0.1583	0.9918	0.066
Mandalay Region	1.86	1.87	-0.1830	0.9963	0.050
Mon State	2.35	2.36	-0.1894	1.0009	0.065
National	2.29	2.30	-0.1274	0.9762	0.050

Data Source: Immigration and Manpower Department, 1986; Department of Population, 2015

In alignment with under-reporting suggested by the P/F ratios, substantial adjustments of the 1983 estimates from Tanintharyi and Yangon were made, while fewer changes were made for Ayeyarwady and Magway. To keep the adjustments consistent across states/regions in 2014, the level of the ASFR curve was not adjusted for Rakhine despite evidence in the P/F ratios and literature that births may be under-reported in the state. If the level was also adjusted using the same techniques employed to adjust shape and level of the 1983 data, the 2014 TFR for Rakhine would be an estimated 3.47, but because it is difficult to gauge the level of under-reporting in Rakhine with the available data this estimate may also be inappropriate. Regardless, it is likely that Rakhine has a higher fertility rate that is closer to the high rates reported in Chin state than to the near replacement level fertility reported in the 2014 Census.

3.3.2.3 *Sub-National Fertility Estimates*

Examination of the spatial distribution of the implied TFR and TFR at the township level show a pattern in fertility change characterised by the establishment of a core-peripheral fertility dynamic (Map 3-3). In 1983, fertility appeared lower in the major urban areas of Yangon and Mandalay, but do not present other obvious patterns, for example between divisions (generally located along the international borders and later renamed "regions") and the states (found in the central plains and south). However, by 2014 clear differences are apparent between the central regions and the external states. Examination of fertility at this lower administrative unit removes many of the stark differences seen between neighbouring states/regions in Map 3-2.



Map 3-3. Comparison of township level iTFR (1983) and TFR (2014)
Data Sources: Immigration and Manpower Department, 1986; Department of Population, 2015; Myanmar Information Management Unit, 2007

Comparison of regional variation in total fertility shows that the inter-state/division range of township fertility rates did not change substantially between 1983 and 2014. However, average township fertility rates have shifted down – weighted by the 1983 under-five mortality rate, the

average township fertility rate fell from 4.3 in 1983 (standard deviation = 0.97) to 2.7 in 2014 (standard deviation = 0.04). Although fertility appeared to generally fall across the country, the township fertility rate increased in nearly 10%, 27, of the country's townships, all in rural minority states.

This represents a statistically significant decline in the estimated average total fertility across townships of approximately 1.6 (CI: -1.71 - -1.48, $p << 0.001$). Paired t-tests were used to explore the difference between township fertility declines in states and regions. The declines in both states and regions were statistically significant. In states, the average decline in township fertility was 1.04 (CI: 0.81 – 1.26, $p < 0.001$) from 4.39 in 1983 to 3.30 in 2014. In regions, fertility declined by 1.93 (CI: 1.82 – 2.03, $p < 0.001$) from 4.31 to 2.38 during the same period. A difference-in-difference test found that the difference in fertility decline from 1983 to 2014 between states and regions, 0.89, was also significant ($p < 0.001$). Historically, states and regions have experienced economic and social development at differing speeds (see Chapter 1 for more information), and these findings suggest that these differences may have contributed to differing fertility trajectories. Characteristics of geographic administrative areas associated with fertility at the district level are explored in more detail in Chapter 4.

As was previously illustrated, there was a need to adjust upwards the reported level of total fertility for 1983. While this was partially achieved by weighting the iTFR by the under-five mortality rate, data are not available to do a full adjustment of fertility rates at the township level. As a result, the true township TFRs may have been higher in 1983. For example, the iTFR for Chin State in 1983 ranged between 4.51 and 5.23, while the adjusted TFR for the state was 6.04 (see Table 1). As a result, the declines in some townships may have been greater and it is probable that increases found in some peripheral townships were the result of under-estimated iTFRs in 1983. However, even if the 1983 numbers are low, there is still evidence of a general fall in fertility across the country with stalled fertility in remote areas.

3.3.3 Changing mortality and migration patterns

3.3.3.1 ***Child mortality***

There is evidence that child mortality declined steadily and substantially between 1983 and 2014. The *2014 Census Thematic Report on Mortality* estimated the national infant and under-five mortality trends from 1968 to 2012 using data from previous population surveys (Department of

Population, 2016b). These estimates show a decline from an infant mortality rate of approximately 148 infant deaths per 1000 live births in 1968 to 62 in 2012. The decline appears to have levelled off in the 1990s, but may again be declining. Despite these general improvements, child mortality in Myanmar is high when compared to other countries in the region (Figure 3-10).

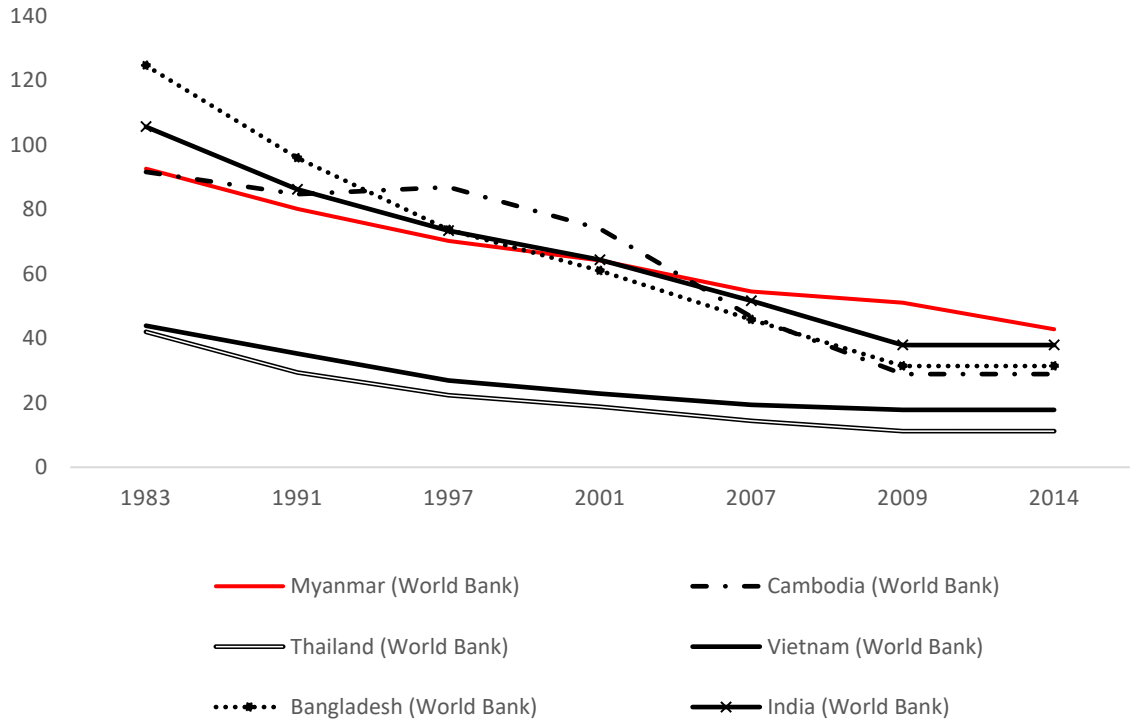


Figure 3-10. Infant mortality trends in Myanmar and surrounding countries, 1983-2014
Data Source: World Bank, 2016

Under-five mortality rates (U5M) and infant mortality rates (IMR) appear to be improving across all geographic areas. However, disparities in mortality rates for both infants and children under five years old are present. In 1983, these disparities follow generally expected patterns of poorer mortality outcomes in peripheral states, with especially high infant and under-five mortality in Kachin (IMR 128.8, U5M 162.5) and Rakhine (IMR 134.0, U5M 169.9). In 2014, early-age mortality in both states appears to have improved dramatically, with the highest infant and under-five mortality rates now found in Ayeyarwady (IMR 86.2, U5M 103.6) (Figure 3-11). Ayeyarwady's poor improvements in early-age mortality may be because the area was badly affected by the Cyclone Nagis in 2008. As a result, access to services was disrupted and the division's health

infrastructure may have continued to be especially strained, resulting in poorer health outcomes for young children.

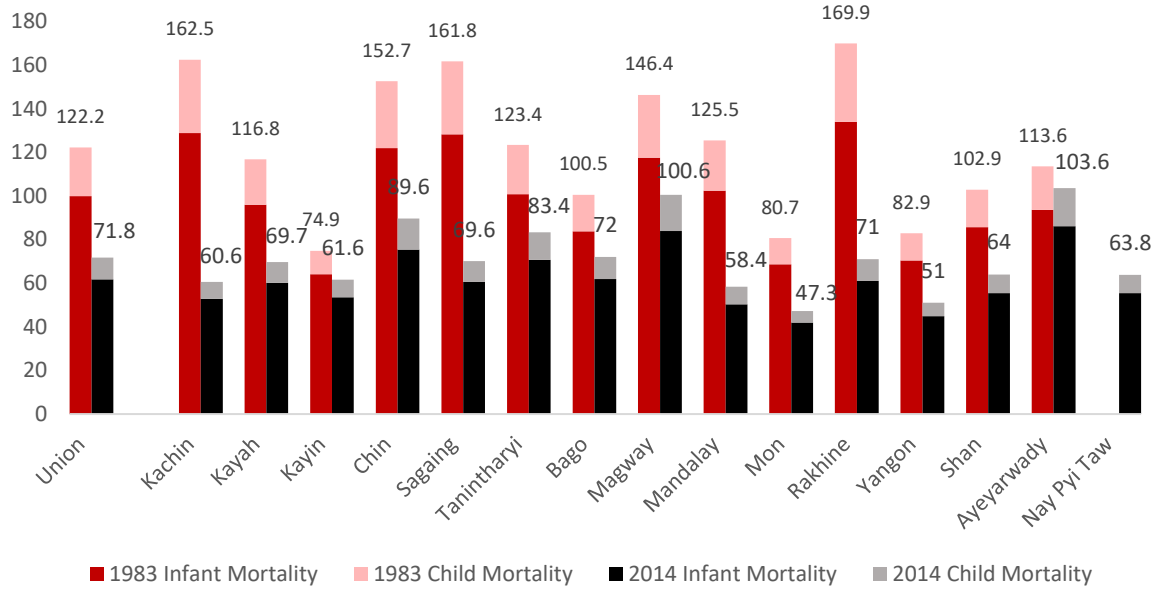


Figure 3-11. Changes in under-five mortality in states/regions of Myanmar, 1983-2014
Data Sources: Immigration and Manpower Department, 1986; Department of Population, 2015

Some of the improvements, particularly in places like Rakhine and Kachin raise questions about the accuracy of census data on early age mortality. Compared to those modelled by the World Bank (Figure 3-12) and to those in the 2015-16 DHS Report, IMRs from the 2014 Census are substantially different. The same is true for under-five mortality. At the national level, under-5 mortality was estimated at 71.8 deaths per 1000 live births in the census, compared to only 40 in the DHS. A similar discrepancy is found between the 2014 census data and World Bank estimates. Spoorenberg's (2013) estimates present yet another discrepancy as they are closer to those directly reported in the 2014 Census.

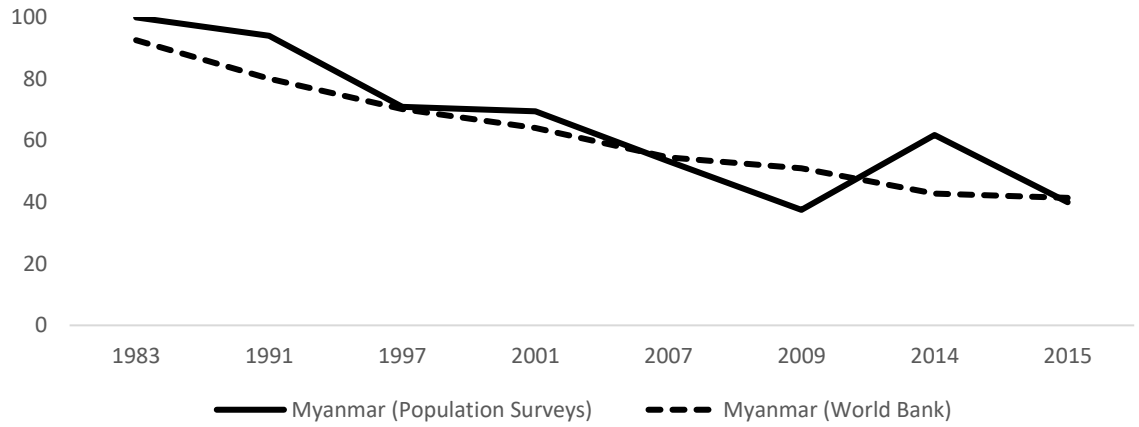


Figure 3-12. Reported vs estimated infant mortality, Myanmar 1983-2015
Data Sources: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Immigration and Manpower Department, 1986; World Bank, 2019

3.3.3.2 ***Adult mortality***

Myanmar also has relatively poor adult mortality outcomes when compared to other countries within Southeast Asia and the developing world. Male life expectancy in 2014 was especially low compared to similar countries at only approximately 60 years. Women had a higher life expectancy of 69 years. Life expectancy for both men and women was highest in Nay Pyi Taw (63.7 and 71.6 years respectively) and lowest in for men (57.4 years) and women (63.5 years) in Chin state. Although low for the region, these estimated life expectancies represent great improvements from 1991, when the Population Change and Fertility Survey estimated life expectancy of just under 54 years for women and 50 years for men (Immigration and Population Department, 1995). Figure 3-13 (below) shows male-female mortality differentials by age in 2014. They show substantial differences in infant mortality between males and females, equal trends through childhood and early adulthood, and finally a relative increase in mortality for males beginning at around 25 years old.

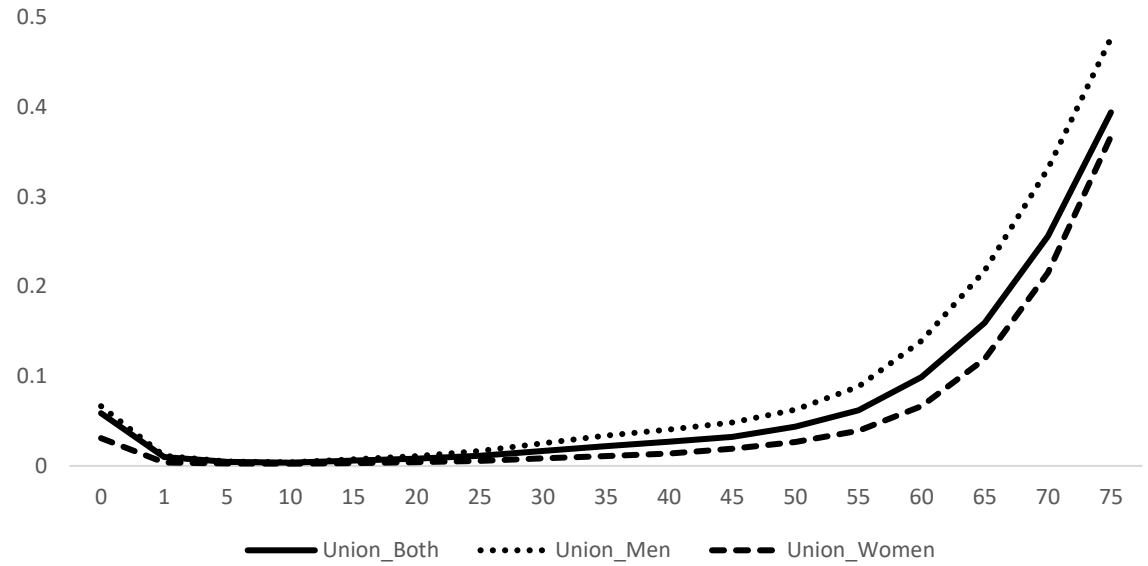


Figure 3-13. Age-specific mortality, Myanmar 2014
Data Source: Department of Population, 2016b

Focussing more on sex and age specific mortality rates for men and women of reproductive age provides greater insight into how differential mortality may affect population change in Myanmar. The differences between male and female mortality rates are unique for the region (Figure 3-14). Male and female mortality rates are more similar in other countries than they are in Myanmar, which appears to have a jump in male mortality rates beginning at age 25, at least ten years earlier than similar increases in other countries. Unlike for early age mortality, the 2014 Census and the 2015-16 DHS produced similar mortality estimates (data not shown).

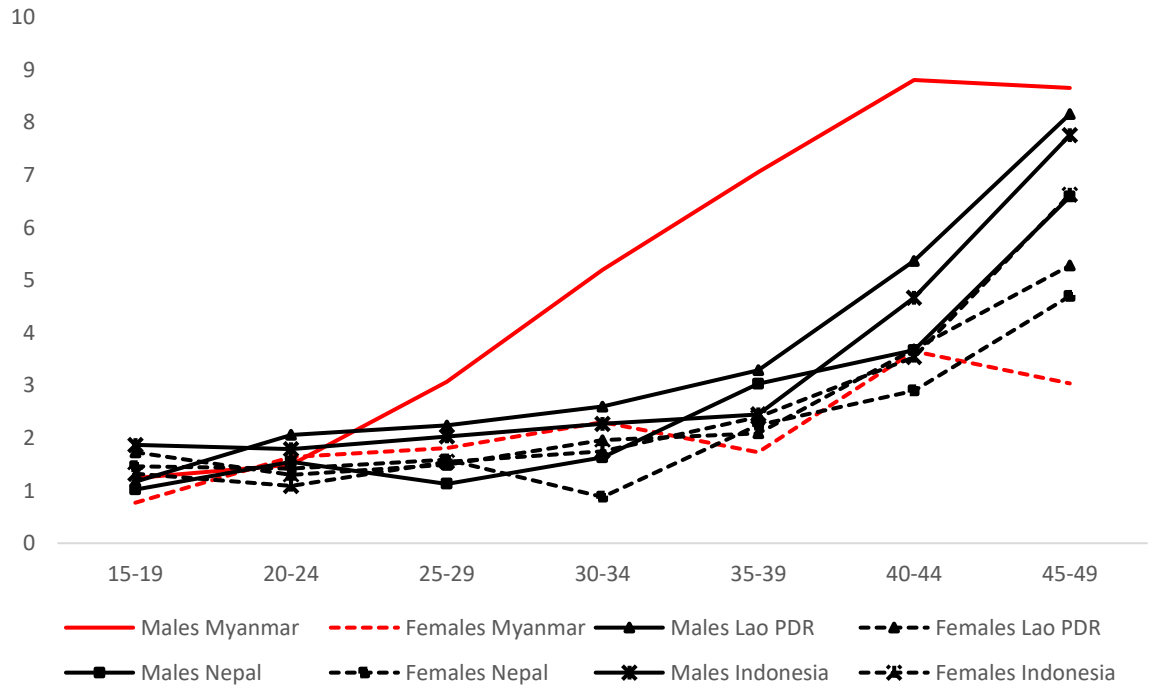


Figure 3-14. Male vs. female mortality rates in Asia
Data Sources: World Bank, 2016; Ministry of Health and Sports and ICF, 2017

3.3.3.3 ***Migration***

Approximately 19% of all citizens of Myanmar reported migrating within the country at some point in their life during the 2014 Census, with a similar proportion of males and females reporting lifetime internal migration. In Yangon, more than 50% of the population reported that they had ever migrated within the country. Those currently living in Chin were least likely to report lifetime migration, at only 6.4%. However, Chin had the highest outmigration for a state/region in 2014 with a net-migration of -167.7 per 1000 residents. In contrast, Yangon and Nay Pyi Taw, the commercial and political centres of the country, had highly positive net-migration rates of 246 and 211 in-migrants per 1000 residents, respectively (Department of Population, 2016c). As Figure 3-15 shows, net-migration varied across the rest of the states/regions in 2014. There was little variation in movement by sex for most of the states/regions.

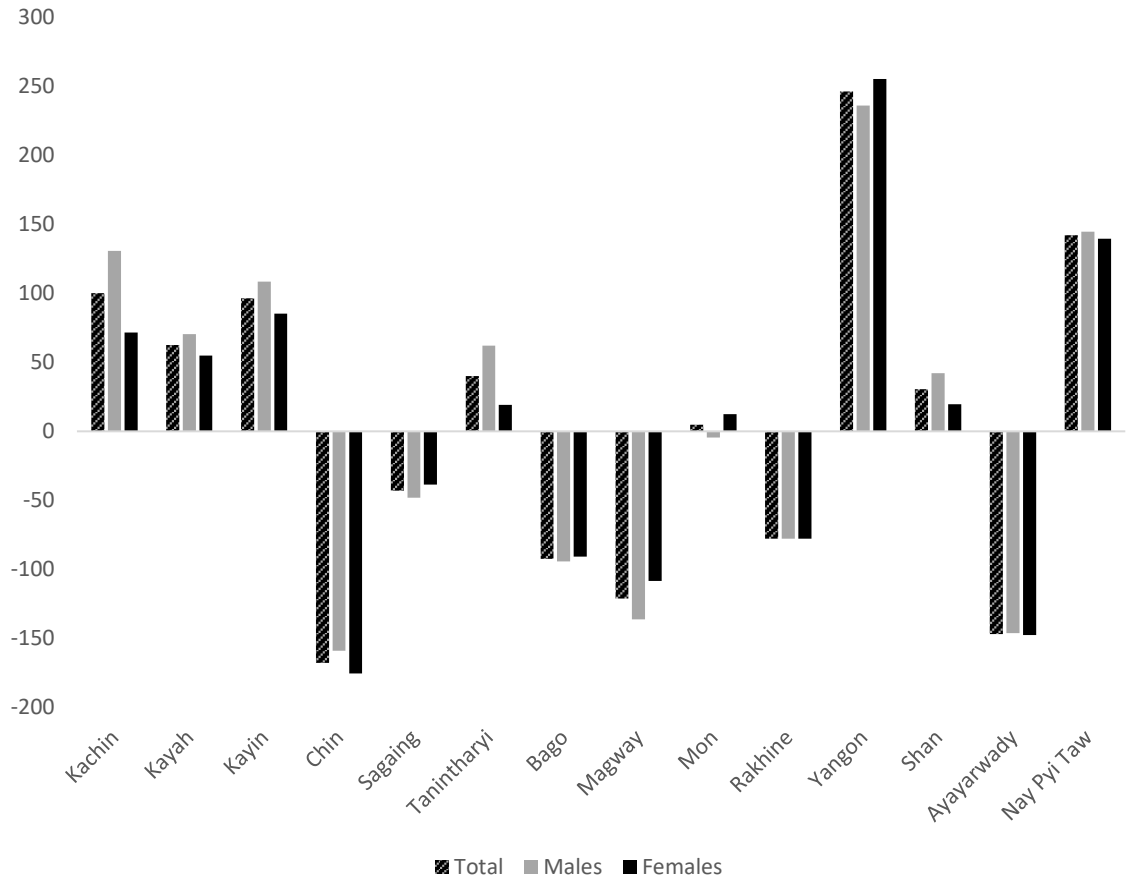


Figure 3-15. Net migration by sex and state/region, Myanmar 2014
Data Source: Department of Population, 2016c

Although a similar number of men and women migrate within Myanmar, the reasons for migration are slightly different. While the most common reason for males to move was to seek employment, females were most likely to move following family (Department of Population, 2016c), suggesting a dynamic where men move ahead of their families to find work before being joined by family.

While males and females migrate internally at similar rates, emigration is more common amongst males, although there is variation by receiving country. Thailand is the most common international migration destination for both males and females by far. More than 1.4 million former residents of Myanmar were estimated to be living in Thailand according to their family members in 2014, approximately 70% of all estimated emigrants. The International Organization for Migration's estimates for emigration from Myanmar show an increase in emigration over the past twenty-five years, led primarily by an 88% and 90% increase in the number of men and women, respectively, migrating to Thailand (International Organization for Migration, 2016).

Most national and international migration appears to take place during young adulthood (ages 15 to 29) for both males and females. Interestingly, the greatest proportion of all internal migrants in these age groups appear to be moving from urban areas to rural areas, perhaps in pursuit of employment at factories or mines. The *2014 Census Thematic Report on Migration and Urbanization* noted that urban-rural migrants were younger and more likely to be employed in the manufacturing and construction sectors (Department of Population, 2016c). International age and sex-specific migration patterns differ by the socioeconomic status of the receiving country. For example, a quarter of male migrants to Thailand and China moved there when they were between the ages of 15-19, while male emigration to high income countries like Singapore, Japan and South Korea does not reach similar proportions until ages 20-24 and peaks between ages 25-29. In contrast, females aged 15-19 were most likely to emigrate across destinations (Figure 3-16).

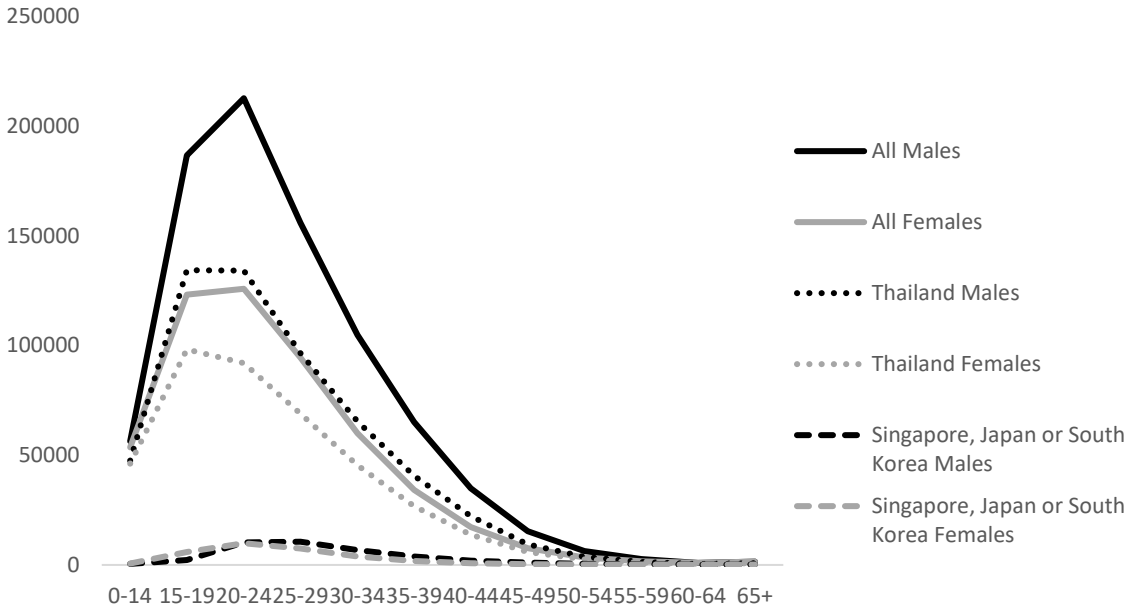


Figure 3-16. Age at emigration by destination country, Myanmar 2014
Data Source: Department of Population, 2016c

Migration due to conflict is not seriously explored in any of the population surveys. The 2014 Census allowed respondents to indicate that internal migration was due to conflict, but less than 1% of internal migrants listed conflict as a reason for moving. This is despite estimates of large internally displaced persons (IDPs) and refugee populations. As of early 2016 there were 446,000 IDPs living in eastern Myanmar and six IDP camps in Kayin and Shan states (Thailand Burma Border Consortium, 2016), and more than 900,000 Rohingya refugees seeking shelter in Bangladesh alone as of mid-2018 (International Organization for Migration Bangladesh, 2019). While the census captured information about some of this movement, it is likely that individuals

living in IDP camps were not included in the 2014 Census, and numerous townships in eastern Myanmar and Rakhine, from which refugees left, were excluded from the Census due to safety and security concerns.

3.4 Discussion and conclusions

This analysis sought to expand previous research into population change in Myanmar, exploring intercensal changes at the national and sub-national levels. The results show that although Myanmar's population has increased in line with other countries in the region over the past one hundred years, recent growth (between the 1983 to 2014 intercensal period) has been slower than projected. This stagnated population growth appears to have occurred despite improvements in under-five mortality outcomes due to substantial fertility decline and increased emigration, especially among men of reproductive age.

Additionally, the results presented here show evidence of a widening urban-rural divide that can be exemplified by the changes occurring in several states/regions. In Chin state, in the far west of the country, there was little change in the population structure between 1983 and 2014. There is evidence of stalled, and potentially increasing, fertility with few improvements in mortality outcomes, along with high out-migration both to other parts of the country and overseas. At the township level, there is evidence that the changes, or lack thereof, seen in Chin state represent those among other peripheral areas along Myanmar's western international borders. Areas in the far west of Rakhine and Sagaing show similar patterns, despite evidence of greater change taking place across the state/region as a whole. The situation appears somewhat similar in some peripheral and remote areas in eastern Myanmar. However, the porous Thai-Myanmar border has led to even more pronounced increases in emigration from Shan, Kayah and Kayin states.

Stalls in population change in peripheral states stand out more clearly compared to the rapidly changing regions, like Yangon or Mandalay, lying in Myanmar's central valleys. The urban centres of the country show evidence of dramatic fertility decline, falling child mortality rates and positive net-migration. Total fertility in Yangon, Mandalay and Nay Pyi Taw had fallen below the replacement level of 2.1 by 2014. Regions bordering Yangon and Mandalay along the central corridor of the country (for example Magway and Bago) also had low total fertility rates in 2014, around 2.1. Even Sagaing region, which has townships in the Naga Self-Administered Area along the Indian border with high total fertility (up to 6.14), had a regional TFR of 2.25 in 2014 due to

below replacement levels in almost half of the region's townships, especially those bordering Mandalay. Initial comparisons between townships in the external states and central regions found a statistically significant difference between the declines in these two types of administrative areas.

The results also support increased focus on changing fertility and migration in Myanmar. Unfortunately, data limitations mean that these relationships cannot be explored empirically. Instead, this chapter provides some context for considering these relationships on a theoretical level. In Myanmar, where little to no fertility occurs outside of marriage, it is reasonable to assume that delays in union formation or spousal separation related to changing migration patterns may contribute to the country's fertility decline. As Map 4 shows, there are substantially different sex ratios for individuals of reproductive age across the country. Sex-specific migration trends may differ due, at least in part, to the types of opportunities awaiting male and female migrants in host communities. For example, Myanmar is rich in natural resources ranging from coal and natural gas to gold and jade. Internal migration to find employment at mines is common and many of the areas in Map 1 with high male-to-female sex ratios are also areas with large mines (LaJeunesse Connette *et al*., 2016). Although some men working in mines are later joined by their wives, others either delay marriage or are separated from their spouses for extended periods. The spike in emigration to Thailand (the most common emigration destination) for both males and females aged 15-19 also suggests a possible delay in marriage for emigrants. However scarce and questionable data limit empirical work to explain the mechanisms through which migration affects fertility in greater detail.

Excess male mortality is also found in Myanmar, which could limit fertility. The differences in adult male and female mortality could be caused by a number of factors. The *Thematic Report on Mortality* (Department of Population, 2016b) notes that the gender difference in mortality is much greater in Myanmar than in other Southeast Asian and developing countries, but not quite as great as in developed countries. The report posits that female mortality rates in Myanmar reflect the socioeconomic development of the country, but that males seem to be dying at higher than expected rates. This could be due to higher risk behaviour such as alcohol and tobacco use, a greater likelihood of being involved in motor vehicle accidents, participation in high-risk professions, or other similar reasons (Department of Population, 2016b). Mining again serves as an example. Several high profile landslides at jade mines highlight how the mostly unregulated

industry puts both formal and informal workers at increased risk of mortality and morbidity ('Myanmar landslide buries at least 54 jade miners', 2019; 'Myanmar landslide', 2015).

However, while it is possible that the excess male mortality contributed to the slower than projected population growth in Myanmar, data from the previous population surveys suggest a weak relationship. The crude death rate (CDR), the only measure of overall mortality available in all surveys, show that while there is some fluctuation in the CDR over time, the differences between men and women appear fairly consistent, a finding supported by Spoorenberg's estimates of life expectancy between 1983 and 2010 (Spoorenberg, 2013). What cannot be explored in greater detail with available data is whether the mortality rate for men of reproductive ages has changed in recent years, a change with a more obvious pathway to influencing fertility decline and the deceleration of population growth.

Collectively, the changes in components of population growth begin to describe the reasons behind the slower than projected population growth in Myanmar. The results presented here suggest that the improvements in mortality over the intercensal period were marginal and male-female differences have not changed dramatically over the past thirty years. The results also show how migration has clearly increased. A description of these changes at a sub-regional level provide some insight into how this increased migration may be influencing fertility. However, the lack of more detailed data on mortality and migration at an individual level, or over time, limit the analysis which can be done. In contrast, data are available to explore the geographic and individual factors contributing to the country's considerable fertility decline. These additional factors, such as changing marriage patterns, increasing urban-rural divides and conflict, will be explored throughout this thesis, considering migration and excess male mortality where possible.

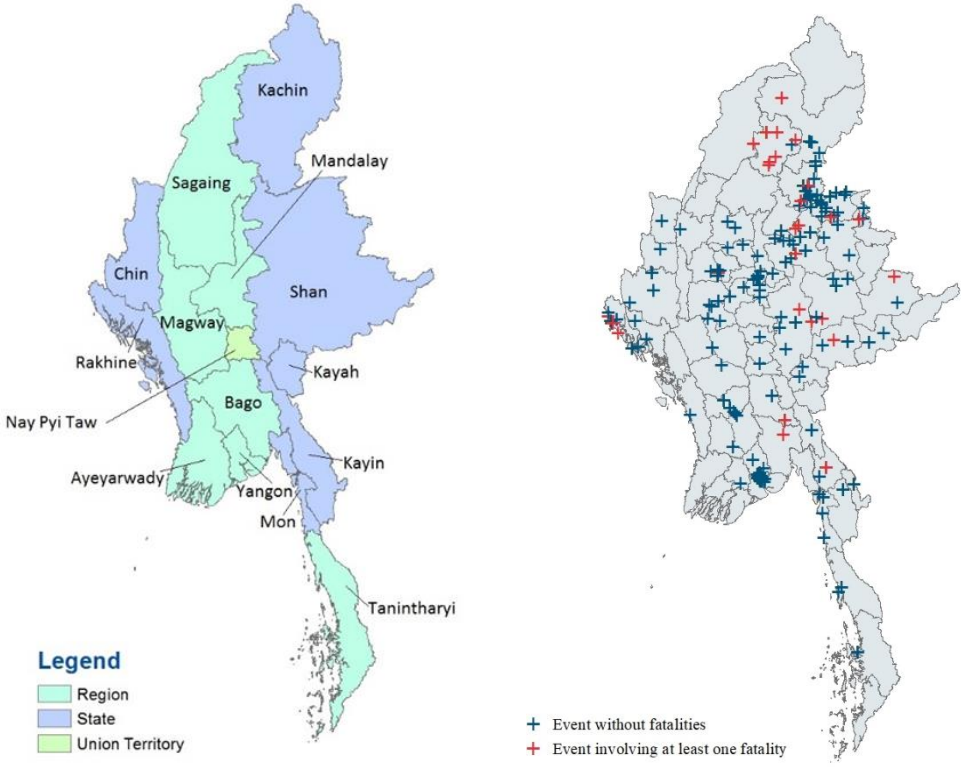
Chapter 4 The Geography of Changing Fertility in Myanmar

4.1 Introduction

As the previous chapter demonstrated, Myanmar has experienced rapid population growth over the past half century, more than tripling in population since establishing its current borders in 1948. However, the most recent census data show a smaller than forecasted population: intercensal estimates assumed sustained population growth and projected a population between 45 and 64 million by 2003 (Maung, 1986; Myint, 1991; Tint, 1991; Spoorenberg, 2013), but the 2014 Census counted only around 51 million people and recent analyses show evidence of decelerating population growth consistent with fertility decline (Spoorenberg, 2013; World Bank, 2019). This chapter examines the geography of, and the factors associated with, this fertility decline.

Myanmar is a geographically diverse country. As previously discussed, Border States (Map 4-1a) are typically remote, sparsely populated and mountainous. Travel is difficult due to the terrain and civil unrest, and the populations of Border States are ethnically heterogeneous. As a result, factors typically associated with fertility are affected. For example, access to health facilities and education is poor. The majority of health facilities offering maternal and reproductive health services in Chin and Shan states are more than 21 miles from the closest medical depot (Department of Medical Research *et al*., 2016). In eastern Shan state, only 8.5% of women were estimated to have secondary or higher education in 2009-2010 and in 2014 only 66% of Shan state's population were literate (Ministry of National Planning and Economic Development and UNICEF, 2011; Department of Population, 2016a).

Border States have also been affected by conflict during the past decades. Conflict event data for the census year of 2014 indicate that conflict incidents were widespread throughout the country, though most intense in Rakhine, northern Shan, and western Kachin states (Map 4-1b). Although less frequent, Kayin state also regularly experienced conflict during the same period. The most intensive conflicts have been in peripheral areas inhabited by ethnic minorities, such as Rakhine state.



(a) (b)

Map 4-1. States and regions of Myanmar, 2014 (a), and conflict incidents during year 2014 (b)
Data Sources: Myanmar Information Management Union, 2007; Raleigh *et al*., 2010

Finally, access to digital technology was severely restricted until 2013 when private mobile telephone providers were introduced. Official statistics report that the number of mobile telephone users increased 100 times over between 2010 and 2016, but critics have noted that rural areas and women were left behind during the rapid growth of the country's telecommunications systems (Shadrach, 2018).

In comparison, those living in the central regions of the country are predominantly ethnically Burmese and are of generally higher socioeconomic status. These areas have better physical and telecommunications infrastructures, meaning that access to health, education and mobile communications services is better. Although conflict events have been reported in central Myanmar, most do not result in fatalities, and major battles take place outside of major metropolitan areas.

This chapter examines regional fertility trends using data from the 1983 and 2014 censuses, validated using data from the recently released 2016 Demographic and Health Survey (DHS). Aggregate data from the 2014 census are examined to provide insight into the factors influencing

fertility at a sub-regional level, and how these factors may contribute to our understanding of other health and social outcomes across the country.

Maps were generated to show the geospatial distribution of fertility and associated factors using ArcGIS 10.4.1 and applying Shapefiles and Place Codes from the Myanmar Information Management Unit (2007). Statistical analysis was carried out using Microsoft Excel and IBM SPSS Statistics v.24.

4.2 Data and methods

Data for 1983 were abstracted from individual state- and region-level published census reports. The reports include tables of population by five-year age groups and sex for each township, but do not include information on births below the state/region level (Immigration and Manpower Department, 1986). For this reason, as with the township estimates presented in Chapter 3, the implied Total Fertility Rate (iTFR) was used to obtain fertility estimates for smaller geographic areas (Hauer *et al.*, 2013). The iTFR uses data on the population aged under five years to estimate the annual number of births in a particular area, and divides this by the population of women in the fertile age range to estimate the mean age-specific fertility rate across the fertile ages. Multiplying this by the number of years in the fertile age range produces the iTFR. The iTFR has been found to perform well compared with other methods of estimating the TFR, such as the Bogue-Palmore method (Hauer *et al.*, 2013). The iTFR as originally proposed assumes no child mortality or migration. The iTFR estimates were multiplied by 1.2 to account for the national under-five mortality rate from 1983, this helped account for the expected number of children born in the last five years who would have died before the census. To check the reliability of the iTFR estimates, township level TFRs were also indirectly estimated based on the female age structure for each township (see Appendix B for additional details). iTFR and indirect estimates were found to be sufficiently similar to assume that consideration of the age structures of individual townships did not substantially change fertility estimates for the township.

Township TFR estimates computed for the 2014 Census were used for 2014 (Department of Population, 2016a). As a check on the accuracy of the Census data, the state/region TFRs reported in the census were compared with those from the 2016 DHS (Ministry of Health and Sports and ICF, 2017), and were found to be very similar (See Chapter 2). Of the 322 townships with data from either 1983 or 2014, 18 could not be compared between the two years. This was

primarily because of the creation of new districts during the intercensal period (notably the union territory and capital of Nay Pyi Taw in 2005). The census data for conflict areas are known to be deficient. Access to some areas was restricted during both census enumerations. In 1983, access to 830 village tracts was restricted and another 112 were only partially enumerated. In 2014, enumeration was restricted in Kachin, Kayin and Rakhine states: the number of non-enumerated village tracts is not documented, but an estimated 1.2 million individuals lived in the non-enumerated areas. In most cases, the census estimated population figures and demographic characteristics for these townships, but eight townships were excluded completely from data collection during at least one of the two censuses. Data for these townships are not included in maps presented in this chapter. However, as the census records do not identify the townships that were only partially enumerated, these townships have been included in the analysis.

WorldPop (2017), while generating population estimates for Myanmar, identified several townships and districts requiring adjustment. In their analysis, three townships in Rakhine were merged, two townships and a district were merged in Kachin; and additional mergers of areas took place in Shan state. Limitations on the availability of micro-data meant that we could not reconstruct the TFRs of new townships for comparison between the two censuses or derive TFR estimates for the merged geographic areas suggested by WorldPop.

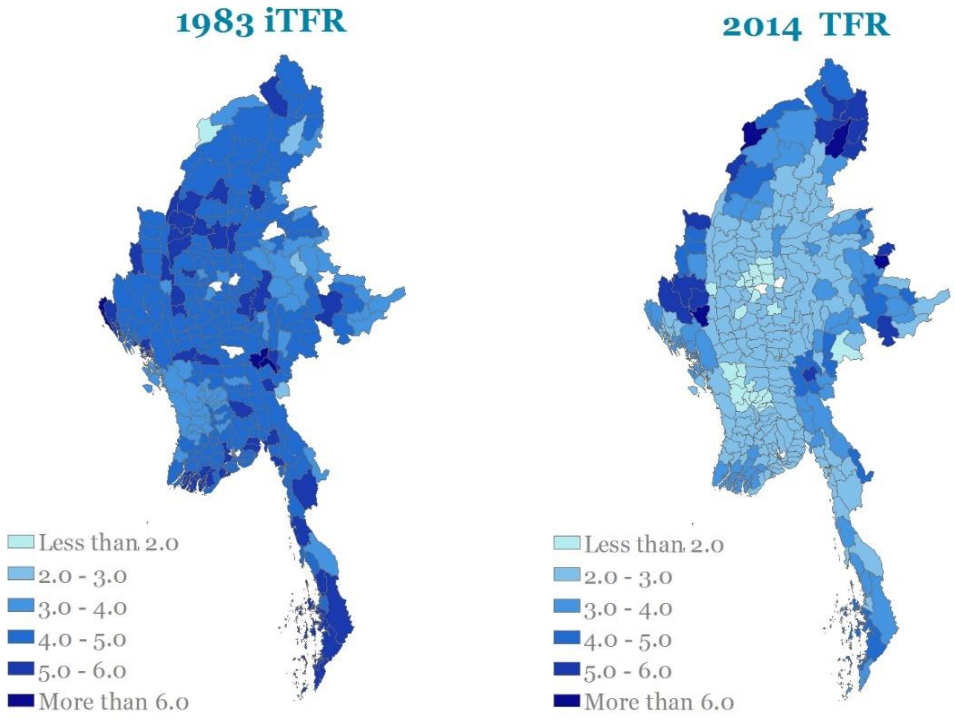
New townships and partially enumerated townships were included in the regression analysis of the district-level 2014 census data. As a check, models were re-run with all districts and excluding those districts for which data might be unreliable. While the coefficient estimates varied slightly, the direction and magnitude of the effects, and the standard errors, were similar with and without the contested districts.

4.3 Results

4.3.1 Geographical variations in fertility, 1983-2014

In 1983, geographical fertility variations in Myanmar were modest (Map 4-2a). Fertility was low in parts of Shan state and in areas of Rakhine state, and Bago and Ayeyarwady regions, but there were few other obvious patterns. By 2014, the TFR in a broad swathe of the centre of the country was below three children per woman, and in several townships it was below two children per woman (Map 4-2b). The lowest rates were found in townships in Mandalay and Magway regions

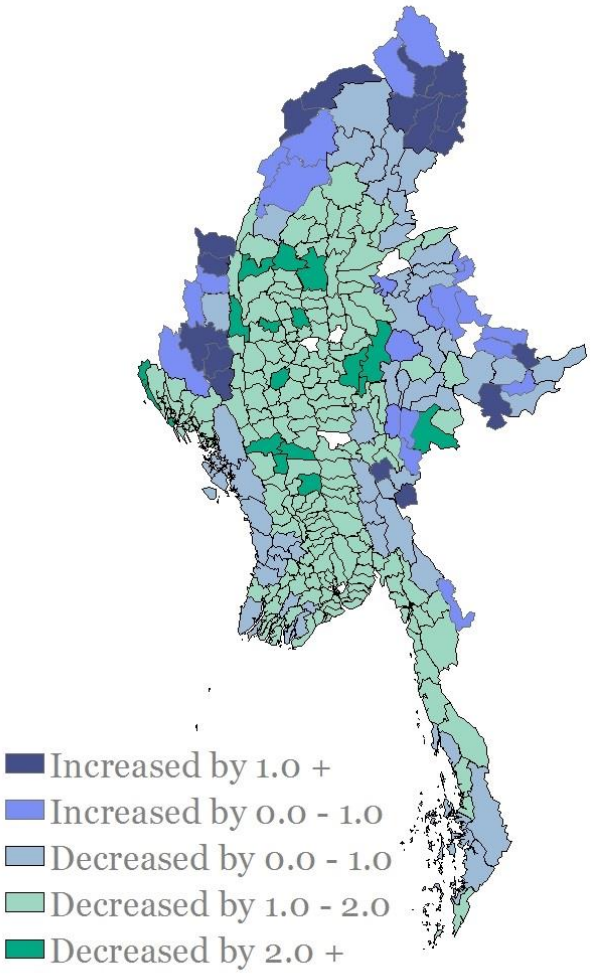
and in an area spanning the west of Bago region and the north of Ayeyarwady region. By contrast, several townships in peripheral border areas of the north and west, and in Shan state in the east, had TFRs in excess of five children per woman. Most of Chin state had a TFR of more than four children per woman.



(a) (b)

Map 4-2. Township fertility rates: Myanmar, 1983 (a) and 2014 (b)
Note: For method of calculation of iTFR for 1983, see Hauer *et al*. (2013).
Data Sources: Myanmar Information Management Union, 2007; Immigration and Manpower Department, 1986; and Department of Population, 2016a.

Previous comparisons of 1973 and 1983 census data suggest that the fertility decline began in the early 1970s in urban areas but also reached into rural parts of the country (Myint, 1991). At the state/regional level, a similar pattern of decline is found from 1983 to 2014. However, analysis of township level estimates (Map 4-3) suggest that larger declines in some urban townships may be masking stalls or increases in fertility decline in peripheral areas. The general pattern is of fertility decline in the central valley, but constant or increasing fertility in the rural, ethnically heterogeneous, periphery.



Map 4-3. Estimated change in total fertility rate: Myanmar, 1983 to 2014
Note: The figures mapped here are the absolute differences in each township between the implied total fertility rate in 1983 and the total fertility rate in 2014.
Data Sources: Myanmar Information Management Union, 2007; and Department of Population, 2016a.

4.3.2 Factors associated with fertility in 2014

The 2014 TFRs shown in the previous section are estimated at the township level, but data used to measure factors associated with fertility are only publicly available at the district or state/region levels. For this reason, examination of the factors associated with fertility in Myanmar based on the 2014 Census was conducted for the 71 districts then extant. Besides information on fertility, district proportions of married and educated women, households with safe sanitation, households with dirt floors, households that were apartments or condominiums,

and households with access to various modes of digital communication were extracted from the 2014 census data. These indicators were selected because they have either: 1) been found to be associated with fertility in previous work (marriage, female education); 2) are indicators of poverty and living conditions (type of housing, sanitation) or; 3) indicate exposure to mass media and communication. Finally, ArcGIS 10.4.1 was used to calculate the average distance from a road intersection in each district using raster data developed as a part of the Global High Resolution Population Denominators Project (University of Southampton Department of Geography and Environmental Sciences *et al*., 2018).

Based on preliminary analysis of the correlations between the various measures of digital connectivity, the number of measures was reduced to two. The first is household access to a radio. The second is the first component from a principal component analysis of the remaining connectivity variables: household ownership of a computer, mobile phone, internet and television. Each of the different instruments of connectivity loads positively on the component, so high values of the component denote a high level of connectivity. Analysis of DHS data in other countries reveals that the residents of households with televisions are wealthier, older, better educated and more likely to live in urban areas (Westoff and Koffman, 2011) than households with access to a radio. It may be, therefore, that access to a radio is measuring a basic level of digital connectivity, whereas the principal component is measuring the extent of connectedness among households beyond a basic level.

Regression model estimated the relationships between various characteristics and district-level TFR. The 71 districts are nested within the 15 states/regions. Self-administered regions and zones were not considered separately for this analysis. The inter-cluster correlation for an empty (variance components) model of the TFR clustered on state/region was 0.47, indicating that just under half of the inter-district variation in the TFR was explained by differences between the states/regions. Therefore, final models use district as the unit of analysis, but include a random intercept at state/region level to account for potential state/region characteristics.

The results (Table 4-1) showed that only the two measures of access to digital communication, average distance to a road intersection and the proportion of women aged 25 years and over with some education were statistically significant at conventional levels ($p < 0.05$). Variables measuring other household characteristics, including access to sanitation, and other proxies for social and economic status were not significant once access to digital communication and women's education were accounted for. Examination of the residuals from Model 2 found relatively high

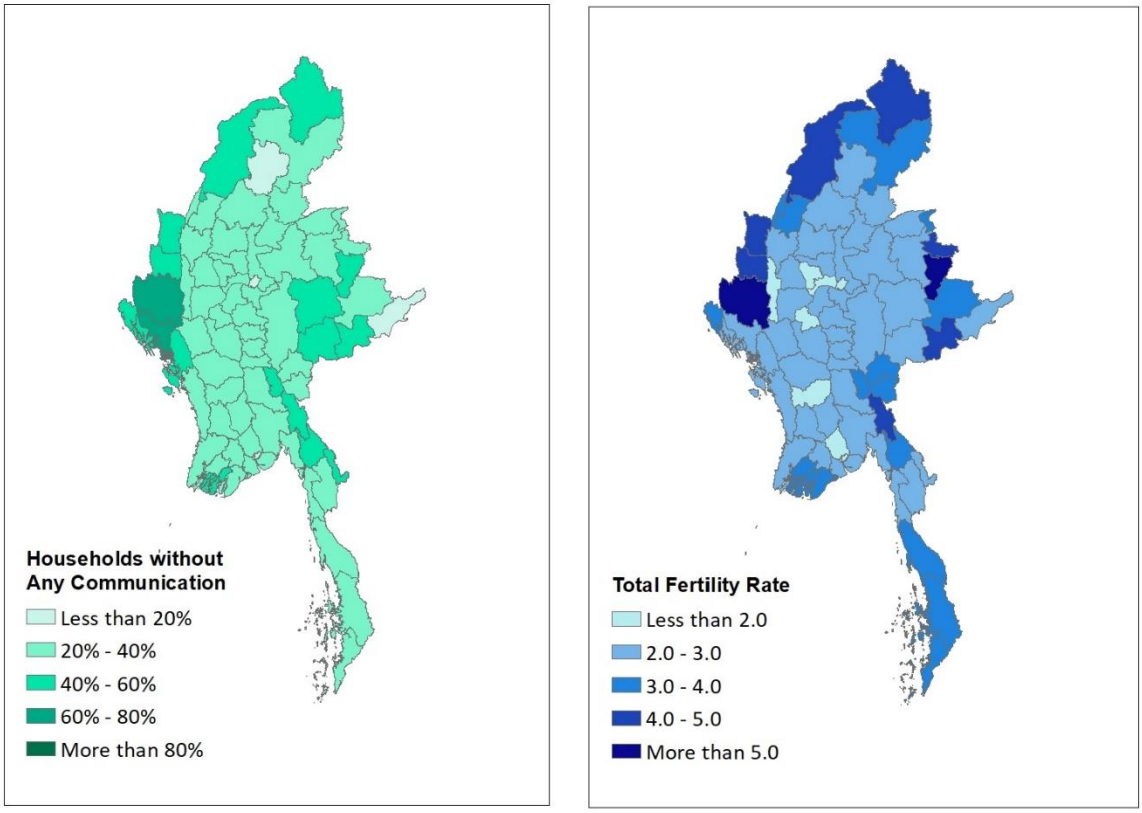
errors in some contested areas (such as Rakhine) but no other strong geographical patterning (see Appendix E).

Table 4-1. Regression of total fertility rate on district-level characteristics: Myanmar, 2014

Covariate	Model 1		Model 2	
	Parameter estimate	Standard error	Parameter estimate	Standard error
Intercept	4.422	0.238	4.370	0.305
Percentage of households that own a radio	-0.045	0.007	-0.024	0.004
Principal component score for household ownership of other digital communication methods	-0.390	0.072	-0.203	0.061
Average distance to a road intersection across the district			0.021	0.004
Percentage of female population aged 25 years and over with some education			-0.015	0.004

Note: The models include a random intercept at the state/region level.
Source: Department of Population, 2016a). University of Southampton Department of Geography and Environmental Science *et al*., 2018

The proportion of households with access to radio and the proportion of adult women with education are negatively associated with the TFR. Household ownership of televisions, mobile phones, and computers, or access to the internet, is associated with lower fertility. Districts where there was a greater average distance to a road intersection had higher fertility. The strong relationship between household access to digital communication and fertility in 2014 can be illustrated by Map 4-4. In large parts of Sagaing region, Kachin, Shan and Kayin states and the whole of Chin state, fewer than three out of every five households had access to any form of digital communication, and in parts of Chin and Rakhine states the figure was fewer than two out of every five households (Map 4-4a). Many of these areas (notably southern Chin, northern Kachin and eastern Shan states) are the areas of highest fertility (Map 4-4b).



(a) (b)

Map 4-4. Percentage of households without access to any form of digital communication (a) compared with total fertility rate (b): districts of Myanmar, 2014
Data Sources: Myanmar Information Management Union, 2007; Department of Population, 2016a

4.4 Discussion

A detailed examination of the spatial distribution of fertility in Myanmar in 1983 and 2014 reveals a growing core-peripheral divide between low and high fertility areas. As expected (Myint, 1991), fertility appears to have declined in areas of greater development and higher socioeconomic status. But in 2014, better information connectivity has an independent association with fertility decline. Where households have better access to digital communication, fertility is low, and access to digital communication is a stronger predictor of the district total fertility rate than other measures of development. These relationships remain despite the inclusion of a variable measuring physical remoteness through road networks.

The 2014 Census came at a time of very rapid change in access to mobile telephones and the internet in Myanmar. It may be that in the future the disparity in access between the central and the peripheral areas will diminish. It is also possible that in 2014 part of the disparity was the

result of under-reporting of digital connectivity in conflict zones. However, even if this is so, the 2014 snapshot has illuminated divisions within the country which are closely associated with fertility differentials. The geographical areas that lag behind in terms of fertility transition are remote from the centre of Myanmar geographically, socially and politically. Similar patterns in fertility decline have been observed in other countries and regions (Watkins, 1991; Bongaarts and Watkins, 1996; Guilmoto and Rajan, 2001; Amin *et al.*, 2002; Potter *et al*. 2010). Physical distance from other communities or urban centres is still important to measuring remoteness, as seen in this analysis, but digital and social remoteness is becoming increasingly important and can be seen as a proxy for an area's level of development and poverty (Copus, 2001; Department of Population, 2016b). Thus, access to digital communication may be useful as a means of measuring overall remoteness as an alternative to more traditional spatial measures. While the rapid expansion of telecommunications in the country may lead to greater use of mobile technology, internet and computers in rural parts of the country, evidence from other countries suggests that even when widely available, internet users tend to have higher education levels and come from higher socioeconomic households (Pearce and Rice, 2013).

Remoteness affects fertility in several ways. Centrality leads to stability, which can decrease the need for the economic protection provided by having a large family (Cain, 1980). Living in well-connected areas improves access to new information and potentially leads to a spread of fertility limiting and spacing behaviour (van de Walle, 1992; Casterline, 2001; Rosero-Bixby and Casterline, 1993). In Myanmar, the central 'corridor' is mainly ethnically Burmese. Women living in this part of the country, especially in urban areas, are more likely to speak the official language of the country, to be better educated and to be engaged in the labour market, all characteristics linked with declining fertility. These characteristics of central Myanmar, which also include non-traditional marriage patterns and socioeconomic development, have been suggested as the main drivers of fertility change (Jones, 2007; Chan and Taylor, 2013). Finally, a strong association between digital connectivity and fertility is also consistent with the fertility diffusion hypothesis argued by Watkins (1991) and empirically tested by Bongaarts and Watkins (1996).

As new ideas and technologies have become more available in central Myanmar, those in remote areas remain isolated by the combination of difficult terrain, ongoing conflict and the fact that many of those living in these areas belong to ethnic groups speaking different languages, which complicates health messaging. Accessing family planning services or health care from one of these areas may mean hours of travel over poorly maintained roads or walking through dense rain

forest (Teela *et al*., 2009). Health workers face additional challenges locating and caring for displaced villagers and ensuring the safety of their staff (Teela *et al*., 2009; Lee *et al*., 2006). Furthermore, prolonged conflict itself may have affected fertility in these areas in a number of different ways not explored in this analysis. Finally, language barriers may limit rural populations' ability to use mobile devices and comprehend health messaging from mobile or online sources, which are unlikely to be in all languages, when it becomes available (Pearce and Rice, 2013). The results presented in this chapter suggest that physical and technological isolation have an independent effect on fertility in Myanmar.

While this analysis helps to explain the factors associated with fertility change in Myanmar, limitations of the census data must be acknowledged. An estimated 1.2 million people living in village tracts and townships not enumerated in the censuses were excluded from this analysis. While the censuses attempted to estimate the populations living in these areas, these estimates assume that these townships behave similarly to those around them. However, the populations of these townships are, in general, highly exposed to conflict and have restricted access to health and technology services. Future analysis of sub-national fertility trends in Myanmar would benefit from a deeper examination of the relationship between conflict and fertility.

Myanmar is an economically and culturally diverse nation, with 135 recognised ethnic groups living in remote rainforests, mountain villages, flat plains and fertile deltas. In this diverse setting, often plagued by internal conflict, the country is undergoing its fertility transition. The fertility transition in Myanmar is characterised by a rapid decline in core areas with stalling or even increasing fertility rates in remote, peripheral areas of the country. Current fertility rates are significantly associated with household access to digital communication, physical remoteness and district levels of female education. There is increased geographical diversity in fertility rates across Myanmar, as seen elsewhere in Asia. Additional analysis is needed to evaluate the causes for fertility decline, but this initial research indicates that the peripheral areas have not experienced fertility transition due to their isolation and lack of connectedness to physical and virtual networks. There is a need to explore to what extent digital connectivity is a proxy indicator for levels of modernisation and access to family planning and reproductive health services, and the extent to which it measures the intensity of social networks and the diffusion of information.

Chapter 5 Proximate Determinants of Fertility in Myanmar

5.1 Introduction

As illustrated in Chapter 3, Myanmar has followed a pattern of mortality decline followed by fertility decline leading to demographic change consistent with classic demographic transition theory. However, the precipitous fall in total fertility was unexpected. Globally, the mechanisms fuelling demographic transition, especially related to fertility change, vary, but collective theories support examination of fertility through an assessment of the risk of exposure to conception and pregnancy throughout a woman's reproductive lifespan (Davis and Blake, 1956; Bongaarts and Potter, 1983; Cleland and Hobcraft, 1985). Chapter 1 introduced two prominent theoretical frameworks for assessing fertility; the "proximate determinants" and "intermediate variables" frameworks. The popular proximate determinants of fertility model assesses fertility by measuring changes in a group a four main indicators affecting exposure to conception and childbirth (Bongaarts and Potter, 1983). Under this framework, direct determinants of fertility include societal and biological elements that limit exposure to intercourse and conception (for example entry into marriage) and elements determining timing and spacing of pregnancy (for example use of contraception, postpartum amenorrhea and breastfeeding, spontaneous and induced abortion rates) (Bongaarts and Potter, 1983). The proximate determinants framework identifies changes in marriage patterns, contraceptive use, postpartum infecundity and induced abortion as those most important for and easily measurable during the assessment of fertility change, while other frameworks (for example Davis and Blake's intermediate variables framework) consider these four elements in additional to other factors impacting individual and population fertility (Davis and Blake, 1956; Cleland and Hobcraft, 1985).

Myanmar's population surveys provide enough data to analyse the role of the "proximate determinants" in driving fertility change in the country. In this chapter, trends in each of the main four proximate determinants of fertility are examined from 1983 to 2015-16. Changes are described and discussed as they relate to indirect determinants of fertility, which include socioeconomic, environmental, cultural, and other factors related to a couple's life (Cleland and Hobcraft, 1985). Finally, the Bongaarts model for quantifying the effects of each determinant on

fertility is applied to data from population surveys and fertility estimates outlined in previous chapters to identify possible reasons for fertility decline over the past thirty years. In doing so, this chapter takes a closer looks at the proximate determinants framework using data from Myanmar, and explores the framework's appropriateness for explaining fertility change in fragile states such as Myanmar.

5.2 Methods

As with the chapter describing population change in Myanmar between 1983 and 2014, this chapter begins with an analysis of census, Demographic and Health Survey (DHS) and other available population data to describe changes in contraceptive use, postpartum infecundity (including breastfeeding), abortion and marriage rates. However, the descriptive results presented here also weave in historical and theoretical discussions of the importance of the descriptive findings. Results presented in the section on abortion include both reported prevalence along with the author's estimates of the total abortion rates (TARs) for 1991, 1997, 2001, 2007 and 2015 calculated using methods developed by the Guttmacher Institute and MEASURE DHS to estimate the TAR using DHS data (Westoff, 2008). Breastfeeding rates were calculated by the author using individual level multi-indicator cluster survey (MICS) and DHS data.

Following this descriptive analysis of survey data, estimates are presented to quantify the relationships between and the contribution of the four proximate determinants to fertility change in Myanmar between 1991 and 2015-16 (and for 1983 when possible). The analysis uses national level data from the 1983 Census, 1991 PCFS, 1997 FRHS, 2001 FRHS, 2007 FRHS and the 2015-16 DHS (see Chapter 2 for an overview of data sources) to calculate indices for marriage, contraception, abortion and infecundity, as well as several additional measures of fertility, according to methods developed by Bongaarts (1978), where:

$$TFR = TF * C_i * C_c * C_a * C_m \quad \textit{(Equation 1)}$$

$$TMFR = TNM / C_c \quad \textit{(Equation 2)}$$

$$TNM = TFR / C_m \quad \textit{(Equation 3)}$$

$$TF = TNM / C_i \quad \textit{(Equation 4)}$$

- ***TFR*** = Total fertility rate, the observed average number of children a woman in a certain population could expect to have over her lifetime.
- ***TF*** = Total fecundity rate, or, the maximum number of children expected in the population if marriage were universal, *and* there was no period of postpartum amenorrhea (breastfeeding) or postpartum abstinence, *and* women did not use any methods of contraception, including induced abortion.
- ***TMFR*** = Total marital fertility rate, defined as the number of children a woman would expect to have if she was married for the entirety of her reproductive years, from age 15 to age 50.
- ***TNM*** = Total natural marital fertility rate, understood to be the expected fertility rate in a population with a given TMFR in the absence of contraception and induced abortion.
- C_i = index of postpartum infecundity, which includes both postpartum amenorrhea and postpartum abstinence. C_i equals 1 in the absence of postpartum infecundity and 0 if women remain infecund indefinitely following childbirth.
- C_c = index of contraception. C_c equals 1 when no women of reproductive age (typically measured for married women only) use a method of family planning, and 0 if all women use family planning to completely prevent conception.
- C_a = index of induced abortion. C_a equals 1 when there a population does not practice abortion and 0 if all pregnancies are aborted. As reliable data on abortion is often difficult to obtain, many analyses of fertility using the proximate determinants framework set C_a to 1.
- C_m = index of marriage. C_m equals 1 if all women of reproductive age are married and 0 if none are married.

Although it appears from previous analysis that reported intercensal TFRs require adjustment, data were not available to do robust adjustments. Population projections incorporating migration and mortality were able to estimate a more likely fertility decline trajectory, but these estimates are imprecise. For this reason, the national TFRs reported in population surveys and those adjusted through population projection in Chapter 3 were both used to calculate the measures of fertility reported in this chapter.

Marriage and contraception indices were easily calculated using the following equations:

$$C_m = \{\sum m_a * g_a\} / \sum g_a \qquad \textit{(Equation 5)}$$

$$C_c = 1 - 1.08 * \mu * e \qquad \textit{(Equation 6)}$$

where m_a was the proportion of women married in each five-year age group from ages 15-49 years old, and g_a was age-specific fertility rate (ASFR) for the group. For C_c, μ was the married contraceptive prevalence rate and e was the average use effectiveness for the method mix at each time point and was calculated by:

$$e = \{\sum e_m * \mu_m\} / \mu \qquad \textit{(Equation 7)}$$

which weights e_m (the method use-effectiveness for method m) based on Trussell *et al.*'s overview of contraceptive effectiveness in *Family Planning: A Global Handbook for Providers* (Trussell *et al*., 2011). Contraceptive use information is not available for 1983, so an assumption was made that only sterilization and traditional methods were available. Prevalence for these methods was set equal to those reported in 1991. The assumption that some methods of family planning were available prior to 1991, despite the absence of public sector promotion of contraceptive use, is based on anecdotal reports of private sector availability (Myint, 1991) and is corroborated by Myanmar's Family Planning Program Effort Index score for 1982 (Ross and Stover, 2001) both of which are discussed later in this chapter.

Calculating the infecundity and abortion indices proved more challenging. The DHS allows for a comprehensive estimation of infecundity for 2015-16 that includes postpartum abstinence. However, further analysis of the reported period of postpartum infecundity compared to the average length of breastfeeding raised questions about the accuracy of the infecundity estimates. For example, despite a reported 24 average months of breastfeeding, the DHS records only 3.4 months of postpartum amenorrhea and 4.5 months of postpartum insusceptibility. Additionally, the infecundity estimates would indicate a 60% reduction in postpartum amenorrhea between 2007 and 2015-16. For this reason, C_i was calculated based on breastfeeding duration rather than average length of amenorrhea, as follows:

$$C_i = 20 / (18.5 + i) \qquad \textit{(Equation 8)}$$

$$i = 1.5 + 0.56L \qquad \textit{(Equation 9)}$$

where L equals the average length of breastfeeding. The C_i for 1983 was set equal to 1991.

Finally, the total abortion rate (TAR) is notoriously difficult to estimate, but is required for calculating C_a. As total fertility and contraceptive prevalence estimates were available, TAR was calculated for each year as previously described MEASURE DHS and Guttmacher Institute methods (Westoff, 2008), such that:

$$C_a = TFR / (TFR + 0.4(1 + \mu) TAR) \quad \text{(Equation 10)}$$

Recent revisions to the proximate determinants model were considered, but ultimately the more simplistic one presented above was used for several reasons. First, Bongaarts (2015) and Stover (1998) both suggested revisions to the calculation of C_m to include unmarried women exposed to pregnancy through extramarital sexual activity. While these adjustments are reasonable in many settings, they are not relevant or needed in Myanmar. In the 2015-16 DHS, 95.5% of births reported in the last five years were to currently married women, with the other 4.5% reported by women who were either divorced, widowed, or otherwise separated from their husbands. No births were reported to never-married women. The other primary revision suggested for the proximate determinants model has been an adjustment to account for overlap between postpartum infecundity and contraceptive uptake. As was previously discussed, analysis of the most recent DHS data raised questions about the accuracy of infecundity estimates in Myanmar, making it challenging to effectively estimate an index of overlap between postpartum infecundity and contraceptive use. Finally, the calculations presented here at the national level allow for the inclusion of the greatest amount of temporal data in the estimates due to limitations on the types of data available across surveys.

5.3 Descriptive overview of proximate determinants of fertility in Myanmar

5.3.1 Family planning

The role of family planning in fertility decline is clearly documented (Bongaarts and Potter, 1983; Easterlin and Crimmins, 1985; Bongaarts, 1986). The use of family planning assumes that there is a demand for controlling childbirth. This demand may materialize slowly, influenced by other societal changes such as improved health care and education, urbanisation and the establishment of a family planning program (Caldwell, 1976; Easterlin and Crimmins, 1985). While demand for family planning may increase because of changes in society, it is difficult to use if it is not available or accessible. Therefore, strong family planning and reproductive health policies and programs are important. Across Asia, family planning programs and anti-natalist policies gained popularity in the 1970s. Over the subsequent years, they have taken many forms, including policies and programmes, and included a variety of government and non-government partners (Jones and Leete, 2002). The success of these varying government interventions is measured in part by the

Family Planning Program Effort Index score (Ross and Stover, 2001). Myanmar's score rose from 1972 to 1999, but the country performs poorly when compared to its neighbours (Figure 5-1). This may be because of the relative newness of Myanmar's family planning program and its fragmented introduction.

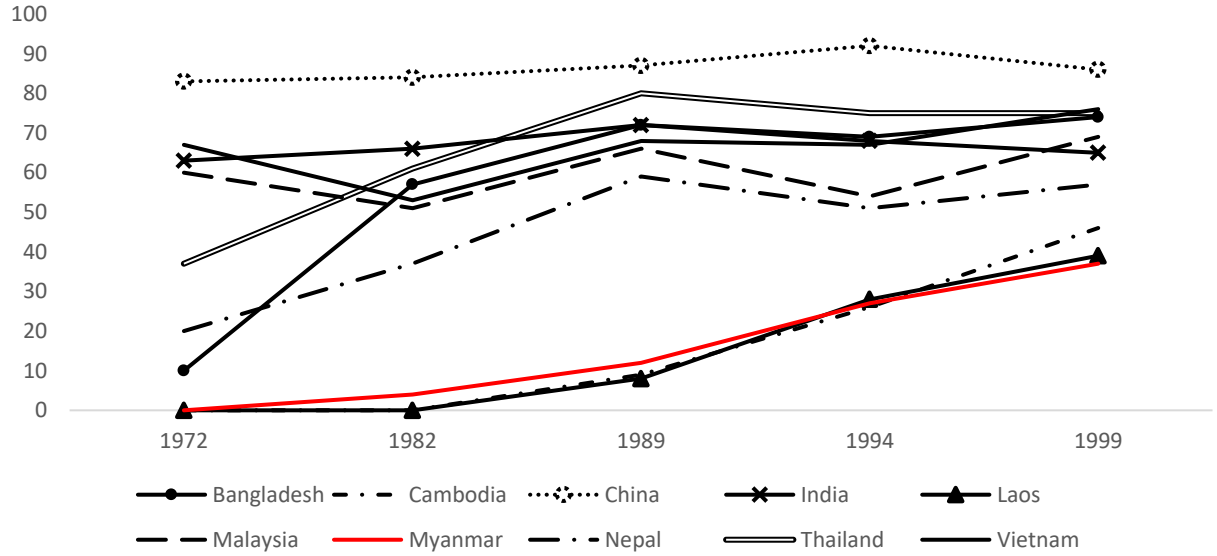


Figure 5-1. Family Planning Effort Index scores for select Southeast Asian countries, 1972-1999
Data Source: Ross and Stover, 2001

Prior the early 1990s, Myanmar did not have an official family planning program. Anecdotal reports suggest that family planning was available and used (Myint, 1991), but only through the private sector (Ministry of Health *et al*., 1997). A national program was introduced in 1991 in partnership with the United Nations Population Fund (UNFPA) and originally implemented in 79 of the 326 townships (Ba-Thike, 1997). Coverage remained steady throughout the 1990s, reported in 72 townships in 1999 (Reynolds *et al.*, 1999), but had nearly doubled to 132 townships, in the centre of the country, by 2010 (Myanmar Ministry of Health, 2010). More recently, the 2009-2013 Reproductive Health Strategic Plan (RHSP) laid out plans for expanding provision of high quality reproductive health services, including for birth spacing (Myanmar Ministry of Health, 2010). Additional government commitment to family planning was outlined in the ministry's statement in support of Family Planning 2020, a global partnership aiming to empower women and girls through government and non-government investment in rights-based family planning. However, it is unclear whether or not appropriate funding was allocated to ensure that these plans were implemented and the RHSP acknowledged a need to work with mobile health clinics to reach vulnerable populations and improve health information systems (Myanmar Ministry of Health, 2010).

Although government support for voluntary use of family planning has increased, the government has also attempted to impose several controversial policies limiting fertility on minority populations. For example, Rohingya couples have been required since 1994 to obtain permission from the state to marry, a process that can take years. The government has also attempted to explicitly limit Rohingya births, by requiring married couples to promise to limit family size to two children (Arakan Project, 2012). Despite these requirements, access to family planning is limited, especially for affected populations. The 2015 Health Facility Assessment for Reproductive Health Commodities and Services found that many facilities had trouble stocking contraceptives and other reproductive health supplies. Less than 50% of all primary health facilities in the conflict stricken and remote states of Rakhine, Kayin and Kayah stocked three or more methods of family planning at the time of the survey. Stocks were similarly limited at secondary facilities – nationally only 62.5% of secondary health facilities reported adequate stocks of five or more methods (Department of Medical Research and UNFPA, 2016).

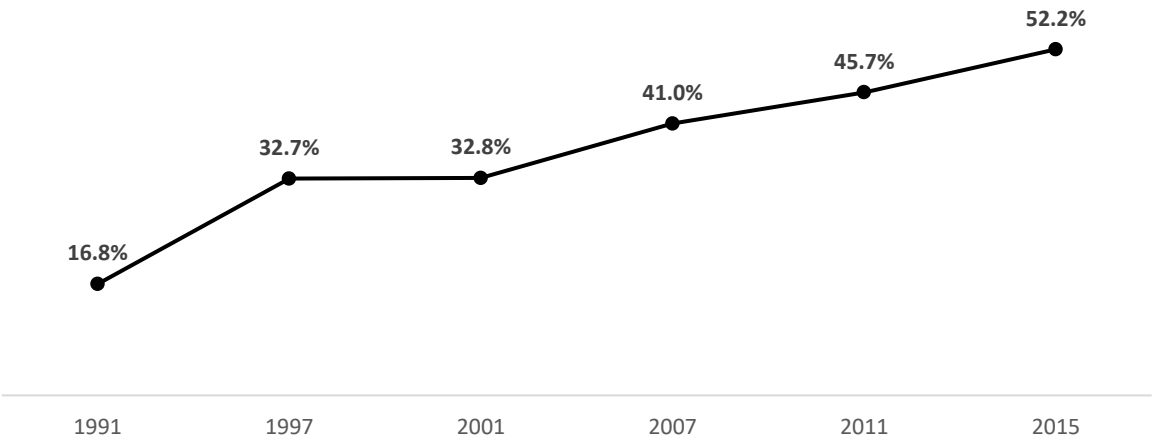


Figure 5-2. Changes in contraceptive prevalence, Myanmar 1991-2015
Sources: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Ministry and Health and Sports and ICF, 2017

Despite these challenges, contraceptive use by married women has increased steadily since 1991 (Figure 5-2, above). That year, shortly after the national program was initiated, the contraceptive prevalence rate (CPR) was only 16.8% among married women (United Nations Population Fund, 2010). A sharp increase in marital CPR is seen from between 1991 and 1997, following the introduction of combined oral contraceptive pills and depomedroxyprogesterone acetate (DMPA) injections at primary level health facilities in 1996 (Jhpiego *et al*., 2017). As Figure 5-3 shows,

injectable contraceptives appear to account for the increase in overall use over the past twenty-five years, with use of traditional and permanent methods declining.

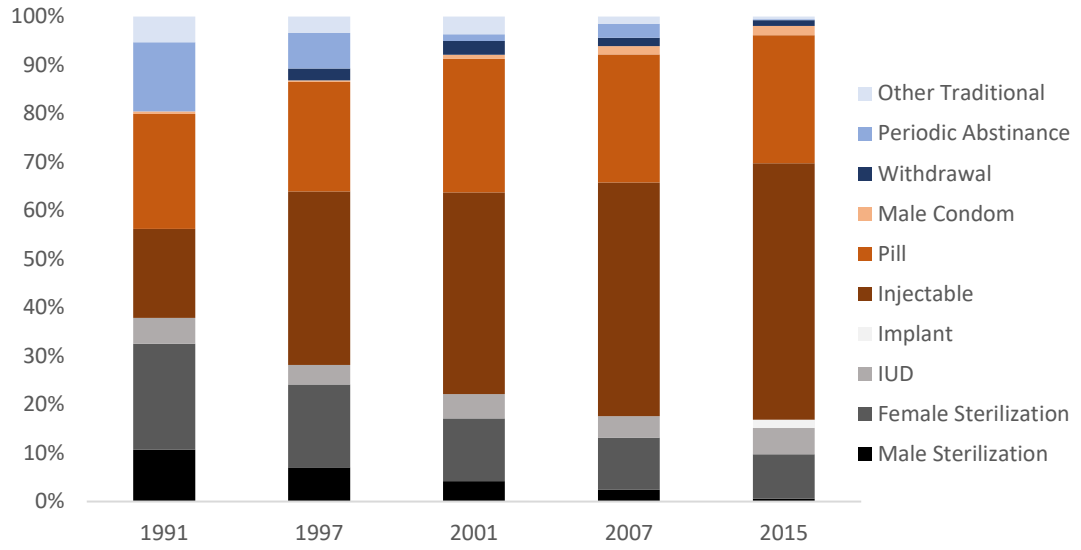


Figure 5-3. Changes in contraceptive method mix, Myanmar 1991-2015
Sources: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Ministry and Health and Sports and ICF, 2017

These changes also represent a decline in the percent of women wanting to space or limit births, but not using family planning. The 1991 Population Changes and Fertility Survey estimated that 64.2% of married women who were not using a method of family planning "should" be using one because they either did not want another child ever or they wanted a child later (Immigration and Population Department, 1995). Twenty-five years later, the unmet need for family planning, with the slightly different definition of the percent of *all* women wanting to limit or space births but not using a method, had fallen to 16.2% (Ministry of Health and Sports and ICF, 2017).

Although at the national level this indicates that by 2015-16 more women who "should" be using a method were using one, regional disparities have become more pronounced. In 1991, there was less variation in the need for family planning across the country. As few as 60.3% of the married women not using a method of family planning and living in the combined area of Mon, Tanintharyi and Kayin indicated that they wanted to limit or space births, compared to a high of 70.5% of similar women in Rakhine. In 2015-16, women in the isolated western states of Chin, Rakhine and Magway report unmet need of as high as 23-24%, compared to 12-14% in the central corridor from Mandalay south to Yangon (Ministry of Health and Sports and ICF, 2017). These patterns mirror the geographic roll-out of the national family planning program and highlight the continued challenges facing women living in rural, ethnic minority areas of the country.

Even for those with access to family planning, access to a wide selection of methods is rare. Since 1991, the top three methods used in nearly every area of the country have been injectables, contraceptive pills and female sterilization (Immigration and Population Department, 1995; Ministry of Health and Sports and ICF, 2017). These trends are unsurprising as combined pills and DMPA remain the only two reversible methods officially supported by the public health system (Jhpiego *et al*., 2017). In 1991, Magway differed from other areas with few women using pills and many more using IUDs (23% of all users in Magway used an intrauterine device (IUD) compared to only 5% of users nationally). By 2015-16, fewer women in Magway used contraceptive pills, but the popularity of sterilization had declined so that pills had entered the top three most popular methods in the state. Chin's method mix was also notable in 2015-16 as it was the only area where injectables were not among the most common methods and the only area where implants made the top three. Use of implants was not recorded in population surveys before the 2015-16 Census and it is not one of the methods provided by the government through public health facilities. Instead, Chin was the only state or region where more than 10% (17.9%) of women reported accessing family planning through an NGO clinic. Kayin, the only state/region where pills were the most popular method, also relied less on facilities as sources of family planning, almost one third (29.2%) of contraceptive users obtained their last method from a shop, a church or a friend.

If true, these numbers suggest progress in the provision of reproductive health services. However, this progress should be viewed with caution. Nationwide, 13% of family planning users reported getting their last method from a shop, church or friend, while another 13% obtained their most recent method from a non-government pharmacy. Reliance on these sources raises concern - the RHSP acknowledges that while contraceptives should be available at pharmacies, women often actually receive low quality, counterfeit drugs or improperly use the method they choose (Ministry of Health, 2010). Therefore, while contraceptive rates may have increased, the rates may not represent an equivalent increase in protection against pregnancy and thus may not have impacted fertility as much as possible.

Collectively, it is clear that access to and use of family planning have both improved since 1991. However, it is equally evident that those improvements have been slow and have been less successful at reaching more isolated communities. While these improvements undoubtedly contributed to the decline in fertility from 1991 to 2015, the comparatively late introduction of a

national family planning program suggests that family planning probably did not contribute to the major decline that took place in the 1970s and 1980s.

5.3.2 Abortion

In addition to family planning, abortion is one of the few ways couples can deliberately limit their fertility (Davis and Blake, 1956; Bongaarts and Potter, 1983). Abortion trends should be examined during any assessment of fertility, but especially when low contraceptive prevalence rates are reported, as is the case in Myanmar. Regionally, the Guttmacher Institute and the World Health Organization estimate that a woman living in Southeast Asia will, on average, have around one abortion in her lifetime (Westoff, 2008). However, abortion is difficult to estimate and almost universally under-reported.

Myanmar is no exception. Abortion is prohibited unless to save the life of the woman and punishment for providing induced abortion for any reason can incur up to 3 years in prison and fines (Ba-Thike, 1997). However, all available population surveys report incidence of abortion. Little change was seen across the first three surveys, with 5.87% of married women reporting ever having an abortion in 1997 and 4.7% reporting the same ten years later. The estimates from 1997, 2001 and 2007 are considerably lower than those from the 2015-16 DHS, which reports that 15.9% of all women have ever terminated a pregnancy.

The difference does not likely represent a three-fold increase in abortion prevalence between the surveys, but likely stems from two sources. The first is the use of differing terminology in the surveys. While the FRHSs conducted in 1997 and 2007 explicitly ask about abortions, including probing women to talk about how abortions are performed, the DHS limits its discussion to pregnancy termination and does not differentiate explicitly between spontaneous abortions (miscarriages) and induced abortions. This likely means that the DHS percentages include both types of abortions, while the FRHS results included induced abortions only, and are therefore not comparable. However, it also seems likely that these percentages are underreported in both types of surveys. Therefore, rather than relying on self-reported use of induced abortion, estimates of the total abortion rate (TAR) were calculated based on methods developed by the Guttmacher Institute and the DHS program that use data on TFR and contraceptive prevalence to estimate the TAR (Westoff, 2008). Estimates were calculated with and without the inclusion of traditional family planning method coverage. These estimates indicate that the use of abortion has declined in Myanmar over the past twenty years.

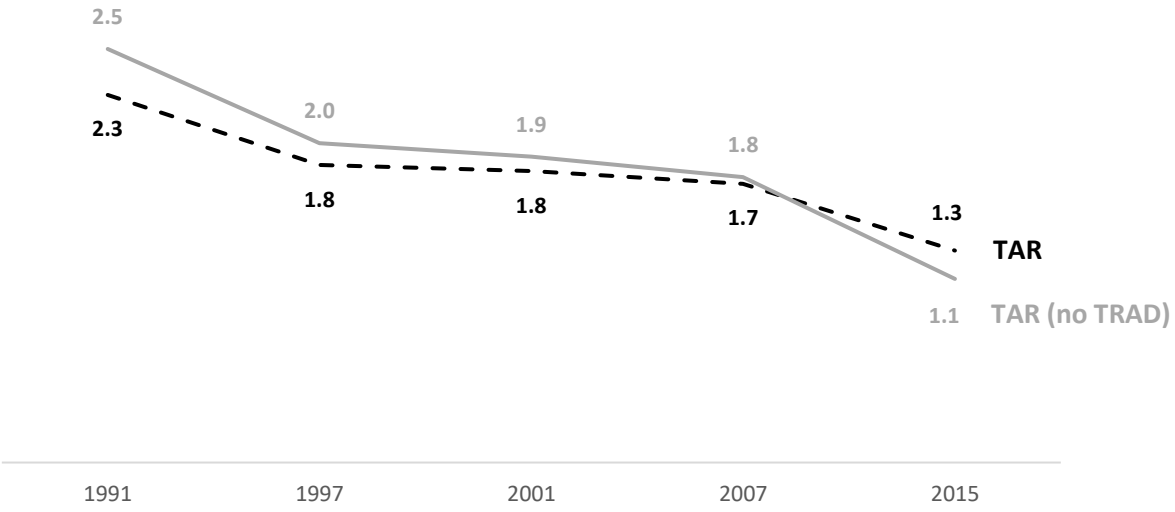


Figure 5-4. Estimated national total abortion rate[2] (abortions per 1000 women), Myanmar 1991-2015
Data Source: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Ministry and Health and Sports and ICF, 2017

These estimates are slightly higher than those in neighbouring countries. For example, Nepal was estimated to have a TAR of between 0.9 and 1.2 in 2006, while India was only estimated to have a TAR of 1.0 in 2005. However, Cambodia, another country with a troubled conflict history, had an estimated TAR of between 1.4 and 1.7 in 2007, which appear closer to trends observed in Myanmar (Westoff, 2008). Overall, the decline in TAR is in line with improved access to and use of modern methods of contraception.

Within Myanmar, Ayeyarwady stands out for having a higher percentage of women, 8.15%, who reported having an abortion in 1997 and then around 6% in 2001 and 2007 (Population Department and UNFPA, 1999; Department of Population and UNFPA, 2004; Department of Population, 2009). Women from Yangon also reported relatively high use of abortion in the earlier surveys (7.8%, 7.4%, 8.2%). However, the earlier population surveys group several states and regions together and may not fully describe geographic variation in abortion. The more recent DHS data suggests instead that prevalence of pregnancy termination is especially high in more marginalized areas. In Kayin, 26.2% of all women reported ever having a termination. In Chin, which has the country's highest total fertility rate and lowest CPR, nearly as many women

[2] "no TRAD" indicates the estimated TAR if traditional methods of family planning are excluded from the contraceptive prevalence estimates. Traditional methods include withdrawal, the rhythm/calendar method, and other methods whose effectiveness is less studied.

reported ever having a termination (23.3%) as reported ever using a modern method of family planning (25.4%). Although not entirely comparable to previous surveys, the DHS data suggest that pregnancies end before delivery more often in these marginalised areas, perhaps due to higher rates of induced abortion.

Beyond the importance of abortion as fertility limiting behaviour, it is important to understand its prevalence because it represents serious risk of bodily harm or death for women in Myanmar. Abortion providers tend to be those with nothing to lose, i.e. unlicensed, untrained, etc. (Sheehy *et al.*, 2015). This leads to unsafe abortions contributing substantially to an estimated 10% to nearly 60% of all maternal deaths in facilities (Ba-Thike, 1997; Ministry of Health and the WHO, 1997; Sheehy *et al.*, 2015). In the 1990s, hospitals in rural, hard to reach areas, reported that women were admitted to hospitals at equal rates for births and abortion complications (Ba-Thike, 1997). Maternal deaths may be due to women and providers' lack of knowledge about the availability and use of post-abortion care (PAC). For those seeking PAC, reception can be unwelcoming and many women avoid seeking the service (Sheehy, 2015). The RHSP mentions a desire to prevent unsafe abortions, but does not identify means for doing so – instead stating an interest in improving PAC services (Myanmar Ministry of Health, 2010).

Government hesitancy to address issues of unsafe abortion could be due to the lower status of many abortion seekers. Anecdotal evidence suggests that abortions are more common among low-income and marginalized women. For example, Rohingya women living in an area limiting official recognition to only two births may choose to abort their third pregnancy rather than give birth to a child that will immediately be black listed (Arakan Project, 2012). The use of abortion as a means of family planning is also supported by Ba-Thike's (1997) analysis of abortion hospital admissions in the 1990s, which found that women seeking care for abortion complications were almost all married and multiparous. Her analysis cites a previous, unpublished, study in North Okkalapa Township in Yangon which found that women without any education, coming from low-income households were more likely to seek abortions (Ba-Thike, 1997).

Properly estimating abortion trends in Myanmar is challenging given the available data. However, estimates of abortion rates and maternal deaths due to abortion combine to suggest that abortion has contributed to changes in the country's fertility rate, with diminishing importance as abortion is replaced by modern methods of contraception as means of controlling fertility.

5.3.3 Marriage

Marriage rates are thought to impact fertility by determining when women enter their socially-sanctioned childbearing years. Depending on the setting, it may be appropriate to include stable sexual unions that do not result in marriage in analysis (Bongaarts and Potter, 1983; Stover, 1998; Bongaarts, 2015). However, few births are recorded outside of marriage in Myanmar. Therefore, in Myanmar, and throughout much of Asia, age at marriage tends to be inversely related to fertility; as the average age at marriage increases, the total fertility rate for a country declines (Jones, 2007). As entry into marriage often indicates entry into sexual union, the inverse is also often true with divorce and widowhood indicating an end of reproduction.

Marriage patterns in Myanmar have differed from those in neighbouring countries since population surveying began under English colonial rule. Census surveyors in the early twentieth century noted that approximately two-thirds of women were married before the age of 20 and 90% before age 25 in 1931 (Bennison, 1933). At the time, this was recognized as differing from the rest of India, where, in the early 1900s, marriage often occurred in a woman/girl's teenage years. In fact, the surveyors noted that marriage patterns in Myanmar were more similar to those noticed in England and Scotland at the same time (Bennison, 1933).

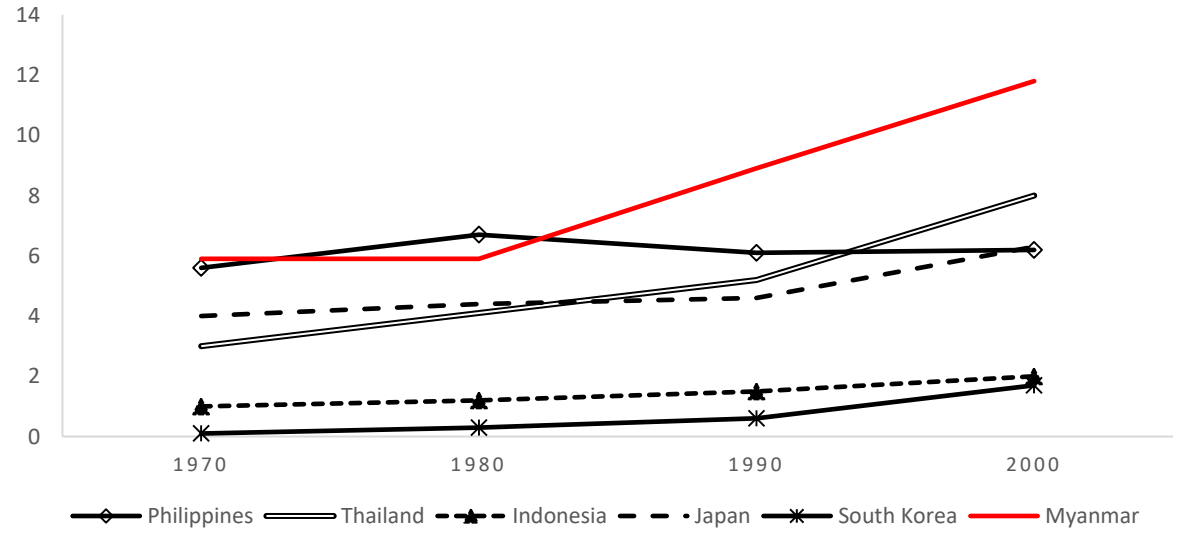


Figure 5-5. Percent of women never married aged 45-49 in Asia, 1970-2000
Data Source: Jones, 2005

Marriage patterns in Myanmar still differ from those in neighbouring countries. For example, the percent of women who have never married in Myanmar, especially for women aged 45-49 years, is higher than in neighbouring countries (Figure 5-5).

In 1991, 9.1% of the female population aged 45-49 had never been married (United Nations, 1998). According to the 2014 Census data, the percentage never married has increased to 10.8% (Department of Population, 2015). In Cambodia, only 6.1% of women were never married between 45-49 years in 2010 (National Institute of Statistics and ICF Macro, 2011) and 2.6% in Laos in 2011-12 (Ministry of Health and Lao Statistics Bureau, 2012). Because most childbearing takes place during marriage in Myanmar, this represents a large proportion of the female population not exposed to pregnancy. The reasons for this increase in never-married women are unknown, but may be related to relational disruptions resulting from armed conflict, economic out-migration of young men, and gender disparities in education or employment among the population of reproductive age. The relationships between education, employment status and entry into marriage are examined in greater detail in the next chapter.

Women who do get married tend to marry later than in other countries - the legal age of marriage in Myanmar is 16 with parental consent, 18 without permission, but in practice couples marry later. Data from the last 25 years shows that just over 40% of women marry before age 25 with little change noted since 1991. In 1983, the national singulate mean age at marriage (SMAM) was 22.5. Aside from Rakhine, where women were married at age 20 on average, the average age at first marriage for women across the country was around 22 or 23 years. Women married when they were slightly older in the more urban divisions of Yangon (23.2) and Mandalay (23.1). By 2014, average age at first marriage had increased in many areas. Perhaps the greatest changes were seen in Magway where the SMAM increased from 22.5 in 1983 to a national high of 26.7 in 2014. Yangon (25.2), Sagaing (24.1) and Mandalay (24.7) also saw increases in mean age at marriage to above the 1983 national average.

Contributing to the rise in SMAM is the fall in the percent of adolescent females who are married. While this has not substantially changed nationally, areas with especially high adolescent marriage and fertility rates in 1983, such as Rakhine and Bago, have seen fewer adolescents marry over the past 30 years. In 1983, Rakhine had a surprisingly high 31% of girls aged 15-19 married, down to 15.4% in 2014. A small proportion, less than 0.1%, of the total number of women married in the 1983 census, 7,659, were girls aged 10-14. Similar data are not available for 2014, but this number is expected to have fallen.

Although there have not been major changes in the percent of adolescents who marry, changes are seen in the fertility rate among adolescents (Table 5-1). A comparison of the unadjusted adolescent fertility rates for 1983 and 2014 show a decline of almost 50%. However, Chin and

Shan states still show high adolescent fertility rates of 50 and 59 births per 1000 girls 15-19 years old, with little change in the unadjusted rates between surveys.

Table 5-1. Comparison of state/region adolescent fertility rates, 1983 vs 2014

	1983		2014	
State/Region	Reported	Adjusted[3]	Reported	Adjusted
Kachin	34	60	25	34
Kayah	45	86	25	36
Kayin	35	60	28	38
Chin	31	60	31	44
Sagaing	37	62	21	28
Tanintharyi	31	61	24	33
Bago	40	61	18	25
Magway	45	63	17	23
Mandalay	35	57	15	20
Mon	40	65	18	24
Rakhine	72	110	22	31
Yangon	39	59	14	17
Shan	38	73	37	51
Ayeyarwady	55	71	26	35
Nay Pyi Taw	--	--	21	28
Union	39	59	22	29

Data Sources: Immigration and Manpower Department, 1986; Department of Population, 2016a

Increases in SMAM and decreases in the percent of adolescents who get married help understand fertility trends in Myanmar by demonstrating a delay in exposure to the risk of pregnancy. This risk also decreases when a marriage dissolves due to the death of a spouse. Widowhood is especially high in Myanmar, with few women re-marrying when their husband dies. Although relatively uncommon for younger women, many older women are widowed. Widowhood is approximately three times more common for women than for men. While widowhood has become marginally less common since 1983 (11% of all women over 15 in 1983 to 10% in 2014), the relatively high proportion of females who are widowed compared to males has not changed.

[3] Adolescent fertility rates equal the number of births in the last 12 months per 1000 adolescent females aged 15-19. Rates were calculated by the author using census data. Reported rates reflect those calculated using the reported number of births in the last 12 months and the number of adolescent females aged 15-19. Adjusted rates are those estimated using the Myanmar standard fertility schedule and the IUSSP worksheet, as described in Chapter 3.

Widowhood appears to vary across geographic areas. In 1983, Kachin (13.5%) and Rakhine (13.8%) had particularly high prevalence of widowhood among the female population over 15. In both states, along with Chin and Kayah states, nearly one third of all women had been widowed by age 55. This compares to a low of 15% in Ayeyarwady and around 20% for the urban regions of Yangon and Mandalay. By 2014, the variation in prevalence of widowhood was less pronounced. Rakhine still had the highest overall percent of widowhood for females over 15, 12.9%. Some islands in Rakhine showed higher prevalence of around 16%. However, townships with high levels of internal conflict, particularly in Rakhine, show a suspiciously low (around the national average of 10%) prevalence of widowhood suggesting that non-enumerated areas may increase the overall trends were data from these areas available.

Comparing ASFRs across censuses, we see that the difference between ASFR and marital ASFR is greatest for younger women, as expected (Figure 5-6). The data suggest that the shape of the ASFR curves for both overall fertility and marital fertility did not change substantially from 1983 to 2014, but the height of the curves fell.

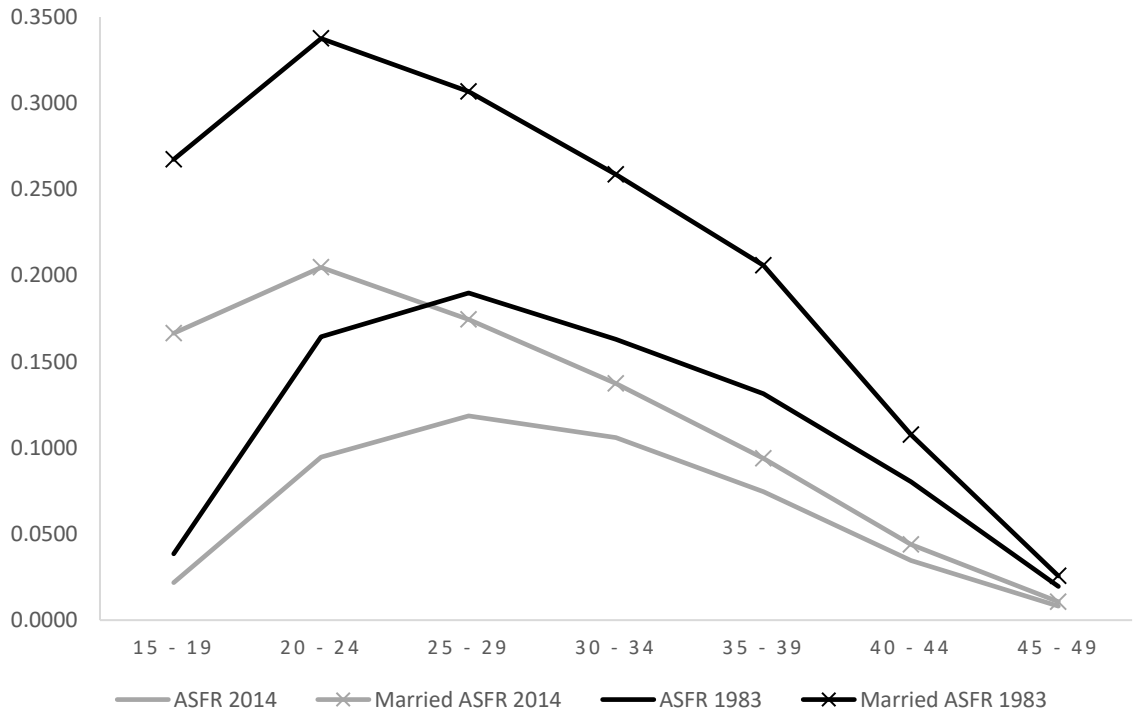


Figure 5-6. General vs. married ASFR, Myanmar 1983 and 2014
Data Sources: Immigration and Manpower Department, 1986; Department of Population, 2015

ASFRs curves are similar across nearly all regions. Generally, marital fertility appears highest in the 20-24 age group for both 1983 and 2014. The exception is Mandalay in 1983, which shows high

adolescent (15-19 years) fertility when compared to the age-specific fertility rates for other age groups. ASFR curves presented in the *Thematic Report on Fertility and Nuptiality* (Department of Population, 2016a), prepared following conclusion of the 2014 Census, were adjusted to include more than 90,000 additional births. The authors assumed many of these births would have been to younger mothers resulting in ASFR curves which decline almost linearly from the youngest to the oldest age group. Aside from the 15-19 year age group, the patters presented in this analysis match those found in the *Thematic Report*.

5.3.4 Breastfeeding

Breastfeeding can also dramatically impact fertility by contributing to and lengthening postpartum amenorrhea (Bongaarts, 1980). In order for breastfeeding to prevent pregnancy through the lactational amenorrhea method (LAM) of family planning, three conditions must be met: 1) breastfeeding must be exclusive, meaning that nothing besides breastmilk is given to the infant; 2) the infant must not be more than six months old; and 3) the mother's menses must not have returned. There is some evidence that LAM can be protective for longer than six months as long as menses have not returned (Short *et al*., 1991; Cooney *et al*., 1996), but the scientific community has yet to expand this definition.

Reports of exclusive breastfeeding from MICS conducted over the course of 15 years show inconsistent trends in the popularity of exclusive breastfeeding. In 1995, the MICS showed that 30% of infants less than four months old were exclusively breastfed (Department of Planning and Statistics and UNICEF, 1995). This fell to 15.8% of infants under four months old in 2000 (Department of Health Planning and UNICEF, 2000), and then rose to 29.3% in 2009-10 (Ministry of National Planning and Economic Development and UNICEF, 2011). The 2015-16 DHS data show that 56.3% of infants under four months old were being exclusively breastfed.

The variation across years warrants further analysis of the available individual level data from 2000 and 2015. With these individual level data, breastfeeding trends could be examined by age of the infant and by type of breastfeeding. A comparison of the percent of women exclusively and fully breastfeeding by age of their child, calculated from MICS and DHS data, is included in Figure 5-7 below. Exclusive breastfeeding indicates that a woman is feeding her child only breastmilk with no formula or other supplemental foods or liquids. Full breastfeeding is very similar to exclusive breastfeeding, but includes water as a supplement to breastmilk. According to current definitions, the LAM method of family planning relies on exclusive breastfeeding only, and full

breastfeeding, while potentially protective against pregnancy, is not considered a method of family planning.

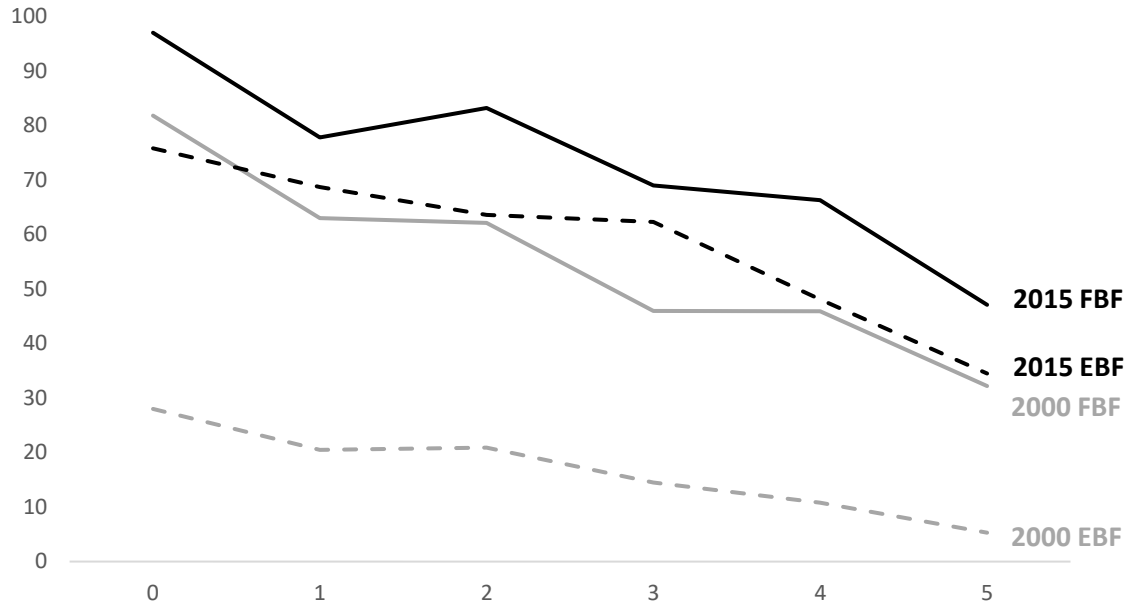


Figure 5-7. Full vs. exclusive breastfeeding by age (months), Myanmar 2000 and 2015
Source: Department of Health and Planning and UNICEF, 2001; Ministry of Health and Sport and ICF, 2017

This figure suggests that the timing of the surveys in the calendar years may account for some of the major differences and inconsistencies across survey years, rather than indicating a significant increase in breastfeeding. Full breastfeeding practices are more similar between the two survey years than exclusive breastfeeding practices. The 2000 MICS was conducted from June-August, while the majority of data collection for the DHS was conducted between December and April. June-August would have been substantially warmer and the greater difference between full and exclusive breastfeeding found in the 2000 data is expected. Although it cannot be proven, exclusive breastfeeding for 2000 during a comparable timeframe would have likely been closer to 30%, which was reported in the MICS conducted in 1995 and 2009-10. The data collection timeline for 1995 is not available, but the 2009-10 MICS was implemented from October to March. This would support fairly consistent rates of exclusive breastfeeding during the 1990s and early 2000s, with an increase in exclusive breastfeeding by the time of the 2015-16 DHS.

The population surveys also report average length of postpartum amenorrhea. In 1991, married women reported being amenorrheic for an average of 12.9 months after childbirth. From 1997 to 2007, the period ranged from 9.5-9.8 months. By 2015-16, women reported only 3.4 months of

postpartum amenorrhea. This downward trend suggests a decrease in women's protection from unwanted pregnancies immediately after childbirth. However, the long average period of breastfeeding and high exclusive breastfeeding rates reported in 2015-16 raise questions about the reported short period of postpartum amenorrhea.

Breastfeeding and amenorrhea patterns differ substantially from neighbouring countries. For example, in Cambodia 75% of infants under six months are exclusively breastfed (National Institute of Statistics and ICF Macro, 2011). Even the increases in breastfeeding between the Myanmar 2009-10 MICS and the 2015-16 DHS have been noted as insufficient. Exclusive breastfeeding is recommended at a global level until a child is six months old. Complementing breast milk before six months does not add nutritional value and exposes the child to potential contaminants found in other food sources. Some potential reasons for the low breastfeeding rates include increased female workforce engagement outside of the home, inadequate breastfeeding counselling by health care providers, and changing social norms that provide less community and family support to breastfeeding mothers (Thet *et al*., 2016). The low breastfeeding rates in Myanmar are identified as a direct contributor to problems with infant malnutrition (Ministry of National Planning and Economic Development and UNICEF, 2011). As such, low rates of breastfeeding may affect fertility by shortening natural periods of postpartum amenorrhea and contributing to infant mortality.

Results

The estimates for fertility indices from the five population surveys show increased use of contraception and declines in the length of postpartum infecundity and marriage rates (Table 5-2). Only C_a, which considers TFR in its calculation, changes depending on whether the reported or estimated TFRs are used. C_a estimates using the reported TFRs show no real change. Those calculated from the estimated TFRs suggest little change in the abortion index, especially after 1983. The biggest change in the combined indices occurred between 1983 and 1991. After 1991, a slow but consistent decline in the combined indices is shown.

Table 5-2. Estimated fertility indices for Myanmar, 1983 to 2015-16

		1983	1991	1997	2001	2007	2015
Reported TFR	C(m)	0.72	0.58	0.56	0.55	0.53	0.60
	C(i)	0.57	0.57	0.65	0.63	0.64	0.60
	C(c)	0.96	0.84	0.68	0.62	0.60	0.48
	C(a)	0.81	0.71	0.74	0.71	0.68	0.74
	Combined	0.32	0.20	0.18	0.15	0.13	0.13
Estimated TFR	C(m)	0.72	0.58	0.56	0.55	0.53	0.60
	C(i)	0.57	0.57	0.65	0.63	0.64	0.60
	C(c)	0.96	0.84	0.68	0.62	0.60	0.48
	C(a)	0.81	0.76	0.77	0.76	0.74	0.74
	Combined	0.32	0.21	0.19	0.17	0.15	0.13

Table 5-3 shows estimated fertility measures. Most relationships stay even over time. The exception is the apparent widening gap between TNM and TMFR over time, which is in line with the increasing rates of contraceptive use. Although using the adjusted TFRs raises the estimated Total Fertility, and other fertility measures, as expected, this adjustment does not have a substantial influence on the directionality or magnitude of any relationships between fertility measures.

Table 5-3. Fertility estimates for Myanmar, 1983 to 2015-16

		1983	1991	1997	2001	2007	2015
Reported TFR	TF	12.06	10.38	10.93	11.03	10.11	13.46
	TNM	6.88	5.92	7.15	6.98	6.48	8.02
	TMFR	6.60	4.97	4.88	4.36	3.86	3.81
	TFR (reported)	4.73	2.86	2.72	2.39	2.03	2.3
Estimated TFR	TF	11.96	13.40	12.72	14.35	13.98	13.46
	TNM	6.82	7.64	8.32	9.08	8.96	8.02
	TMFR	6.54	6.41	5.68	5.67	5.34	3.81
	TFR (estimated)	4.69	3.69	3.17	3.11	2.81	2.30

5.4 Discussion

According to the proximate determinants of fertility framework, changes in family planning use, abortion prevalence, breastfeeding duration and marriage must explain Myanmar's recent fertility changes. The results presented in this chapter show that, using Bongaarts' methods for

empirically assessing fertility change, increased contraceptive prevalence explains much of the country's fertility decline between 1983 and 2014. However, a review of existing literature, including family planning and population policies, raises questions about the role of family planning in Myanmar's more extended fertility decline. Examining changes in other determinants of fertility provides greater insight into the changes taking place across the country.

The oldest complete data used for this analysis come from 1991, just as the government introduced a national family planning program. At the time, the country's reported total fertility rate was 2.86 (3.69 adjusted), already quite low compared to countries of similar development status, but the national contraceptive prevalence rate was only 13.6%. The low CPR appears to have been offset by the long, two years of breastfeeding and potentially by other external factors like conflict and male migration and mortality. Over the next twenty-five years, this dynamic changed. By 2015-16, the contraceptive use index had fallen by half, while postpartum infecundity appeared unchanged.

Although this analysis demonstrates the increasing importance of family planning in Myanmar, it also highlights the widening geographic disparities in access and use. Data collected during the 2015-2016 DHS show great regional variation in unmet need. Women in the isolated western states of Chin, Rakhine and Magway reporting unmet need of as high as 23-24%, compared to 12-14% in the central corridor from Mandalay south to Yangon (Ministry of Health and Sport and ICF, 2017). This could be due to trouble stocking health facilities with contraceptives and other reproductive health supplies (Department of Medical Research *et al*, 2016).

The 2015-16 married CPR of 51.3% and unmet need of 16% suggest poor access to family planning compared to Southeast Asia as a whole of 62.2% and 13.7% for CPR and unmet need in 2010, respectively (Alkema *et al*., 2013). Furthermore, while the TFR in Myanmar hovers near the replacement level of 2.1, the CPR is far below the 75% expected for countries to complete the demographic transition (Bongaarts, 1986). This suggests that other factors, including the other proximate determinants and social and political changes, may contribute to fertility decline more in Myanmar than in other settings.

The comparatively high rate of never-married women in Myanmar may contribute to fertility change. While the percentage of women who were married and the SMAM did not change substantially over between 1991 and 2015-16, there has been a steady increase in the percentage of never-married women aged 45-49. The small changes in the proportion of all women of

reproductive age who were married and the SMAM is reflected in the small changes in marriage indices across the five surveys. However, attention should be paid to the substantial decline in C_m from 1983 to 1991, suggesting evidence of more influential marriage changes in earlier periods. For example, the mean age at marriage increased by more than two years (22.4 to 24.5) between 1983 and 1991, and the percentage of women aged 45-49 never married (self-reported as "single") nearly doubled from 5.9% in 1983 to 9.11% in 1991. These relationships suggest a need to explore the role of changing marriage patterns on fertility in Myanmar in greater detail to understand how these changes may affect fertility separately from improved access to contraceptives and outside of the somewhat limited exploration of marriage used in the proximate determinants framework.

While this analysis provides a base for discussing the factors associated with fertility decline in Myanmar, data limitations challenge any ability to make more generalized statements about the change. The population surveys conducted between 1991 and 2007 all combined large geographic areas. For example, Sagaing and Chin are combined, but examination of census and DHS data suggests that these two states had very different trends in all proximate determinants and in fertility over the period of analysis. As state/regional comparisons could not be made, fertility indices were compared at the national level. However, even these comparisons require an acceptance that the samples which combine states and regions are still representative of the country as a whole. Data accuracy is also affected by the surveyors' decision to exclude areas impacted by violence. In the absence of a true alternative, this analysis accepts the assumption that excluded areas are similar to those included in the surveyed populations. However, future analysis will examine how internal conflict may have influenced the country's fertility decline and fertility limiting behaviours. Finally, this analysis is limited by the lack of data on all proximate determinants besides marriage before 1991. It is clear that a substation fertility decline took place before 1991, but the current availability of data makes further analysis of the changes occurring during this period challenging.

Overall, the introduction and roll out of modern methods of family planning are seen as key ingredients for fertility decline, and have clearly contributed to recent fertility decline in Myanmar. However, by the time a national family planning policy was introduced in Myanmar in 1991, substantial fertility decline had already taken place. By 2015-16, the TFR had fallen further, nearing replacement level, and CPR had increased to a more expected level. While this may indicate improvements in access to health services and a shift towards intentional pregnancy

prevention, the findings also suggest that much of the initial decline in fertility in Myanmar can be explained by changing marriage patterns, or by other fertility measures that cannot be examined using these methods or the proximate determinants framework. Further analysis of marriage patterns, as well as an assessment of the associations between infrastructure development, peacekeeping and fertility are needed in order to describe the complex factors underlying fertility decline in the country.

Chapter 6 Changing Marriage Patterns amid Social Transition in Myanmar

6.1 Introduction

Increasing proportions of women worldwide are never marrying, including throughout Asia. In several Asian countries, 10% or more of the female population aged 45-49 years were reported to have never married during the country's most recent census. While high proportions never marrying may be offset by increases in cohabitation and childbearing outside of marriage in other parts of the world (Jones and Gabhaju, 2009; Goldstein and Kenney, 2001), these practices are less common in Asia. Many Asian countries with high percentages of never married women, for example Japan (15.9% in 2015), Hong Kong (15.5% in 2016) and Singapore (12.8% in 2011), also tend to have low, or very low, fertility, and relatively high levels of development (United Nations Statistics Division, 2018).

In comparison with these countries, Myanmar is less developed. According to World Bank estimates, the per-capita gross domestic product in Myanmar was less than 5% of Japan's in 2017 (World Bank, 2019). The country's life expectancy of only 67 years is among the lowest outside of sub-Saharan Africa, and 15 years lower than Japan, Singapore or Hong Kong (Wang *et al*., 2012). Additionally, Myanmar has experienced prolonged conflict and unrest since gaining independence in the mid-twentieth century. Despite these conditions, women in Myanmar remain unmarried at similar levels to wealthier, very low fertility countries elsewhere in Asia.

Changes in women's educational attainment and participation in the labour force have been identified as driving factors for changes in marriage patterns across the globe (Choe and Retherford, 2009; Jones, 2004). For example, school attendance, at least until the graduate level, is often incompatible with marriage for women. This may especially be the case in societies with gendered domestic roles, where improvements in women's status, either through education or economic advancement, have been linked to lower marriage rates among women (Jones, 2004; Jones and Gubhaju, 2009; Ono, 2003).

Similarly, a focus on career advancement has been cited as a reason for delayed marriage. In South Korea, where an increasingly better educated workforce has found steep competition for

jobs after leaving university, there has been a clear drop in female participation in the labour force around ages 25-29 years as women exited the labour market to marry and have children before re-entering the market in their early 30s (Choe and Retherford, 2009). A similar trend in labour force engagement was seen in Japan prior to the early 2000s. More recently in Japan, from 2000 to 2006, the percentage of married women who participated in the workforce rose from 58% to 71%. However, although more married women actively participate in employment in Japan, women's reimbursement and engagement in leadership positions remain lower than that of men (Shambaugh *et al.*, 2017).

Improvements in women's education and professional advancement can create a marriage squeeze in the population when both education and employment favour women, especially in countries where there is a strong belief that men should be a family's primary provider (Gender Equality Network, 2018). In contrast, countries that have shifted domestic roles to distribute household labour more equitably among men and women as women's social and economic position has improved are more likely to have seen an increase in marriage among the better educated (Ono, 2013). This is true of the United States, and possibly Japan, where marriage among well-educated women has increased as female education and economic independence become more accepted within the country (Goldstein and Kenney, 2001; Shambaugh *et a*l., 2017).

This chapter presents the results of a descriptive assessment of changes in marriage, education and employment in Myanmar over the last half century, followed by an analysis of the underlying trends and socioeconomic and demographic factors associated with entry into marriage among men and women in Myanmar using data from Myanmar's first Demographic and Health Survey (DHS). Changes in female education level and labour force engagement in Myanmar are compared with other countries in the region. Differences in education and work experience among women in Myanmar are then explored by age cohort, before an assessment of how the differences affect entry into marriage for men and women in divergent ways is presented. Myanmar is an interesting case for the reasons mentioned above: it has evolved a marriage pattern that exhibits characteristics similar to those of much more developed and prosperous Asian countries, despite its poverty and lower levels of development. Although not explored in depth in this chapter, these changing marriage patterns have been highlighted as a potential reason for the country's rapid fertility decline. It thus poses a challenge to the conventional account of changing marriage patterns being a consequence of rapid economic and social development.

6.2 Methods

The paper begins by describing trends in marriage, education and labour force engagement in Myanmar from the mid-1900s until 2016 and comparing these trends to other countries in the region. An assortment of data sources were used, including census and other population survey reports, publicly available district aggregate data from the 1983 and 2014 Myanmar censuses, and individual level data from the 2015-2016 DHS (Ministry of Health and Sports and ICF, 2017). More details on each data source can be found in Chapter 2.

While the initial analysis provides a descriptive overview of changes in marriage, education and labour force engagement patterns over time in Myanmar, later analysis explores the differences in the characteristics of never-married and ever-married men and women in Myanmar using individual level DHS data from 12,885 women and 4,737 men. The DHS used a stratified two-stage sample design, identifying 30 households from each of 442 clusters. All women between the ages of 15-49 years who were residing in each of these households were eligible for the survey. Men between the ages of 15-49 years from every second household were eligible for the survey and their participation did not depend on their residency in a household with an eligible woman (Ministry of Health and Sports and ICF, 2017). Data from all individuals in both samples was included in the analysis, which was conducted using Stata/SE 15.0 and adjusted for DHS sampling using Stata's standard complex survey adjustment functions.

Results of chi-squared tests are shown to compare the distributions of binary current status variables (never- married and ever-married) by social and economic characteristics. These tests were run for men and women separately for all five-year age cohorts from ages 15 to 49 years, where age is that given at the time of the 2015-16 DHS. For the purposes of this chapter, only results for the cohorts aged 25-29, 35-39 and 45-49 years in 2015-16 are shown, as these demonstrate variation across cohorts. Results from the cohort aged 15-19 years in 2016 are not included, because the household characteristics of the individuals in this cohort are assumed to be highly dependent upon the characteristics of the individuals' parents per se and may not necessarily reflect the influence of individual status on marriage.

The effect of social and economic characteristics on the timing of entry into marriage was assessed using Cox proportional hazard regression models, estimating the hazard for duration ***t*** of an individual changing from a never-married to an ever-married status. The Myanmar DHS did not

include a question on age at first marriage, but did include data on age at first cohabitation. None of the women interviewed by the DHS indicated that they were living with a man to whom they were not married, and very few woman reported sexual activity outside of marriage. For these reasons, age at first cohabitation can be used in place of age at first marriage for this population. Duration was measured as the amount of time (***t***) elapsing between the person attaining the age of 10 years until either the recorded date of first cohabitation (the event) or the occurrence of the survey (censored cases). Attainment of age 10 years was used as the start event after an examination of ages at first cohabitation found this to be the youngest reported age for females to begin cohabitation.

The Cox regression model does not include parametric estimates of the variation of the underlying hazard with duration: it allows the underlying hazard to be determined non-parametrically by the data (Bradburn *et al.*, 2003; Cox and Oakes, 1984). This approach without specifying the form of the underlying hazard is appealing for the analysis of marriage in Myanmar because of the unusually high proportions never marrying, which suggest that marriage patterns may deviate from those found in other settings. The model with a non-parametric underlying hazard offers an opportunity to explore the distribution of hazards without the constraints stemming from a parametric specification. Similar approaches have been used to analyse marriage trends in other countries (Adebowale *et al.*, 2012; McGinnis, 2003; Ikamari, 2005).

Results include those from eight models representing different age cohorts for men and women, which include either three or four independent variables. Models for specific age cohorts include the highest level of education an individual achieved and their current work status as primary indicators of interest, and urban/rural wealth quintile as a control. In addition, the pooled model includes a covariate indicating the age cohort. All models include an interaction to control for likely associations between higher education and labour force engagement. Both household wealth status and urban/rural status were initially included in the models, but substantial confounding was identified between these variables. Household wealth status is measured by constructing a wealth index and identifying the wealth quintile within which each household falls. When a single wealth index was computed for all households, then urban households tended to fall into higher wealth quintiles and rural households into lower wealth quintiles. More recent DHSs include wealth quintile variables created separately for urban and rural settings, and then scaling these to generate a composite index that would allow comparability between urban and rural areas (Rutstein, n.d.). This helps to adjust for differences in how wealth manifests for urban

and rural dwellers. Therefore, only the adjusted wealth quintile variable was included in this analysis.

6.3 Results

6.3.1 ***Changing marriage patterns***

Most women in Myanmar who marry tend to do so by the age of 25 years. This is similar to women in countries like Cambodia, Nepal and India, according to data from the most recent surveys in the region (National Institute of Statistics *et al.*, 2011; International Institute for Population Sciences and ICF, 2017; Ministry of Health, Nepal *et al.*, 2017; United Nations Statistics Division, 2018). However, marriage patterns for women in Myanmar are more similar to the marriage patterns of men from comparison countries (Figure 6-1). After age 25 years, marriage rates in Myanmar tend to level off, leading to similar rates of never marriage in Myanmar and more developed nations like Japan. While there are clear gender differences in marriage patterns in all countries, the tendency for more women to remain unmarried in Myanmar is different from other countries in the region.

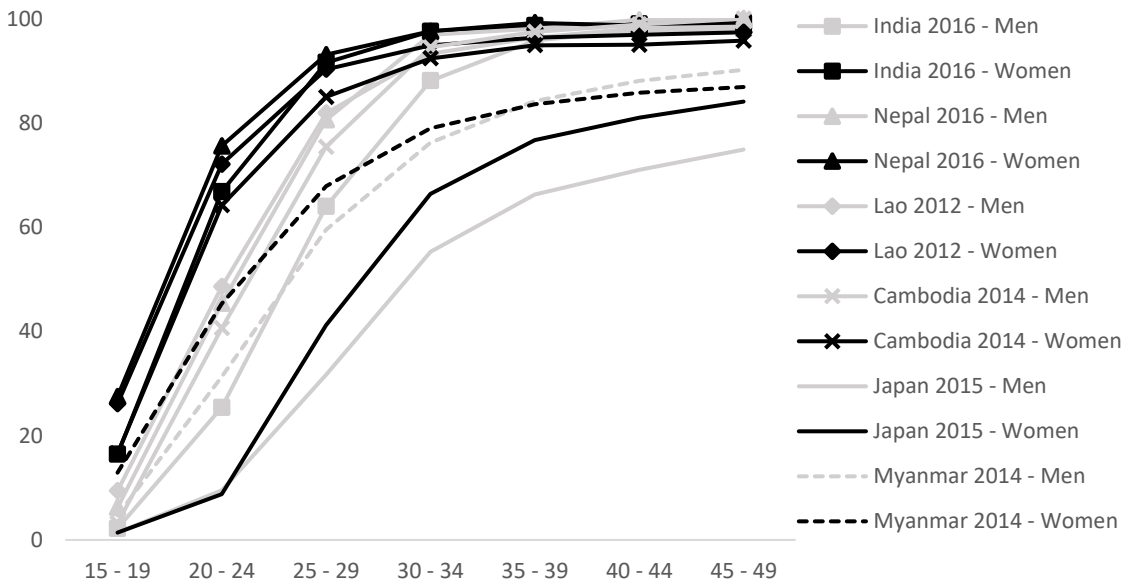


Figure 6-1. Percentages ever married by age in selected Asian countries
Data Source: National Institute of Statistics *et al.*, 2011; International Institute for Population Sciences and ICF, 2017; Ministry of Health, Nepal *et al*., 2017; United Nations Statistics Division, 2018

These differences represent a shift in marriage patterns over the past 40 years. The changes show

lower percentages married for younger age groups in each successive census for both men and women. The data suggest that an increasing number of women delayed marriage between 1973 and 1983, but eventually married. However, by 2014, a greater proportion of women were delaying marriage past their reproductive years: in both 1973 and 1983, 94% of women then aged between 45 and 49 years had ever married, this percentage fell to 87% in 2014. Men also appear to have delayed marriage increasingly over time, but unlike women, almost all men still eventually marry by ages 45-49 years.

The changes found at the national level are also observed in states and regions: the percentage of women who had never married increased in every state and region from 1983 to 2014. Mandalay, Yangon and Sagaing showed the biggest increases of 10.3, 7.9 and 9.1 percentage points respectively. Mandalay and Yangon show remarkably high percentages of unmarried women: in 2014, approximately 15% of the female population aged 45-49 years in Yangon had never married, while more than 17% of women in this age group in Mandalay in 2014 were single. The range of variation also changed from 1983 to 2014. In 1983, the percentage unmarried among women aged 45-49 years ranged from 1.7% in Rakhine to 7.3% in both Yangon and Mandalay. In 2014, this ranged from 6.4% in Shan to 17.6% in Mandalay. The DHS found similar patterns, with 19.3% of women aged 45-49 years in Mandalay never having married compared to only 6.0% in Chin. Yangon and Mandalay have the largest populations of any states or regions in the country, so their dramatic changes in marriage patterns have the greatest influence on the overall changes. While areas with more unmarried women are also generally areas with more unmarried men, women aged 45-49 years living in these areas are still approximately 50% more likely to be unmarried then men.

As celibacy has increased over the last 45 years, the SMAM has risen from 23.9 years in 1973 to 25.9 years in 2014. Although not as high as some other Asian countries (South Korea and Japan both have SMAMs around 30 years), women in Myanmar marry later than in neighbouring countries. For example, in Bangladesh the SMAM is only around 16 years, and in Thailand it was close to 22 years in 2009 (World Health Organisation Regional office for South-East Asia, 2016; National Institute of Population Research and Training *et al.,* 2016). Collectively, these trends show clear differences in the marriage patterns of men and women in Myanmar, and suggest that they may differ from those in neighbouring countries.

6.3.2 Increasing educational levels and labour force engagement

Education levels have changed rapidly in Myanmar over the last 50 years (Figure 6-2). Based on analysis of the 1973 census, fewer than 40% of both the male and female populations over the age of five years had received any education. Ten years later, around half of the population had some formal education. These improvements in educational attainment continued until the 2000s. By 2007, nearly 90% of the population had some education, and enrolment in higher education increased from less than 2% of the over 15 population in 1983 to more than 10% of females and around 8.5% of males over age 15 in 2014. The 2014 census also found that more than 90% of the total population aged over 10 years was literate, with little or no difference between males and females (Department of Population 2015). Most geographic areas have percentages literate between 80-95%. However, a smaller proportion of the population of Shan state was literate (67%) and the state had marked gender disparities (72% men and 62% women were literate) (Department of Population, 2015).

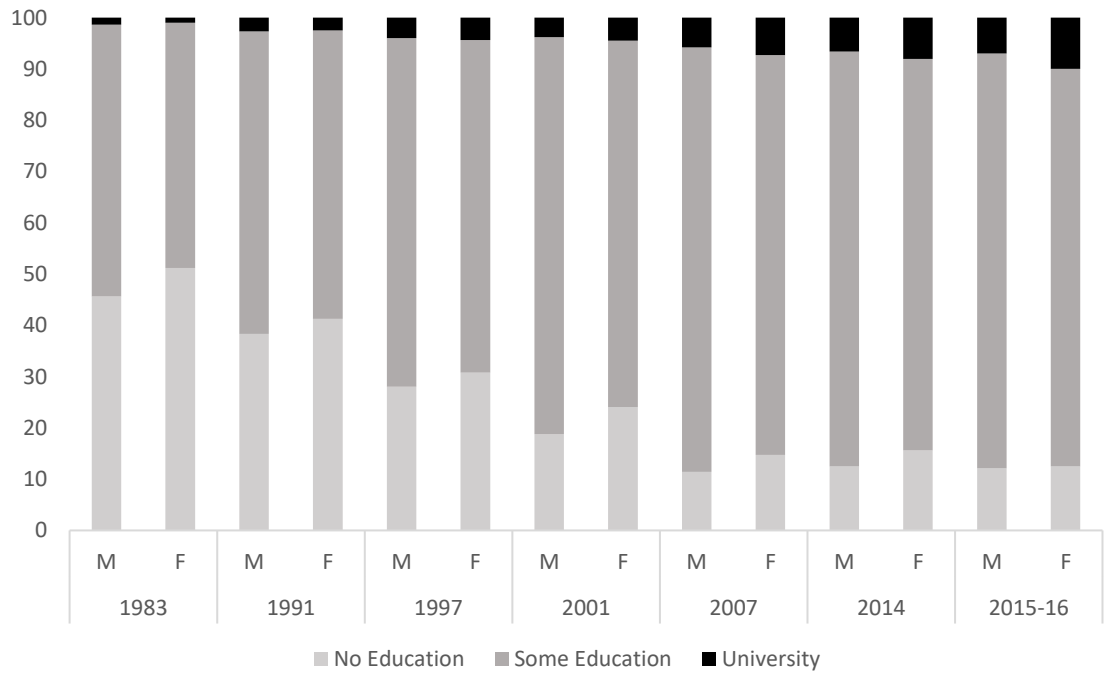


Figure 6-2. Changes in the distribution of educational attainment, Myanmar 1982-2016
Data Source: Department of Population and UNFPA, 2004; Department of Population and UNFPA, 2007; Department of Population, 2015; Ministry and Health and Sports and ICF, 2017

Although many people in Myanmar still lack formal education, men and women appear to have completed at least primary education at similar rates. This is unique for the region. Historically there have been substantial sex differentials in education in southern and eastern Asia. For

example, in 1970 and 1971, more than twice as many men as women over the age of 25 years had at least a primary level of education in Hong Kong and Indonesia, and 25% more men than women over the age of 25 years had a primary level of education in South Korea (World Bank, 2019). These patterns persisted through the 1980s. More recent estimates suggest that Myanmar's female education rates appear high for the region. While 81.2% of women and 86.7% of men aged over 25 years had received some education in Myanmar in 2014, in the same year fewer than half the women in the same age group in Bangladesh and only around 72% in Indonesia had at least primary education. In the previous year, only an estimated two thirds of the female population aged over 25 years in Thailand had received any education (World Bank, 2019).

Similarly, female engagement in the labour force has changed over the past half century. In 1973, only around one third of females aged over 10 years were employed outside of the home, while more than 50% worked as unpaid household workers (Maung, 1986). By 2014, female engagement in the formal workforce had increased to more than 40% of those aged over 10 years, and only one third of these reported working in the home (Department of Population, 2015). The majority of this change appears to have come from increased workforce participation among younger women. In 1983, fewer than 20% of 15-19 year-old women were employed, but 40% were working in 2014. Similarly, only one third of 20-24 year old women were working in 1983, while more than half worked in 2014. Labour engagement for men in similar age groups also increased over the same period.

Although female labour market engagement in Myanmar has increased since the 1970s, estimates from the International Labour Organisation suggest that participation has declined over the last two decades (between censuses) and remains low compared to neighbouring countries of Nepal and Cambodia (Figure 6-3). This may be due to a transition in the type of work women are doing in Myanmar, consistent with educational advancements. Most employed men (81.1% in 2015-2016) and women (63.9% in 2015-2016) work in agricultural or manual labour positions (Ministry of Health and Sports and ICF, 2017). However, women are increasingly taking on office jobs and leadership positions. In 1983, only 2.8% of women aged 19-49 years held managerial or professional positions. By 2014, this had increased to 7.8% of women of reproductive age, slightly higher than the percentage of men reporting the same positions (7.1%). Furthermore, more than a quarter of women reported working in sales or clerical positions, compared to only 11.3% of men.

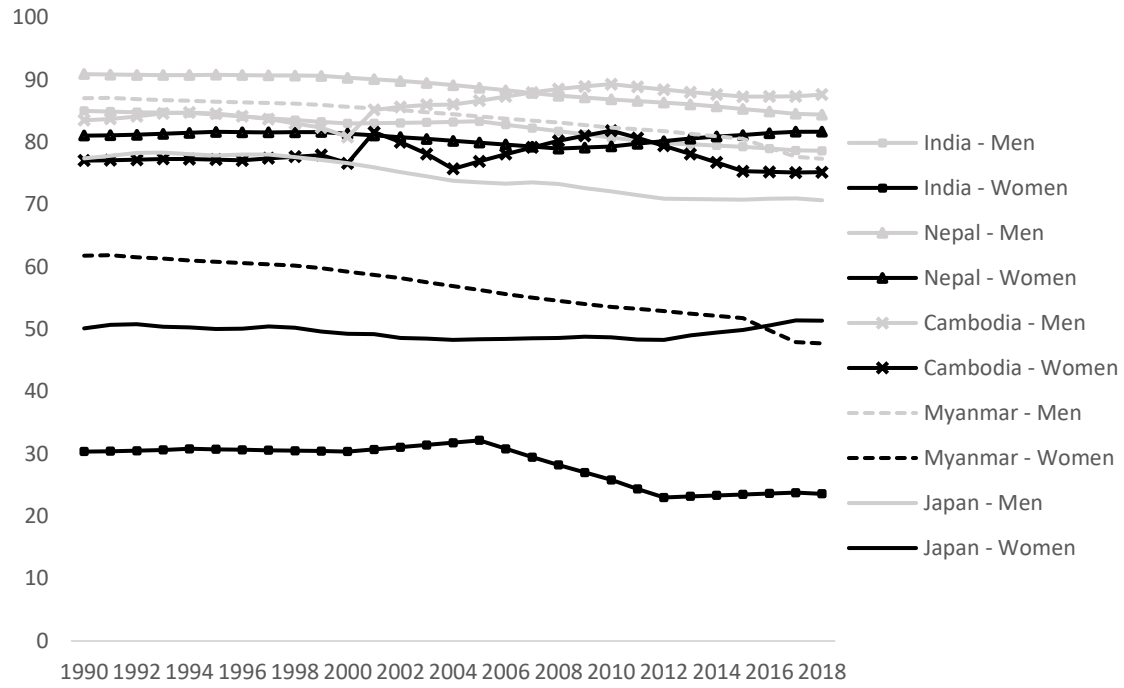


Figure 6-3. Change in the percentage of the male and female populations aged 15 years and over participating in the labour force, 1990-2018: selected Asian countries
Data Source: World Bank, 2019

6.3.3 Factors associated with marriage

Among women aged 45-49 years in 2016, 12.8% had never married. Never-married women in their late forties were more likely than were ever-married women of the same age to live in urban areas, work at a professional level, and fall into a higher wealth quintile (Table 6-1). They also had higher levels of educational attainment. These associations were found for women aged 25-29 and 35-39 years in 2016 as well. In addition, significantly more unmarried women were engaged in the labour force than younger married.

Only 5.2% of men aged 45-49 years in 2016 had never married and the never-married men were not significantly different as a group from the majority of men of the same age who had married (Table 6-2). Among the three age cohorts studied, only among men aged 25-29 years were there clear differences between men who had married, and those who had not. In this age cohort, unmarried men were more likely to live in an urban area, have achieved university or higher education, and fall into the highest wealth quintile. Married men were more likely to be working, but unmarried men were more likely to work in a professional or managerial position.

Table 6-1. Characteristics of women in selected age cohorts in Myanmar in 2015-2016, by marital status, % (n)

Age in 2016	Ever-married	Never-married	Total
25-29 years	***n* = 1,354**	***n* = 513**	***n* = 1,867**
Urban**	25.5 (345)	39.0 (200)	29.2 (545)
Higher education**	10.8 (147)	25.8 (133)	15.0 (280)
Highest wealth quintile**	17.4 (236)	30.0 (154)	20.9 (390)
Currently working**	59.7 (808)	83.5 (429)	66.3 (1,237)
In professional or managerial employment**	4.7 (63)	13.9 (71)	7.2 (134)
Ever had sexual intercourse**	100.0 (1,354)	1.0 (5)	72.8 (1,359)
35-39 years	***n* = 1,623**	***n* = 331**	***n* = 1,954**
Urban**	27.5 (446)	40.0 (133)	29.6 (579)
Higher education**	9.8 (159)	20.9 (69)	11.7 (228)
Highest wealth quintile**	20.8 (337)	37.1 (123)	23.5 (460)
Currently working**	68.7 (1,118)	81.8 (270)	71.1 (1,388)
In professional or managerial employment**	5.0 (82)	11.6 (38)	6.2 (120)
Ever had sexual intercourse**	100.0 (1,623)	0.0 (0)	83.1 (1,623)
45-49 years	***n* = 1,,432**	***n* = 210**	***n* = 1,642**
Urban**	29.7 (415)	38.4 (84)	30.9 (500)
Higher education**	5.6 (79)	19.7 (45)	7.5 (122)
Highest wealth quintile**	22.6 (316)	35.6 (78)	24.3 (394)
Currently working	68.2 (953)	74.8 (164)	69.1 (1,117)
In professional or managerial employment**	4.7 (65)	13.0 (29)	5.8 (94)
Ever had sexual intercourse**	100.0 (1,399)	0.0 (0)	86.5 (1,399)

**p-value for chi-sq test ≤0.001

Data Source: Ministry of Health and Sports and ICF, 2017

Table 6-2. Characteristics of men in selected age cohorts in Myanmar in 2015-2016, by marital status, % (n)

Age in 2015-2016	Ever-married	Never-married	Total
25-29 years	***n* = 464**	***n* = 213**	***n* = 677**
Urban*	26.8 (124)	38.0 (81)	30.3 (205)
Higher education**	8.5 (40)	20.1 (43)	12.2 (83)
Highest wealth quintile*	17.6 (82)	28.6 (61)	21.0 (143)
Currently working*	97.3 (452)	90.6 (193)	95.2 (645)
In professional or managerial employment*	6.0 (28)	12.8 (27)	8.1 (55)
Ever had sexual intercourse**	100.0 (464)	21.6 (46)	75.3 (510)
35-39 years	***n* = 608**	***n* = 71**	***n* = 679**
Urban	27.5 (167)	36.6 (26)	28.4 (193)
Higher education	8.2 (50)	9.9 (7)	8.4 (57)
Highest wealth quintile	18.9 (115)	19.7 (14)	18.9 (129)
Currently working	95.7 (582)	95.8 (68)	95.7 (650)
In professional or managerial employment	9.2 (56)	8.5 (6)	9.1 (62)
Ever had sexual intercourse**	99.8 (607)	23.9 (17)	91.8 (624)
45-49 years	***n* = 541**	***n* = 30**	***n* = 571**
Urban	26.5 (144)	26.7 (8)	26.5 (151)
Higher education	4.3 (23)	6.6 (2)	4.4 (25)
Highest wealth quintile	16.9 (92)	26.7 (8)	17.5 (100)
Currently working	94.8 (513)	90.0 (27)	94.6 (540)
In professional or managerial employment	7.0 (39)	0.0 (0)	6.7 (39)
Ever had sexual intercourse**	100.0 (541)	13.3 (4)	95.4 (545)

*p-value for chi-sq test ≤0.05

**p-value for chi-sq test ≤0.001

Data Source: Ministry of Health and Sports and ICF, 2017

6.3.4 Marriage patterns by age group

Cox regression assessed men's and women's transitions into marriage, focusing on highest completed educational level and current workforce engagement. The models were run separately for three different age cohorts and for the pooled sample, and also included an interaction term to adjust for a relationship between educational attainment and workforce engagement (Table 6-3).

Table 6-3. Effect of selected social, economic and demographic characteristics on marriage hazards for men and women in Myanmar

		Women		Men	
		Hazard ratio	***p*-value**	**Hazard ratio**	***p*-value**
25-29 years old	Education				
	None (reference category)	--	--	--	--
	Primary	0.71	0.007	0.65	0.213
	Secondary	0.62	0.002	0.27	0.035
	Higher	0.47	0.000	0.09	0.015
	Wealth index (adjusted for urban and rural residence)				
	Poorest (reference category)	--	--	--	--
	Poor	0.91	0.399	0.80	0.132
	Median	0.80	0.036	0.57	0.004
	Rich	0.65	0.000	0.62	0.006
	Richer	0.61	0.000	0.60	0.008
	Currently working	0.96	0.809	0.83	0.708
	Education-currently working interaction	0.78	0.002	1.73	0.085
35-39 years old	Education				
	None (reference category)	--	--	--	--
	Primary	0.78	0.021	0.84	0.448
	Secondary	0.67	0.004	0.47	0.056
	Higher	0.49	0.000	0.29	0.045
	Wealth index (adjusted for urban and rural residence)				
	Poorest (reference category)	--	--	--	--
	Poor	0.70	0.000	0.90	0.502
	Median	0.73	0.001	0.93	0.622
	Rich	0.60	0.000	0.81	0.160
	Richer	0.55	0.000	0.89	0.430
	Currently working	0.94	0.567	0.93	0.766
	Education-currently working interaction	0.95	0.409	1.25	0.292
45-49 years old	Education				
	None (reference category)	--	--	--	--
	Primary	0.76	0.008	1.49	0.201
	Secondary	0.62	0.002	1.97	0.234
	Higher	0.28	0.000	2.79	0.250
	Wealth index (adjusted for urban and rural residence)				
	Poorest (reference category)	--	--	--	--
	Poor	0.97	0.779	0.83	0.205
	Median	0.98	0.842	1.03	0.868
	Rich	0.90	0.239	0.83	0.221
	Richer	0.90	0.353	0.83	0.242
	Currently working	0.80	0.060	2.24	0.055
	Education-currently working interaction	1.07	0.378	0.58	0.062

Table 6-3 (Continued). Effect of selected social, economic and demographic characteristics on marriage hazards for men and women in Myanmar

		Women Hazard ratio	Men *p*-value	Women Hazard ratio	Men *p*-value
All age Cohorts	Age				
	15-19 years	0.71	<0.001	0.68	0.071
	20-24 years	0.94	0.246	0.89	0.241
	25-29 years	1.09	0.087	0.99	0.852
	30-34 years	1.02	0.639	0.93	0.268
	35-39 years	0.98	0.681	0.94	0.341
	40-44 years	1.03	0.511	0.94	0.362
	45-49 years (reference category)	--	--	--	--
	Education				
	None (reference category)	--	--	--	--
	Primary	0.79	0.000	0.79	0.046
	Secondary	0.66	0.000	0.51	0.001
	Higher	0.43	0.000	0.26	0.000
	Wealth index (adjusted for urban and rural residence)				
	Poorest (reference category)	--	--	--	--
	Poor	0.81	0.000	0.91	0.123
	Median	0.75	0.000	0.80	0.001
	Rich	0.65	0.000	0.77	0.000
	Richer	0.61	0.000	0.78	0.000
	Currently working	0.90	0.053	1.20	0.240
	Education-currently working interaction	0.88	0.000	1.20	0.103

Data Source: Ministry of Health and Sports and ICF, 2017

For all women, higher educational attainment and wealth status were associated with lower hazard ratios of entering into marriage. Women who were currently working also had an approximately 10% lower hazard of entering into marriage at any age, but this effect was not as strong for the full sample as those of education and wealth status. Higher levels of education were associated with lower hazards of entry into marriage for women from all three age cohorts, but older women (those aged between 45-49 years in 2015-2016) were most affected. While higher wealth decreased the marriage hazard for women aged 25-29 and 35-39 years in 2015-2016, higher wealth did not affect entry into marriage for older women.

The same patterns were found for men, although the smaller sample means that we cannot have the same level of confidence in the results. Higher levels of education and increasing wealth are associated with a reduced hazard of marrying overall. However, the impact of education varies by age cohort. Among younger men (aged 25-29 years in 2015-2016), increasing education greatly reduces the chance of marrying, whereas the reverse is true among men aged 45-49 years in 2015-2016. Similarly, current workforce engagement did not affect entry into marriage for the younger age cohorts, but more than doubled the marriage hazard for men aged 45-49 years.

6.4 Discussion

Delays to marriage and increases in the proportion of women never marrying have been observed across Asia for the past several decades (Smith, 1980; Xenos and Gultiano, 1992; Jones and Gubhaju, 2009). While attention has been paid to demonstrating the relationship between delays in marriage and fertility decline, fewer studies explore why women in particular are increasingly choosing to delay marriage or not to get married, and how their behaviour may differ from that of men of similar social status. This analysis has explored changes in marriage trends in Myanmar and sought to identify demographic and social characteristics associated with marriage in the country. According to these results, women in Myanmar are increasingly unlikely to marry, a trend similar to several other countries in Asia but unusual for the country's level of socioeconomic development. Women's decreasing rates of marriage in Myanmar are associated with higher levels of female education and female engagement in the workforce. Further analysis found that these relationships held across age cohorts. In contrast, higher education decreased the hazard of entering into marriage for younger men, but increased the marriage hazard for older men. Collectively, these results suggest that belonging to a higher status group has differential effects on men and women in Myanmar, improving the chances of marriage in the long term for men, while decreasing the likelihood of marrying for women.

These relationships between marriage and sociodemographic characteristics are not unlike those found in other Asian countries experiencing marriage squeezes. However, the patterns in Myanmar appear especially gendered. Existing literature on marriage in Asia suggests that two distinct groups have emerged to represent the populations who delay marriage or never marry. The first includes women who have benefited from increased educational attainment and employment opportunities arising from changing social and cultural norms. The second comprises men who face growing economic insecurity and inability to manage the financial costs of marriage and family life (Raymo *et al.*, 2015). The results of this analysis support the existence of the first group (of women) in Myanmar, and provide some evidence for the existence of the second group (of men). Among the oldest age cohort, aged 45-49 years in 2015-2016, women with higher levels of education and those who work have lower hazards of entering into marriage. In contrast, the opposite results are seen for men in this age cohort. However, this second finding is less convincing considering that most men (all but 5.2%) still marry. This is a noticeable contrast to other countries in the region, like Japan, Hong Kong and Singapore, where more men aged 45-49 years remain unmarried than do women.

The analysis in this paper suggests that changes in women's status, especially related to education, contribute to changing marriage patterns. The status of and opportunities for men in rapidly developing countries have not changed in the same way as those for women, and while it is culturally acceptable for women to marry men of higher status, it is less so for men to marry women of higher status (Jones 2004). Analysis of the 1973 Census showed that literacy was considerably higher among males than females, with increasing gaps as age increased. In 1973, half of all women aged 45-49 years were illiterate, compared to only 17.7% of men (Maung, 1986). Although men aged 45-49 years today are still more likely than women of the same age to be literate (90.2% compared to 80.3%), the gap has decreased (Ministry of Health and Sports and ICF, 2017). Women are also now more likely to have secondary or higher education than men (14.5% of women compared to 11.9% of men) signifying dramatic changes in women's status in the country and their options for employment outside of the home (Ministry of Health and Sports and ICF, 2017).

Across Asia, the continued expectation that women fulfil traditional roles within marriage has been identified as one reason that women delay marriage (Raymo *et al*., 2015). In Myanmar, women are expected to work in the house once they are married, while men pursue careers outside of the home (Gender Equality Network, 2018). This analysis suggests a conflict between gender norms and improving access to education and professional advancement for women.

The influence of social norms on marriage for higher status women in Myanmar may be exacerbated by an apparent shortage of men of reproductive age in the country. As of 2014, there were over one million more women of reproductive age (15-49 years) than men, and an overall sex ratio of 93 men for every 100 women (Department of Population, 2015). Considering a slight age difference in partners such that women aged 20-24 years tend to marry men aged 25-29 years, the sex ratio falls to 89 men per 100 women. Emigration is a major driver of this shortage. The 2014 Census estimated that around two million Myanmar migrants lived abroad, more than 60% of whom were men (International Organisation for Migration, 2016). However, these men are unlikely to be missing spouses for the unmarried women identified in this analysis. The International Organization for Migration estimates that the majority of emigrants go on to work in the commercial fishing, agriculture, manufacturing and hospitality sectors, which often offer lower wages and poor working conditions in host countries (International Organisation for Migration, 2016). The high status of the never-married women observed in this analysis suggest that those men who have emigrated would not necessarily have been eligible to marry these

women. However, the delayed marriage among higher status men found in this analysis may be due, in part, to an interest in remaining flexible to moving for work. For example, male emigrants to Singapore, nearly half of whom emigrate from Yangon, appear to comprise more highly skilled workers (International Organisation for Migration, 2016; Department of Population, 2016b). In Yangon, therefore, the emigration of high-status men could create a shortage of potential spouses and account for some of the high proportion of women who never marry in the region, around 15%, especially as these women are often better educated and more likely to be working themselves.

While migration likely plays a role in driving the marriage squeeze, the emigration patterns in Myanmar do not differ widely from similar countries in the region (for example Nepal or Bangladesh), and other factors reducing the number of available men in Myanmar should be considered. Male mortality is much higher than female mortality, especially among people of reproductive age. Analysis of 2014 Census and vital registration data found that the age-specific mortality rates (ASMRs) for men in five-year age groups between 25 and 49 was between three and five times greater than female mortality rates (Department of Population, 2016a; Oung *et al.*, 2017). In comparison, male ASMRs are only up to twice as large as female ASMRs in neighbouring Lao and Nepal (Ministry of Health and Lao Statistics Bureau, 2012; Ministry of Health *et al*., 2017). Furthermore, ASMRs in Myanmar for males in these age groups appear to have increased over the last several decades. The 1991 Population Changes and Fertility Survey (PCFS) estimated a mortality rate of 9.5 per 1000 men aged 25 years, just over half the ASMR for the same group in 2014 (16.7 per 1000) (Ministry of Immigration and Population, 1995). In contrast, the ASMR for women aged 25 years declined from 6.0 to 5.6 per 1000 from 1991 to 2014. Life expectancy in Myanmar, around 60 years for men and 67 for women, is also low for Southeast Asia, even compared with other countries with recent periods of prolonged conflict (Wang *et al*., 2012).

The reasons for these changes in mortality remain unknown, as cause-specific mortality data are unavailable or incomplete (Oung *et al.*, 2017). However, excess male mortality may be caused by higher risk behaviour among men. For example, Myanmar is one of the largest sources of opium in the world and is also home to large jade and ruby mines. Areas producing opium and gemstones also tend to be areas with more intense armed conflict and harsher landscapes. Countries with similar illicit drug and conflict environments, for example Colombia, have also experienced marriage squeezes on women (Holland Jones and Ferguson, 2010). In addition to the physical risk men living in these areas face, they may also be more likely to abuse alcohol and

other drugs. A recent survey found that 2% of adults living in opium producing villages in eastern Myanmar used opium (United Nations Office on Drugs and Crime, 2015), and mental or behavioural disorders due to psychoactive substance use were the seventh leading cause of registered deaths in 2013 (Oung *et al*., 2017). Less frequently registered is the growing HIV/AIDS burden in the country. Myanmar had more new HIV infections in 2015 than all but five other Asian and Pacific countries. Almost four times as many men as women died from AIDS-related causes in 2017 and more than twice as many men are currently living with HIV in the country than women (Joint United Nations Program on HIV/AIDS, 2018).

Unfortunately, data on cause of death or socioeconomic and demographic characteristics of those who die are not readily available from Myanmar and assumptions can be made about the relationship between high male mortality and low female marriage. Additionally, although inferences could be made about mortality trends over the past several decades using published survey reports, this data must be viewed with caution. Certain areas of Myanmar are routinely non-enumerated during national surveys and censuses. For example, around 1.2 million people lived in areas non-enumerated for security reasons during the 1983 and 2014 censuses (Immigration and Manpower Department, 1986; Department of Population, 2015). The 1991 PCFS identifies several sampling limitations arising from state officials' ability to exclude townships and villages from the sampling frame, and the subsequent decision not to adjust the sample design following these omissions (Ministry of Immigration and Population, 1995). The DHS data, upon which this analysis is largely based, includes five clusters that are replacements for areas deemed insecure during survey implementation (Ministry of Health and Sports and ICF, 2017).

In addition to the data limitations caused by ongoing conflict in Myanmar, the potential impact of conflict exposure on marriage should be considered. Changing marriage patterns have been identified as a possible demographic response to conflict (Hill, 2004; Fargues, 2000; Jayaraman *et al.*, 2009). This relationship is not explored in detail in this analysis, but it should be noted that areas where conflict is most intense, for example Shan and Rakhine states, have higher proportions of ever married women, especially among younger age cohorts. However, understanding whether the differences are related to conflict exposure requires further analysis.

Despite these data limitations, the consistency of trends across data sources and the quality of the data that are available support the existence of a female marriage squeeze disproportionately affecting well-educated and wealthier women in Myanmar. Supplementary reports and previous

research help to demonstrate the similarities between the causes of this marriage squeeze and those found in wealthier Asia countries, and provide additional evidence of the contribution of excess male emigration and mortality on the marriage squeeze in Myanmar.

The start of this chapter posited the conundrum that Myanmar's marriage pattern for women increasingly resembled the patterns of much richer countries in the East and South-east Asian region, whereas the marriage pattern for men was like that of countries at a similar level of economic development. The explanation for this does not lie in a different kind of association between marriage and social and economic variables in Myanmar. Rather it is peculiar combination of social and economic circumstances in Myanmar relative to other countries. Myanmar's distinctive characteristics include a more rapid than average improvement in female education, coupled with greater than average excess male mortality in the young adult ages and a higher emigration among young men when compared to women, all of which have occurred over a time period when expectations of women's role within the household after marriage have not changed greatly. The improvement in female education and increased labour force participation have therefore made high status women less willing to marry and embrace the double burden of work outside the home, and simultaneously reduced the pool of 'acceptable' partners. Meanwhile, excess mortality and emigration have reduced the supply of men for marriage and consequently increased their marriage rate.

Chapter 7 Conflict Exposure and Fertility in Myanmar

7.1 Introduction

Conflict affects fertility through various pathways, but a clear effect is difficult to determine. It has been observed that some couples consciously postpone childbearing during periods of conflict until they are in a more secure place, having either arrived in a safe environment or returned to normal life in their home area (Agadjanian *et al.*, 2008). Alternatively, changing marriage patterns during conflict have been cited as a reason for fertility change. For example, fertility increased in Palestine during the first *Intifada*[4], possibly due to an increased desire for the social and economic stability of marriage (Fargues, 2000), while postponement of childbearing and spousal separation, has been identified as a possible cause for fertility decline in Eritrea during the country's war with Ethiopia[5] (Blanc, 2004). However, the direction and magnitude of the effect of conflict on fertility appears to vary by the individual country and context of the conflict.

This thesis builds on existing fertility frameworks that quantify the effect of fertility behaviour on fertility outcomes, such as Bongaarts and Potter's proximate determinants (1983) and Davis and Blake's intermediate variables framework (1956), to consider how conflict and socioeconomic development interact to affect fertility behaviour. The framework presented in Chapter 1 provides several pathways for understanding these relationships, which are explored in more detail in this chapter. The framework suggests multiple ways for conflict to affect fertility. Conflict may lead to excess male mortality, which may in turn lower a woman's likelihood of ever marrying. Male participation in armed combat, or the need to relocate away from conflict-affected areas for employment, may decrease a couple's coital frequency. Additionally, frequent conflict events may limit the resources that a government puts into health or educational infrastructures in an area, especially if that area is also physically remote. As a result, women may have limited access to family planning, or may be less educated or less likely to engage in formal employment. Additionally, both exposure to higher levels of conflict and lower levels of

[4] Conflict has plagued Palestine and Israel for decades, but can be divided into several periods of heightened violence. The *First Intifada* was one such period of Palestinian uprising against Israeli occupation of the West Bank and Gaza, occurring between 1987 and 1993.

[5] The Eritrea-Ethiopia War took place between 1998 and 2000. Those living in contested areas were exposed to intense conflict, and sections of the border between Eritrea and Ethiopia remain contested.

development may be associated with higher maternal stress, poor pre-natal and delivery services, and other factors associated with poor birth outcomes.

Until recently, demographers explored the relationships between conflict and fertility outcomes using data on national level changes in conflict intensity (Blanc, 2004; Lindstrom and Berhanu, 1999) or through proxy variables for conflict, such as sibling deaths (Jayaraman *et al.*, 2009). While this allows for a general examination of long-term, population level effects of conflict on fertility, examination of the mechanisms facilitating these changes is more difficult. Additionally, these approaches limit the ability of scholars to explore the effects of different types of conflict events on fertility. Studies that achieved this level of analysis observed different population responses to violent events, such as battles, non-violent political events, and peaceful events, like ceasefires (Williams *et al.*, 2004).

In the 2010s, micro-level conflict events data started to become available through projects like the Armed Conflict Location and Event Data Project (ACLED), bringing time-specific, geo-located conflict-event data for more than fifty countries to a broad audience (Raleigh *et al.*, 2010). The availability of this type of data led to new research linking conflict events to individual level data from health surveys, but few provide in-depth analyses of the accuracy of the data or the appropriateness of making these links (Sedda *et al*., 2015; Delbiso *et al*., 2017; Wagner *et al*., 2018). Those who have examined conflict event data in detail have found that these data are susceptible to error because they are taken from media reports and manually coded by multiple individuals (Eck, 2012; Ruggeri *et al.*, 2011). Nevertheless, these data are important tools for exploring the effects of conflict on a multitude of health and development outcomes, allowing for detailed exploration of theoretical frameworks explaining the relationships between conflict and health outcomes.

7.1.1 Contextual considerations for Myanmar

Clashes between national and local leaders began almost immediately following Myanmar's independence in 1948. Ethnic Burmese, who made up the majority of the population and resided in the central, more economically stable plains, ran the government and were at odds with ethnic minority groups living in peripheral areas. The government legitimized this conflict through the *Pya Ley Pya (Four Cuts)* campaign, introduced in the 1960s, which divided the country into nine military zones in order to contest the network of insurgent groups (Smith, 1991). In disputed zones, residents may be denied citizenship and subjected to state-sanctioned brutality, forced

migration and labour. Essential supplies and medicines are also often limited. Soldiers dispatched to contested areas have the right to shoot opposition forces on sight (Smith, 1991). This can lead to targeting of aid workers and medical personnel attempting to bring supplies to villages in disputed zones (Footer *et al.*, 2014). The disruption caused by these actions has caused the internal displacement of up to 644,000 people in eastern Myanmar (United Nations High Commission for Refugees, 2019; Internal Displacement Monitoring Centre, 2019). A 2012 ceasefire between the government and 10 of the 11 main insurgent groups in the East has led to reports of a fragile and gradual improvement in conditions in eastern Myanmar (Footer *et al.*, 2014). However, clashes have intensified and become the focus of international media in the west as more than 700,000 Rohingyas have fled across the border to Bangladesh since August 2017 (International Organization for Migration, 2018).

Amidst this conflict, Myanmar experienced considerable demographic change. The World Bank fertility estimates suggest that, immediately following independence, Myanmar experienced an initial increase in fertility before experiencing a rapid and unexpected decline (World Bank, 2019). Analyses of age-specific and total fertility rates during this time provide further insight. The World Bank estimates show a decline in fertility from 6.1 in 1960 to 2.2 in 2014 (World Bank, 2019). These projections generally agree with data from the 1973, 1983 and 2014 censuses, which report TFRs of 5.65, 4.81 and 2.29 respectively. However, previous analysis of these data suggest that reported TFRs may under-estimate the true total fertility rate (TFR) (Myint, 1991; Tint, 1991). Adjusted estimates found a TFR of approximately 5.25 per woman in 1983 (Myint, 1991), and between 2.37 and 5.27 for the 2008-2013 period (Tint, 1991), indicating a high level of variability and uncertainty surrounding fertility estimates for the country. Chapters 3 and 4 provide additional insight into fertility decline in the country, and confirm that a rapid fertility decline, characterised by increasing differences between central Myanmar and the rural peripheral areas of the country, took place between 1983 and 2014 (Schuster et al., 2019). The areas of the country with slow or stalled fertility decline are also those plagued by violence, presenting a clear case study for exploring the relationships between conflict exposure and fertility.

7.2 Data

Both ACLED and the Uppsala Conflict Data Program (UCDP) capture conflict event data for Myanmar. UCDP differs from ACLED data in that it has fewer conflict categories and is less likely to capture a non-fatal violent event. Some have argued that UCDP data are more reliable for the

events that they include, although there are fewer (Eck, 2010). However, this chapter is interested in assessing exposure to different types of conflict events within a fine geospatial location, a process for which ACLED data may be a better fit. Here the more theoretically useful ACLED data are compared with the potentially more accurate UCDP data in an effort to validate the ACLED data for use in this analysis.

For the 2010 to 2016 period, a comparison of events resulting in fatalities shows similarities in the data: ACLED recorded an average of 112 events leading to one or more fatality (hereafter known as a "fatal event") per year, while UCDP recorded an average of 96 fatal events. At the state/regional level (see Map 1-1), more than 95% of all fatal events in both datasets were concentrated in five states. These five states are the same in both datasets, but the numbers reported in each dataset are inconsistent. For example, events in Shan state make up 45% of the total number of events reported by ACLED, but only 35% of those reported by Uppsala. Events in Kayin account for almost 25% of all of Uppsala's events, but only 10% of ACLED's events. A more detailed analysis of individual events found that only 60% of the events in the Uppsala database include geographic information below the state/region (administrative level 1). In contrast, 100% of the ACLED events have geographic information down to the township level (administrative level 3). Although the datasets do not match perfectly, they share the same general temporal trends and identify the same high intensity locations. These similarities suggest that either dataset could be used to measure conflict at the state/region level, but that only the ACLED dataset has the potential for micro-level analysis.

Another characteristic of the data to consider is their flexibility for additional interpretation. ACLED datasets include full descriptions of each event, while Uppsala's event database only includes references to the original source material and a broad event coding system. The greater detail found in the ACLED database, along with the wider variety of events, allows events to be categorized so that different types of conflict and violence can be assessed separately. For example, with the ACLED data it is possible to consider how non-fatal, but still disruptive events like mass arrests, forced labour, or rape in communities can affect populations.

No standard exists against which to compare either data set because both rely on media reports of conflict events, noted by many other researchers as being unreliable (Flaherty and Roberts, 2019; Otto, 2013; Ruggeri *et al*., 2011). However, they remain the best options for analysing the relationships between conflict events and health outcomes in Myanmar. In comparing the two, the detail in the ACLED data, both for geo-referencing events and for categorizing event type, sets

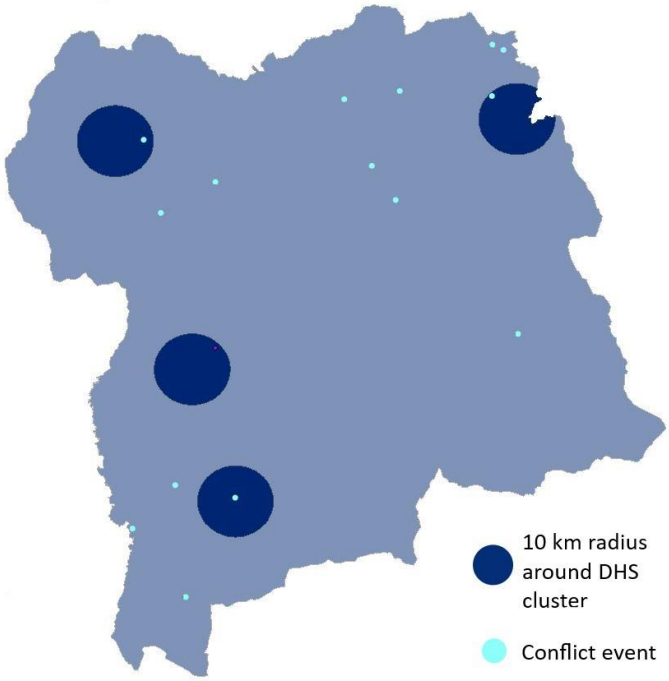
it apart for this particular analysis, but the differences found through comparison themselves demonstrate the need to critically assess these data before analysis.

7.2.1 Preparation of ACLED data for analysis

Given the above data question on data reliability, all ACLED data used for this analysis were examined and cleaned prior to use. Data were pulled from 1 January 2010 (first available date) until 7 July 2016 (last day of DHS data collection). Duplicate events (i.e. multiple entries for a multi-day event) were removed, along with non-violent events like the establishment of military bases, signing peace agreements, or the imposition or removal of curfews.

The event type classification for each event was then checked and several entries were changed. The three battle categories were collapsed into a single category. The "remote violence" and "strategic development" categories were heavily revised, most often changed to "bombing", "landmine" or "battle". Additionally, many events in the "violence against civilians" category were re-coded into the new "property destruction", "mass arrests", "forced service" and "rape" categories to more clearly capture types of conflict. A total of 665 events, not including the consolidation of the various battles categories, were re-coded, 18.9% of all events. More information about the re-coding can be found in Appendix F.

Once ACLED data were cleaned, they were uploaded into ArcGIS along with DHS cluster location data. Across global DHS data collection, the location information for urban clusters contain between 0 and 2 km of error, while location error for rural clusters may be intentionally set at up to 10 km (Perez-Heydrich *et al.*, 2013). For these reasons, a 10 km buffer zone was set around the GPS location of each cluster to ensure that the cluster itself was captured as well as



Map 7-1. Illustrative map of Loilen District, Shan State, with DHS cluster 10 km buffer zones and conflict events
Data Source: Myanmar Information Management Unit, 2007; Raleigh *et al*, 2010; Ministry of Health and Sport and ICF, 2017

events taking place within a localized area (Map 7-1). ArcGIS's spatial joins processes were used to count the number of each type of conflict event that occurred within each buffer area between January 2010 and July 2016. The attributes of cluster level data were then linked to individual data from the 2015-16 Myanmar DHS using the Cluster ID Number variable available in both data sets, such that every woman surveyed from a given cluster was assigned the same value for each conflict exposure variables.

7.3 Methods

This chapter starts by presenting a descriptive analysis of the 3,522 conflict events that took place across Myanmar during the five years before DHS data collection in Myanmar. This chapter focuses on physical proximity rather than temporal trends in order to establish the appropriateness of using ACLED data for this type of analysis, but acknowledges that future work combining temporal and geospatial modelling would be of benefit. Descriptive analysis demonstrates the geographic distribution of each type of event. Following this descriptive presentation of conflict events across space and time, this analysis compares the demographic characteristics of women living in areas exposed to conflict and those living in areas without any conflict events over the previous five years. The relationships between exposure to the identified conflict events and fertility outcomes are then empirically explored through logistic regression. The analysis concludes by demonstrating the geospatial relationship between DHS clusters and ACLED conflict events, and discussing possible limitations inherent in data collection in areas of conflict.

For several reasons, the logistic regression uses a sample of 7,759 currently married women. Fertility is generally limited to within marriage in Myanmar, with few couples cohabitating or procreating before marriage. As a check, an assessment of the number of births in the last five years to women in the sample was conducted based on their current marital status. Currently married women accounted for 95.6% of the women reporting a birth in the last five years, with none of the never married women reporting any births. The remaining 4.4% of the births were to women who were currently widowed, divorced or separated from their husbands[6]. Along with

[6] Women in Rakhine were most likely to report that their marriage had ended (10.9%), with a similarly high percentage of recent births (10.4%) taking place within this population. Divorce appeared to drive this difference - divorce was twice as common in Rakhine as the national average. In contrast, marriage dissolution was as common for women in Yangon and Mandalay as for women in other states, but women

never married women, these women were also excluded to facilitate a cleaner analysis of the relationships between other demographic characteristics, conflict and fertility outcomes. However, while this eases interpretation, it means that analysis does not explore the complex relationship between marriage and conflict.

The primary independent variable used for the logistic regression was exposure to conflict, defined in this analysis as exposure to at least one conflict event between January 2010 and July 2016. Including the January 2010 to July 2016 period ensures that all events recorded during the gestational period for all births taking place in the five years before the DHS have been included along with the births themselves. Binary analysis was run for each event category, for exposure to any conflict, and for exposure to any non-protest event. Multivariate analysis only considers three types of conflict exposure (exposure to protests, battles and forced service), along with exposure to any conflict and exposure to any non-protest event. Exposure to protests and battles were selected to represent exposure to violent and non-violent types of conflict, while forced service was included in the multivariate modelling because previous research in Myanmar found a relationship between forced service and poor health outcomes (Parmar *et al*., 2014).

Outcome measures are loosely based on the intermediate variables framework and include: early sexual debut, sex in the last four weeks, current use of family planning, last birth unwanted and previous pregnancy termination. Additionally, two outcome variables assess the relationships between conflict exposure, demographic characteristics and any births within the last one or five years. Collectively, these outcome measures serve as proxy variables to begin measuring how conflict interrupts biological processes dictating fertility. For example, early sexual debut (itself a proxy for entry into marriage in Myanmar) and sex within the last four weeks can be used to help understand how conflict exposure changes a woman's exposure to pregnancy risk. The model for contraceptive use initiates discussion about health service disruption and contraceptive knowledge in conflict affected areas. Questions about pregnancy unwantedness and termination further contribute to this discussion regarding pregnancy intention and fertility decision-making in conflict settings. Ideally, the question on pregnancy termination would be separated into spontaneous and induced termination. Interpretation of relationships between conflict and these

whose marriages had ended were much less likely to report a recent birth (2.6% and 0.9%, respectively). These differences demonstrate regional variation in marriage patterns, but suggest that these different are not directly related to conflict as Shan and Kayin appear similar to other states/regions and little variation in widowhood is seen across the country.

two types of terminations may be different, with induced terminations demonstrating a potential unmet need for contraception in conflict areas and spontaneous terminations linked to higher maternal stress or other poor maternal health outcomes due to conflict exposure. Although each of these indicators serve as a proxy rather than a direct measure of the relationships between fertility decision making and conflict exposure, discussion of the collective group allows for a preliminary exploration of these relationships in Myanmar.

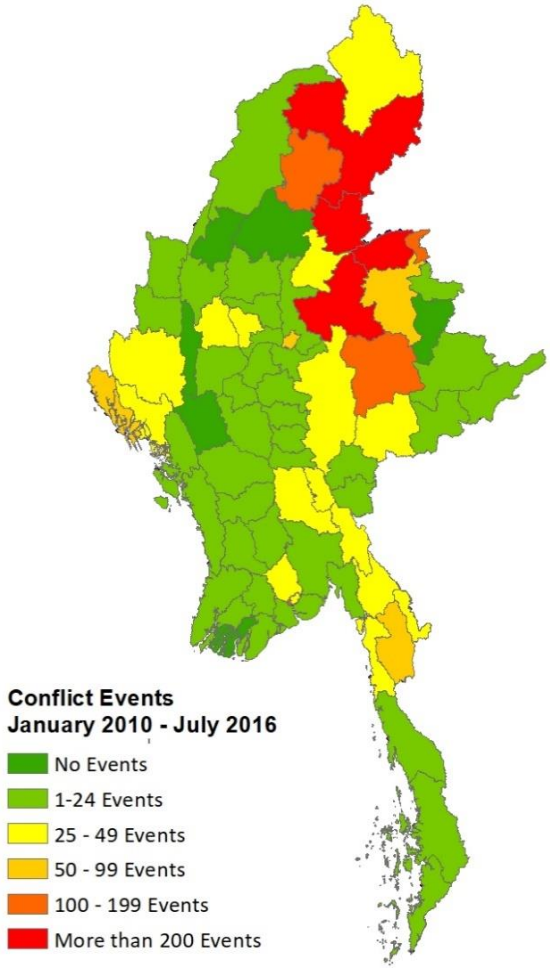
The results of the binary logistic regression show simple relationships between conflict exposure, by conflict type, and sexual and reproductive health and fertility outcomes. Multivariate models assess the effect of conflict events on outcome variables when controlled for woman's age, education level, urban/rural residency and exposure to mass media (as measured by household ownership of a television). Throughout this analysis, estimated sample proportions, means and odds ratios were developed using the SPSS Complex Samples package to account for the complex sampling design employed during the Myanmar DHS.

7.4 Results

7.4.1 Description of conflict events

The data show an initial decline in fatal events, perhaps related to several ceasefire agreements signed in 2011, before a notable increase in both fatal and non-fatal events in 2015. More than half of both fatal and non-fatal events were battles, half of which (1118 of 2048 of all battles, 254 of 495 fatal battles) took place in Shan state. Nearly all of the remaining battles took place in either Kachin or Kayin. Battles accounted for nearly 80% of all deaths recorded in the ACLED database. Around 42% of all battle-related deaths took place in Shan state, with another 28.5% in Kachin state and 20% in Kayin state. Map 7-2 shows the location of high-intensity districts within these states.

Beyond the mortality and morbidity caused by battles, these events led to other hardships for affected communities. For example, the notes from an entry from Shan state on July 6th, 2016 indicate that although no fatalities were recorded, 350 townspeople fled the village. A firefight between the Shan State Progress Party and the Burmese military on October 27, 2015 led to the closure of 14 schools and the temporary displacement of more than 3000 civilians from villages around the battle. Again, no fatalities were recorded in the ACLED database.



Most battle-related fatalities were military personnel, while deaths due to violence against civilians, the second most common fatal event type, include women, children and the elderly. Most fatalities were in Shan or Rakhine state. In Shan state, many event notes describe isolated instances of individuals being arrested or abducted by members of armed groups (government and

Map 7-2. Distribution of conflict events, January 2010 - July 2016
Data Source: Raleigh *et al.* 2010; Myanmar Information Management Unit, 2007

non-government) before later being found dead. In Rakhine the event notes are similar, but almost all mention the specific targeting of Rohingyas and show stronger evidence of civilian-on-civilian violence than is found is other states or regions.

After battles, protests were the second most common event recorded in the ACLED database for Myanmar, with 665 events. Unlike other common event types, protests appeared relatively peaceful – less than 1% of the recorded protests resulted in a fatality. More than a quarter of all protests took place in Yangon, the former national capital and largest city. Another quarter took

place in the urban areas of Monywa (Sagaing Region) and Mandalay. A number of protests, about 15% of all protests, took place in Rakhine state. Across these four areas, protests fall into approximately three general categories: 1) protests against factories or in response to labour disputes, 2) student-led protests advocating for democratic processes, and 3) civilian-led protests against the loosening of legal restrictions on the Muslim Rohingya population. Protests, and occasionally riots, also arise periodically in response to individual violent events against civilians.

7.4.2 Conflict exposure and demographic and household characteristics

Nearly half of all women in the sample had been exposed to at least one conflict event in the past five years. Battles were the most common event in the ACLED database, but women in the sample were most often exposed to protests, violent events against civilians and bombings. Only around 12% were exposed to battles. Exposure to conflict events, including exposure to battles and protests as individual event types, was much more common in urban areas (unadjusted odds ratio significant at $p<0.001$), even when non-violent protest events were excluded.

Those with low or no education were least likely to be exposed to any conflict event, 35.4% and 32.7% respectively. Women with higher education were most likely to be exposed, 71.8%. Women with no education were most likely to be exposed to battles (17.7%), property destruction (9.5%), forced service (4.4%), looting (3.6%), rape (5.4%) and communal violence (3.9%). Higher educated women were most likely to be exposed to landmines (12.9%), bombings (42.4%), violence against civilians (38.9%), mass arrests (25.3%), riots (32.5%) and protests (63.9%).

More than half (59.6%) of all women lived in homes with televisions. Those who lived in urban areas were more likely to live in a home with a television than those living in rural areas, 86.3% and 50.1% respectively ($p<0.001$). As a result, conflict exposure was significantly associated with household ownership of a television. Residency was not significantly associated with the number of years of education she had received ($F=1.398$, $p=0.237$**).** A comparison of conflict exposure across age cohorts found no clear differences across age cohorts or conflict event types.

7.4.3 Conflict exposure and sexual behaviour

Only around 2% of currently married women debuted sexually before age 15. However, this nearly doubles to 3.7% for women exposed to battles and increases to nearly 10% among the

small group exposed to communal violence (see Appendix G for comparison of sexual and reproductive health outcomes for all conflict exposure groups). Unadjusted odds ratios suggest that exposure to any riots or protests in the past five years reduces the likelihood of early sexual debut, but not significantly. In Myanmar, few women report having sex outside of marriage, indicating that this variable may also indicate that adolescent marriage is more common in areas exposed to battles, communal violence and rape. Most married women had engaged in sexual activity in the last four weeks, but significantly fewer women exposed to battles or rape in their communities had recently had sex. Exposure to protests did not appear to change the likelihood of engaging in sexual intercourse.

These effects held when controlling for other demographic characteristics of the women: exposure to battles increased the percentage of married women who engaged in sexual activity at a young age, but decreased the percentage of women who had recently engaged in sexual intercourse (Table 7-1). Other conflict event types did not appear to significantly affect sexual behaviour among married women.

7.4.4 Conflict exposure and conception

Unlike the effects on pregnancy outcomes, which differed by event type, women exposed to nearly all types of conflict events were less likely to be currently using a modern method of family planning when compared to those who had not been exposed to events through bivariate analysis. The most dramatic differences were seen for those exposed to disruptive events like forced service, looting or rapes in the community. No difference was found between women exposed and not exposed to protests.

When adjusted for demographic and household characteristics (Table 7-1), exposure to battles and forced service significantly reduced the odds that a woman was currently using modern contraception. Inclusion of demographic and household characteristics shifted the effect of protests on modern contraceptive use slightly, so that women exposed to any protests were more likely to be currently using a modern method of contraception, but this was insignificant at $p < 0.05$.

7.4.5 Conflict exposure and birth outcomes

Overall, only 11.5% of the currently married women gave birth within the year before the survey. No statistical difference was found between exposure to conflict in the last five years and giving birth in the last one year. Births within the last five years were more common, with 44.1% of women reporting a birth during this period. Exposure to any conflict, exposure to protests, violence against civilians, riots, bombs, and mass arrests were negatively associated with having a birth in the last year. Exposure to battles, communal violence, and forced service were positively associated with pregnancy outcomes over the longer period.

Few women reported that their last birth had been unwanted. Those exposed to any conflict event were less likely to report an unwanted pregnancy, but this relationship was not significant. Women exposed to battles were significantly more likely to report that their last birth was unwanted. In contrast, pregnancy terminations were more common for women who were not exposed to conflict events. Women who had been exposed to bombings, mass arrests, rapes, riots or protests were significantly less likely to have ever terminated a pregnancy when demographic characteristics were not considered.

Most relationships held when using logistic regression controlling for demographic characteristics, residency (urban/rural) and exposure to mass media as measured by household ownership of television sets (Table 7-1). Exposure to "any" conflict event did not significantly affect the odds of giving birth once other covariates were considered. When considered separately, exposure to protests, battles and forced service each significantly affected the odds of giving birth in the past five years. Exposure to any battles more than doubled the odds that a woman's last pregnancy was unwanted, while exposure to protests significantly reduced the odds of a woman ever having a terminated pregnancy. The type of pregnancy termination, induced versus spontaneous, could not be assessed.

Table 7-1. Odds of fertility related behaviour, by conflict exposure type

Outcome Variable	Unadjusted Odds Ratio	95% CI	Adjusted Odds Ratio[7]	95% CI	Negelkerke Pseudo R-Sq
Any Event					
Early Sexual Debut	0.920	0.588 – 1.441	1.248	0.771 – 2.018	0.068
Sex in Last Four Weeks	0.946	0.791 – 1.131	0.984	0.803 – 1.207	0.017
Currently Using FP	0.791	0.674 – 0.929	0.958	0.802 – 1.144	0.068

[7] Includes covariates of current age, highest level of education, urban/rural status and household ownership of a television.

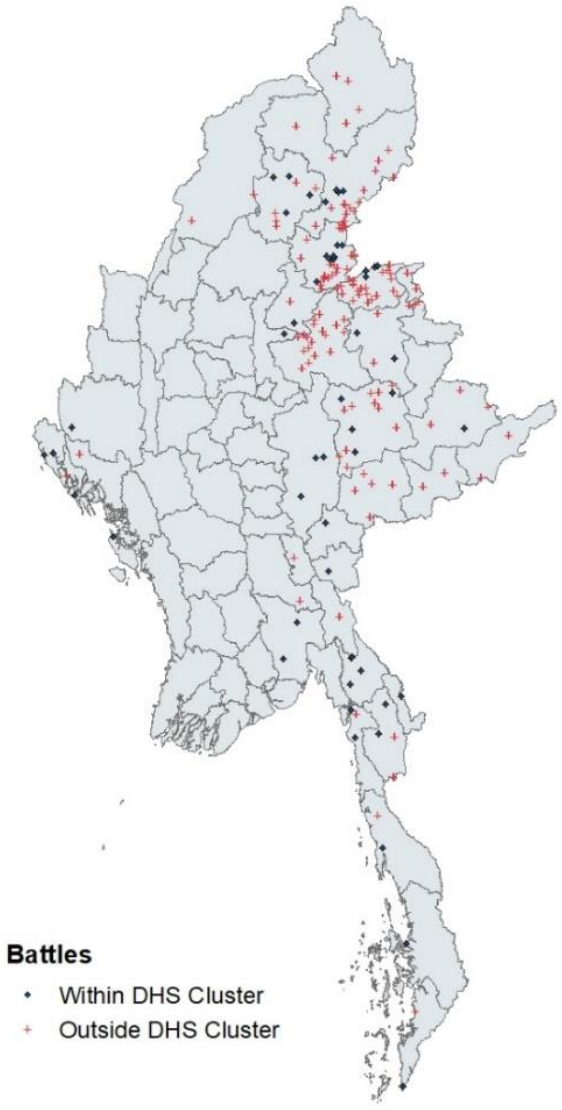
Birth in Last Year	0.920	0.767 – 1.103	0.941	0.777 – 1.139	0.122
Birth in Last Five Years	0.843	0.743 – 0.957	0.887	0.754 – 1.044	0.213
Last Birth Unwanted	0.771	0.460 – 1.294	0.955	0.587 – 1.555	0.032
Pregnancy Termination	0.870	0.743 – 1.019	0.873	0.716 – 1.065	0.031
Any Non-Protest Event					
Early Sexual Debut	1.052	0.667 – 1.662	1.470	0.904 – 2.391	0.070
Sex in Last Four Weeks	0.919	0.762 – 1.108	0.940	0.764 – 1.156	0.017
Currently Using FP	0.737	0.622 – 0.874	0.866	0.725 – 1.035	0.069
Birth in Last Year	0.953	0.790 – 1.151	0.979	0.813 – 1.179	0.122
Birth in Last Five Years	0.880	0.771 – 1.004	0.920	0.781 – 1.084	0.213
Last Birth Unwanted	0.859	0.501 – 1.471	1.149	0.704 – 1.876	0.032
Pregnancy Termination	0.860	0.730 – 1.013	0.867	0.705 – 1.066	0.031
Protests					
Early Sexual Debut	0.633	0.384 – 1.043	0.850	0.491 – 1.469	0.067
Sex in Last Four Weeks	1.055	0.869 – 1.281	1.136	0.913 – 1.412	0.017
Currently Using FP	0.887	0.749 – 1.049	1.102	0.906 – 1.340	0.068
Birth in Last Year	0.877	0.719 – 1.070	0.886	0.723 – 1.085	0.122
Birth in Last Five Years	**0.779**	**0.683 – 0.888**	**0.792**	**0.675 – 0.930**	**0.214**
Last Birth Unwanted	0.469	0.274 – 0.803	0.526	0.227 – 1.219	0.038
Pregnancy Termination	**0.770**	**0.649 – 0.913**	**0.743**	**0.605 – 0.912**	**0.033**
Battles					
Early Sexual Debut	**2.041**	**1.224 – 3.404**	**1.947**	**1.214 – 3.122**	**0.074**
Sex in Last Four Weeks	**0.681**	**0.546 – 0.849**	**0.677**	**0.534 – 0.859**	**0.021**
Currently Using FP	**0.589**	**0.449 – 0.773**	**0.631**	**0.482 – 0.825**	**0.073**
Birth in Last Year	1.134	0.912 – 1.411	1.092	0.862 – 1.384	0.122
Birth in Last Five Years	**1.213**	**1.048 – 1.404**	**1.232**	**1.072 – 1.417**	**0.213**
Last Birth Unwanted	**2.207**	**1.156 – 4.216**	**2.395**	**1.301 – 4.407**	**0.044**
Pregnancy Termination	1.030	0.823 – 1.288	1.072	0.845 – 1.359	0.031
Forced Service					
Early Sexual Debut	2.157	0.748 – 6.222	1.653	0.628 – 4.348	0.068
Sex in Last Four Weeks	1.012	0.604 – 1.698	1.007	0.586 – 1.729	0.017
Currently Using FP	**0.460**	**0.224 – 0.944**	**0.443**	**0.225 – 0.872**	**0.071**
Birth in Last Year	1.297	0.762 – 2.205	1.148	0.712 – 1.853	0.122
Birth in Last Five Years	**1.515**	**1.089 – 2.107**	**1.399**	**1.102 – 1.776**	**0.213**
Last Birth Unwanted	1.827	0.736 – 4.539	1.584	0.569 – 4.409	0.033
Pregnancy Termination	0.932	0.496 – 1.753	0.973	0.511 – 1.855	0.030

Data Source: Ministry of Health and Sport and ICF, 2017

7.4.6 Limitations of analysis of conflict data

DHS data are well regarded, and the quality of data collected during survey implementation in Myanmar appears consistent with implementation in other areas. However, as Chapter 2 shows in greater detail, some aspects of the sampling and its effects on this analysis should be discussed as they may influence conflict exposure estimates. For example, perhaps due to the decision to replace the five conflict-affected clusters with other nearby clusters, the populations living closest

to many of the conflict events captured in the ACLED database were not sampled during DHS implementation. Out of the 3,522 events that took place during the January 2010 to July 2016 period, only 1,627 (46.2%) took place within 10 km of a DHS cluster (Map 7-3).



Map 7-3. Locations of battles, January 2010 – July 2016
Data Source: Raleigh *et al.*, 2010; Myanmar Information Management Unit, 2007

Populations affected by battles may be especially under-represented, with only 32.7% of all battles taking place within 10 km of a DHS cluster. This mainly affected three districts, Kyaukme and Muse in Shan State and Bhamo in Kachin State. Only 74 battles from these three districts were linked to a DHS cluster, out of a possible 1,049 battles taking place during the review period. Kyaukme has the second largest population of all districts in Shan state and more than 10% of all conflict events in the country took place in the district. However, because none of the DHS

clusters were located within 10 km of an event, the unrest and uncertainty caused by these events, and those in similarly excluded conflict-intense areas, may not be appropriately captured in the analysis. As a result, the impact of conflict exposure, especially exposure to battles, may be much larger and more widespread than this analysis suggests.

7.5 Discussion

The analysis presented in this chapter had two primary objectives: 1) to critically assess the use of micro-level conflict event data for demographic analysis; 2) to demonstrate the use of linked ACLED conflict event data and individual data from the DHS to theoretically and empirically examine relationships between conflict exposure and fertility outcomes. This chapter shows how ACLED and DHS data can be combined, discusses possible analytic limitations and begins to explore how exposure to any type of conflict, and exposure to specific types of conflict, influences fertility through indirect measures.

The ACLED data show that conflict events were most common in Shan, Kayin and Kachin, with a rise in conflict events in Rakhine in the year prior to the DHS. The majority of the recorded events were battles, but protests and isolated violent events targeting civilians were also common. Review of the data notes helps demonstrate how even non-fatal events contribute to displacement and uncertainty in an area, which may lead to different reproductive and health behaviour. Analysis of the DHS data shows that almost half of the surveyed women had been exposed to at least one of these events in the past five years. This is consistent with previous studies of conflict exposure in Myanmar (Parmar *et al*., 2007).

In addition to describing conflict exposure, this analysis explored relationships between conflict exposure and fertility behaviour using a modified theoretical framework based on previous theory discussed by Bongaarts and Potter (1983), and Davis and Blake (1956), among others. Specifically, it examines relationships between conflict exposure and three areas of sexual and reproductive health behaviour that indirectly affect fertility: intercourse, conception and birth. As the analysis only uses the currently married sample from the DHS, it does not explore relationships between conflict exposure and marriage trends, but does look at other factors affecting sexual behaviour within unions.

Overall, logistic regression found that exposure to conflict events, once controlling for demographic characteristics, affected the variables of interest, and that relationships differed

based on the event type. Exposure to battles had a positive effect on the probabilities of early sexual debut and on the probability that the most recent birth was unwanted. In line with these findings, exposure to battles decreased the probability that a married woman was currently using any method of family planning. Unsurprisingly, given these findings, women exposed to battles were more likely to have given birth in the last five years. Although most results showed that exposure to battles had a positive effect on fertility, women living in areas where a battle had taken place were less likely to have engaged in sexual activity in the last four weeks. This aligns with previous research, which has suggested that coital frequency can fall during times of conflict due to spousal separation while men engage in combat or seek employment elsewhere, reduced sexual urge due to stress or disorientation, or a conscious decision to limit fertility where access to contraceptive methods is limited (Lindstom and Berhanu, 1999; Agadjanian *et al*., 2008). However, it appears that the earlier sexual debut and low contraceptive use overcome any fertility limiting effects of lower coital frequency in conflict areas. In contrast, exposure to protests had no significant effect on sexual behaviour or contraceptive use, but did decrease a woman's odds of having a birth in the last five years or having ever terminated a pregnancy. These differing effects align with previous research into the effects of violent and non-violent political events on fertility-related behaviours. For example, research in Nepal also found differing effects by violent versus non-violent event type on fertility-related behaviours such as entry into marriage and contraceptive uptake (Williams *et al*., 2012).

This chapter additionally presents findings on the relationship between fertility and violent, but non-fatal, events, as measured by forced service, to show that areas experiencing this type of insecurity also experience higher fertility. Unlike exposure to battles, exposure to forced service did not appear to have an effect on sexual behaviour. However, this type of exposure had a greater effect than battles on decreasing the odds of contraceptive use and increasing the odds of giving birth in the last five years. Parmar *et al*. (2014) found that household experience with forced service was also significantly related to poorer infant and child mortality outcomes. Forced service and battles tend to take place in similar areas, suggesting that it may be the combination of the two types of events in an area that lead to the greater effect. For example, health workers may be especially cautious about serving communities where both armed conflict and civilian abductions occur contributing to the low contraceptive use in these areas.

The framework introduced in this thesis seeks to provide a pathway for identifying the mechanisms leading to the relatively high probabilities of giving birth if exposed to violent conflict

events. Others have explored existing frameworks to begin to identify how conflict may affect intermediary variables leading the differential fertility. For example, the proximate determinants of fertility framework provides efficient tools for understanding a population's fertility behaviour, and is used extensively throughout demographic research, but the effects of external factors, such as conflict, are difficult to measure (Bongaarts and Potter, 1983). As a result it may be more appropriate to return to Davis and Blake's broader intermediate variables framework (1956), as was done during the National Research Council's roundtable on the demography of forced migration, to explore the effect of conflict or humanitarian crisis on additional factors influencing fertility (Hill, 2004).

Davis and Blake's theoretical framework allows for a broader discussion of fertility decision-making dynamics within couples. For example, while contraceptive use is important, examining use alone during times of conflict may miss learning and programmatic opportunities. Even when marriage rates are high, research shows that some couples consciously postpone childbearing during periods of conflict until they are in a more secure place, having either arrived in a safe environment or returned to normal life in their home area (Agadjanian *et al*., 2008). For this reason, the thesis' framework, allows for examination of sexual behaviour, such as frequency of sexual intercourse, as well as contraceptive use.

Although this analysis begins to explain how conflict and fertility behaviour interact, it would be improved by using a time-varying conflict exposure variable. Using time-varying variables could potentially improve model fit, strengthen theoretical understanding of the influence of each type of conflict event on fertility behaviour and decision-making, and allow for the exploration of other fertility-related behavioural responses. Similar micro-level analysis of conflict events in the Chitwan Valley of Nepal used discrete time-event history models to assess time to major life events when conflict exposure was considered (Williams *et al*., 2012). Although an important next step in analysing the effect of individual-level exposure to conflict on reproductive decision-making, inclusion of these types of variables must be considered carefully before using.

Finally, while the ACLED data were useful for this analysis, this chapter highlights concerns about linking conflict-event data to household surveys like the DHS for this type of analysis if these surveys do not reach those most affected by conflict. Only 12% of the women surveyed for the DHS reported exposure to a battle in the last five years and despite many of the recorded battles taking place in rural areas, surveyed women living in urban areas were more likely to live in a cluster where a battle took place. This suggests that a large and important group of women

exposed to violent events are excluded from the sample used for this analysis. For these reasons, along with the decision to re-code nearly many of the recorded events, future researchers are encouraged to conduct thorough, detailed reviews of conflict event and household survey data before proceeding with analysis to ensure a full understanding of the limitations in use and interpretation.

Following a critical assessment of available conflict events data from Myanmar, this paper presents findings to suggest that exposure to conflict affects recent fertility in the country. However, the direction of the effect differs based on the type of exposure, with exposure to violent and de-stabilizing events associated with higher fertility and exposure to non-violent protests associated with lower fertility, when controlling for other demographic factors. By examining additional indirect measures of fertility, this chapter begins to demonstrate how earlier sexual debut and lower use of family planning may contribute to higher fertility in conflict affected areas. These findings could only be identified by using micro-level conflict event data linked with globally respected survey data like the DHS, demonstrating the importance of developing these new analytic approaches further. However, data reliability and survey sampling limitations during times of conflict must be considered before using these data and in the dissemination of findings.

Chapter 8 Discussion and Conclusions

8.1 Summary of key findings

The research outlined in this thesis had three primary aims: 1) to describe how fertility has changed in Myanmar across different geographic regions over the last thirty years, 2) to identify the social and demographic factors associated with identified changes, and 3) to explore how exposure to conflict may have influenced fertility changes within the country. Considering the late introduction of national family planning programming, understanding of the factors influencing fertility decline in Myanmar were initially unclear, but this research hypothesized that fertility change in Myanmar could be primarily attributed to social change, influenced by the protracted conflict experienced across much of the country. Through careful evaluation of census and survey data, this research achieved each of these objectives.

First, results from direct and indirect fertility estimates and assessments of census and survey data, presented in Chapters 3, show that the country experienced intercensal fertility decline at the national level. These findings were consistent with previous analyses of census and survey data from the country conducted during the 1983-2014 intercensal period (Spoorenberg, 2013; Myint, 1991; Tint, 1991). However, this analysis built on previous estimates demonstrating that Myanmar's changing fertility patterns were characterized by rapid decline in central, well-connected areas of the country with stagnated, possibly increasing, fertility along the country's rugged international borders. Additionally, this research corroborated findings suggested by Spoorenberg (2013) before the release of the 2014 census and 2015-16 DHS data that while population change in the country was likely fuelled by this rapid fertility decline, other factors including excess male mortality and substantial increases in emigration from Myanmar also contributed to population changes seen across the country.

Further analysis of the determinants of fertility at a district level (Chapter 4) found that, in addition to being geographically located along international borders, high fertility areas were more socially and physically remote and had lower female education rates. These findings suggest that at some level fertility limiting ideas and behaviours are spreading through social and mass media networks, in support of fertility diffusion theories applied in other settings across the globe (Lesthaeghe, 1983; Bongaarts and Watkins, 1996; Casterline, 2001). However, the exact

mechanisms through which these behaviours are spread is not identified, nor is the intentional nature of adopting these behaviours.

Chapter 5's decomposition of the proximate determinants of fertility over time found that, as expected, family planning has played an increasingly important role in Myanmar's fertility decline as it has become more available. However, the same analysis also helped sustain questions about changing marriage patterns. Jones' (2004) disaggregation of factors affecting total fertility decline between 1983 and 1991, although based on a likely underestimation of the 1991 TFR, suggested that 38% of the decline could be attributed to changes in nuptiality in the country. Jones notes the high percentage of women who never marry as the driving force behind this change. This population was further examined through Chapter 6's analysis of the factors associated with remaining unmarried at later age. This assessment found that women of higher education and professional standings were less likely to marry. This result aligns closely with findings from other parts of Asia, where increased female education rates and employment opportunities have been linked to fertility decline (Xenos and Gultiano, 1992; Jones, 2004; Choe and Retherford, 2009; Raymo *et al*, 2010).

Collectively, findings from the analysis of social change and fertility in Myanmar, presented in Chapters 3-6, suggest that economic development, such as improved road and telecommunications networks, as well as increased access to education and careers, especially for women, have substantially contributed to fertility decline in the country. However, this research also established the potential limitations of economic and social development on fuelling future decline by exploring how exposure to conflict affects these mechanisms. Chapter 7 therefore showed how armed conflict (such as battles) was more common in remote areas, and was associated with different sexual and reproductive health behaviours, including low contraceptive use, and higher recent fertility. Analysis found that this effect increased when women lived in areas experiencing forced service, suggesting that higher levels of insecurity, both psychological and physical, limit the diffusion of ideas or practices related to lower fertility.

Overall, these findings suggest that as Myanmar continues to develop economically and socially, the national level of fertility may continue to decline, but that these declines mask growing disparities in health and fertility between urban areas and rural, conflict-affected parts of the country, supporting the use of the theoretical framework presented in this thesis.

8.2 Theoretical implications

Prior to beginning analysis of fertility data in Myanmar, several theoretical frameworks and theories were considered. Ultimately, this research introduces a framework based on Davis and Blake's (1956) intermediate variables framework and Bongaarts and Potter's (1983) proximate determinants framework, modified to allow for greater discussion of the role of external factors such as conflict and isolation on the risk of exposure to several biological processes affecting fertility, namely sexual intercourse, conception, and successful delivery (Figure 8-1). The framework considers how a matrix of factors, such as changing social norms, economic growth, varying access to health and other social services, excess or improving morbidity and mortality, and displacement all influence one another to ultimately affect the intermediate variables that change a woman's sexual and reproductive health experience.

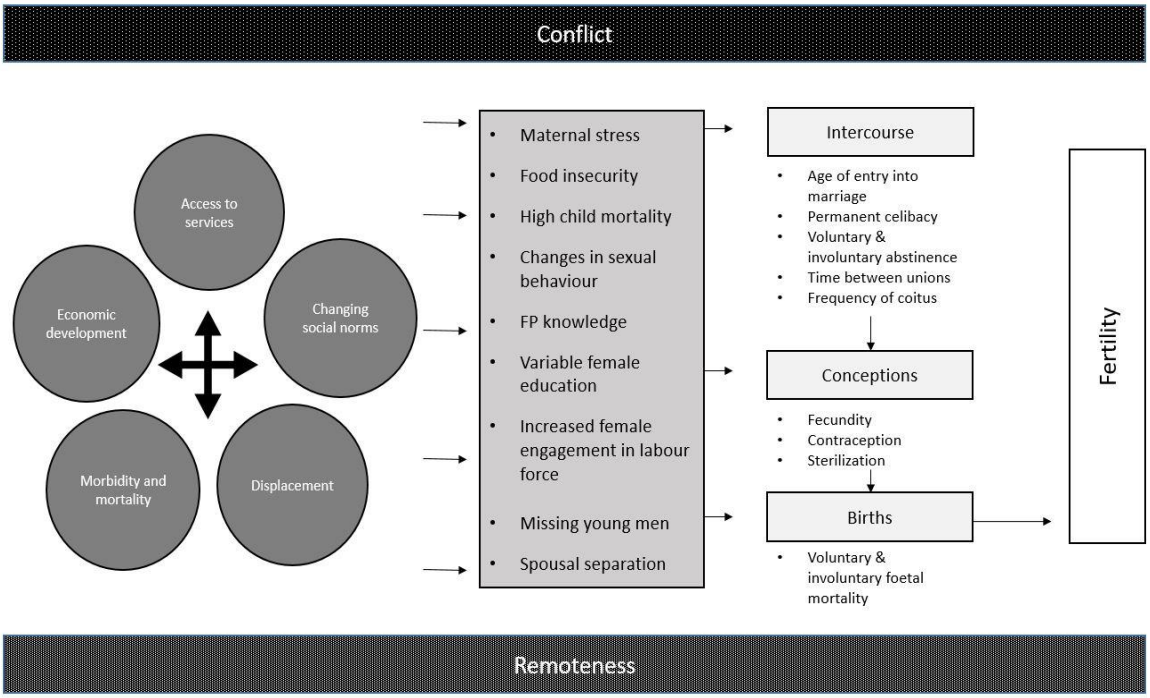


Figure 8-1. Theoretical framework

After empirical examination of Bongaart's proximate determinants of fertility (see Chapter 5), Davis and Blake's intermediate variables emerged as potentially preferable for explaining fertility and fertility change in Myanmar, although admittedly more difficult to measure. As Chapter 5 shows, using Bongaart's approach appears to emphasize the role of family planning on fertility decline. While increased access to and use of modern methods of family planning undoubtedly contributed to more recent decline, even adjusted estimates of fertility in the country show a

dramatic decline in fertility taking place prior to any public sector provision of contraceptives. Therefore, any emphasis on family planning may undervalue other changes influencing fertility in the country.

A more comprehensive explanation of fertility change in the country includes discussion of the many nuanced changes in marriage patterns. The proximate determinants framework includes only age-specific percentage of women who have ever been married to assess changes in age at first marriage. As Chapter 6 showed, there have certainly been changes in patterns of entry into marriage in Myanmar. This is also the case in other countries experiencing conflict, but these changes may not tell the whole story. For example, following the Rwandan Genocide, women were less likely to marry early if they lived in a DHS cluster where more sibling deaths were reported. This was attributed, in part, to the breakdown of kinship systems during the conflict that were traditionally used for matchmaking (Jayaraman *et al.*, 2009). In a review of existing literature on adolescent transitions during conflict, Neale *et al.* (2016) found evidence for both increased and decreased marriage rates among adolescent populations across the globe. As Chapter 7 demonstrates, women are more likely to marry earlier in areas of Myanmar experiencing conflict. As these areas are also rural and isolated by poor technological and transportation infrastructure, a further understanding of context is important before making assumptions about any causal relationships between conflict exposure and marriage. This is especially important considering the delays in entry into first marriage among more highly educated, professional women (see Chapter 6) who are less likely to be living in conflict affected areas.

While these changes are clearly important, this framework and thesis encourages further research to understand how age at marriage dissolution changes fertility during times of conflict. If many women were widowed at a young age in a population, as can happen during conflict, the potential fertility limiting effect of widowhood would not be considered under Bongaart's framework. Instead those women who are widowed would be assumed to have the same fertility potential as currently married women in the same population. However, as Kraehnert *et al*. (2019) demonstrate in their assessment of fertility following the Rwandan Genocide, decreases in adult sex-ratios resulting from violent conflict are linked to decreased fertility, especially for women in older cohorts. Although this is not directly attributed to increased widowhood, the authors note disruptions to the marriage market and spousal matching for older women following the genocide. This thesis does not explore widowhood in detail, but notes that Rakhine State, where

minority groups are especially marginalised, had the highest percentage of women whose marriages had dissolved. The *Thematic Report on Fertility and Nuptiality* notes that many women whose marriages have dissolved, especially widows, have children. However, the average number of living children for widows aged 40-45 was lower than for currently married women of the same age, suggesting a need to consider the contribution of widowhood to fertility dynamics in the country (Department of Population, 2016a).

In addition to considering more nuanced marriage trends, the expanded list of fertility measurements, coupled with the indirect determinants of conflict exposure and isolation, allows researchers to consider how things like increasing male emigration, conscription of men in armed forces, or economic or political stressors may affect coital frequency (Blanc, 2004). Migration in particular has been highlighted as a potential factor affecting fertility during times of national stress or conflict. For example, Williams and colleagues (2012) found that recent exposure to violent conflict significantly increased the chances that an individual would emigrate out of Nepal during the country's civil unrest in the late 1990s and 2000s. However, a similar relationship was not found among survey respondents in eastern Myanmar despite observation of dramatic increases in emigration over the past several decades (Parmar *et al.*, 2019). Although respondents did not directly cite conflict as a reason for moving in Parmar *et al.*'s study, or in the 2014 Census, reasons for moving out of conflict areas can be indirectly linked to conflict through the framework presented in this thesis. For example, in both surveys the most common reasons for leaving conflict-affected areas were to pursue higher education or better employment opportunities. As discussed throughout this thesis, fewer opportunities for education and employment are available in conflict-affected areas because of the interrelationships between lower development investment, greater social and technological isolation, and challenging terrain in these areas. Therefore, although emigration may not be directly conflict related, there is evidence to suggest that conflict indirectly influences an individual's migratory decision-making.

Marriage and migration both interrupt fertility by limiting exposure to the risk of pregnancy. It is important to also consider how conflict and isolation may affect fecundity. For example, it is possible that high levels of stress could lead to decreased fecundity. This stress could result from several sources beyond actual fear of violence (Lynch *et al*., 2014). Similarly, maternal malnourishment has been linked to increased rates of miscarriages and stillbirths following natural disasters (Frankenberg *et al.*, 2015; Lindstrom and Berhanu, 1999), but has yet to be studied as a component of fertility change during protracted conflict. The *Four Cuts* program

specifically aims to cut off access to food, funds, intelligence and recruits (Smith, 1991; Grundy-Warr and Yin, 2002), so living in a conflict area also means living in an area of lower socioeconomic development with limited access to goods and services. As a result, women living in these areas may be malnourished, may not be able to receive needed obstetric or gynaecological health services, or may have higher rates of drug use and infectious disease due to also living in areas producing opiates, all which may also lead to infertility (Urdal and Che, 2013).

For similar reasons, a focus on factors affecting both voluntary and involuntary foetal mortality is useful in the context of Myanmar and other areas experiencing civil unrest. Analysis of relationships between conflict exposure and pregnancy termination presented in this thesis found no clear relationship between the two in Myanmar, but was also unable to differentiate between induced and spontaneous terminations. The proximate determinants framework concentrates on voluntary abortion alone, but women living in conflict areas may experience involuntary foetal and neonatal deaths at a higher rate than the general population. For example, one study in Colombia found a significant relationship between exposure to landmines at the municipality level and birth outcomes, estimating that the absence of landmine explosions could indirectly prevent 360 neonatal deaths per year (Camacho, 2008). Another analysis of operating theatre records found a significant increase in reported miscarriages during a period of armed conflict in Banghazi, Libya (Bodalal and Agnaeber, 2012). Pregnancy conditions leading to these outcomes may have been treatable or avoidable if not for the reduced access to prenatal care found in areas of conflict (Price and Bohara, 2013).

Child mortality rates may also rise during periods of conflict. While increased foetal mortality during conflict likely links to decreased fertility, increases in child mortality are often associated with increased fertility. Child deaths may occur due to malnutrition or increased prevalence or severity of infectious disease caused by the limiting of access to key health resources in conflict affected areas (Wagner *et al.*, 2018). An increase in child mortality was noted in Matlab, Bangladesh during the Bangladeshi Civil War. Although not tested empirically, researchers posited that infant deaths in particular may alter fertility rates by interrupting lactation, leading to an increase in the number of women at risk for conception (Curlin *et al*., 1976). In Rwanda, the death of a child was positively associated with increased short-term fertility, suggesting child mortality may also be linked to a parental desire to replace lost children (Kraehnert *et al*., 2019).

Collectively, this discussion demonstrates the need to consider a larger set of fertility determinants in Myanmar. Furthermore, it shows that interpretation of findings should include a

consideration of the indirect effects of conflict and isolation on any identified changes. The refined framework also expands theory that concentrates more on the mechanisms of fertility decline to also consider how those mechanisms evolve over space and time. Many past analyses of the effect of conflict on fertility have focused on establishing a relationship rather than a framework for understanding these relationships (Curlin *et al.,* 1976). As a result, no clear patterns or relationships have been established (Hill, 2004). By exploring how fertility limiting behaviour may diffuse between individuals across geographic areas, and how those geographic areas are affected by conflict or other structural barriers to social and economic development, researchers can more purposefully consider how conflict and fertility relate. In the case of Myanmar, it is likely that fertility is affected on an individual level both by direct effects of violence on biological processes and indirectly through the structural and administrative barriers put in place to limit access to health, education, food and other key services that may affect a couple's ability to plan and bring to term pregnancies.

8.3 Policy and programme implications

The 2014 Census arose from recommendations from the United Nations Population Fund and the international health and development community following the election of the first civilian government in decades. The political shift to an at least nominally civilian government opened Myanmar to the international community and garnered interest for an improved understanding of population dynamics in the country. However, while the international community welcomed the ability to more accurately estimate the humanitarian and economic needs of the country, concerns were raised over the potential for the government to use the data to identify and further discriminate against ethnic minorities.

The analysis in this thesis hopefully addresses some of these concerns by highlighting the importance of female education and workforce engagement, and of strengthened physical and telecommunication infrastructure to promoting fertility decline and other positive health and social outcomes. A 2013 analysis of demographic change, socioeconomics and health resources on life expectancy in Cambodia, Laos and Myanmar found that increases in education levels in the population and access to improved health services improved life expectancy (Chan and Taylor, 2013). Coupled with the findings from this thesis, government investment in social and economic development projects, particularly in peripheral, border areas, would be an appropriate response

to any desire to stabilise fertility, along with potentially also improving the country's poor mortality rates.

Additional expansion of the existing government-supported family planning program to peripheral areas would also benefit women and couples seeking to limit their fertility and likely improve the health outcomes and women and children in Myanmar. As Chapter 5 demonstrates, increased contraceptive use has helped support continued fertility decline since the introduction of the government program in 1991. However, in 2015-16 the unmet need for family planning in peripheral states was nearly twice as high as the unmet need in central regions. Evidence from Chin suggests that non-government organizations (NGO) are currently filling gaps in government-supported family planning provision in the state: almost 20% of family planning users reported obtaining their last method from an NGO clinic. Population Services International is one of the main organizations providing family planning services, and has noted great improvements in uptake by integrating family planning into the private health sector and promoting family planning use through social franchising (Aung *et al.*, 2017). These approaches, particularly the strengthening of existing private sector providers to offer family planning, may also contribute to improved access to contraceptives across the country. An expansion of family planning and reproductive health service delivery through both the existing public and private health systems would be ideal.

As noted in Chapter 1, Myanmar has recently taken steps to decentralise many of the social and health programs listed above. If successfully rolled-out, the decentralisation has the potential to give local governments more authority to allocate funds towards the social and health programs described above. However, the intensifying violence in Rakhine and continued reports of violent events in other peripheral areas of the country suggest that available funds for health services may continue to be allocated to the delivery of acute and emergency services, and that the national government may not yet be ready to invest in rural areas.

8.4 Challenges and limitations

Chapter 2 outlined several challenges with the data used for the analysis presented in this thesis. For example, some parts of the country were excluded from data collection in both censuses due to security concerns. These concerns were also used to justify the modification of the 1983 Census sampling frame for intercensal population surveys into one that may have been less

representative of the country as a whole. These sampling issues, as well as restricted access to individual data from the intercensal population surveys, meant that more accurate intercensal estimates of total fertility rates were not available for this thesis. Instead, Chapter 3 presents newly estimated TFRs from 1983 and 2014 that were adjusted using IUSSP tools with a newly developed standard fertility schedule in place of the Booth Standard. Chapter 3 additionally includes estimates of intercensal fertility from a population projection that considered changes in mortality and migration over the past several decades. While these adjustments more accurately represent changing fertility in the country, limitations still exist.

Additionally, this thesis originally intended to include an empirical analysis of the changes in demographic and social characteristics of districts in 1983 and 2014 to further explain the associations between these changes and fertility decline. However, the same types of sub-regional data were not available from the 1983 and 2014 Censuses. For 1983 this thesis uses the implied TFR (iTFR) at the district and township levels. For 2014, it uses TFRs calculated using a piecewise linear model for the 2014 Census' *Thematic Report on Fertility and Nuptiality* (Department of Population, 2016a). While detailed information about social and housing conditions were available from 2014, examination of 1983 data found fewer options for district level analysis. For these reasons, this thesis only looks at associations between district-level fertility and social and demographic characteristics related to social and physical remoteness in 2014.

The limitations of the 1983 data, and the absence of any national reproductive health surveys prior to the 1990s, also made analysis of the proximate determinants of fertility difficult prior to 1991. This is particularly unfortunate considering the onset of Myanmar's fertility transition began as early as the late 1960s. As a result, analysis of more traditional aspects of fertility change suggest a strong influence of changing contraceptive prevalence in the country. While this undoubtedly contributed to more recent decline, it is unlikely to be the reason for the initial decline. Evidence from the literature suggests that changing marriage patterns may have played a role in earlier transition, and factors associated with delayed marriage are explored in Chapter 6, but these changes and others which may have led to early fertility decline could not be investigated in detail with the currently available data.

Finally, the last analytic chapter in this thesis presents methods for linking geospatial conflict-event and fertility data collected from household surveys. As Chapter 7 notes, the conflict-event

data are inherently biased by the humans who report, identify and categorize the events. Using the ACLED data instead of the UCDP data allowed greater flexibility and facilitated accuracy checks on reported events, but any subsequent revisions are still subjective based on the biases of individual researchers. Furthermore, because household surveys, and at least in Myanmar's case census enumeration, often excludes areas experiencing acute or particularly intense conflict, the analysis presented in Chapter 7 likely underestimates the effect of conflict exposure on fertility-related behaviour. Some options for overcoming this limitation are outlined in the next section, but could not be avoided in Myanmar's case.

8.5 Implications for future research

The research presented in this thesis provides a theoretical base for expanding our understanding of fertility change in fragile states. However, additional work is clearly required. While a relationship between conflict exposure and several key variables measuring exposure to sexual intercourse, conception and birth is established on a broad level, a more detailed analysis, considering temporal exposure would strengthen these links. As has been done in Nepal, approaches could include the use of time-varying conflict exposure variables to examine whether exposure to conflict over a prolonged period differentially affects time to marriage, time from marriage to first birth or other measures of parity progression (Williams et al., 2012). In other settings, where sexual intercourse is more likely to occur outside of marriage, similar analysis would be useful to explore time to first intercourse.

Survival analysis with time-varying conflict exposure variables may be particularly useful to expanding understanding on how conflict affects marriage patterns. This thesis does not attempt to disentangle this complex relationship. However, marriage is clearly an important determinant of fertility in Myanmar, and likely in other conflict affected settings (Lindstrom and Berhanu, 1999; Blanc, 2004). As this thesis established, marriage patterns have changed in Myanmar in line with improvements in education and female workforce engagement, requiring a more detailed examination of how these changes interact with conflict exposure, again on both an individual and a systemic level.

There is also merit in expanding the spatial methods used in this thesis to other surveys or census microdata. For example, census microdata from Colombia, which has experienced similar, prolonged internal armed conflict, are available down to the municipality level for five censuses

conducted over a course of forty years from IPUMS-International (Minnesota Population Center, 2018), while geolocated conflict event data are available for Colombia from the Uppsala Conflict Data Program from 1989 to 2018 (Sundberg and Melander, 2013). ACLED data for many African countries extends as far back as the late 1990s and could potentially be linked to DHS data, while ACLED has also recently begun expanding its database to include conflict event data from Europe and the Middle East (Raleigh *et al*, 2010). It is likely that other data sources will also continue to evolve to allow for geospatial analysis. As long as the precautions outlined in this thesis are taken, these data sources and methods offer many opportunities for improved understanding of the effects of conflict on numerous health and social conditions.

Finally, researchers may be interested in exploring spatial diffusion of conflict alongside fertility decline. The methods used in previous analyses of social and economic factors leading to changes in the geographic distribution of high or low fertility (Rosero-Bixby and Casterline, 1993; Kluesener *et al*., 2016) could be expanded to include conflict exposure variables. This type of analysis may help to empirically demonstrate how conflict serves as a barrier to the spread of fertility limiting ideas and behaviours, or to the resources needed to achieve a couple's preferred fertility.

8.6 Conclusions

The key conclusions of this study are summarised below:

1. Myanmar has experienced fertility decline over the past thirty years, much of which occurred before the introduction of government-supported family planning programming.
2. Fertility decline has been faster and more complete in the central part of the country. This is associated with higher social and physical remoteness of peripheral areas, and may also be associated with conflict.
3. Areas with greater fertility decline also show evidence of economic and social changes affecting fertility, such as increased female education rates and labour force engagement and an unusual marriage pattern that has resulted in a relatively high proportion of women remaining permanently celibate.
4. Further fertility decline may be delayed by barriers to the spread of these changes, including the persistent armed conflict and anti-minority policies in effect in peripheral areas.

These conclusions contribute to a deeper understanding of how classic demographic theory can be understood in the context of a country experiencing rapid socioeconomic development in the midst of protracted armed conflict. While common social changes, such as improved female education and acceptance of family planning, are shown to clearly contribute to fertility decline in the country, the evidence also suggests a serious risk of already marginalized populations being left behind as the rest of the country prospers due to the physical and social barriers caused by conflict. Improved understanding of how conflict exposure affects social change and the diffusion of fertility limiting behaviour on both the individual and systemic levels is needed to improve the situation for millions of people across Myanmar and in similar fragile states. The theoretical framework and methods presented in this thesis provide recommendations for how to achieve this improved understanding and move towards peace and equitable development.

Appendix A Geographic Regions for Analysis

1983 Census	1991 PCFS	1997 FRHS	2000 MICS	2001 FRHS	2009-2010 MICS	2014 Census	ACLED	Uppsala
Union	Union	Union	Union	Union	Union	Union	Myanmar	Myanmar
Urban	Urban	Urban	Urban	Urban	Urban	Urban	No	No
Rural	Rural	Rural	Rural	Rural	Rural	Rural	No	No
Kachin	Kachin/ Kayah/ Shan	Kachin/ Kayah/ Shan	Kachin	Kachin/ Kayah/ Shan	Kachin	Kachin	Kachin	Kachin
Kayah			Kayah		Kayah	Kayah	Kayah	Karenni
Shan			Shan (North)/ Shan (East)/ Shan (South)		Shan (North)/ Shan (East)/ Shan (South)	Shan	Shan	Shan
Mon	Kayin/ Mon/ Tanintharyi	Kayin/ Mon/ Tanintharyi	Mon	Kayin/ Mon/ Tanintharyi	Mon	Mon	Mon	Mon
Tenasserim			Tanintharyi		Tanintharyi	Tanintharyi	Tanintharyi	None Recorded
Karen			Kayin		Kayin	Kayin	Kayin	Karen
Chin	Chin/ Sagaing	Chin/ Sagaing	Chin	Chin/ Sagaing	Chin	Chin	Chin	None Recorded
Sagaing			Sagaing		Sagaing	Sagaing	Sagaing	None Recorded
Pegu	Bago	Bago	Bago	Bago	Bago (East)/ Bago (West)	Bago	Bago	None Recorded
Magwe	Magway	Magway	Magway	Magway	Magwe	Magway	Magway	None Recorded
Mandalay	Mandalay	Mandalay	Mandalay	Mandalay	Mandalay	Mandalay/ Naypitaw	Mandalay/ Naypitaw	Mandalay/ Naypitaw
Rakhine	Rakhine	Rakhine	Rakhine	Rakhine	Rakhine	Rakhine	Rakhine	Arakan
Rangoon	Yangon	Yangon	Yangon	Yangon	Yangon	Yangon	Yangon	None Recorded
Irrawady	Ayeyarwady	Ayeyarwady	Ayeyarwady	Ayeyarwady	Ayeyarwady	Ayeyarwady	Ayeyarwady	None Recorded

Appendix B Methods used to estimate fertility, by administrative level and year

Level(s)	Year(s)	Method	Application	References
National State	1983 2014	Parity/Fertility Ratio	Age-specific parity/fertility (P/F) ratios were calculated for 1983 and 2014 in Excel© according to the methods outlined in the United Nations' *Manual X*. Parity for each age group (*i*) was calculated by the formula below: $P(i) = \frac{Number\ of\ children\ ever\ born\ (i)}{Number\ of\ women\ (i)}$ Next, the cumulated fertility schedule for each year was calculated as below, where *f* equals the age-specific fertility rate for each age group. $\phi(i) = 5\,[\sum_{j=0}^{i} f(i)]$ *F* was then calculated for each age group, *i* (1 through 7) as follows: $F(i) = \phi(i-1) + a(i)f(i) + b(i)f(i) + c(i)\phi(7)$ where *a, b*, and *c* are constant values used for calculating P/F ratios when using data linked to the woman's age at the time of the survey, as outlined in Table 7 of *Manual X*.	United Nations, 1983 Moultrie *et al.*, 2013

			P/F ratios calculated through these methods were used to assess data quality and to assess fertility around the time of each census. P/F ratios used for adjusting total fertility rates were calculated using the spreadsheet provided by the International Union for the Scientific Study of Population's (IUSSP) *Tools for Demographic Estimation*, the use of which is explained in greater detail in Chapter 3 and below.	
National State	1983 2014	Relational Gompertz Model	All TFR adjustments using the relational Gompertz model were made using the spreadsheet made available through the IUSSP's *Tools for Demographic Estimation.* The worksheet allows users to set the type of question used to determine maternal age (for example, age at survey or age at reported birth) and to change the type of model variant fit through the workshop (shape only or shape and level). Once these selections are made, users enter observed age-specific parities and age-specific fertility rates from the data they wish to assess and/or adjust. The spreadsheet then calculates a series of age-specific F-Points and P-Points, leading to fitted fertility curve that ultimately estimates corrected age-specific fertility rates, parities and P/F ratios. The model's Alpha, Beta, average T	Moultrie *et al.*, 2013

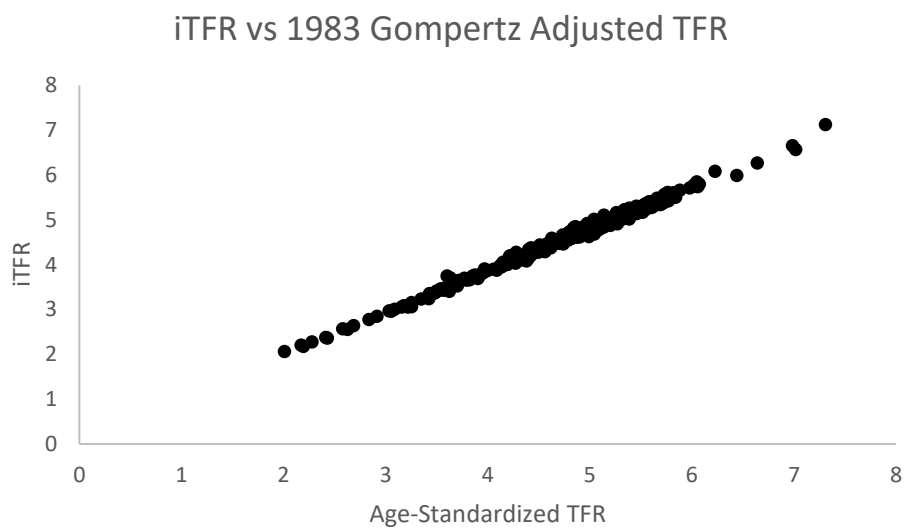
			statistics, along with its root mean square error are also calculated and available to the user to assess model fit. Diagnostic plots are also automatically populated to improve interpretation. The spreadsheet uses Gompits (Ys(X)) and cumulated period fertility (Fs(X)) estimates from Booth's standard. However, as explained in Chapter 3, assessment of diagnostic plots and statistics suggested that the Booth Standard was inappropriate for use in Myanmar. For this reason, Ys(X)s and Fs(X)s for each single-year of age were calculated using a new, Myanmar-specific, standard fertility schedule. Details on standard development are included in Section 3.2.2 of this thesis, and resulting Ys(X) and Fs(X) estimates are included in Appendix C.	
National	1998 2003 2008	Population Projection	A single Excel© spreadsheet was used to project the 1983 census enumerated population forward to 2014 using the United Nations general model life tables. Initial projections used life tables based on male and female life expectancies and total fertility rates reported in the closest national population survey, and assumed no migration. Because these projections resulted in age patterns not matching the 2014 census enumerated population, steps were taken to adjust migration and total fertility rates for each five year projection period.	Department of Population, 2016c

	2013		Adjustments for migration were made using data from the 2014 Census, which asked when former household members left Myanmar and emigrated abroad. The *Thematic Report on Migration and Urbanization* includes international migration estimates for four year time periods between 2000 and 2014 and a general estimate for the period before 2000. The age-sex structure for all emigrants was applied to the above emigration estimates. The following annual emigration estimates were used for projections: - Projection of 1983 population to 1988 – 20% of estimated emigrants prior to 2000 - Projection of 1988 population to 1993 – 30% of estimated emigrants prior to 2000 - Projection of 1993 population to 1998 – 50% of estimated emigrants prior to 2000 - Projection of 1998 population to 2003 – 2000-2004 emigration estimates - Projection of 2003 population to 2008 – 2005-2009 emigration estimates - Projection of 2008 population to 2013 – 2010-2014 emigration estimates TFR estimates were initially based on those reported in the censuses and population surveys between 1983 and 2014. However, due to concerns about data quality and inconsistencies in population projections and census enumeration when using these data, a variety of adjustments were made to the	

			TFR estimates used for population projections. The following methods were used to roughly adjust the TFRs used for population projections: - Projection of 1983 population to 1988 – Gompertz adjusted age-specific fertility rates for 1983 (see above) - Projection of 1988 population to 1993 – The spreadsheet used to compute the 1983 and 2014 Gompertz-adjusted ASFRs, including the Myanmar-specific standard, was used to adjust the ASFRs reported in the 1991 PCFS. As PCFS data quality could not be assessed as thoroughly as census data to confirm the use of this approach, a simple average of the Gompertz-adjusted ASFRs and the reported ASFRs was used to estimate fertility for this period. - Projection of 1993 population to 1998 – Estimates of the number of births and woman-years of exposure for 1997-2000 were used to estimate the age-specific fertility rates for ages 15-19, 20-24, 25-29 and 30-34. The ASFRs reported in the 1997 FRHS were used for age groups 35-39, 40-44 and 45-49. Estimates of births and exposure were based on the birth history data available from the 2015-16 DHS. - Projection of 1998 population to 2003 – Estimates of the number of births and woman-years of exposure for 2001-2004 were used to estimate the age-specific fertility rates for ages 15-19, 20-24, 25-29, 30-34 and 35-39. The ASFRs reported in the 2001 FRHS were used for age groups 40-44 and 45-49. Estimates of births and exposure were based on the birth history data available from the 2015-16 DHS. - Projection of 2003 population to 2008 – Estimates of the number of births and woman-years of exposure for 2005-2009 were used to estimate the age-specific fertility rates for ages 15-19, 20-24, 25-29, 30-34, 35-39 and 40-44. The ASFRs reported in the 2007 FRHS were used for age groups 45-49. Estimates of births and exposure were based on the birth history data available from the 2015-16 DHS. - Projection of 2008 population to 2013 – Gompertz adjusted age-specific fertility rate for 2014 (see above)	

			Applying the migration and fertility adjustments outlined above to the population projections improved the fit of the projected and enumerated populations. The improvements can be seen through examination of Figures 3-3 and 3-4 in Chapter 3.	
District Township	2014	None	District and township level estimates for 2014 were not calculated separately for this thesis due to insufficient data. The thesis instead uses those presented in the *Thematic Report on Fertility and Nuptiality*. District level estimates for 1983 are not included in this thesis.	Department of Population, 2016a
Township	1983	iTFR	The iTFR was calculated in Excel© for each township in 1983 using population data reported in the Census. The iTFR uses data on the population aged under five years to estimate the annual number of births in a particular area, and divides this by the population of women in the fertile age range to estimate the mean age-specific fertility rate across the fertile ages. iTFR is calculated as follows: $iTFR = n * \left[\frac{(5P0)}{nWx}\right]$ where n is the age period for women in the sample (in this case 35 years), ${}_5P_0$ is the population aged 0 to 4 and ${}_nW_x$ is the total number of women aged x to x+n.	Hauer *et al.*, 2013

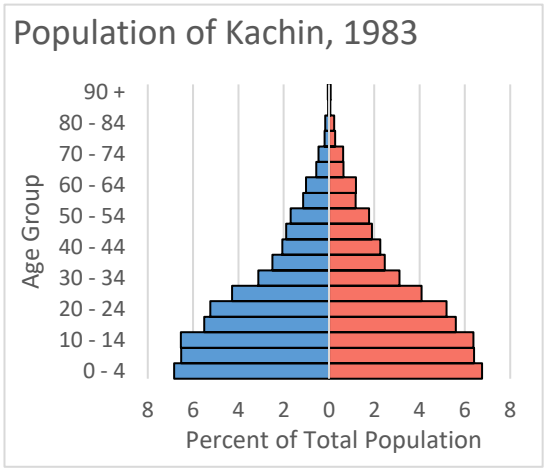
			For the purposes of this thesis, the iTFR was multiplied by 1.2 in order to account for the 1983 under-five mortality rate.	
Township	1983	Indirect Estimation	The following methods were used to confirm that variation in the female age structure of individual townships was not great enough to suggest that iTFR estimates were inaccurate. Using Excel©, the number of expected births in the last year for each five-year age group for women aged 15 to 49 years was estimated by multiplying the 1983 national level ASFR for each age group by the number of women counted in that age group for each township in the 1983 Census. It was assumed that women surveyed in 1983 would have spent half of the last five years in the next youngest age group. Therefore, for each age group over 15-19, ASFRs for the current and previous age groups were used. For example, the following equation was used to calculate the expected number of births to women aged 20-24 at the time of the Census: $Births_{20\text{-}24} = \frac{Women_{20-24} * ASFR_{15-19}}{2} + \frac{Women_{20-24} * ASFR_{20-24}}{2}$ Next, age-group estimates were summed and divided by the national under-five mortality rate of 1.2 to calculate a total number of expected births for that township. The number of observed births was then divided by the number of	Township

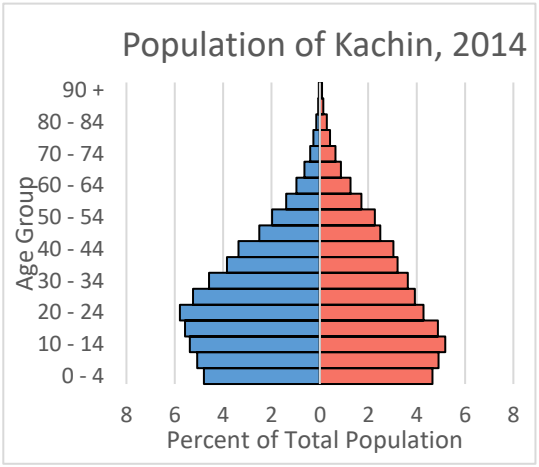
			expected births to calculate an adjustment factor. Finally, the national Gompertz-adjusted national TFR was multiplied by the township adjustment factor to estimate an age-standardized TFR for the township. The iTFRs and age-standardized TFRs for each township from 1983 are plotted in the figure below.  As the figure demonstrates, the two estimates are similar. A linear trendline developed using Excel© had an estimated R^2 of 0.9927. It was therefore concluded that including more detailed information about the age structure of individual townships in iTFR calculations would not have substantially improved the estimates. iTFR could therefore be used in Chapters 3 and 4.	

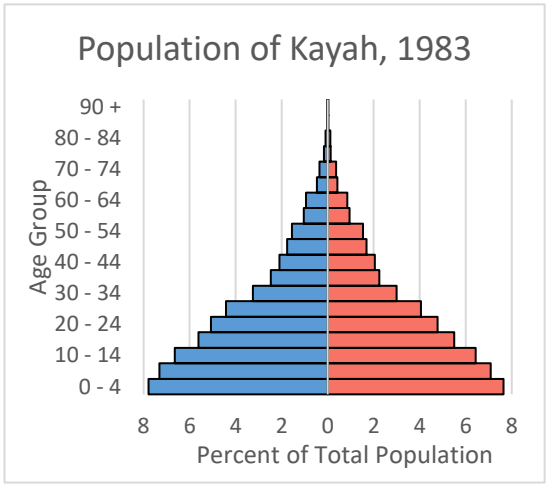
Appendix C Myanmar Specific Standard

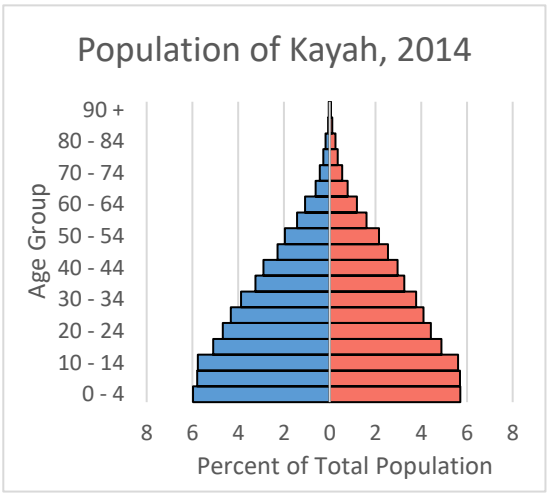
Age	ASFR	Fs(X)	Ys(X)	Age	ASFR	Fs(X)	Ys(X)
12	-0.044	0.001	-2.027	34	0.113	0.667	0.903
13	-0.036	0.001	-2.027	34.5	0.109	0.688	0.983
13.5	-0.029	0.001	-2.027	35	0.106	0.708	1.063
14	-0.022	0.001	-2.027	35.5	0.102	0.727	1.145
14.5	-0.014	0.001	-2.027	36	0.097	0.746	1.228
15	-0.007	0.001	-2.027	36.5	0.093	0.764	1.312
15.5	0.000	0.001	-2.027	37	0.089	0.781	1.397
16	0.008	0.001	-2.027	37.5	0.084	0.797	1.484
16.5	0.015	0.001	-2.027	38	0.080	0.812	1.571
17	0.022	0.001	-2.027	38.5	0.075	0.827	1.659
17.5	0.029	0.001	-2.027	39	0.070	0.840	1.748
18	0.037	0.001	-2.027	39.5	0.066	0.853	1.837
18.5	0.044	0.001	-2.027	40	0.061	0.864	1.926
19	0.051	0.010	-1.520	40.5	0.056	0.875	2.015
19.5	0.059	0.022	-1.345	41	0.052	0.885	2.104
20	0.066	0.034	-1.217	41.5	0.047	0.894	2.192
20.5	0.072	0.048	-1.111	42	0.043	0.903	2.278
21	0.079	0.063	-1.016	42.5	0.039	0.910	2.361
21.5	0.086	0.080	-0.928	43	0.035	0.917	2.442
22	0.092	0.097	-0.846	43.5	0.031	0.923	2.519
22.5	0.098	0.116	-0.767	44	0.027	0.928	2.592
23	0.103	0.136	-0.691	44.5	0.024	0.932	2.660
23.5	0.109	0.157	-0.617	45	0.021	0.936	2.723
24	0.114	0.178	-0.544	45.5	0.018	0.940	2.779
24.5	0.118	0.201	-0.473	46	0.015	0.943	2.830
25	0.122	0.224	-0.402	46.5	0.013	0.945	2.874
25.5	0.125	0.248	-0.331	47	0.010	0.947	2.912
26	0.128	0.273	-0.261	47.5	0.009	0.949	2.945
26.5	0.131	0.298	-0.191	48	0.007	0.950	2.974
27	0.132	0.323	-0.121	48.5	0.006	0.951	3.000
27.5	0.134	0.349	-0.051	49	0.006	0.953	3.023
28	0.134	0.375	0.019	49.5	0.006	0.954	3.047
28.5	0.135	0.401	0.089	50	0.006	0.955	3.073
29	0.135	0.426	0.160	50.5	0.007	0.956	3.103
29.5	0.134	0.452	0.231	51	0.008	0.958	3.139
30	0.133	0.478	0.302	51.5	0.010	0.959	3.185
30.5	0.132	0.503	0.374	52	0.012	0.962	3.246
31	0.130	0.528	0.447	52.5	0.015	0.965	3.325
31.5	0.128	0.552	0.521	53	0.018	0.968	3.433
32	0.126	0.576	0.596	53.5	0.023	0.973	3.581
32.5	0.123	0.600	0.671	54	0.027	0.978	3.794
33	0.120	0.623	0.747	54.5	0.033	0.984	4.125
33.5	0.117	0.645	0.825	55	0.038	0.991	4.745

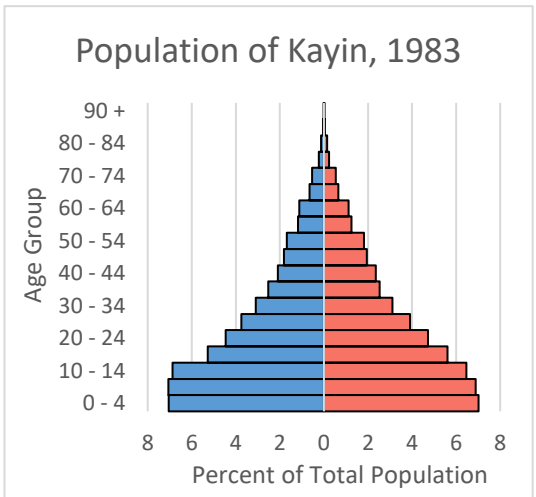
Appendix D Population Pyramids for Individual States/Regions, 1983 and 2014

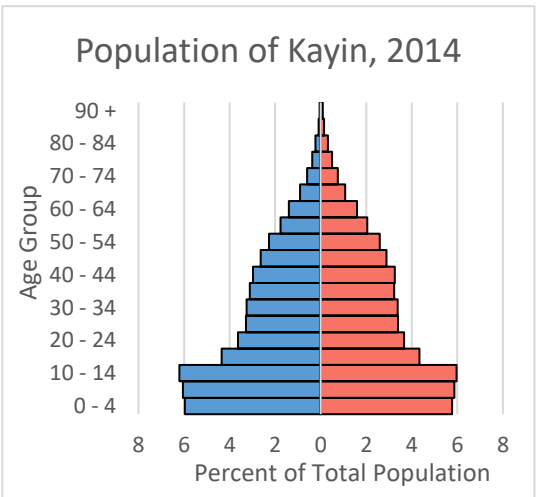


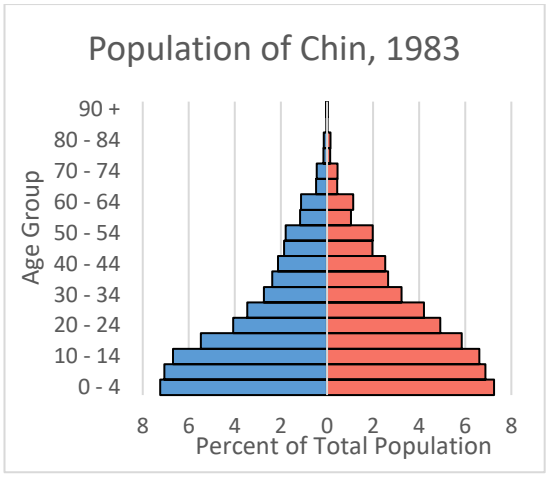


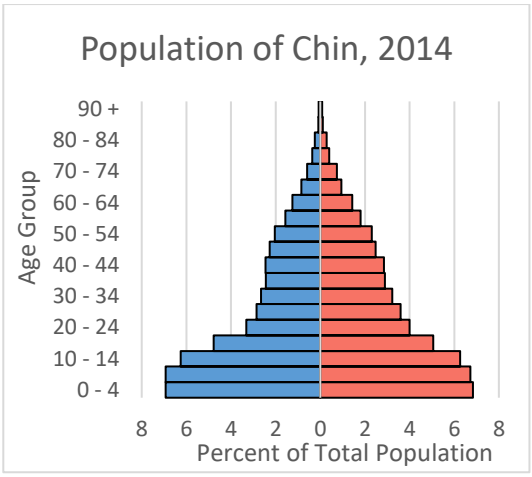


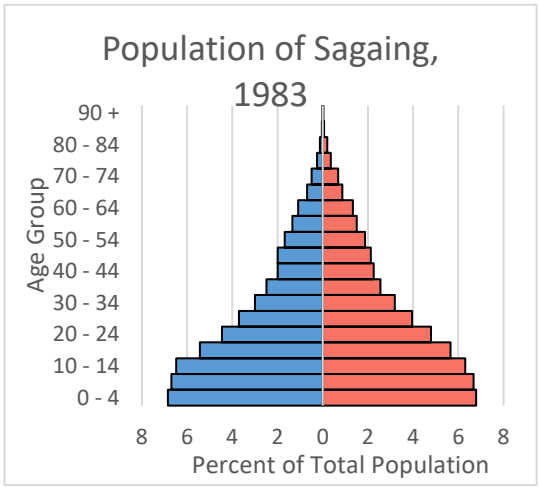


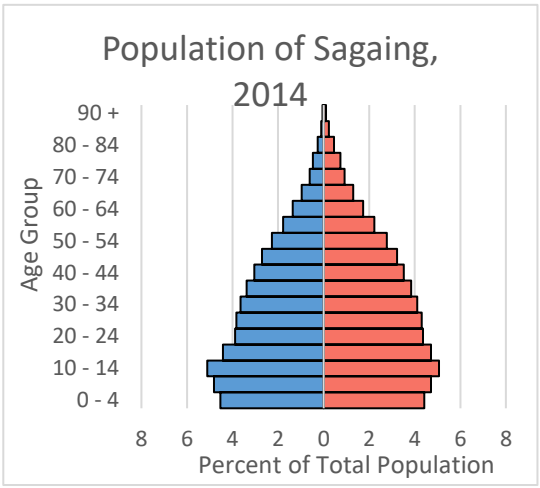


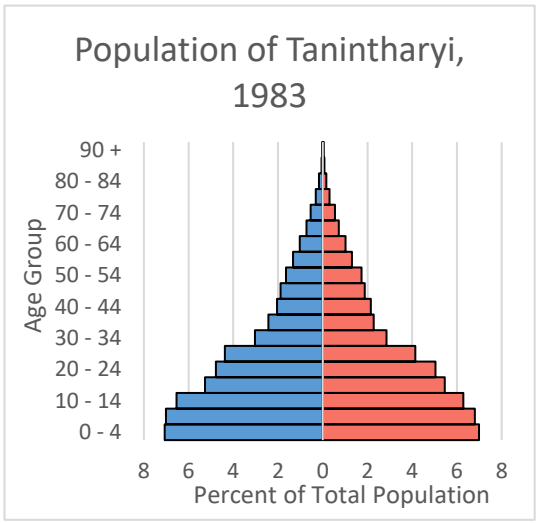


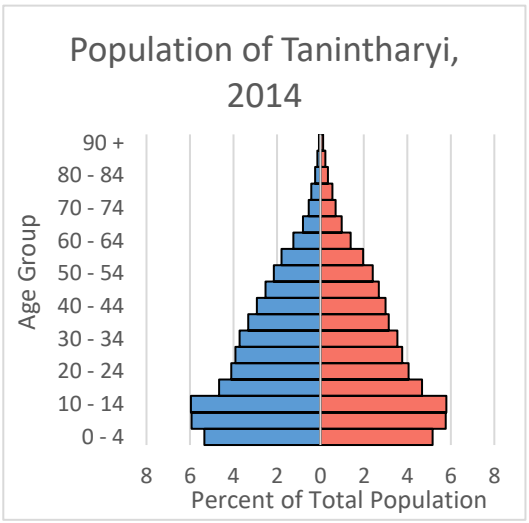

Population of Chin, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

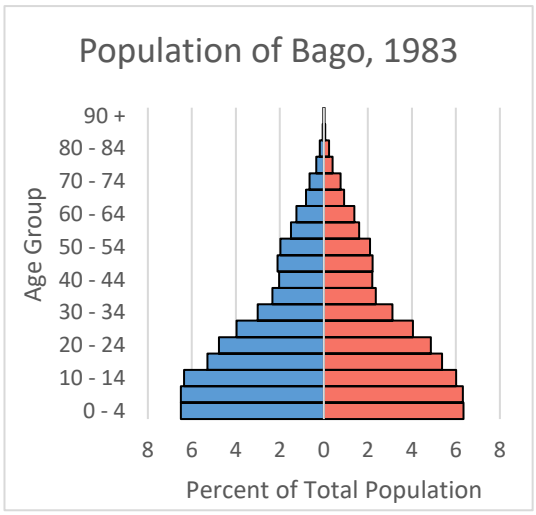

Population of Chin, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

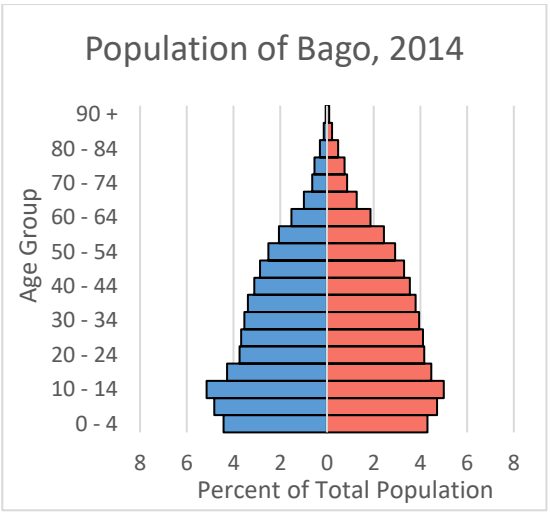

Population of Sagaing, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

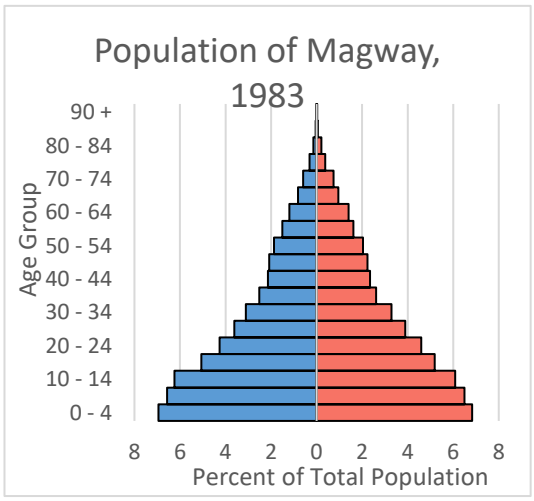

Population of Sagaing, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

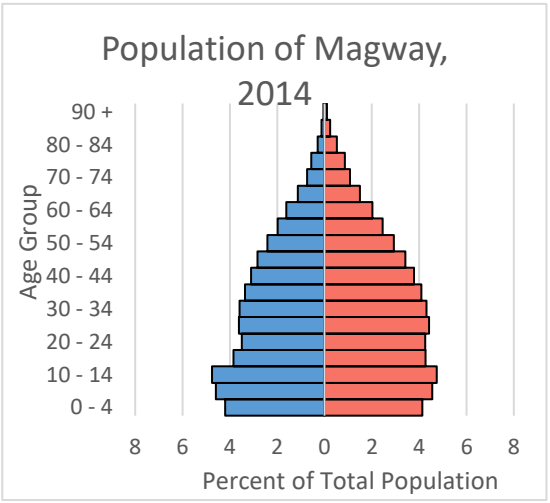

Population of Tanintharyi, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

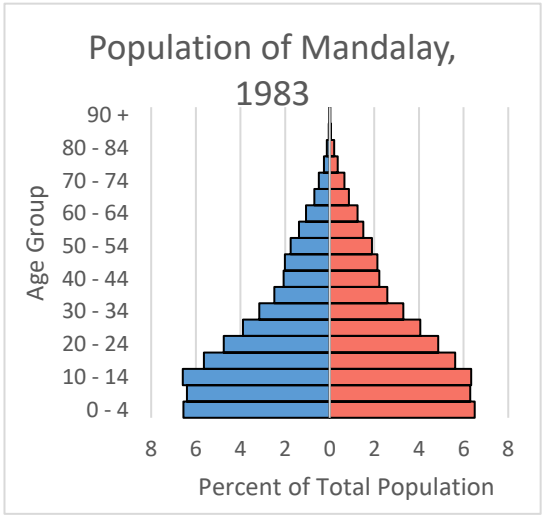

Population of Tanintharyi, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

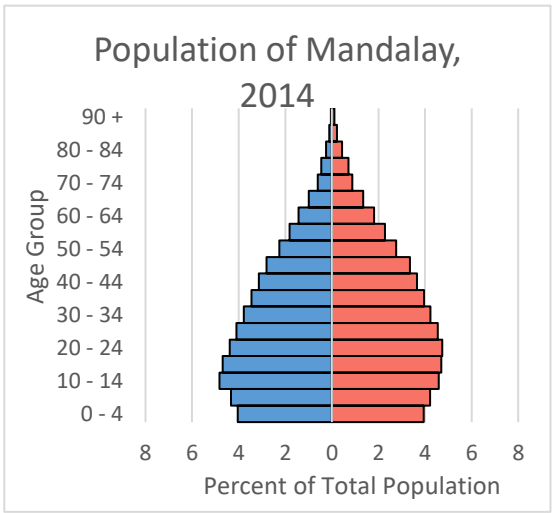

Population of Bago, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

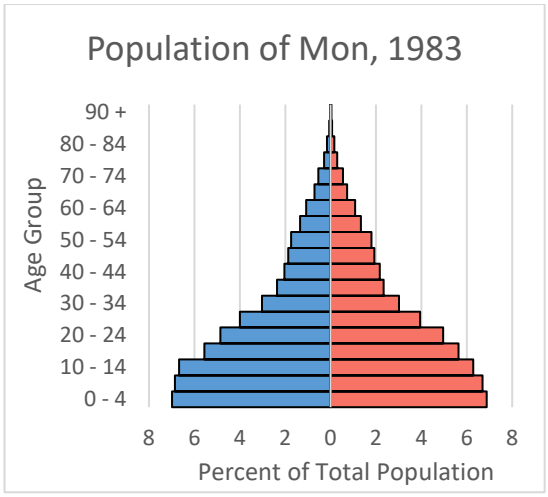

Population of Bago, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

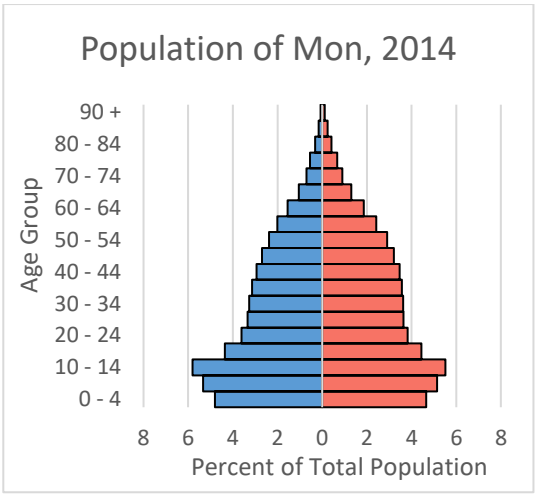

Population of Magway, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

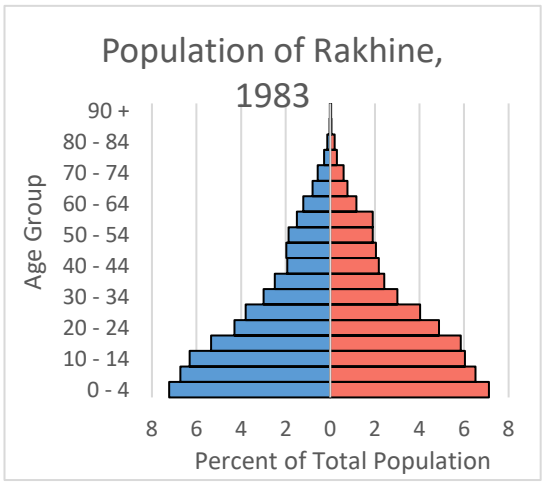

Population of Magway, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

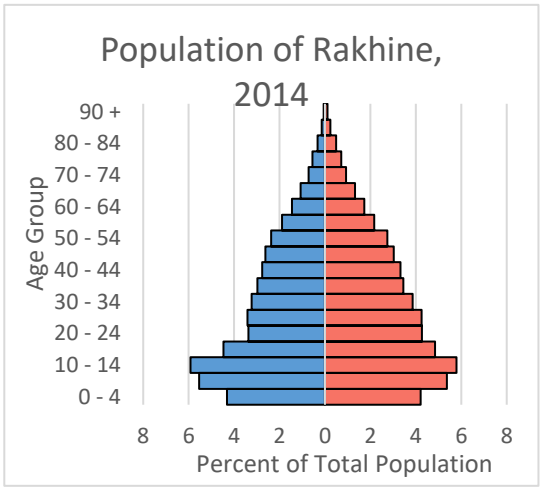

Population of Mandalay, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

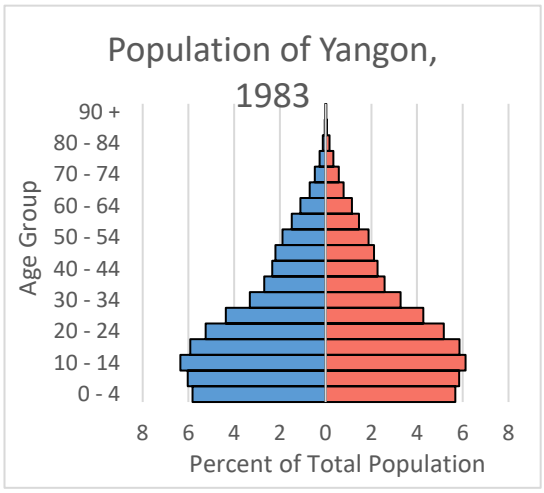

Population of Mandalay, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

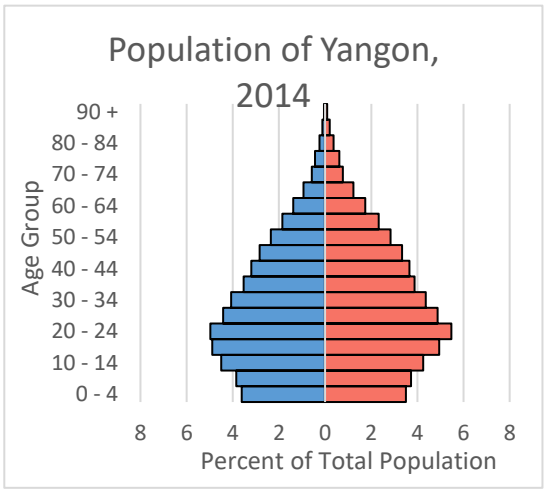

Population of Mon, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

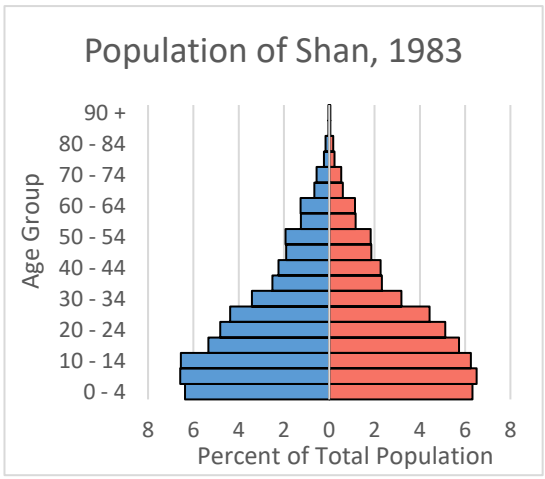

Population of Mon, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

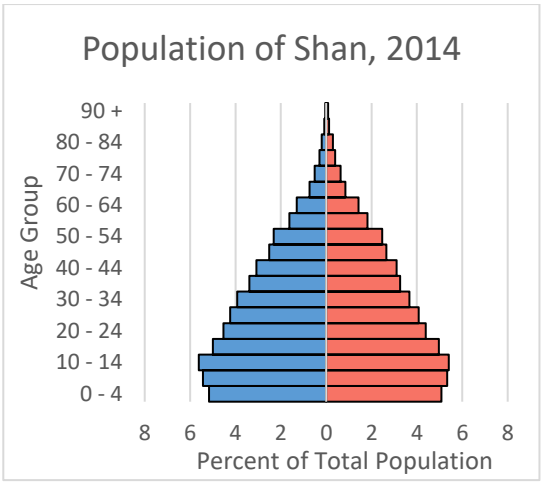

Population of Rakhine, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

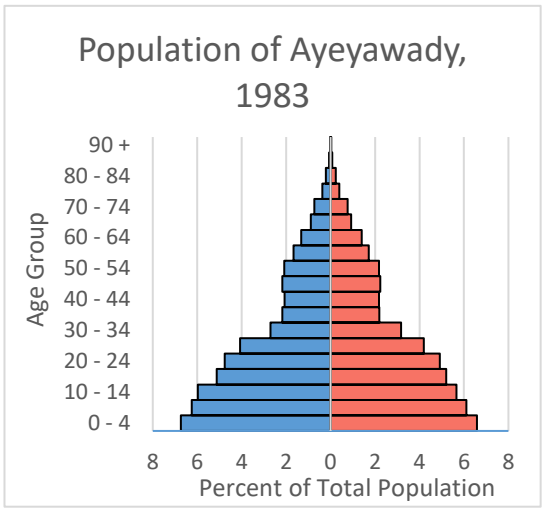

Population of Rakhine, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

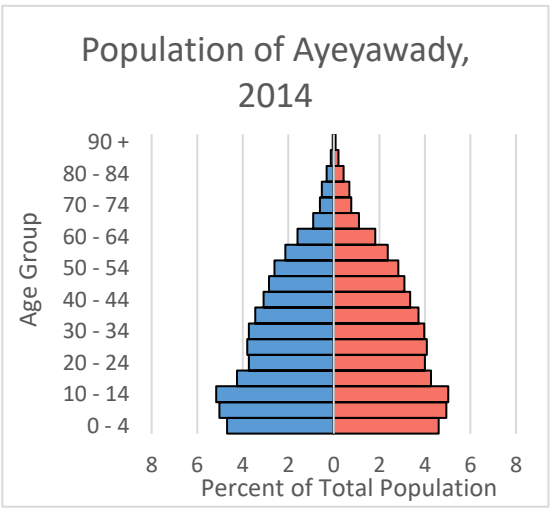

Population of Yangon, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

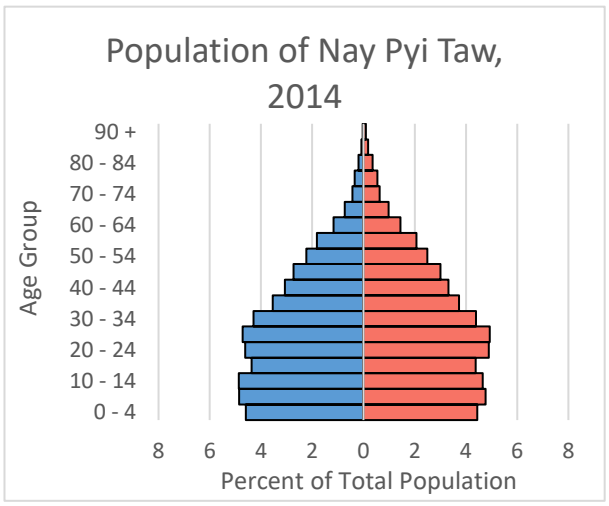

Population of Yangon, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population


Population of Shan, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

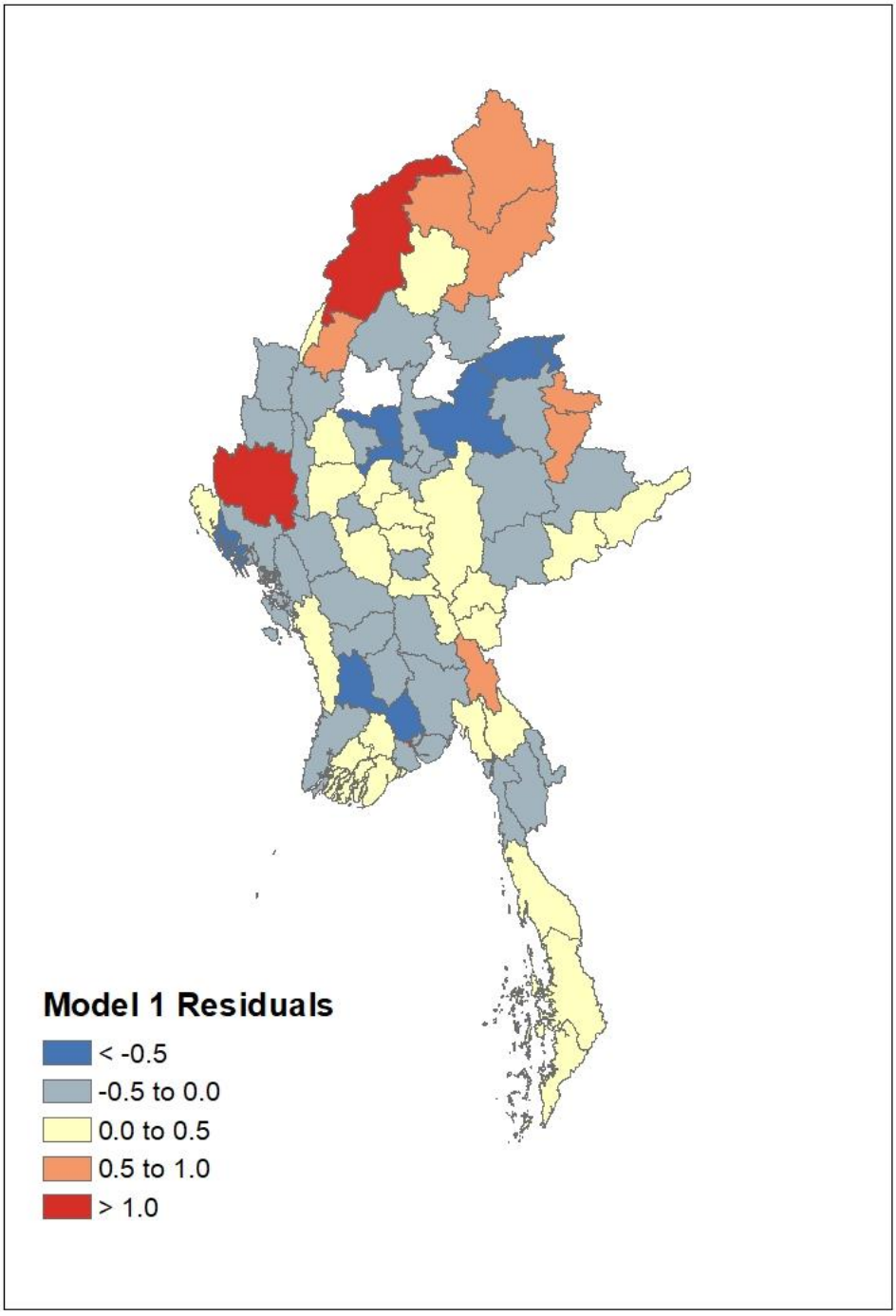

Population of Shan, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

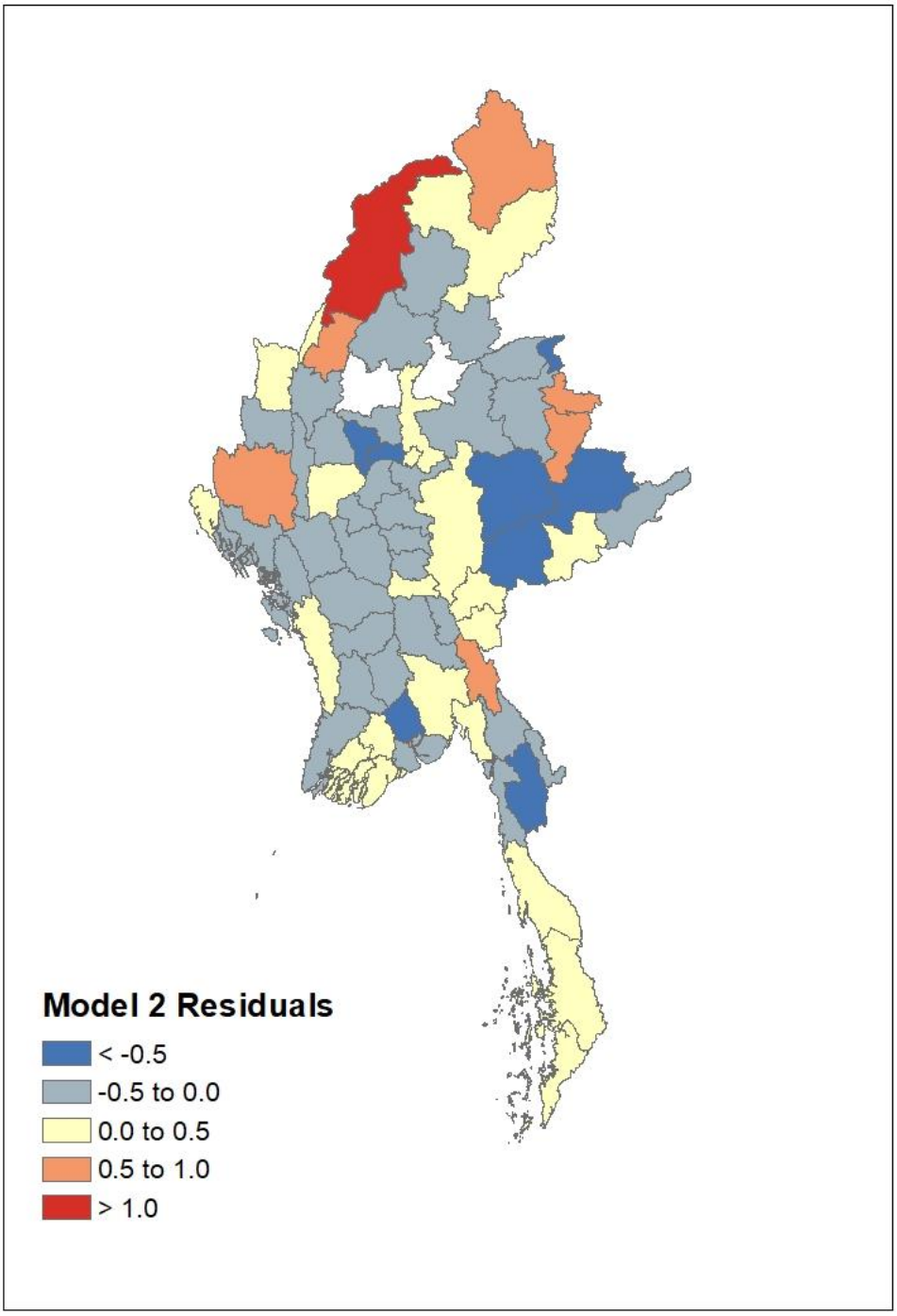

Population of Ayeyawady, 1983
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population


Population of Ayeyawady, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population


Population of Nay Pyi Taw, 2014
Age Group
90 +
80 - 84
70 - 74
60 - 64
50 - 54
40 - 44
30 - 34
20 - 24
10 - 14
0 - 4
8 6 4 2 0 2 4 6 8
Percent of Total Population

Appendix E Geographic Distribution of Residuals from Table 4-2




Model 2 Residuals
< -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
> 1.0

Appendix F Overview of Conflict Event Recoding

Original Category	Recoded Category	Number Recoded	Percent of Original Category	Percent of Total Events	Illustrative Example of Recoded Event
Battle – Government Regains Territory	Battle	30	100%	0.1%	May 7, 2016 – "Fighting was reported between the Burma Army and The KIA. The Burma Army captured two of the KIA's hilltop posts."
Battle – No Change of Territory		1,894	100%	53.8%	April 18. 2015 – "Fighting broke out between government forces and KIA troops in Tanai, forcing hundreds of villagers to flee their homes. No casualties were reported."
Battle – Non-state Actor Overtakes Territory		2	100%	0.0%	February 9, 2015 – "MNDAA troops and its allies seized Myanmar army's 125th Light Infantry Battalion (LIB) frontline posts 'Ai Nyawng Guan post, Maw Htai post, Nam Gut post, and Man Dung Pa post, Shan state."
Non-violent Transfer of Territory		1	100%	0.0%	October 8, 2013 – "in Yeethakon village [geocode for nearby Thanbyuzayat township], Mon state, the New Mon State Party was forced by the Myanmar army to abandon its base."
Remote Violence	Battle	133	35.2%	3.8%	November 15, 2015 – "in Mohyin township, the Myanmar army launched an airstrike on KIA Brigade 8 positions."
	Bombing	104	27.5%	3.0%	November 21, 2013 – "in Tamu township, Sagaing, a bomb exploded."
	Landmine	66	17.5%	1.9%	October 13, 2010 – "a landmine exploded in Mogaung Township, Kachin State. Two villagers were killed and one injured."
	Property Destruction	9	2.4%	0.0%	April 30, 2012 – "The Kachin Independence Army derailed nine railroad carriages and damaged railroad tracks around 2.4 kilometres from Hsahmaw Railway Station. The bombings occurred in Nantsiaung railway station near Moenyin. The explosion injured two civilians."

Appendix E, Continued

Remote Violence	Violence Against Civilians	66	17.5%	1.9%	December 5, 2011 – “Military Forces of Myanmar launched mortar attacks against civilians in Tar Law villages, Mytkynia township, in Kachin State.”
Riots/Protests	Communal Violence	4	0.1%	0.0%	June 8, 2012 – “violent clashes continued between Buddhists and Muslim groups, rioters torched villages in Buthidaung townships, Rakhine State. No information on fatalities.”
	Property Destruction	1	0.0%	0.0%	July 1, 2016 – “A Buddhist nationalist group burned down a Muslim prayer hall.”
	Protest	665	97.7%	18.9%	June 5, 2016 – “in Myitkyina Township (Myitkyina, Kachin), around 50 residents staged a protest against Chinese Ambassador Hong Liang over attempts to negotiate the controversial Myitsone dam project.”
	Riot	10	1.5%	0.0%	March 28, 2013 – “the military and police shot at least five people who were rioting in Padigon, Bago division. No fatalities noted.”
	Violence Against Civilians	1	0.0%	0.0%	June 27, 2013 – “2 Rohingya were shot and killed by government security forces in Pauktaw Township, Rakhine state. Officials claim that the individuals were shot when the security forces tried to disband a group of Rohingya IDPs who were attacking them.”
Strategic Development	Battle	1	0.1%	0.0%	December 8, 2010 - "in Hpalu village, Kawkareik, Kayin state, the bodies of six KNU/KNLA Peace Council (KPC) soldiers were found hacked to death. The soldiers had been detained and interrogated by the Myanmar army. Event coded.”
	Bombing	6	0.6%	0.0%	September 15, 2014 – “in Myawaddy township, Kayin state, a bomb was discovered and defused.”
	Communal Violence	1	0.1%	0.0%	January 22, 2014 – “in Nam Lim Pa village, Kachin state, a mass shallow grave was found with three bodies that appeared to have been severely tortured by the Myanmar army.”

Appendix E, Continued

Strategic Development	Forced Service	1	0.1%	0.0%	April 2, 2014 –"in Namhsan township, the TNLA forcefully recruited Lisu villagers."
	Landmine	1	0.1%	0.0%	October 14, 2013 – "in Ahlone township, Yangon, police said a small mine was found fixed under a table at Western Park 2, a Chinese restaurant in western Yangon. No fatalities."
	Looting	29	29.9%	0.1%	October 12, 2014 – "in Wan Pasaung, Kyethi township, Shan state, the Myanmar army took rice, pigs, food and other materials from the villagers."
	Mass Arrest	16	16.5%	0.0%	June 16, 2012 – "the Myanmar army arrested around 134 Rohingya, among them many youth, from the following villages in Maungdaw Township, Rakhine State: Pandawpin, Thayai Gonetan, Oo Doung, Bagonena, Kawzabil, Lambagonena."
	Property Destruction	39	40.2%	1.1%	June 5, 2014 – "in Maungdaw township, Rakhine state, the police burnt down the Kyauk Hla Gaar market."
	Village Disruption	3	3.1%	0.0%	February 19, 2016 – "government forces took over control of villages around Tot Sang, Kyaukme Township, Shan State and searched people moving in and out of the villages."
Violence Against Civilians	Bombing	5	1.1%	0.0%	November 13, 2011 – "in Myitkyina (Myitkyina, Kachin), unidentified armed men threw a hand grenade into an orphanage and killed 10 people and seriously injured 27 others."
	Communal Violence	1	0.0%	0.0%	October 23, 2012 – "in Yan Thei village, Mrauk-U township, Rakhine state, a group of armed Rakhine individuals attacked Rohingya villagers who had been disarmed by the riot police prior to the Rakhine group arriving. At least 52 Rohingya villagers are thought to have been killed."

	Forced Service	26	5.9%	0.1%	August 1, 2013 – “in Hpai Kawng village, near Muse township, Shan state, the Myanmar army abducted 3 civilians and forced them to serve as guides and porters.”

Appendix E, Continued

Violence Against Civilians	Mass Arrest	25	5.9%	0.1%	April 29, 2015 – “Villagers from Welgyi Chaung and Linsin Yoarthit villages in Kyauktaw Township allege that 70 fellow villagers were arrested and tortured by the Myanmar Army, after being accused of supporting the Arakan Army. The villagers were allegedly tortured from April 23-28. Some villagers allegedly had their heads split and hands broken.”
	Property Destruction	48	10.9%	1.4%	April 26, 2013 – “the Myanmar military set fires in KIA areas, burning down 49 houses in Wara Zup village, Kachin state. No fatalities reported.”
	Rape	50	11.4%	1.4%	November 7, 2010 – “soldiers of the Myanmar army’s LIB 304 attempted to rape a woman, the wife of a NDF party committee member, in Matupi town, Chin state. She was hospitalized due to a head injury.”
	Riot	1	0.0%	0.0%	June 22, 2012 – “Rakhine rioters killed two persons from Tharaykuntan (Barsawra) village, Maungdaw, Rakhine.”

Appendix G Women Engaging in Sexual or Reproductive Health Behaviour, by Conflict Event Type

Outcome Variable	Exposed % (n)	Unexposed % (n)
Any Event	**N=3,186**	**N=4,573**
Early Sexual Debut	2.0 (62)	2.1 (97)
Sex in Last Four Weeks	76.3 (2,431)	77.3 (3,536)
Currently Using FP	**24.9 (793)**	**29.5 (1,350)**
Birth in Last Year	6.3 (201)	7.6 (348)
Birth in Last Five Years	41.7 (1,327)	45.8 (2,097)
Last Birth Unwanted	1.7 (58)	2.6 (108)
Pregnancy Termination	13.2 (793)	14.9 (1,350)
Any Non-Protest Event	**N=2,726**	**N=5,033**
Early Sexual Debut	2.1 (58)	2.0 (102)
Sex in Last Four Weeks	75.9 (2,070)	77.4 (3,989)
Currently Using FP	**23.8 (648)**	**29.7 (1,495)**
Birth in Last Year	6.4 (174)	7.4 (372)
Birth in Last Five Years	42.1 (1,147)	45.2 (2,276)
Last Birth Unwanted	1.8 (53)	2.4 (113)
Pregnancy Termination	13.0 (648)	14.8 (1,495)
Battle	**N=920**	**N=6,839**
Early Sexual Debut	**3.7 (34)**	**1.8 (126)**
Sex in Last Four Weeks	**70.4 (648)**	**77.8 (5,319)**
Currently Using FP	**19.2 (177)**	**28.8 (1,967)**
Birth in Last Year	8.0 (74)	6.9 (472)
Birth in Last Five Years	48.4 (445)	43.6 (2,979)
Last Birth Unwanted	**3.6 (37)**	**2.0 (129)**
Pregnancy Termination	14.5 (177)	14.2 (1,967)
Bomb	**N=1,387**	**N=6,372**
Early Sexual Debut	2.1 (37)	2.0 (122)
Sex in Last Four Weeks	78.2 (1,085)	76.6 (4,883)
Currently Using FP	**21.3 (295)**	**29.0 (1,848)**
Birth in Last Year	5.7 (79)	7.4 (472)
Birth in Last Five Years	40.5 (562)	44.9 (2,862)
Last Birth Unwanted	2.4 (17)	2.1 (149)
Pregnancy Termination	**11.4 (295)**	**14.8 (1,848)**

Appendix F, Continued

Communal Violence	**N=96**	**N=7,663**
Early Sexual Debut	**9.2 (14)**	**2.0 (146)**
Sex in Last Four Weeks	81.1 (78)	76.9 (5,890)
Currently Using FP	16.6 (16)	27.8 (2,127)
Birth in Last Year	10.1 (10)	7.0 (536)
Birth in Last Five Years	57.3 (55)	44.0 (3,368)
Last Birth Unwanted	2.9 (2)	2.2 (164)
Pregnancy Termination	5.9 (16)	14.3 (2,127)
Forced Service	**N=173**	**N=7,586**
Early Sexual Debut	4.2 (11)	2.0 (149)
Sex in Last Four Weeks	77.1 (128)	77.0 (5,840)
Currently Using FP	15.1 (26)	27.9 (2,117)
Birth in Last Year	9.5 (16)	7.0 (531)
Birth in Last Five Years	54.3 (94)	43.9 (3,329)
Last Birth Unwanted	3.8 (7)	2.1 (159)
Pregnancy Termination	13.4 (26)	14.2 (2,117)
Landmine	**N=535**	**N=7,224**
Early Sexual Debut	1.4 (8)	2.1 (152)
Sex in Last Four Weeks	77.6 (415)	76.9 (5,553)
Currently Using FP	23.4 (125)	27.9 (2,018)
Birth in Last Year	5.5 (29)	7.2 (520)
Birth in Last Five Years	40.3 (215)	44.4 (3,208)
Last Birth Unwanted	2.5 (2)	2.1 (164)
Pregnancy Termination	13.6 (125)	14.2 (2,018)
Looting	**N=179**	**N=7,580**
Early Sexual Debut	2.4 (7)	2.1 (152)
Sex in Last Four Weeks	71.4 (128)	77.0 (5,840)
Currently Using FP	**10.6 (19)**	**28.0 (2,124)**
Birth in Last Year	5.0 (9)	7.1 (538)
Birth in Last Five Years	44.7 (80)	44.1 (3,343)
Last Birth Unwanted	2.7 (3)	2.2 (163)
Pregnancy Termination	13.1 (19)	14.2 (2,214)
Mass Arrest	**N=800**	**N=6,959**
Early Sexual Debut	1.4 (9)	2.1 (151)
Sex in Last Four Weeks	80.7 (647)	76.5 (5,321)
Currently Using FP	**21.1 (169)**	**28.4 (1,974)**
Birth in Last Year	5.4 (43)	7.2 (501)
Birth in Last Five Years	38.5 (308)	44.8 (3,115)
Last Birth Unwanted	2.3 (5)	2.2 (161)
Pregnancy Termination	**10.4 (169)**	**14.6 (1,974)**

Appendix F, Continued

Property Destruction	**N=593**	**N=7,166**
Early Sexual Debut	2.4 (32)	2.0 (128)
Sex in Last Four Weeks	77.3 (458)	76.9 (5,509)
Currently Using FP	27.1 (161)	27.7 (1,982)
Birth in Last Year	5.5 (33)	7.2 (516)
Birth in Last Five Years	40.8 (242)	44.4 (3,182)
Last Birth Unwanted	1.8 (19)	2.2 (147)
Pregnancy Termination	11.9 (161)	14.4 (1,982)
Protests	**N=2,517**	**N=5,239**
Early Sexual Debut	1.5 (10)	2.3 (150)
Sex in Last Four Weeks	77.5 (1,952)	76.6 (4,016)
Currently Using FP	26.0 (655)	28.4 (1,488)
Birth in Last Year	**5.9 (149)**	**7.7 (403)**
Birth in Last Five Years	**40.0 (1,006)**	**46.1 (2,417)**
Last Birth Unwanted	1.8 (31)	2.5 (135)
Pregnancy Termination	**12.1 (655)**	**15.2 (1,488)**
Rape	**N=241**	**N=7,518**
Early Sexual Debut	**4.7 (4)**	**2.0 (155)**
Sex in Last Four Weeks	**69.4 (167)**	**77.2 (5,800)**
Currently Using FP	**16.8 (40)**	**28.0 (2,103)**
Birth in Last Year	6.9 (17)	7.0 (526)
Birth in Last Five Years	47.3 (114)	44.0 (3,310)
Last Birth Unwanted	3.0 (4)	2.1 (161)
Pregnancy Termination	**9.9 (40)**	**14.3 (2,103)**
Riot	**N=930**	**6,829**
Early Sexual Debut	1.1 (11)	2.2 (148)
Sex in Last Four Weeks	77.7 (722)	76.8 (5,245)
Currently Using FP	24.5 (227)	28.1 (1,916)
Birth in Last Year	5.7 (53)	7.2 (492)
Birth in Last Five Years	37.5 (348)	45.0 (3,075)
Last Birth Unwanted	1.1 (6)	2.4 (160)
Pregnancy Termination	**10.2 (227)**	**14.7 (1,916)**
Violence Against Civilians	**N=1,471**	**N=6,288**
Early Sexual Debut	2.1 (29)	2.0 (130)
Sex in Last Four Weeks	74.9 (1,101)	77.4 (4,866)
Currently Using FP	**19.3 (284)**	**29.6 (1,859)**
Birth in Last Year	**5.8 (85)**	**7.4 (465)**
Birth in Last Five Years	40.6 (597)	45.0 (2,827)
Last Birth Unwanted	2.2 (20)	2.2 (146)
Pregnancy Termination	12.7 (284)	14.5 (1,859)

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