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Factors associated with adolescent pregnancy in Nepal : A multilevel analysis

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Graduate School of Public Health
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Yoojin Jeong

Factors associated with adolescent pregnancy in Nepal
: A multilevel analysis

지도교수 김 선 영

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위 원 장 이 태 진 (인)
부위원장 황 승 식 (인)
위 원 김 선 영 (인)

Abstract

In developing countries, approximately 21 million girls aged 15-19 become pregnant. Adolescents are exposed to higher rates of pregnancy-related health problems compared to women aged 20 or more. Early childbearing also deteriorates their future, driving them to drop out of schools. Nepal is one of the countries that have large burden of adolescent pregnancy and has regional differences within the country. However, previous research on Nepal only focused on individual level determinants and there is a research gap on investigating factors associated with adolescent pregnancy using multilevel models. Thus, this study aims to identify the individual- and community-level determinants of adolescent pregnancy in Nepal using a multilevel model.

The data used in this study is the 2016 Nepal Demographic and Health Survey (DHS), which is a hierarchically structured data. The study included a sample of 12,862 women aged 15-49 who are nested in 383 clusters (community). Two additional age groups of 15-19 (N = 2,622) and 20-29 (N = 4,400) were analyzed. A mixed-effect two-level logistic regression was fitted to determine the individual- and community-level factors and to differentiate each community.

The dependent variable was defined as whether an individual gave her first birth during 10-19 or, for only 15-19 aged individuals, currently pregnant. Independent variables were categorized into individual- and community-level, using the Social Determinants of Health conceptual model developed by WHO. Descriptive analysis, chi-squared analysis, and multilevel logistic regressions were conducted. For the multilevel analysis, sample weights of both level-1 (individual) and level-2 (cluster) were applied. Four random intercept models were fitted: Model 1 as the null model, Model 2 with only individual level variables, Model 3 with only community level variables, and Model 4 with all of the variables.

Results show that the prevalence of adolescent pregnancy in Nepal were 38 % in the full sample, 13 % in the 15-19 aged sample, and 40 % in the 20-29 aged

sample. Regarding fixed effects, in all three samples, the age at first marriage was found to be significantly associated with the outcome, showing the highest AOR values. In the full sample and 20-29 age group, ethnicity, educational level, and spousal age gap were also significantly associated. As for the random effects, the multilevel model analysis in this study showed that the community effect on adolescent pregnancy was inconsiderable, especially in the full sample, with an ICC value of only 4.93 %. The 15-19 and 20-29 age group had ICC values of 16.85 % and 9.89 %, respectively, thus the community effect was found to be different among the full sample and the two subgroups.

One of the key implications of this study regarding each predictor was the strong associations of child marriage on adolescent pregnancy in Nepal. Results of this study further suggests that caste/ethnicity and individual educational level are likely to influence adolescent pregnancy through child marriage. Nepal has high prevalence of not only adolescent pregnancy but also child marriage, and the government has committed to end child marriage by 2030 to achieve the Sustainable Development Goals (SDGs). Thus, it is crucial to allow Nepali girls to continue their education in reducing adolescent pregnancy and child marriage.

Furthermore, the multilevel analysis of this study revealed that there is not much community effect on adolescent pregnancy in Nepal, especially in the full sample. Therefore, in future research, using more rigorous multilevel models, such as three-level or random coefficient models, is recommended. Nevertheless, this study was the first to investigate determinants of adolescent pregnancy using a multilevel model in Nepal setting, filling the current research gap.

Key words : Adolescent pregnancy, Adolescent sexual and reproductive health, Child marriage, Nepal, South-East Asia, Multilevel analysis

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List of Abbreviations

AIC	Akaike information criterion
AOR	Adjusted odds ratios
BIC	Bayesian information criterion
CBS	Central Bureau of Statistics
DHS	Demographic and Health Surveys
GDP	Gross Domestic Product
HRW	Human Rights Watch
ICC	Intraclass correlation coefficient
ICRW	International Center for Research on Women
LMICs	Low- and middle-income countries
MDG	Millennium Development Goals
MoH	Ministry of Health
MoHP	Ministry of Health and Population
PARO	Plan Asia Regional Office
PCV	Proportional change in variance
SBA	Skilled birth attendant
SDGs	Sustainable Development Goals
SDH	Social Determinants of Health
SEAR	South-East Asian Region
UN	United Nations
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNNCT	United Nations Nepal Country Team
WHO	World Health Organization
WHO ROSEA	World Health Organization Regional Office for South-East Asia

Chapter 1. Introduction

1.1. Background

1.1.1 Adolescent Pregnancy in Low- and Middle-income Countries

By the definition of the World Health Organization (WHO), adolescents are individuals aged between 10 to 19. Today, there are more adolescents than ever before with 1.2 billion globally, consisting about one sixth of the world population. This number is likely to increase through 2050, especially in low- and middle-income countries (LMICs) (WHO, n.d.). In the South-East Asian region, 22 % of the whole population are adolescents, reaching about 350 million (WHO, n.d.). In previous decades, Nepal also faced demographic changes that resulted in its largest proportion of youths (aged 10-24), with 32.8 % in 2011. It is projected that this percentage will remain higher than 25 % until 2031 (CBS, 2014 in UNFPA, 2017).

The WHO recognizes the significance of adolescent health in achieving the Sustainable Development Goals (SDGs), which states that adolescents and youths, in many cases, are vulnerable populations. Subsequent to the Millennium Development Goal (MDG) 5.B, which sought to 'achieve universal access to reproductive health', SDGs cover a range of health issues on sexual and reproductive health and rights (WHO, 2015). Promoting and protecting the sexual and reproductive health and rights of adolescents is crucial in ending preventable maternal mortality (Vogel et al, 2015). Among the health risks that adolescents face, complications in pregnancy and unsafe abortions are leading causes of death for 15-19 aged girls (WHO, n.d.-a). Globally, compared to older women, adolescents bear a disproportionate burden of pregnancy-related death and disability. Although

adolescents constitute about 11 % of all births worldwide, they account for 13 % of all deaths and 23 % of all disability-adjusted-life-years (DALYs) from maternal conditions (WHO, 2010b).

Low- and middle-income countries (LMICs) show higher prevalence of adolescent pregnancy than high-income countries. In developing countries, approximately 21 million girls aged 15-19 become pregnant, at least half (49%) of which are unintended. For girls under 15, it is estimated that at least 777,000 births occur in developing regions (WHO, 2020). Similarly, while the adolescent fertility rate[1] is 7.1 per 1000 in East Asia, it is as high as 129.5 in Central Africa (WHO, 2020). Globally, out of all births to adolescents, a vast majority (95 %) occurs in developing countries (WHO, 2010b).

Even among different LMICs, adolescent birth rates are substantially different by regions or countries. While adolescent birth rates of LMICs in South Asia and West Africa are 112 per 1000, those in Eastern Asia are only 6 per 1000 (UNFPA, 2015). Along with Sub-Saharan Africa, South Asia shows high prevalence of adolescent pregnancy. While 16 million women under 20 give birth worldwide each year, about 37.5 % (6 million) of them are from South Asia. Births to adolescents constitute about 16.4 % of all births in this region. This percentage varies even within South Asia, from 21.4 % in Nepal to 4 % in Maldives (Figure 1) (WHO ROSEA, 2015). In a similar manner, a study using the World Health Organization Multicounty Survey on Maternal and Newborn Health (2010-11) found Nepal's adolescent birth rate to be 131 births per 1000 deliveries, while the rates were lower

[1] Age specific fertility rate (ASFR) is defined as the annual number of births to specific age group of women per 1,000 of women in that age group.

in many other South-East Asian countries that were included in the analysis. The rates were 29 in India and Vietnam, 40 in Pakistan, 60 in Sri Lanka, and 117 in Thailand (Figure 2) (Ganchimeg et al, 2014).

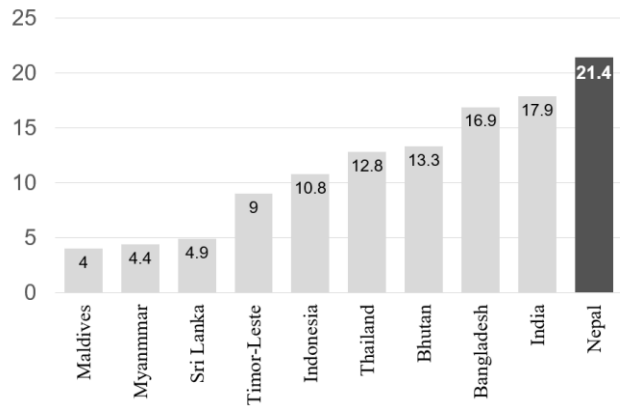

Figure 1. Birth to adolescents as percentage of all births (%) in SEAR countries[2] (Source : WHO ROSEA, 2015).

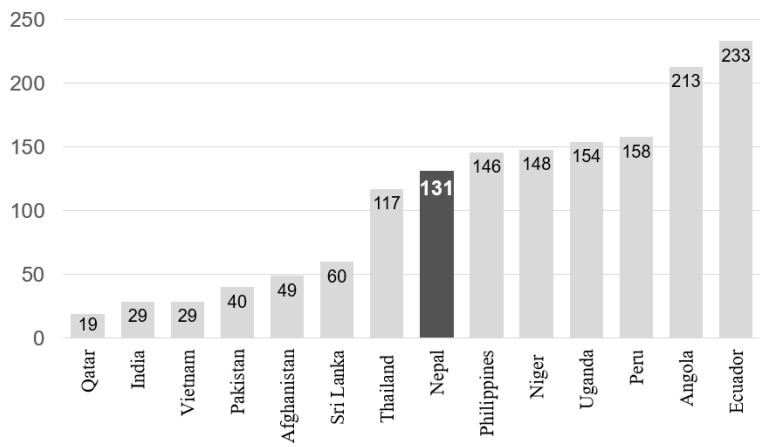

Figure 2. Number of adolescent births per 1000 births (Source : Ganchimeg, et al, 2014).

The prevalence of teenage pregnancy in these less developed regions has seen some successful outcomes over a few decades, including South-East Asia. In nearly

[2] SEAR; South-East Asia Region

all countries in the region, the rates of adolescent childbearing have decreased over past decades. Nepal, for instance, saw its annual birth per 1000 for women aged 15-19 decline from 129 (1995-2000) to 103 (2005-10). The number is expected to be 74 per 1000 for 2020-25 (WHO ROSEA, 2015). In developing countries worldwide, adolescent birth rates decreased from 170 births per 1000 during 1950-55 to 106 in 2010 (UNFPA, 2015). However, there is still room for improvement, because this rate in developing countries is still four times higher than high-income countries (UNFPA, 2015).

Furthermore, child marriage is closely linked to adolescent pregnancy in developing countries. Defined as "any formal marriage or informal union between a child under the age of 18 and an adult or another child" (UNICEF, 2020, para.1), those who are married as children are predisposed to be pregnant during adolescence. About 90 % of births to adolescents occur within marital relationships (WHO, 2010b). In South Asia, negative cultural norms exist on sex outside of marriage, so premarital childbearing is presumed to be rare (Bajracharya et al, 2019). Therefore, issues of child marriage and adolescent pregnancy cannot be separated.

1.1.2 Outcomes of Adolescent Pregnancy

Adolescent pregnancy results in detrimental consequences to girls' health and future. Adolescent girls are exposed to higher rates of pregnancy-related health problems compared to women aged 20 or more. Such adverse health conditions include maternal death during delivery, perinatal deaths, obstetric fistula, unsafe abortions, pregnancy induced hypertension (PIH), systemic infection, premature

delivery, and perineal and cervical tears (Wado et al, 2019; Poudel et al, 2018; WHO ROSEA, 2015; Brown, 2012; Maharjan et al, 2019; UNFPA, 2015). In particular, a systematic review conducted in South Asia found that pre-term delivery, birth asphyxia, PIH, spontaneous abortion, fetal distress, and anemia as some of the harmful conditions due to adolescent pregnancy (Raj et al, 2010).

When adolescents give birth, the newborn babies also face health risks. Stillbirths and death during the first week after birth are 50 % higher among babies to mothers under the age 20 than those to mothers aged 20-29 (WHO, 2008). Using 23 Demographic and Health Survey (DHS) data carried out during 2002-06, a study found that the rates of perinatal mortality are higher to adolescent mothers, compared to 20-29 aged mothers (International Institute for Population Sciences & Macro International, 2007 in WHO, 2010b).

Early childbearing is likely to deteriorate the adolescent mothers' future, as it leads them to face more risks of dropping out from schools and have limited employment opportunities (WHO ROSEA, 2015). A report from UNICEF have identified that secondary school dropout is linked with early marriage and childbearing in South Asia (Bajracharya et al, 2019), which implies the negative outcomes of these practices on potential empowerment and decision-making capabilities for girls. Teenage pregnancy limits future opportunities not only for girls but also to their children, perpetuating their poverty (UNFPA, 2015).

Early motherhood has a crucial role in determining the future population's size and age structure. Economic growth can be encouraged by raising the ages at which women bear their children, as the population size decrease and age structure is reshaped. SDGs, especially those related to reproductive health and women

empowerment, can also be accelerated by later childbearing (UN, 2019). In Nepal, one of the drivers of early pregnancy is communal expectation to have children immediately after marriage (Alejos, 2015). As such, it is cited that early marriage, along with the societal pressure to have a child, often a son, constrain economic development in Nepal (Mishra, 2017). Social participation and well-being of adolescents and youths are crucial for national economic development. This can be achieved by Nepal's commitments to secure adolescents' sexual and reproductive health and reproductive rights, to protect their human rights, and to effectively prepare them for productive activities. Investments that target these generation is, therefore, critical (UNFPA Nepal, 2017).

1.1.3 Using a Multilevel Analysis

In terms of adolescent sexual and reproductive health, there are a few conceptual frameworks focusing on the factors that affect beyond individual level. One example is the Social Determinants of Health (SDH) framework, developed by the WHO Commission on Social Determinants of Health (Figure 3). It describes how the social, economic, and political pathways induce a series of socioeconomic positions that stratify populations, thus shaping the determinants of health status of individuals and creating health inequity (WHO, 2010a). Although the SDH framework has frequently been used on early childhood determinants that affect adult health, research that focuses on adolescence as the key stage in the SDH framework is limited (Viner et al, 2012).

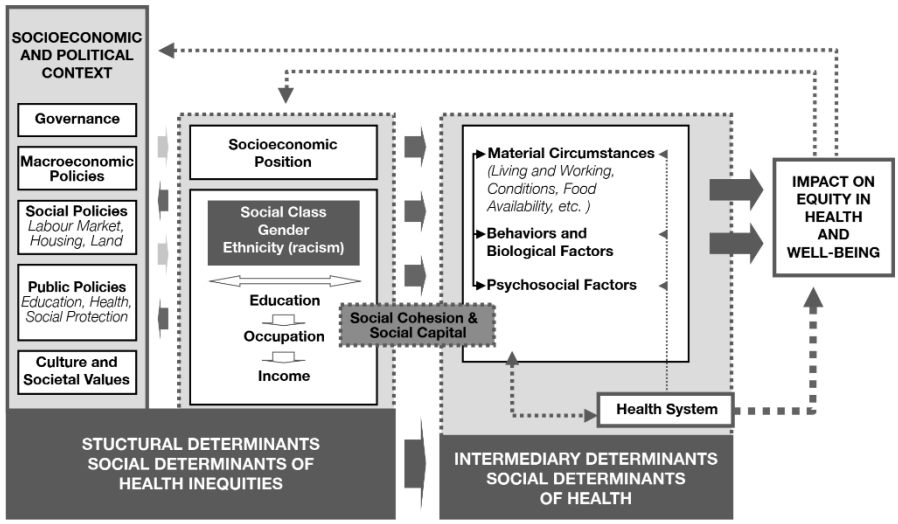

Figure 3. The Social Determinants of Health (SDH) framework (Source : WHO, 2010a).

Another conceptual model is the ecological framework (Figure 4). This model involves the various factors that affect individuals' health behaviors and outcomes, operating at four levels: individual, relationship, community, and societal (Krug et al, 2002). This framework has been used in understanding the multifaceted nature of violence, but also been applied in achieving outcomes in adolescent sexual and reproductive health, suggesting different strategies to tackle these issues in each level[3] (Svanemyr et al, 2015; Hajizade-Valokolaee et al, 2017).

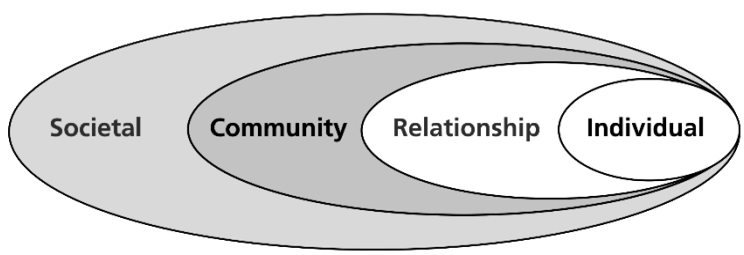

Figure 4. The ecological framework (Source : Krug et al, 2002).

[3] Svanemyr et al (2015) pointed out the key elements in creating the environment to improve adolescent sexual and reproductive health in different levels: empowering adolescents (individual), building and supporting relationships that bring positive health behaviors (relationship), creating positive social norms and community support (community), and promoting laws and policies (societal).

One qualitative study has applied such multilevel approach. Alejos (2015) used three frameworks to explicate the barriers and facilitators of adolescent pregnancy in Nepal: (1) the social determinants of health framework to explain factors that cause health inequities, (2) the ecological framework to consider the various levels adolescents are affected regarding their health, (3) and the social representation theory to understand the complexity of how social knowledge is shaped by individuals, groups, and communities. They recognized that the sexual and reproductive health of Nepali adolescents is influenced by numerous factors from different levels, such as weak national laws on the access of contraception and health information, community norms and attitudes that conflict with gender equality, family's pressure on marriage and/or pregnancy, schools without sex education, and partner's refusal to use condoms.

Quantitative studies that use survey data can also take such multilevel approach into consideration. The DHS data has a hierarchical structure, where individuals (level 1) are 'nested' within communities, or clusters (level 2). Multilevel research is needed to analyze hierarchically structured data, because in such samples, the individual observations that are nested in a certain group are often more homogeneous than those nested in other groups. This causes the assumption of independence to be violated, which means that observations may not be independent with one another (Hox et al, 2018; Liu, 2015; Snijders & Bosker, 2012). When using a large-scale social data, such as the DHS, there may be community level factors that are not quantified in the survey but have significant effects to the outcome (Boco, 2010). In multilevel models, variables at higher levels can be explicitly included in the model to estimate their effects on the outcome (Liu, 2015).

Despite its importance, there is only a handful of previous research that explicitly applied a multilevel approach in identifying determinants of adolescent pregnancy in LMICs. Recently, a limited number of studies that not only included community-level variables in analysis but also estimated the variance of the intercept among different groups (communities) were conducted (Birhanu et al, 2019; Wado et al, 2019; Aguía-Rojas et al, 2020; Kefale et al, 2020). However, regarding its regional setting, most of these studies were conducted in African countries. Birhanu et al (2019) and Kefale et al (2020) focus on Ethiopia. Wado et al (2019) investigates the issue on five East African countries, which are Kenya, Tanzania, Uganda, Malawi, and Zambia. A more recent study by Aguía-Rojas et al (2020) is set in Colombia, located in Latin America. Although South-East Asia is one of the regions that are largely affected by adolescent pregnancy, there is a research gap in this region that applied a multilevel model to identify its determinants.

To date, there are two studies that examined factors associated with teenage pregnancy in Nepal using nationally representative surveys (Pradhan et al, 2018; Poudel et al, 2018). However, there is a research gap in two ways. First, these studies used the classical model of logistic regression, where community-level independent variables are only additionally included in the model. Snijder and Bosker (2012) clearly mentions that such classical multivariate regressions do not entirely make use of the multilevel structure of a given data. This is because these models assume *a priori* that the hierarchical structure can be fully explained by the independent variables. Unless all group sizes are equal to one, nested data cannot be completely represented by the independent variables in a regression model where the variability of the dependent variable is not partitioned into within-group and between-group

variability (Snijder & Bosker, 2012). Thus, this study aims to fill this gap by fitting a mixed-effects multilevel model that explicitly accounts for the hierarchical structure of the Nepal DHS data, thus estimating both the fixed- and random-effects.

Second, although both Pradhan et el (2018) and Poudel et al (2018) pooled three cross-sectional DHS data, they only selected individuals aged 15 to 19. Although adolescent pregnancy refers to being pregnant during the age 10-19, current adolescents are yet to be fully exposed to the potential risks of pregnancy. For instance, some girls aged 16 might not have been pregnant last year, when a survey was conducted, thus not recorded as having experience of adolescent pregnancy, but when a group of girls becomes pregnant a year later, at the age 17, they would have been experienced it. Despite this, as the DHS is not a cohort survey, such cases would not be recorded in the survey. Therefore, those who are currently between the ages 15 to 19 cannot be assumed that they have been fully exposed to the risk of adolescent pregnancy. This study aims to fill this research gap by analyzing the full sample (15-49) and two subgroups (15-19 and 20-29), thus including survey participants who were fully exposed of the risk.

To summarize, there has yet been research that investigated the associated factors on adolescent pregnancy with a concise multilevel approach in South-East Asia, let alone Nepal. There have been two previous studies in Nepal setting, but both used classical regression models and included only 15-19 aged women. This study aims to fill the current research gap by fitting a comprehensive mixed-effects multilevel model and selecting a larger body of samples provided by the 2016 Nepal DHS.

1.2 Purpose of the Study

This study aims to examine the individual- and community-level factors that affect adolescent pregnancy in Nepal. The following is the specific goals of this study :

1) What are the individual- and community-level factors that are significantly associated with adolescent pregnancy?
    a. Does Nepali caste/ethnicity have statistically significant association with adolescent pregnancy, holding other factors fixed ?
    b. Does individual education level have statistically significant association with adolescent pregnancy, holding other factors fixed ?
2) Are there between-group variances of the possibility of adolescent pregnancy in each community (cluster)?
3) Are there differences in determinants of adolescent pregnancy in each sample: full sample, 15-19 aged group, and 20-29 aged group?

Chapter 2. Literature Review

2.1 Heterogeneity of Caste/Ethnicity in Nepal

Nepal is a heterogenous society. The population of Nepal is divided by 103 caste and ethnic groups[4] and have 106 languages and dialects (Pradhan & Shrestha, 2005). A more recent report by UNFPA Nepal (2017) identified a total of 125 caste/ethnic groups. The geographical distribution of caste/ethnicity in Nepal has a perceptible pattern, where specific group is concentrated in specific regions (Pradhan & Shrestha, 2005). Table 1 presents the main caste/ethnicity groups (11) in Nepal, based on the 103 social groups identified by the 2001 Census (Bennett et al, 2008). Details of specific groups listed are in Appendix A.

Table 1. Main caste/ethnicity groups in Nepal

Main Caste/Ethnic Groups (7)	Caste/Ethnic Groups with Regional Divisions (11)	
I. Caste Groups		
1. Brahaman/Chhetri	1.1	Hill Brahman
	1.2	Hill Chhetri
	1.3	Tarai/Madhesi Brahman/Chhetri
2. Tarai/Madhesi Other Castes	2.1	Tarai/Madhesi Other Castes
3. Dalits	3.1	Hill Dalit
	3.2	Tarai/Madhesi Dalit
II. Adivasi/Janajatis		
4. Newar	4	Newar
5. Janajati	5.1	Hill/Mountain Janajati
	5.2	Tarai Janajati
III. Other		
6. Muslim	6	Muslim
7. Other	7	Other

(Source : Bennett et al, 2008)

The stratification of Nepal's caste/ethnicity shows sharp differences in their social determinants of health and health status. For example, as shown in Figure 5,

[4] This study uses the definitions of caste and ethnicity that were used by Gurung (2003): *caste* is a social group that is 'vertically stratified by ritual status' within the Hindu caste system and *ethnicity* is a social group that is 'horizontally distributed in space' by 'mother tongue, native area, and religions tradition' (Gurung, 2003, p.3).

each caste/ethnicity group has distinctive status in its economic well-being. An analysis of the 2006 Nepal DHS data showed that the Terai/Madhesi Brahmans/Chhetris, Newars, and Hill Brahmans are economically better off than others: about 56 %, 55 %, and 41 % of each group, respectively, are in the highest wealth quintile. More than half of Dalits (56.2 %), however, are in the lower (i.e., first and second lowest) wealth quintile. Interestingly, even within a specific caste/ethnic group, regional identities seem to affect wealth. Ethnic groups that originate from the Hill region are generally in the lower quintile than those from Terai/Madhesi region[5] (Bennett et al, 2008).

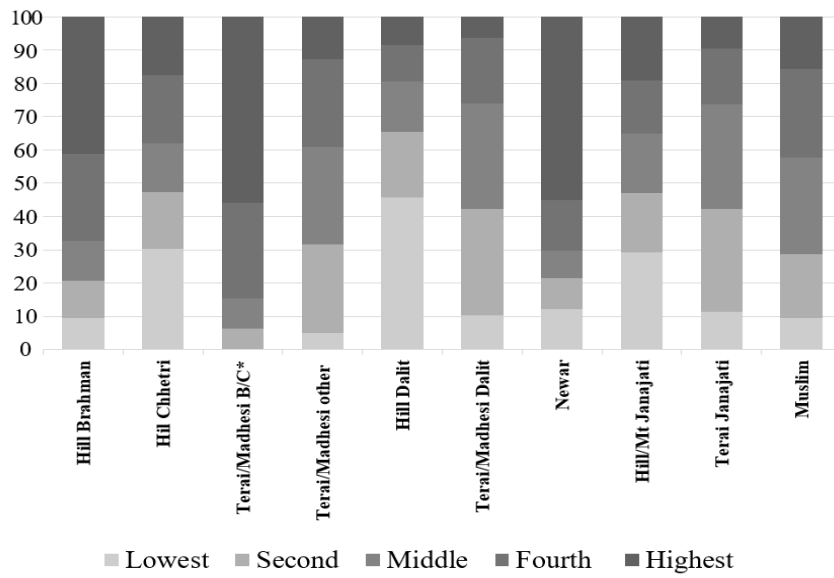

Figure 5. Percent distribution by wealth quintile according to caste/ethnicity (Source : Bennett et al, 2008).
*Note: *B/C: Brahmin/Chhetri; *Mt: Mountain*

Differences of educational attainment were found among case/ethnicity and, in this case, gender as well (Figure 6). Comparing women in each caste/ethnicity

[5] The Terai (or Tarai) region, located in southern Nepal and northern India, runs parallel to the lower lands of the Himalayas (Britannica, n.d.).

group, nearly 85 % of Terai/Madhesi Dalits, 78 % of Muslims, and 75 % of Terai/Madhesi other did not receive any education. In contrast, only 13 % of Terai/Madhesi Brahmin/Chhetri women had no education. Gender gaps in education were found in all caste/ethnic groups. A vast majority (85 %) of Terai/Madhesi Dalit women had no education, but only less than half (46 %) of men did. While 26 % of Hill Brahmin women did not receive any education, which is, in fact, second lowest among women, only 3 % of Hill Brahmin men did (Bennett et al, 2008).

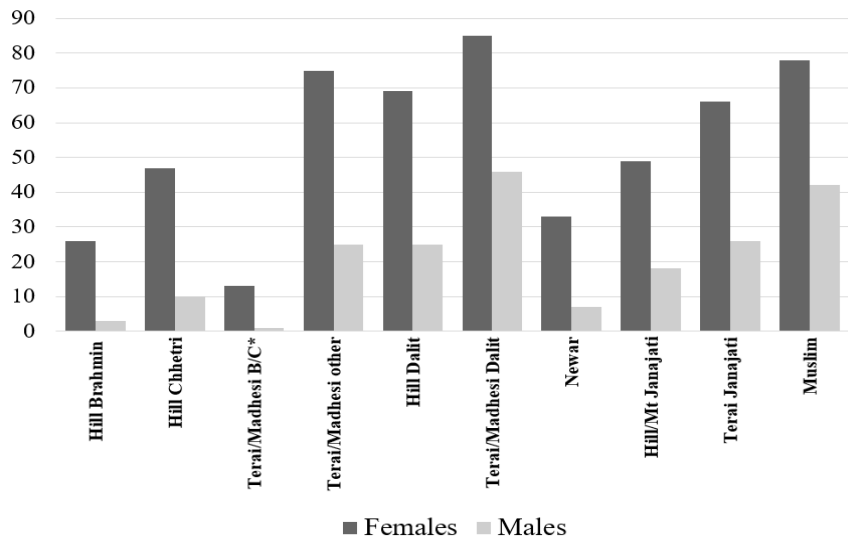

Figure 6. Percentage of females and males without any education by caste/ethnicity (Source : Bennett et al, 2008).
*Note: *B/C: Brahmin/Chhetri; *Mt: Mountain*

Different caste/ethnicity identity also means different health behaviors and risk factors regarding maternal mortality. Shown in Figure 7, the percentages of births for which mothers received antenatal care from a skilled birth attendant (SBA) are 76 % and 68 % for the Hill Brahman and Newar groups, respectively, but those of the Hill/Mountain Janajati, Terai Janajati, and Muslim groups are much less (Bennett et al, 2008). The percentages of women who had birth in health facilities

were as high as 70 % for Terai/Madhesi Brahmin/Chhetri, but was just 5 % for Terai/Madhesi Dalits (Figure 8). Correspondingly, the numbers vary even among those within the same caste group by their geographical origins. A large majority (70 %) of Terai/Madhesi Brahman/Chhetri had delivery in health facilities, but the percentages of the same caste group with a Hill origin were 35 % (Hill Brahmins) and 17 % (Hill Chhetri).

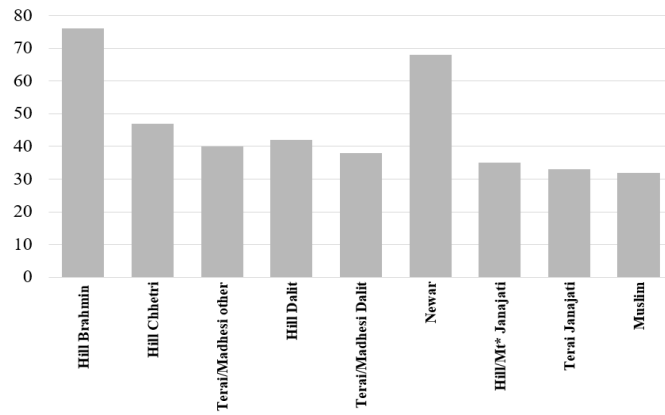

Figure 7.Percentage of births for which mothers received antenatal care from a SBA by caste/ethnicity (Source : Bennett et al 2008).
*Note: Data on the Terai/Madhesi Brahmin/Chhetri group was not provided by the source. *Mt: Mountain*

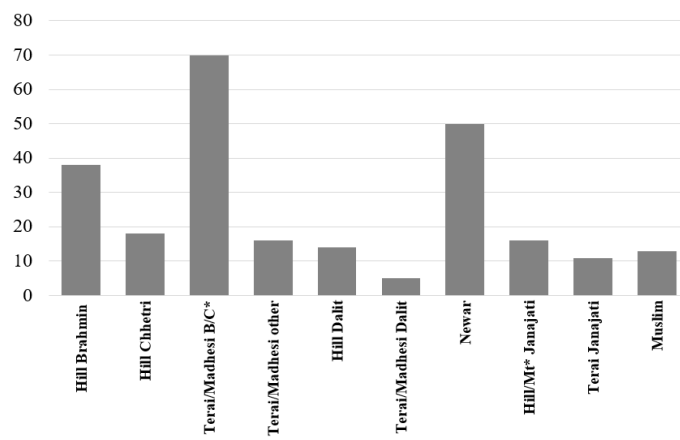

Figure 8. Percentage of deliveries in a health facility by caste/ethnicity (Source: Bennett et al, 2008)
*Note: *B/C: Brahmin/Chhetri; *Mt: Mountain*

Caste/ethnicity is one of the key elements to understand population and health issues in Nepal, along with its large gender inequality and patriarchal social norms. These norms result in many harmful practices that exist in Nepal such as dowry[6] (UNNCT, 2020b), so the issue of adolescent pregnancy cannot be separated from this specific context of Nepal.

2.2. Adolescent Pregnancy in Nepal

In the early 1990s, sexual and reproductive health services for adolescent and youth were rare in Nepal. When the government endorsed the Programme of Action, which was ratified at the International Conference on Population and Development in 1994, Nepal established the National Adolescent Health and Development Strategy in 2000, which aimed to improve the health and socioeconomic status of adolescents (Kafle et al, 2019; Ministry of Health, 2000). Specific goals of this program include reducing adolescent pregnancy and adolescent fertility rate[7] (WHO ROSEA, 2017). As such, the Nepal government acknowledged that the health of adolescents is closely linked to their development, influenced by their socioeconomic environment, family, community and peer relationships, education and employment, and access to health services and knowledge (Ministry of Health, 2000).

In recent years, Nepal has been giving more attention to the younger population. In 2010, the Ministry of Health and Population (MoHP) carried out a

[6] Dowry is "the practice of a bride's family giving cash, property, and/or other gifts to the bridegroom's family as a requirement for marriage of their daughter" (UNNCT, 2020b, p.30).
[7] Another goal includes increasing age at marriage.

nationally representative survey on Nepali adolescents and youths, to specifically focus on this age group in formulating policies and program interventions (MoHP, 2011 in Kafle et al, 2019). In the same year, Nepal launched the National Adolescent Sexual and Reproductive Health Programme, which emphasized universal access of sexual and reproductive health services to adolescents (Mishra, 2017). Likewise, the National Health Policy (2014) and the Nepal Health Sector Strategy (2016-2021) provide guidelines on adolescent health, particularly focusing on sexual and reproductive health. Despite its commitments on adolescents and youths, however, more improvements can be made in the health status of this generation such as fertility and marriage, sexual and reproductive health, and maternal care (Kafle et al, 2019). The destructive earthquake that hit Nepal in 2015 also brought challenges to the Adolescent Sexual and Reproductive Health Programme, complicating an estimated 1.2 million adolescents to access health facilities and services (Mishira, 2017).

Located in South-East Asia[8], Nepal is one of many countries that have large burden of adolescent pregnancy**.** Among the 16 million adolescents worldwide who give birth annually, 6 million of them are from the South-East Asian region. Comparing the percentage of births to adolescents among all births within the region, Nepal is the highest (21.4 %), followed by India (17.9 %) and Bangladesh (16.9 %) (Figure 1). Adolescent fertility rate in Nepal is also high, ranking third in the region with 81 per 1000, after Bangladesh (118) and India (90) (WHO ROSEA, 2015). A report from the United Nations Children's Fund (UNICEF), using the 2016 Nepal

[8] The WHO South-East Asia Region has 11 member states: Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand, and Timor-Leste.

DHS (NDHS) data, showed that 16 % of 20-24 aged and 19 % of 25-29 aged women became pregnant under the age 18 (Bajracharya et al, 2019)[9].

Even within Nepal, there are differences in the prevalence of adolescence pregnancy (and child marriage) among caste/ethnicity groups. Shown in Figure 9, about 31 % of Hill Dalits and 29 % of Terai/Madhesi Dalits adolescents begin childbearing, but the percentages of Hill Brahman and Terai/Madhesi Brahman/Chhetri are 8 % and 11 %, respectively (Bennett et al, 2008).

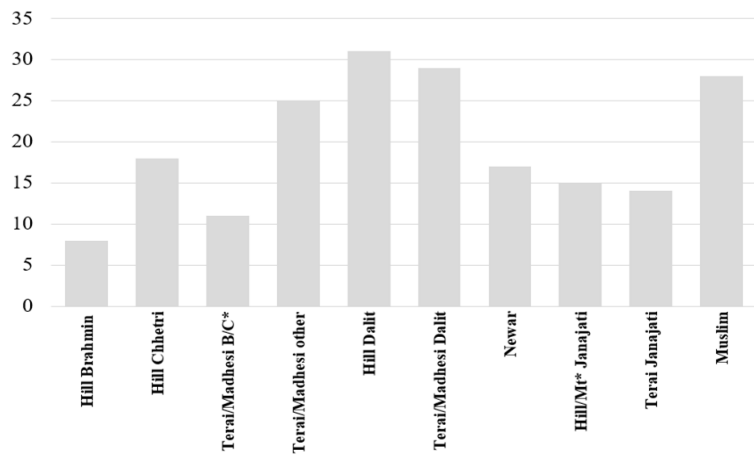

Figure 9.Percentage of childbearing adolescent women by caste/ethnicity (Source: Bennett et al, 2008)
*Note: *B/C: Brahmin/Chhetri; *Mt: Mountain*

Prevalence of adolescent childbearing also vary by geographical regions. Shown in Figure 10, about 26 % of adolescents in the Western Mountain region start motherhood, while the percentage is smaller by half in the Central Mountain region (10.7 %) (WHO ROSEA, 2015). Using the Bayesian geospatial modeling, another study identified geographical differences of teenage pregnancy within Nepal, which

[9] In Bangladesh, these percentages were 36 % and 44 % for 20-24 and 25-29 aged group, respectively. In India, they were 9 % and 16 %, respectively (same source).

varied from 35 % (Eastern) to 53 % (Mid-Western) (Neal et al, 2019). Accordingly, regarding the population health in Nepal, and adolescent pregnancy in particular, examining the distinct caste/ethnic groups and geographical characteristics is essential.

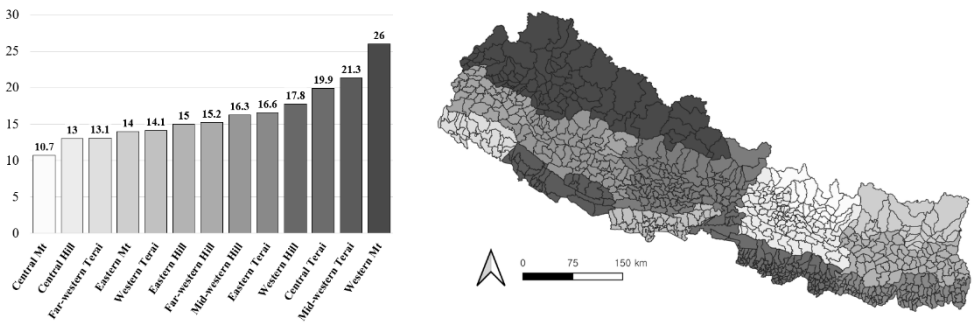

Figure 10. Percentage(%) of adolescents (15-19) who have begun childbearing by each subregion of Nepal (Source: WHO ROSEA, 2015; Shp file source : Open Data Nepal[10])
Note: The map was drawn by the presenter using the QGIS software.

Several studies connect the different patterns in social determinants of health among caste/ethnicity in Nepal with adolescent pregnancy. A study that conducted a cross-sectional survey in a tertiary hospital in Nepal found that large majority (78.3 %) of adolescent mothers dropped out of school (Nepal et al, 2018). In the same study, using the modified Kuppuswamy's socioeconomic status scale[11], more than 90 % of adolescent mothers belonged to the lower middle class or less. Another study found that, although not statistically significant, adolescent pregnancy in Nepal was less likely among Brahmin/Chhetri (AOR [12] : 0.60) and

[10] Shp file source : https://opendatanepal.com/dataset/nepal-municipalities-wise-geographic-data-shp-geojson-topojson-kml
[11] Modified Kuppuswamy's SES scale is used to determine the SES of an individual or family, ranging from 3-29 scores. There are five classes: upper, upper middle, lower middle, upper lower and lower (Saleem, 2020).
[12] AOR; adjusted odds ratio

Madhesi/Muslim (AOR: 0.56) women, compared to women from the Dalit caste. Women with secondary level education (AOR: 0.34) and who had married after 17 (AOR: 0.02) were significantly less likely to be pregnant as adolescence (Devkota et al, 2018).

Adolescent pregnancy and childbearing remain as important issues for Nepal's development. A recent report by UNFPA Nepal (2017) recommended reducing adolescent childbearing as one of the policy implications to achieve sustainable development. It also emphasized meeting universal access to sexual and reproductive health and reproductive rights for young women in Nepal, such as ending child marriage, which would allow more girls to continue education and delay childbearing (UNFPA Nepal, 2017). Such literature highlights taking a multisectoral approach in achieving SDGs in Nepal.

2.3 Determinants of Adolescent Pregnancy

There are several systematic reviews that identified the determinants of adolescent pregnancy in low- and middle-income countries (LMIC) setting (Raj et al, 2010; Pradhan et al, 2015; Kassa et al, 2018; Yakubu & Salisu, 2018). A review based on South Asia identified early age at marriage, being in lower social class, being Hindu, and having low involvement in own decision-making as some of the risk factors of teenage pregnancy (Raj et al, 2010). Similarly, Pradhan et al (2015) pointed out such factors from 12 studies based in LMICs. In South Asia[13], they were

[13] Studies from South Asia that were selected in the systematic review by Pradhan et al (2015) were conducted in one of three countries: Nepal, Bangladesh, or Sri Lanka.

the following: having only primary-level education, lower education level of the partner, being in a lower socioeconomic background, marrying during adolescence, belonging to a majority religion, belonging to a minority ethnic group, feeling marital insecurity (which may lead young married women to have a child as early as possible), and living in rural areas.

Some studies that quantitatively investigated the factors associated with adolescent pregnancy in LMIC setting used the nationally representative Demographic and Health Survey (DHS) data (Pradhan et al, 2018; Poudel et al, 2018; Birhanu et al, 2019; Wado et al, 2019; Islam et al, 2017), other secondary data (Nguyen et al, 2016; Choe et al, 2005; Devkota et al, 2018), or primary data (Sayem & Nury, 2011). Using the DHS data, previous studies show that age at first marriage (Birhanu et al, 2019; Choe et al, 2005; Devkota et al, 2018), ethnicity (Poudel et al, 2018; Choe et al, 2005), education level (Poudel et al, 2018; Wado et al, 2019; Odimegwu & Mkwananzi, 2016; Islam et al, 2017; Devkota et al, 2018), exposure to media (Wado et al, 2019; Birhanu et al, 2019; Islam et al, 2017), employment (Odimegwu & Mkwananzi, 2016), sex of the household head (Odimegwu & Mkwananzi, 2016), husband's age (Pradhan et al, 2018) or spousal age gap (Islam et al, 2017), wealth (Poudel et al, 2018; Islam et al, 2017), and early sexual debut (Pradhan et al, 2018; Nguyen et al, 2016) are significantly associated with adolescent pregnancy. These factors are considered as individual-level factors.

Becoming pregnant during adolescence, however, may be influenced by a combination of individual- and community-level factors. Vogel et al (2015) has stressed that recognizing the socioeconomic pressures that adolescents experience is crucial in reducing teenage pregnancy and maternal mortality. Some previous studies

have been conducted to explicitly include community-level factors in driving adolescents to become pregnant. Those shown to be significantly associated with adolescent pregnancy include province (Pradhan et al, 2018), place of residence (Birhanu et al, 2019; Poudel et al, 2018; Odimegwu & Mkwananzi, 2016; Islam et al, 2017; Choe et al, 2005), community contraception level (Birhanu et al, 2019), community education level (Birhanu et al, 2019), community media exposure (Birhanu et al, 2019) and community poverty level (Wado et al, 2019; Birhanu et al, 2019).

In Nepal, two studies have investigated individual- and community-level factors associated with adolescent pregnancy, using logistic regression models.[14] Poudel et al (2018) pooled three cross-sectional DHS surveys (2006, 2011, and 2016) and applied their modified version of Social Determinants of Health conceptual framework. Using a multivariate logistic regression model, they estimated the adjusted odds ratio (AOR) of adolescent pregnancy for a sample of 7,788 women aged 15-19. Community-level variables initially considered were type of residence, ecological zone, and development region[15], but none of them were included in the final model because the authors applied the backward elimination method in variable selection. The results of the study are as follows. Regarding ethnicity, they found that Dalit and Madhesi women had the AORs of 1.87 and 1.67, respectively, compared to Brahmin/Chhetri women regarding early pregnancy. Educated women

[14] The models used in both studies are classical models of logistic regression, which assume *a priori* that all of the multilevel structure is explained by the explanatory variables.
[15] Because the new administration areas of provinces 1 to 7 were decided in 2015, data collection of Nepal DHS conducted before 2015 has ecological zone and development region as variables related with geographical regions. These are not available in the 2016 Nepal DHS. Ecological zone is categorized into Terai, hill, and mountain, and development region into eastern, central, western, mid-western and far-western.

were much less likely (AOR: 0.60) to be pregnant as adolescence, compared to uneducated women. They also found that women in both the middle and poor household wealth index were more than twice as likely to become pregnant as adolescence (AOR: 2.19 and 2.37, respectively), compared to those in rich household (Poudel et al, 2018).

In a similar perspective, Pradhan et al (2018) also pooled three Nepal DHS data from 2001, 2006, and 2011 to identify factors associated with pregnancy among married adolescents (N = 2,524). They, too, used the multivariate logistic regression model and estimated AORs. Community-level factors initially considered were place of residence, ecological zone, and developmental region. Due to high associations between these variables, however, only the developmental region variable, which was most consistently associated with adolescent pregnancy throughout the three cross-sectional years, was selected in the final multivariate logistic regression. Married adolescents who lived in the eastern region were 1.59 times more likely to become pregnant compared to those in the central region. Adolescents with an ethnic identity of Janajati had an AOR of 1.49, compared to Brahmin/Chhetri women. Individual-level factors associated with adolescent pregnancy were initiating sex at an older age and having an older husband (Pradhan et al, 2018).

As mentioned in Chapter 1.1.3, it is difficult to view that the above two studies comprehensively applied a multilevel approach, because they only considered including community-level variables in a classical multivariate model. In other words, the within-group and between-group variations were not explicitly partitioned. Although set in a different setting, Birhanu et al (2019) and Wado et al (2019) effectively acknowledged the hierarchical structure of the DHS by allowing

to separate within- and between-group effects. These two studies investigated factors associated with teenage pregnancy using 2016 Ethiopia DHS and five East African countries DHS, respectively. Both studies fitted a two-level mixed-effect logistic regression model, including both the individual- and community-level variables and computing the intraclass correlation coefficients (ICC).

Chapter 3. Methods

3.1 Data Source and Study Samples

This study used the individual (women) data from the 2016 Nepal Demographic and Health Surveys (NDHS). The DHS are nationally representative surveys that provide information on the monitoring and impact evaluation in the areas of population, health, and nutrition, such as, but not limited to education, family planning, fertility, maternal health and mortality, unmet need and wealth (DHS Program, n.d.). The 2016 NDHS was implemented by New ERA[16] with the support of the Ministry of Health (MOH). Data was collected from June 19, 2016 to January 31, 2017. During data collection, technical assistance was provided by ICF International through the DHS Program, which is funded by the United States Agency for International Development (USAID) (MoH, Nepal et al, 2017).

The study sample of 2016 NDHS was stratified and selected in two stages for rural areas and three for urban areas. A total of 383 wards (clusters) were selected with proportional probability to its size and, in each cluster, a fixed number of 30 households were selected. A total of 11,473 households were selected for the study sample, of which 11,040 were interviewed successfully. Finally, a total of 13,089 women aged 15 to 49 were identified for individual interviews and 12,862 completed them. Response rates for individual women were 97.9 % and 99.0 % for urban and rural areas, respectively. On average, 33.6 individuals were nested in one single

[16] New ERA is the first non-governmental and non-profit research organization founded in Nepal. It aims to design, implement, and access development programs and policies in the perspective of Nepal (New ERA, n.d.).

cluster.[17]

In this study, along with the full sample, which had 12,862 women aged 15-49, two subgroups of 15-19 (N = 2,622) and 20-29 (N = 4,400) were analyzed additionally. These subgroups were separately analyzed because of two reasons: women aged 30 or more may have recall bias and those under 20 are not yet fully exposed to adolescent pregnancy. First, regarding the outcome variable of the study, which is whether one was/is pregnant during adolescence, there is a possibility of recall bias from older respondents. As such, previous studies that identified determinants of adolescent pregnancy have dealt with this issue by including only younger women (15-19 and/or 20-29) in analysis (Sayem & Nury, 2011; Birhanu et al, 2019; Islam et al, 2017; Wado et al, 2019; Pradhan et al 2018; Poudel et al, 2018). For example, Sayem and Nury (2011) recognized that the age group of 15-29 contributes to fertility rates more than any other age groups in Bangladesh and that of 30 or more is likely to have a higher level of recall bias, thus only selected women aged 15 to 29 in their study.

Second, just as mentioned in Chapter 1.1.3, young women below 20 are not yet fully exposed to the risks of adolescent pregnancy, as adolescents are those between 10 to 19. For this reason, Birhanu et al (2019) selected 2,679 women aged 20-24 in their multilevel analysis. Similarly, Islam et al (2017) divided the sample into two age groups: 15-19 and 20 or over. A UNICEF report comparing four South Asian countries, Bajracharya et al (2019) also selected women who are 20 or older for the same reason. Yet, some studies included only 15 to 19-aged-women in

[17] Minimum number was 8, first quintile was 29, median value was 34, third quantile was 38, maximum number was 61.

analysis (Wado et al, 2019; Pradhan, 2018; Poudel et al, 2018). Therefore, along with the full sample of women aged 15 to 49 (N = 12,862), this study further analyzed two subgroups of those aged 15 to 19 (N = 2,622) and those aged 20 to 29 (N = 4,400) (Table 2).

Table 2. Study sample.

Age group	Weighted Number	Unweighted Number
15-19	2,598	2,622
20-24	2,251	2,306
25-29	2,135	2,094
30-34	1,806	1,789
35-39	1,572	1,584
40-44	1,388	1,336
45-49	1,113	1,131
Total	**12,862**	**12,862**

3.2 Conceptual Model

This study used the adapted version of the Social Determinants of Health (SDH) framework, developed by the WHO, as the conceptual model (Figure 11). The SDH framework shows how social, economic, and political mechanisms affect the socioeconomic positions, which, in turn, influence specific determinants of health (i.e., intermediary determinants). These determinants eventually shape one's health status (WHO, 2010a). The framework has also been used in previous studies on determining factors associated with adolescent pregnancy (Alejos, 2015; Poudel et al, 2018). As shown in Figure 11 and Table 3, independent variables were categorized either as individual- or community-level factors.

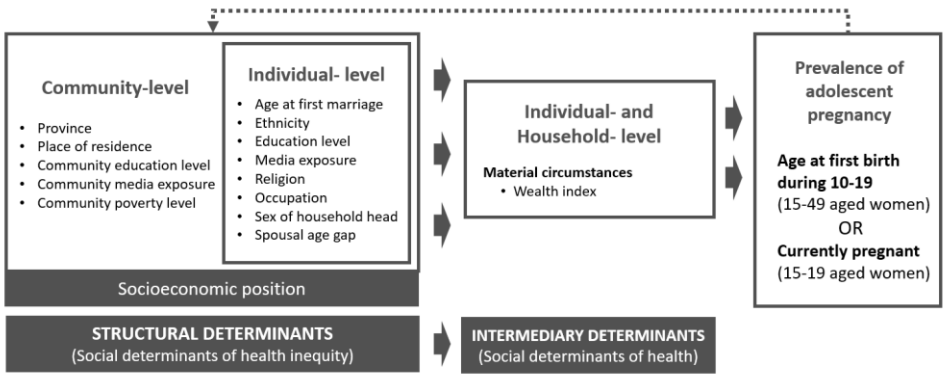

Figure 11.Conceptual framework used in this study. Adapted from WHO, 2010a.

3.3 Definitions of Variables

3.3.1 Dependent Variable

The dependent variable in this study was a binary variable of adolescent pregnancy, defined as whether one was (or is) pregnant during adolescence or not, thus recoded as either [0] No or [1] Yes. Adolescent pregnancy refers to having had her first birth between the age 10 to 19, for women of all ages (i.e., currently 15-49), and/or being currently pregnant, for women aged 15-19.

3.3.2 Independent Variables

The independent variables were categorized either as individual- or community-level. Adapting the conceptual framework of the Social Determinants of Health (WHO, 2010a), individual-level variables were further divided into structural determinants or intermediary determinants. All community-level variables were considered as structural determinants. Shown in Table 3, individual-level variables

of structural determinants were as follows: age at first marriage, ethnicity[18], education level, media exposure, religion, occupation, sex of the household head, and spousal age gap. Individual-level variables of intermediary determinants was wealth index. Community-level variables include province, place of residence, community education level, community media exposure, and community wealth level. Table 3 summarizes the definition and categorization of each variable.

Age at first marriage was recoded into three categories: [0] married before 15, [1] married at 15-17, [2] not married as a child. The last category includes those who were not married before 18 and who have never been in union. When examining the issue of child marriage, the ages 15 and 18 are most frequently used. In a report by the UNICEF, the prevalence of child marriage and adolescent pregnancy was computed by ages 15 and 18 (Bajracharya et al, 2019). Birhanu et al (2019) also categorized the age at first marriage variable into married before 15, married at age 15-17, and not married before 18. Ethnicity was categorized into 11 different groups, which are the following: Hill Brahmin, Hill Chhetri, Terai Brahmin/Chhetri, other Terai caste, Hill Dalit, Terai Dalit, Newar, Hill Janajati, Terai Janajati, Muslim, and other. The Nepal DHS questionnaire uses these 11 categories to consider both geographical identity (e.g., Hill/ Terai[19]) and caste/ethnicity (e.g., Brahmin/ Chhetri/ Dalit for caste and Newar/ Janajati/ Muslim for non-caste). It is worth noting that geographical identity does not mean the region an individual is currently residing in,

[18] Here, ethnicity does not refer to the definition used by Gurung (2003), rather merely as a variable name indicated by the DHS data. However, as mentioned in the next paragraph, this variable accounts for the caste/ethnicity context of Nepal, which was explained in Chapter 2.1.

[19] The Terai (or Tarai) region, located in southern Nepal and northern India, is a region running parallel to the lower lands of the Himalayas (Britannica, n.d.).

but rather the identity one has, based on geographic origins (Bennett et al, 2008). Highest level of education attainment was recoded into three categories: [0] no education, [1] primary or less, and [2] secondary or higher. Being exposed to TV and radio were used to compute the media exposure variable, which was categorized as [0] both at least once a week, [1] only one at least once a week, and [2] no access. Having no access to media refers to 'watching TV and/or listening to the radio' not at all or less than once a week. Religion was recoded into [0] Hindu, [1] Buddhist, [2] Muslim, and [3] others. Occupation was categorized into three groups: [0] agricultural, [1] non-agricultural, and [2] not working. Non-agricultural occupations include, but not limited to, manual, sales/services, and professional/technical work. Sex of the household head is either [0] male or [1] female. The age difference of spouse was recoded into six categories: [0] under 5 years, [1] 5-9 years, [2] 10-14 years, [3] 15-19 years, [4] 20 years or more, and [5] not in union. Here, the 'not in union' category includes respondents who were never in union, widowed, divorced, or no longer living together/separated.

This study used the wealth index variable as the intermediary determinants in individual-level independent variables. The DHS places each household on a continuous scale of relative wealth and separates all households into five quintiles. The index is a composite measure of each household's living standards, using easy-to-collect data on a household's ownership of certain assets such as televisions, building materials used for housing, and types of water and sanitation facilities. As a measure of material circumstances in intermediary determinants, the wealth index was recoded into three categories: [0] poor, [1] middle, and [2] rich.

Initially, this study included two additional independent variables, education

level of partner and age at first sex, but these were omitted in the final analysis after the correlation between variables was tested. Result of the correlation test is in Appendix B.

This study used five community-level variables. Two of these variables, province and place of residence, were initially coded for each individual, thus used directly from the data. Province was divided into seven categories, from Province 1 to Province 7. Nepal's Constituent Assembly approved a new constitution in September 2015, which divides Nepal into seven administrative provinces. The 2016 Nepal DHS data is based on this updated classification. Place of residence is either [0] urban or [1] rural.

The other three community-level variables were generated by aggregating the individual data (N = 12,862) into cluster-level, categorizing each cluster (N = 383) as either high or low after comparing with the clusters' median value of the proportion of a given variable's sub-category, and creating a new variable for each individual depending on the cluster she is nested in. A group mean variable is an essential type of contextual variable, as it can express the difference between within-group and between-group variations (Snijder & Bosker, 2012). In this study, using the Shapiro-Wilk normality test, the proportion of each aggregated variable was found to be not normally distributed. Therefore, similar to previous studies that used multilevel models (Birhanu et al, 2019; Kefale et al, 2020), median values were used, instead of mean values, to categorize these aggregated variables into either high or low. Community education level refers to the proportion of respondents in each cluster whose highest education level is secondary or higher. Coded as either [0] high or [1] low, an individual with a 'high' community education level, for instance,

means she is nested in a cluster with a higher proportion of individuals whose educational attainment is secondary or higher, compared to the median value. Community media exposure is the proportion of respondents in a cluster who are exposed to at least one type of media at least once a week, also coded as [0] high or [1] low. Community wealth level is defined as the proportion of respondents in each cluster whose wealth index is either middle or rich, also coded as [0] high or [1] low.

Table 3. Description of variables

Level	Variable	Definition	Categorization
Dependent Variable	Adolescent pregnancy	Whether one had given her first birth during 10-19 (for 15-49 aged women) OR is currently pregnant (for 15-19 aged women)	0 - No 1 - Yes
Individual Level Independent Variables	***Structural Determinants***		
	Age at first marriage	Age at start of first marriage or union	0 - Married before 15 1 - Married at 15-17 2 – Not married as a child
	Ethnicity	Country-specific ethnicity groups	11 Categories - Hill Brahmin - Hill Chhetri - Terai Brahmin or Chhetri - Other Terai caste - Hill Dalit - Terai Dalit - Newar - Hill Janajati - Terai Janajati - Muslim - Other
	Education level	Highest education level attended	0 - No education 1 – Primary 2 – Secondary or higher
	Media exposure	Listening to the radio and/or watching TV at least once a week	0 - Both at least once a week 1 - Only one at least once a week 2 - No access

Level	Variable	Definition	Categorization
	Religion	Country-specific religions	0 - Hindu 1 - Buddhist 2 - Muslim 3 - Others (Kirat, Christian, other)
	Occupation	Respondent's occupation as collected, country-specific	0 - Agricultural 1 - Non-agricultural (manual, sales/ managerial, professional/technical) 2 - Not working
	Sex of the household head	Sex of the head of the household	0 - Male 1 - Female
	Spousal age gap	Age difference of the respondent and her partner, calculated as : *(Current age of the respondent's partner) - (Current age of the respondent)*	0 - Under 5 years 1 - 5-9 years 2 - 10-14 years 3 - 15-19 years 4 - 20 years or more 5 - Not in union
	Intermediary Determinants		
	Wealth index	A composite measure of a household's cumulative living standard	0 - Poor 1 - Middle 2 - Rich

Level	Variable	Definition	Categorization
	Structural Determinants		
Community-level Independent Variable	Province	Region of residence	7 Categories - Province 1 - Province 2 - Province 3 - Province 4 - Province 5 - Province 6 - Province 7
	Place of residence	Type of place of residence	0 - Urban 1 - Rural
	Community education level	The proportion of respondents in the cluster whose highest education level is secondary or higher, compared with the national median value.	0 - High 1 - Low
	Community media exposure	The proportion of respondents in the cluster who are exposed to either or both media at least once a week, compared with the national median value.	0 - High 1 - Low
	Community wealth level	The proportion of respondents in the cluster whose wealth index is either middle or rich, compared with the national median value.	0 - High 1 - Low

3.4 Model for Analysis

This study used a mixed-effects multilevel logistic regression model to determine the individual- and community-level factors of adolescent pregnancy in Nepal. Given its nested structure of DHS data, individuals within certain cluster is likely to be more homogeneous than those nested in other clusters. As mentioned in Chapter 1.1.3, this may result in the violation of the independence assumption of independence (Hox et al, 2018; Liu, 2015; Snijders & Bosker, 2012), so a multilevel model is more advantageous than a single-level model. Mixed effects refer to fixed and random effects. In multilevel modeling, fixed effects are the regression coefficient estimates that quantify the relationship between the explanatory variables and the outcome variable (West et al, 2014 in Liu, 2015). Random effects refer to the randomly varying estimates across higher level (i.e., cluster level), which includes random intercept and random coefficients[20] (Liu, 2015). In this study, random intercept model is used.

This study first performed descriptive analysis to understand the characteristics of the respondents regarding the individual- and community-level variables. Second, chi-squared analysis was carried out in order to examine the univariate relationship between each explanatory variable and the outcome. Finally, multilevel (two-level) mixed-effects logistic regression models were fitted, where fixed effects are estimated for both individual- and community-level variables and random effects for between-group variations. To employ the two-stage sampling

[20] Random intercept is the random deviation component of the overall intercept. Random coefficient is a random deviation component of the overall fixed effect (Liu, 2015).

designs of the DHS, level-1 and level-2 sample weights were calculated, following the DHS Methodological Reports guidelines (Elkasabi et al, 2020). Both level-1 (individual) and level-2 (cluster) weights were applied to the multilevel analyses, using the *melogit* command with the *svy* option in STATA.

This study fitted a random intercept model. It allows its intercept, but not its slope, to be different for each community (i.e., cluster) (Liu, 2015). For the model diagnosis, this study fitted the following four models. Model 1, which is the null model, has no independent variables. Model 2 has only the individual-level variables and Model 3 only the community-level variables. Model 4 has both the individual- and community-level variables, thus is the full model. The research model is :

$$log\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta_0 + \beta_1 X_{ij} + \beta_2 Z_{ij} + u_j$$

where
- i : *level 1 (individual-level)*
- j : *level 2 (community-level)*
- X : *individual-level variables*
- Z : *community-level variables*
- π_{ij} : *probability of being pregnant for the i^{th} individual in the j^{th} community*
- β_0 : *intercept (i.e., the effect on the response in the absence of predictors)*
- β_1 : *fixed-effect coefficients of individual-level variables*
- β_2 : *fixed-effect coefficients of community-level variables*
- u_j : *random effect for the j^{th} community*

Fixed effects for both the individual- and community-level variables were reported by adjusted odds ratio (AOR) for each category in each variable and its 95% confidence interval (95% CI). Random effects were reported for each model by intraclass correlation coefficient (ICC) and proportional change in variance (PCV). ICC is an index used to measure the proportion of variance in the outcome that can be explained by communities (clusters), ranging from 0 to 1. A larger ICC value indicates a stronger justification of using multilevel models (Liu, 2015). PCV, as its

name suggests, denotes the proportional change of the variance with respect to the null model (i.e., Model 1). ICC and PCV were computed by the following equations:

$$ICC = V_A / (V_A + V_I)$$

where · V_A : *variation between clusters (community)*
· V_I : *variation within a cluster (individual-level)*

$$PCV = (V_N - V_{N+1}) / V_N$$

where · V_N : *community-level variance of the null model*
· V_{N+1} : *community-level variance of the subsequent model*

Goodness-of-fit was evaluated with Akaike information criterion (AIC) and Bayesian information criterion (BIC) for each model. Yet, as AIC and BIC statistics cannot be computed when different levels of sample weights are used (Williams, 2020; DHS Program User Forum, 2015), these are estimated from analyses that did not consider weights. The model with the smallest AIC is usually selected as the best model (Goldstein, 2011). Data cleaning was done in R 3.6.2 and statistical analysis in STATA 15.1.

Along with Models 1 to 4 mentioned above, additional analyses were conducted. First, single-level logistic regressions for each sample were performed to compare with multilevel models. These conventional logistic model results are presented in Appendix C. Next, multilevel models including different sets of independent variables were fitted. Model 5 excludes the age at first marriage variable from the full model (Model 4). Model 6 includes all of the community-level variables, but for the individual-level, only those that were statistically significant at $p<.05$ in Model 5 are included. Model 7 also includes all community-level variables, but

includes fewer individual-level predictors than Model 6. The results of Model 5-7 for each sample are shown in Appendix D. Models 3A to 3C are based on Model 3, including different sets of community-level variables. Model 3A has province and place of residence. Model 3B has the three aggregated community-level predictors. Model 3C includes province, community education level, and community wealth index. The results of these community-focused models are shown in Appendix E. Finally, random effects for specific models and samples are additionally presented. The ICC values were computed for models that include each community-level variable (Table 19 in Appendix F). Similarly, the three samples were further separated depending on the experience of child marriage, and ICC values of the null model for each sample were estimated (Table 20 in Appendix F).

3.5 Ethical Considerations

For DHS, informed consents from all participants are obtained prior to the face-to-face interview. Ethical approval for data collection was obtained from Nepal Health Research Council, Kathmandu, Nepal, and ICF Macro Institutional Review Board, USA. This study used the existing secondary data of the 2016 NDHS, which is distributed after removing all identifier information of the respondents. Consequently, using such data can be determined as exempt research. This study was approved by the Institutional Review Board (IRB) of Seoul National University as exempt research (Approval No.: IRB No. E2011/001-002).

Chapter 4. Results

4.1 Descriptive Statistics

Table 4-6 summarizes the results of the descriptive statistics of the sample and the p-values from the chi-squared analysis of each independent variable and adolescent pregnancy. Table 4, 5, and 6 present the full sample, 15-19 age group sample, and 20-29 age group sample, respectively. All three results are shown as the weighted number of respondents.

In the full sample, out of the 12,862 respondents, about 38 % (N = 4,853) was/is pregnant as adolescence (Table 4). Regarding the age at first marriage, about 10 % (N = 1,299) has been married before 15 and about 34 % (N = 4,358) at 15-17. Thus about 44 % (N = 5,657) of Nepali women aged 15 to 49 was married as a child. About 21 % (N = 2,669) of the full sample has never been in union. Regarding the ethnicity variable, which reflects both the regional identity and caste/ethnicity, the Hill Janajati has the highest proportion with 21 % of the sample, followed by Hill Chhetri with 18 %. Those groups that consist less than 10 % of the population include Terai Janajati (9.8 %), Hill Dalit (8.1 %), Newar (5 %), Muslim (5 %), Terai Dalit (4.3 %), and Terai Brahmin/Chhetri (1.7 %). In Nepal, half (50 %) of women has secondary or higher level of education, while a third (33.3 %) has received no education. About 38 % of women has no access to TV or radio. A large majority (86 %) of Nepali is Hindu. While 47 % of women has an agricultural occupation, about 20 % has jobs in the non-agricultural sector such as manual, sales, or professional work. About a third (33.1 %) is not working.

Table 4. Descriptive statistics results (Full sample).

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Individual Level					
Structural Determinants					
Age at first marriage	Married before 15	172	1127	1299	<.001
		(13.3%)	(86.7%)	(10.1%)	
	Married at 15-17	1201	3156	4358	
		(27.6%)	(72.4%)	(33.9%)	
	Not married before 18	3966	570	4536	
		(87.4%)	(12.6%)	(35.3%)	
	Never in union	2669	0	2669	
		(100.0%)	(0.0%)	(20.8%)	
Ethnicity	Hill Brahmin	1110	402	1512	<.001
		(73.4%)	(26.6%)	(11.8%)	
	Hill Chhetri	1570	773	2343	
		(67.0%)	(33.0%)	(18.2%)	
	Terai Brahmin/Chhetri	152	66	217	
		(69.8%)	(30.3%)	(1.7%)	
	Other Terai caste	927	982	1908	
		(48.6%)	(51.4%)	(14.8%)	
	Hill Dalit	568	474	1042	
		(54.5%)	(45.5%)	(8.1%)	
	Terai Dalit	252	302	554	
		(45.5%)	(54.5%)	(4.3%)	
	Newar	502	138	639	
		(78.5%)	(21.5%)	(5.0%)	
	Hill Janajati	1766	929	2694	
		(65.5%)	(34.5%)	(20.9%)	
	Terai Janajati	797	470	1266	
		(62.9%)	(37.1%)	(9.8%)	
	Muslim	334	309	643	
		(52.0%)	(48.0%)	(5.0%)	
	Other	33	10	43	
		(52.0%)	(48.0%)	(0.3%)	
Education level	No education	1954	2327	4281	<.001
		(45.7%)	(54.4%)	(33.3%)	
	Primary or less	1042	1108	2150	
		(48.5%)	(51.5%)	(16.7%)	
	Secondary or higher	5012	1419	6431	
		(77.9%)	(22.1%)	(50.0%)	
Media exposure	Both at least once a week	1427	584	2011	<.001
		(71.0%)	(29.0%)	(15.6%)	
	Only one at least once a week	3913	2100	6013	
		(65.1%)	(34.9%)	(46.8%)	
	No access	2668	2169	4838	
		(55.2%)	(44.8%)	(37.6%)	

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Religion	Hindu	6841	4199	11040	<.001
		(62.0%)	(38.0%)	(85.8%)	
	Buddhism	467	185	652	
		(71.7%)	(28.3%)	(5.1%)	
	Muslim	338	306	644	
		(52.5%)	(47.5%)	(5.0%)	
	Other	362	164	526	
		(68.9%)	(31.1%)	(4.1%)	
Occupation	Agricultural	3491	2520	6011	<.001
		(58.1%)	(41.9%)	(46.7%)	
	Non-agricultural	1765	827	2592	
		(68.1%)	(31.9%)	(20.2%)	
	Not working	2753	1506	4259	
		(64.6%)	(35.4%)	(33.1%)	
Sex of the household head	Male	5521	3345	8866	.385
		(62.3%)	(37.7%)	(68.9%)	
	Female	2488	1508	3996	
		(62.3%)	(37.7%)	(31.1%)	
Spousal age gap	Under 5 years	3383	2597	5980	<.001
		(56.6%)	(43.4%)	(46.5%)	
	5-9 years	1373	1544	2918	
		(47.1%)	(52.9%)	(22.7%)	
	10-14 years	308	413	721	
		(42.7%)	(57.3%)	(5.6%)	
	15-19 years	57	99	157	
		(36.7%)	(63.3%)	(1.2%)	
	20 years or more	55	44	100	
		(55.6%)	(44.4%)	(0.8%)	
	Not applicable	2832	155	2987	
		(94.8%)	(5.2%)	(23.2%)	
Intermediary Determinants					
Wealth index	Poor	1485	1110	2595	<.001
		(57.2%)	(42.8%)	(20.2%)	
	Middle	2747	1954	4701	
		(58.4%)	(41.6%)	(36.6%)	
	Rich	3777	1790	5566	
		(67.9%)	(32.2%)	(43.3%)	

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Community Level					
Structural Determinants					
Province	Province 1	1524 (70.1%)	649 (29.9%)	2173 (16.9%)	<.001
	Province 2	1203 (46.9%)	1360 (53.1%)	2563 (19.9%)	
	Province 3	1964 (71.9%)	768 (28.1%)	2732 (21.2%)	
	Province 4	801 (64.1%)	448 (35.9%)	1249 (9.7%)	
	Province 5	1433 (63.0%)	841 (37.0%)	2274 (17.7%)	
	Province 6	410 (56.6%)	314 (43.4%)	724 (5.6%)	
	Province 7	673 (58.8%)	472 (41.3%)	1145 (8.9%)	
Place of residence	Urban	5288 (65.5%)	2785 (34.5%)	8072 (62.8%)	<.001
	Rural	2721 (56.8%)	2068 (43.2%)	4790 (37.2%)	
Community education level	Low	3568 (54.3%)	3009 (45.8%)	6577 (51.1%)	<.001
	High	4441 (70.7%)	1844 (29.3%)	6285 (48.9%)	
Community media exposure	Low	3371 (55.7%)	2683 (44.3%)	6054 (47.1%)	<.001
	High	4638 (68.1%)	2170 (31.9%)	6808 (52.9%)	
Community wealth level	Low	2200 (61.5%)	1380 (38.6%)	3581 (27.8%)	.425
	High	5809 (62.6%)	3473 (37.4%)	9281 (72.2%)	
Total		**8009 (62.3%)**	**4853 (37.7%)**	**12862 (100.0%)**	

More than two-thirds (69 %) of the respondents have male family member as the head of their households. The age difference of their spouses is under 5 years for about 46.5 % of women and 5 to 9 years for about 23 %. About 20 % of the sample is poor, 37 % is in the middle, and 43 % is rich.

Provinces 2, 3, and 5 consist roughly 20 % of the Nepali population: 20 %, 21%, 18 %, respectively. Province 1 has 17 %, while Provinces 4, 6, and 7 have 10 %, 6 %, and 9 % of the population, respectively. More than half (63 %) resides in urban areas. About half (51 %) of individuals are from clusters with lower level of community educational attainment. Slightly less than half (47 %) of the full sample is nested in clusters with higher proportions of people with less media exposure. About 28 % of women are living in communities with higher proportion of poor households.

Table 5 is the descriptive statistics of women aged 15 to 19. This age subgroup consists of 2,598 individuals, which is 20.2 % of the full sample. About 13 % (N = 334) of the subgroup was/is pregnant as adolescence. Majority of the subgroup (72.5 %) has never in union. About 4 % (N = 107) has been married before 15 and 20 % (N = 512) between 15 and 17. Thus, about 24 % of 15 to 19-aged Nepali women has already been married as a child, despite some individuals who have not yet been fully exposed to the risk of child marriage. The distribution of caste/ethnicity resembles that of the full sample, with Hill Janajati (21 %) as the largest proportion, followed by Hill Chhetri (17 %), other Terai caste (16 %), Hill Dalit (9.7 %), Terai Janajati (9.6 %), Hill Brahmin (9 %), Muslim (6.5 %), Terai Dalit (5.2 %), Newar (4.5 %), and Terai Brahmin/Chhetri (1.3 %). Unlike the full sample, a large majority of this subgroup (81 %) has secondary or higher level of educational

attainment. About 31 % of the subgroup has no access to media. Similar to the full sample, most (84 %) of 15-19 aged Nepali women is Hindu. As the youngest age group, about 47 % of the subgroup are not working, while another 42 % are working in the agricultural sector. Slightly more than two-thirds (71 %) of the subgroup has a male family member as the household head. A majority (73 %, N = 1,894) of the 15-19 age subgroup is one of the following: never in union, widowed, divorced, or no longer living together/separated. Among individuals not categorized as 'not applicable', which consist of 27 % of the subgroup, 35.5 % (N = 249) have a partner whose age is 5 to 9 years older than themselves.[21] As one of the intermediary determinants, the wealth index of the subgroup is similar to that of the full sample, with about 21 % of poor, 39 % of middle, and 40 % of rich categories. Descriptive statistics on the five community-level variables of the 15 to 19 subgroup is similar to that of the full sample.

[21] The proportion of 35.5 % was computed by only including those 15-19 aged individuals who are not categorized as 'not applicable' in the spousal age gap variable.

Table 5. Descriptive statistics results (15-19 age group).

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Individual Level					
Structural Determinants					
Age at first marriage	Married before 15	32	76	107	<.001
		(29.6%)	(70.4%)	(4.1%)	
	Married at 15-17	274	238	512	
		(53.6%)	(46.4%)	(19.7%)	
	Not married before 18	73	21	94	
		(77.6%)	(22.4%)	(3.6%)	
	Never in union	1885	0	1885	
		(100.0%)	(0.0%)	(72.5%)	
Ethnicity	Hill Brahmin	220	13	233	<.001
		(94.4%)	(5.6%)	(9.0%)	
	Hill Chhetri	398	44	442	
		(90.0%)	(10.0%)	(17.0%)	
	Terai Brahmin/Chhetri	30	2	33	
		(93.3%)	(6.7%)	(1.3%)	
	Other Terai caste	336	80	416	
		(80.8%)	(19.2%)	(16.0%)	
	Hill Dalit	213	39	252	
		(84.4%)	(15.6%)	(9.7%)	
	Terai Dalit	107	27	134	
		(79.6%)	(20.4%)	(5.2%)	
	Newar	108	7	116	
		(93.5%)	(6.5%)	(4.5%)	
	Hill Janajati	482	64	546	
		(88.3%)	(11.7%)	(21.0%)	
	Terai Janajati	223	26	248	
		(89.6%)	(10.5%)	(9.6%)	
	Muslim	138	31	169	
		(81.7%)	(18.4%)	(6.5%)	
	Other	9	0	9	
		(100.0%)	(0.0%)	(0.3%)	
Education level	No education	113	45	159	<.001
		(71.4%)	(28.6%)	(6.1%)	
	Primary or less	265	82	347	
		(76.5%)	(23.5%)	(13.3%)	
	Secondary or higher	1886	208	2093	
		(90.1%)	(9.9%)	(80.6%)	
Media exposure	Both at least once a week	428	39	468	<.001
		(91.6%)	(8.4%)	(18.0%)	
	Only one at least once a week	1172	146	1318	
		(89.0%)	(11.1%)	(50.7%)	
	No access	664	149	813	
		(81.6%)	(18.4%)	(31.3%)	

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Religion	Hindu	1899	285	2184	.044
		(87.0%)	(13.0%)	(84.1%)	
	Buddhism	129	9	139	
		(93.2%)	(6.8%)	(5.3%)	
	Muslim	139	31	170	
		(81.7%)	(18.3%)	(6.5%)	
	Other	97	9	106	
		(91.4%)	(8.6%)	(4.1%)	
Occupation	Agricultural	953	147	1100	.157
		(86.6%)	(13.4%)	(42.3%)	
	Non-agricultural	265	18	283	
		(93.7%)	(6.3%)	(10.9%)	
	Not working	1046	170	1216	
		(86.0%)	(14.0%)	(46.8%)	
Sex of the household head	Male	1596	252	1848	.353
		(86.4%)	(13.6%)	(71.1%)	
	Female	668	83	750	
		(89.0%)	(11.0%)	(28.9%)	
Spousal age gap	Under 5 years	214	164	378	<.001
		(56.7%)	(43.3%)	(14.6%)	
	5-9 years	125	125	249	
		(50.1%)	(49.9%)	(9.6%)	
	10-14 years	30	36	65	
		(45.2%)	(54.8%)	(2.5%)	
	15-19 years	2	6	8	
		(22.7%)	(77.3%)	(0.3%)	
	20 years or more	3	1	3	
		(83.6%)	(16.4%)	(0.1%)	
	Not applicable	1890	3	1894	
		(99.8%)	(0.2%)	(72.9%)	
Intermediary Determinants					
Wealth index	Poor	453	91	545	<.001
		(83.3%)	(16.8%)	(21.0%)	
	Middle	860	158	1018	
		(84.5%)	(15.5%)	(39.2%)	
	Rich	950	85	1035	
		(91.8%)	(8.2%)	(39.8%)	
		453	91	545	

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Community Level					
Structural Determinants					
Province	Province 1	362 (86.9%)	55 (13.1%)	417 (16.0%)	<.001
	Province 2	438 (79.0%)	116 (21.0%)	554 (21.3%)	
	Province 3	479 (92.6%)	38 (7.4%)	518 (19.9%)	
	Province 4	208 (88.8%)	26 (11.2%)	234 (9.0%)	
	Province 5	416 (89.7%)	48 (10.4%)	464 (17.9%)	
	Province 6	143 (87.9%)	20 (12.1%)	163 (6.3%)	
	Province 7	217 (87.4%)	31 (12.7%)	249 (9.6%)	
Place of residence	Urban	1448 (90.3%)	155 (9.7%)	1603 (61.7%)	.001
	Rural	816 (82.0%)	179 (18.0%)	996 (38.3%)	
Community education level	Low	1167 (83.0%)	240 (17.1%)	1407 (54.1%)	<.001
	High	1097 (92.1%)	95 (7.9%)	1192 (45.9%)	
Community media exposure	Low	1102 (83.2%)	223 (16.8%)	1325 (51.0%)	<.001
	High	1162 (91.3%)	111 (8.8%)	1273 (49.0%)	
Community wealth level	Low	676 (86.0%)	110 (14.0%)	787 (30.3%)	.564
	High	1588 (87.6%)	224 (12.4%)	1812 (69.7%)	
Total		**2264 (87.1%)**	**334 (12.9%)**	**2598 (100.0%)**	

Table 6 presents the descriptive statistics for the second subgroup, 20-29 aged Nepali women. Out of the 4,385 individuals, 40 % (N = 1,757) was pregnant during adolescence. Regarding child marriage, about 9 % (N = 396) of this subgroup has been married before 15 and about 33 % (N = 1,451) at 15-17, resulting in 42 % (N = 1,847) of young women to have been married as a child. Including those who were not married under 18, a vast majority (84 %) of 20-29 age group has been married or lived with a partner. The caste/ethnicity distribution of this subgroup is also similar with that of the full sample. Hill Janajati consist the largest proportion (21 %), followed by Hill Chhetri (19 %), other Terai caste (15 %), Hill Brahmin (11 %), Terai Janajati (10 %), Hill Dalit (8 %), Muslim (5 %), Newar (4.5 %), Terai Dalit (4 %), and Terai Brahmni/Chhetri (2 %). In this subgroup, although the percentage of those with secondary or higher education attainment is higher than the full sample (62 % vs 50 %), it is lower than that of the 15-19 age subgroup (62 % vs 81 %). About 36 % of 20-29 aged group has no access to media. Like the two previous samples, a vast majority (86 %) of 20-20 age subgroup is Hindu. About 36 % is not working, while 41 % and 24 % work in the agricultural and non-agricultural sector, respectively. Like other two samples, a majority (68 %) of this subgroup has male as the head of their households. About a quarter (26 %) of these individuals has a partner whose age is 5 to 9 years older than themselves. Descriptive statistics on the five community-level variables of the 20 to 29 subgroup is similar to that of the full sample and the 15 to 19 age subgroup.

Table 6. Descriptive statistics results (20-29 age group).

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Individual Level					
Structural Determinants					
Age at first marriage	Married before 15	42	354	396	<.001
		(10.6%)	(89.4%)	(9.0%)	
	Married at 15-17	315	1136	1451	
		(21.7%)	(78.3%)	(33.1%)	
	Not married before 18	1576	267	1843	
		(85.5%)	(14.5%)	(42.0%)	
	Never in union	695	0	695	
		(100.0%)	(0.0%)	(15.9%)	
Ethnicity	Hill Brahmin	406	96	501	<.001
		(80.9%)	(19.1%)	(11.4%)	
	Hill Chhetri	549	293	842	
		(65.2%)	(34.8%)	(19.2%)	
	Terai Brahmin/Chhetri	48	21	69	
		(70.1%)	(29.9%)	(1.6%)	
	Other Terai caste	267	406	673	
		(39.7%)	(60.3%)	(15.4%)	
	Hill Dalit	157	175	331	
		(47.3%)	(52.7%)	(7.6%)	
	Terai Dalit	66	110	176	
		(37.5%)	(62.5%)	(4.0%)	
	Newar	168	28	196	
		(85.8%)	(14.2%)	(4.5%)	
	Hill Janajati	578	354	932	
		(62.0%)	(38.0%)	(21.3%)	
	Terai Janajati	289	157	446	
		(64.7%)	(35.3%)	(10.2%)	
	Muslim	93	112	205	
		(45.4%)	(54.6%)	(4.7%)	
	Other	7	5	12	
		(58.2%)	(41.9%)	(0.3%)	
Education level	No education	340	579	919	<.001
		(37.0%)	(63.0%)	(21.0%)	
	Primary or less	294	449	742	
		(39.6%)	(60.5%)	(16.9%)	
	Secondary or higher	1995	729	2724	
		(73.3%)	(26.8%)	(62.1%)	
Media exposure	Both at least once a week	512	198	710	<.001
		(72.1%)	(27.9%)	(16.2%)	
	Only one at least once a week	1359	758	2117	
		(64.2%)	(35.8%)	(48.3%)	
	No access	757	800	1557	
		(48.6%)	(51.4%)	(35.5%)	

		Adolescent Pregnancy			*p-value*
		No	**Yes**	**Total**	
Religion	Hindu	2252	1512	3765	<.001
		(59.8%)	(40.2%)	(85.9%)	
	Buddhism	146	63	209	
		(69.9%)	(30.1%)	(4.8%)	
	Muslim	92	111	203	
		(45.2%)	(54.8%)	(4.6%)	
	Other	138	70	208	
		(66.5%)	(33.5%)	(4.8%)	
Occupation	Agricultural	962	827	1789	<.001
		(53.8%)	(46.2%)	(40.8%)	
	Non-agricultural	744	293	1037	
		(71.8%)	(28.2%)	(23.6%)	
	Not working	923	637	1559	
		(59.2%)	(40.8%)	(35.6%)	
Sex of the household head	Male	1805	1181	2986	0
		(60.5%)	(39.6%)	(68.1%)	
	Female	823	576	1399	
		(58.9%)	(41.2%)	(31.9%)	
Spousal age gap	Under 5 years	1243	956	2199	<.001
		(56.5%)	(43.5%)	(50.1%)	
	5-9 years	533	596	1129	
		(47.2%)	(52.8%)	(25.7%)	
	10-14 years	105	130	235	
		(44.8%)	(55.2%)	(5.4%)	
	15-19 years	19	36	54	
		(34.6%)	(65.5%)	(1.2%)	
	20 years or more	12	13	24	
		(47.6%)	(52.4%)	(0.6%)	
	Not applicable	717	27	744	
		(96.4%)	(3.6%)	(17.0%)	
Intermediary Determinants					
Wealth index	Poor	506	406	913	<.001
		(55.5%)	(44.5%)	(20.8%)	
	Middle	787	741	1528	
		(51.5%)	(48.5%)	(34.8%)	
	Rich	1336	609	1945	
		(68.7%)	(31.3%)	(44.4%)	
		506	406	913	

		Adolescent Pregnancy			p-value
		No	**Yes**	**Total**	
Community Level					
Structural Determinants					
Province	Province 1	512 (67.4%)	248 (32.6%)	760 (17.3%)	<.001
	Province 2	349 (39.7%)	530 (60.3%)	879 (20.0%)	
	Province 3	686 (74.5%)	235 (25.5%)	921 (21.0%)	
	Province 4	269 (63.6%)	154 (36.4%)	423 (9.6%)	
	Province 5	483 (62.8%)	286 (37.2%)	769 (17.5%)	
	Province 6	115 (45.8%)	136 (54.2%)	251 (5.7%)	
	Province 7	215 (56.2%)	168 (43.9%)	383 (8.7%)	
Place of residence	Urban	1791 (65.2%)	957 (34.8%)	2748 (62.7%)	<.001
	Rural	838 (51.2%)	799 (48.8%)	1637 (37.3%)	
Community education level	Low	1042 (47.7%)	1141 (52.3%)	2184 (49.8%)	<.001
	High	1586 (72.1%)	615 (28.0%)	2202 (50.2%)	
Community media exposure	Low	1010 (48.9%)	1057 (51.2%)	2066 (47.1%)	<.001
	High	1619 (69.8%)	700 (30.2%)	2319 (52.9%)	
Community wealth level	Low	652 (56.1%)	509 (43.9%)	1161 (26.5%)	0
	High	1977 (61.3%)	1247 (38.7%)	3224 (73.5%)	
Total		**2629 (59.9%)**	**1757 (40.1%)**	**4385 (100.0%)**	

Below is the descriptive statistics regarding the incidence of adolescent pregnancy for each individual- and community-level explanatory variable. Only the result of the full sample is explained. In the full sample, 86.7 % (N = 1,127) of those married before 15 and 72.4 % (N = 3,156) of those married at 15-17 were/are pregnant during adolescence (Table 4). All respondents who have never been in union (N = 2,669) were/are not pregnant as teenagers. The prevalence of adolescent pregnancy substantially varies by caste/ethnicity. While less than a third of Newar (21.5 %), Hill Brahmin (27 %), and Terai Brahmin/Chhetri (30 %) have experienced teenage pregnancy, about half of Terai Dalit (54.5 %), other Terai caste (51 %), and Muslim (48 %) have so. As for educational attainment, only 22 % of those with secondary or higher level of education has been pregnant during 10-19, but about half of those without any education (54 %) and with primary or less (51.5 %) have been so. Among the individuals who responded that they watch TV and listen to the radio at least once a week, 29 % have experienced early pregnancy, but about 45 % of those without any media exposure have so. While the percentages of individuals who were/are pregnant as adolescence for Hindus and Buddhists are 38 % and 28 %, respectively, the percentage reaches 47.5 % for Muslims. About 42 % of those with agricultural jobs was/is pregnant as a teenager. As the spousal age gap becomes wider, the prevalence of teenage pregnancy increases from 43 % for under 5 years to 63 % for 15-19 years, except for those with 20 years or more. More than 40 % of those in poor (43 %) and middle (42 %) wealth index households were/are pregnant during 10 to 19.

The prevalence of adolescent pregnancy varied in different provinces; proportions of teenage pregnancy in each province range from 28 % to 53 %. The

lowest is shown in Province 3 (28 %), followed by Province 1 (30 %). The highest is seen in Province 2 (53 %), which is located in the southeast of Nepal, the Terai region. Provinces 6 and 7 have approximately 42 % and provinces 4 and 5 have slightly lower prevalence, with about 36 %. Regarding place of residence, about 43 % of those living in rural areas has experienced teenage pregnancy. Among individuals who live in communities with lower level of educational attainment, 46 % was/is pregnant as adolescence. For respondents nested in clusters with less access to media, 44 % has been/is pregnant as adolescence. Regarding community wealth level, however, the prevalence of teenage pregnancy is not so much different.

Result of the chi-squared analysis for the full sample shows that, almost all independent variables have significant relationships with the outcome at the <.001 significance level, except for the sex of the household head and community wealth level variables. For the first subgroup, the 15 to 19 age group, the chi-squared analysis indicates that most variables have significant relationships with the outcome at the <.001 significance level, except for four variables: religion, occupation, sex of the household head, and community wealth level. The chi-squared analysis of the second subgroup, the 20 to 29 age group, is the same with that of the full sample: all independent variables, except for sex of the household head and community wealth level, have significant associations with adolescent pregnancy.

4.2 Multilevel Logistic Regression Analysis

This study used a two-level mix-effects logistic regression to investigate factors associated with adolescent pregnancy in Nepal. As a multilevel approach, random intercept models were fitted, not only including individual- and community-level variables, but also computing fixed- and random-effects. Fixed effects are reported with adjusted odds ratios (AOR) and their 95% confidence interval (95% CI). Random effects are shown using intraclass correlation coefficients (ICC) and proportional change in variance (PCV). Goodness-of-fit is reported with Akaike information criterion (AIC) and Bayesian information criterion (BIC). Multilevel analyses in this study applied level-1 (individual) and level-2 (cluster) sample weights.

In this study, three different samples of women aged 15-49 (full sample), 15-19 (subgroup 1), and 20-29 (subgroup 2) were selected. For each sample, different sets of explanatory variables were included, shown in four models (Model 1-4). These results of the fixed- and random-effects for each sample are shown in Table 7-9. Results of additional models (Model 5-7, Model 3A-3C) are presented in the appendix.

4.2.1 Results with a Full Sample

The full sample had 12,862 women aged 15-49 and 383 clusters (communities). Table 7 presents the two-level mixed-effects logistic regression analysis results for the full sample, shown in four different models.

In the following, fixed effects are explained. After the null model, all individual-level variables were added in Model 2. Results show that age at first

marriage, ethnicity, education level, and spousal age gap are statistically significant at p<.001 level. Age at first marriage had the highest adjusted odds ratio (AOR). Women married before 15 were 54.6 times [AOR: 54.55; 95% CI: 43.66, 68.17] more likely to be pregnant as adolescence compared to those who were not married as a child. Those married at 15-17 were 22.7 times [AOR: 22.74; 95% CI: 19.51, 26.52] more likely to be pregnant during adolescence, compared to the same reference group. Regarding ethnicity, compared to Hill Brahmins, Muslims had 2.6 times [AOR: 2.59; 95% CI: 1.03, 6.51], Hill Dalits had 1.6 times [AOR: 1.64; 95% CI: 1.22, 2.19] and Hill Janajatis had 1.4 times [AOR: 1.40; 95% CI: 1.10, 1.80] higher odds of adolescent pregnancy. Women with no education were 1.6 times [AOR: 1.59; 95% CI: 1.33, 1.92] and those with primary or less education level were 1.7 times [AOR: 1.71; 95% CI: 1.44, 2.02] more likely to experience pregnancy during adolescence, when compared with those with secondary or higher educational attainment. Hindu women were 1.6 times [AOR: 1.57; 95% CI: 1.13, 2.20] more likely to be pregnant as adolescents, compared with Buddhists. Regarding the age gap between partners, when compared with those with under 5 years age difference, spousal age gap of 5-9 years, 10-14 years, and 15-19 years increased the odds of adolescent pregnancy by 30%, 53%, and 110%, respectively [AOR: 1.30; 95% CI: 1.13, 1.50] [AOR: 1.53; 95% CI: 1.19, 1.95] [AOR: 2.09; 95% CI: 1.24, 3.53].

In Model 3, only the community-level factors were selected as explanatory variables. Results demonstrate that province (p<.001), community education level (p<.001), and place of residence (p<.01) were statistically significant. Compared to those living in Province 1, those in Provinces 2 and 6 were, respectively, 2.2 and 1.7 times more likely to experience [AOR: 2.19; 95% CI: 1.72, 2.80 and AOR: 1.65; 95%

CI: 1.29, 2.10, respectively]. Among the aggregated community-level variables, individuals living in a community with a higher education level[22] were 30 % less [AOR: 0.70; 95% CI: 0.63, 0.78] likely to be pregnant as adolescents, compared to the reference group.

The final and full model included all of the independent variables. Just as the results of Model 2, Model 4 showed age at first marriage, ethnicity, education level, and spousal age gap to be statistically significant ($p<.001$). Most of these individual-level variables in Model 4 had the same level of significance and similar values of AORs in Model 2. On the contrary, most community-level variables had different results in Model 4 to a large extent. The province variable showed considerable differences. In Model 3, women living in Provinces 2, 4, 5, 6, and 7 all showed higher AORs of adolescent pregnancy compared to Province 1 ($p<.001$, except for Province 5), with a maximum AOR value of 2.2 [95% CI: 1.72, 2.80] for Province 2. In the final model, however, every province did not show a statistically significant value of AOR and had much lower value of AOR. Similarly, community education level lost its statistical significance in Model 4, which had a p-value below .001 in the previous model. Higher level of community wealth index, in contrast, had a weakly significant AOR of 1.3 [95% CI: 1.00, 1.66].

This study also fitted additional models (Model 5-7), which excluded the age at first marriage variable, to further investigate factors associated with adolescent pregnancy. In particular, Model 6 included only the statistically significant variables

[22] Higher education level in this context refers to having one's highest educational attainment as secondary or higher. The proportion of individuals with higher education level was computed for each cluster, then the median value was used to determine 'high' or 'low' category for the community-level variable. More explained in Chapter 3.3.2

in Model 5 as covariates (Table 13 in Appendix D). Results of Model 6 demonstrates that, holding other factors fixed, several caste/ethnicity groups have higher odds of adolescent pregnancy (p<.001). Hill Dalits were 2 times [AOR: 1.97; 95% CI: 1.60, 2.43], Terai Dalit and other Terai caste women were 1.7 times [AOR: 1.73; 95% CI: 1.25, 2.39 and AOR: 1.70; 95% CI: 1.31, 2.21, respectively] more likely to be pregnant during adolescence, compared to Hill Brahmin women. Individual education level was also significantly associated with adolescent pregnancy when other factors were fixed (p<.001). Compared to those with secondary or higher education level, those without any education had 2.3 times [AOR: 2.28; 95% CI: 1.99, 2.62] and those with primary or less education had 2.5 times [AOR: 2.48; 95% CI: 2.15, 2.85] higher odds of early pregnancy.

Furthermore, the random effects are explained by ICC and PCV. Model 1 is a null model without any explanatory variables. For Model 1, the between-group variance was 0.17 and the value of ICC was 0.0493, which indicates that about 4.9 % of the total variation on adolescent pregnancy is explained by community (cluster)-level. The ICC values of Model 2-4 were 3.0 %, 1.9 %, and 3.0 %, respectively. The PCV value in the final model was 0.3853. The AIC values show the goodness-of-fit of each model. Lower AIC values indicate better goodness-of-fit, but values of Model 2 and 4 are not much different (9906 vs 9911, respectively). The PCV value for each community-level variable is presented in Table 19 (Appendix F). Although the ICC value of the null model for the full sample is low, with 4.93 %, province and community education level showed the largest change of variance, with PCV values of 47.9 % and 34.4 %, respectively.

Table 7. Multilevel logistic regression results (Full sample).

MULTI-LEVEL	Model 1		Model 2			Model 3		Model 4		
FULL SAMPLE	**AOR**	**95% CI**	**AOR**	**95% CI**		**AOR**	**95% CI**	**AOR**	**95% CI**	
Individual Level										
Age at first marriage										
Not married as a child			Reference	.	.			Reference	.	.
Married before 15			54.55***	43.66	68.17			54.65***	43.72	68.31
Married at 15-17			22.74***	19.51	26.52			22.87***	19.59	26.70
Ethnicity										
Hill Brahmin			Reference	.	.			Reference	.	.
Hill Chhetri			1.048	0.844	1.301			1.070	0.855	1.339
Terai Brahmin/Chhetri			0.970	0.495	1.900			1.027	0.501	2.106
Other Terai caste			0.979	0.741	1.294			1.033	0.709	1.504
Hill Dalit			1.638***	1.224	2.191			1.664***	1.244	2.226
Terai Dalit			0.858	0.594	1.239			0.885	0.588	1.330
Newar			0.976	0.701	1.360			0.969	0.692	1.357
Hill Janajati			1.404**	1.098	1.795			1.441**	1.123	1.849
Terai Janajati			1.267	0.963	1.667			1.264	0.922	1.732
Muslim			2.590*	1.031	6.507			2.703*	1.069	6.837
Other			1.478	0.440	4.962			1.523	0.448	5.177
Education Level										
Secondary or higher			Reference	.	.			Reference	.	.
No education			1.593***	1.325	1.916			1.572***	1.304	1.896
Primary or less			1.707***	1.444	2.018			1.688***	1.424	2.002
Media Exposure										
No access			Reference	.	.			Reference	.	.
Both at least once a week			1.216	0.986	1.499			1.206	0.976	1.489
Only one at least once a week			1.109	0.965	1.274			1.096	0.952	1.262

MULTI-LEVEL FULL SAMPLE	Model 1 AOR	Model 1 95% CI		Model 2 AOR	Model 2 95% CI		Model 3 AOR	Model 3 95% CI		Model 4 AOR	Model 4 95% CI	
Religion												
Buddhist				Reference	.	.				Reference	.	.
Hindu				1.573**	1.126	2.196				1.649**	1.192	2.283
Muslim				0.560	0.213	1.472				0.583	0.221	1.533
Other				1.530	0.968	2.419				1.590*	1.009	2.508
Occupation												
Not working				Reference	.	.				Reference	.	.
Agricultural				1.019	0.874	1.187				1.027	0.880	1.199
Non-agricultural				1.161	0.956	1.410				1.150	0.945	1.399
Sex of the household head												
Male				Reference	.	.				Reference	.	.
Female				1.145*	1.001	1.311				1.139	0.993	1.307
Spousal age gap												
Under 5 years				Reference	.	.				Reference	.	.
5-9 years				1.302***	1.130	1.500				1.302***	1.128	1.501
10-14 years				1.525***	1.192	1.951				1.522***	1.190	1.946
15-19 years				2.094**	1.243	3.528				2.079**	1.234	3.503
20 years or more				0.799	0.408	1.562				0.792	0.405	1.551
Not in union				0.225***	0.182	0.278				0.223***	0.180	0.275
Wealth index												
Poor				Reference	.	.				Reference	.	.
Middle				1.040	0.874	1.237				1.098	0.907	1.328
Rich				1.160	0.959	1.402				1.134	0.935	1.375
Community-level												
Province												
Province 1							Reference	.	.	Reference	.	.
Province 2							2.192***	1.720	2.795	0.884	0.658	1.187

MULTI-LEVEL FULL SAMPLE	Model 1 AOR	95% CI		Model 2 AOR	95% CI		Model 3 AOR	95% CI		Model 4 AOR	95% CI	
Province 3							1.222*	1.017	1.469	1.150	0.894	1.479
Province 4							1.462***	1.216	1.758	1.204	0.918	1.580
Province 5							1.335**	1.101	1.618	0.953	0.744	1.221
Province 6							1.648***	1.293	2.100	1.081	0.817	1.429
Province 7							1.506***	1.223	1.855	1.253	0.936	1.677
Place of residence												
Urban							Reference	.	.	Reference	.	.
Rural							1.196**	1.075	1.331	1.091	0.946	1.258
Community education level												
Low							Reference	.	.	Reference	.	.
High							0.702***	0.630	0.781	0.882	0.739	1.052
Community media exposure												
Low							Reference	.	.	Reference	.	.
High							0.966	0.859	1.085	1.136	0.954	1.354
Community wealth index												
Low							Reference	.	.	Reference	.	.
High							1.135	0.998	1.292	1.289*	1.003	1.656
Community-level Variance	0.171	0.128	0.227	0.102	0.079	0.132	0.063	0.049	0.081	0.103	0.080	0.132
Observations	12862			12862			12862			12862		
ICC(%)	4.93%			3.01%			1.88%			3.03%		
PCV(%)	Reference			39.01%			61.84%			38.53%		
AIC	16995			9906			16811			9911		
BIC	17010			10137			16901			10217		

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

4.2.2 Results for Subgroups of 15-19 and 20-29

The following are multilevel analysis results of two subgroups: 15-19 aged (N = 2,622) and 20-29 aged (N = 4,400) Nepali women. Model 1 is the null model and Model 4 the full model.

1) Subgroup 1

The fist subgroup had a total of 2,614 women and 382 clusters.[23] Table 8 presents the two-level mixed-effects logistic regression analysis results for subgroup 1, shown in four different models. In subgroup 1, the religion variable was excluded because, in this sample, the 'Muslim' category in religion seemed to affect the coefficient estimate of the 'Muslim' category in ethnicity.

In the following, fixed effects are explained. After the null model, all individual-level variables were added in Model 2. Results showed that age at first marriage, occupation, and spousal age gap were statistically significant. Age at first marriage also had the highest values of AORs than any other variables. Compared to those who were not married as a child, 15-19 aged Nepali girls who were married before the age of 15 were 17.1 times [AOR: 17.13; 95% CI: 4.70, 62.38] ($p<.001$) more likely to become pregnant during adolescence. Those who were married between the ages 15 to 17 were 4.8 times [AOR: 4.80; 95% CI: 1.33, 17.33] ($p<.05$) more likely experience adolescent pregnancy, compared to the same reference group.

[23] Initially, the number of women in subgroup 1 was 2,622 (unweighted) but women categorized as 'other' in the ethnicity variable (N = 8, unweighted) were omitted because they all had the same outcome ('no' adolescent pregnancy). Also, the number of clusters was originally 383, but one cluster (#130) was nested by only two 15-19 aged individuals, one of which had 'other' ethnicity.

Regarding ethnicity, although not significant, Terai Brahmin/Chhetri, Newar, and Hill Dalit in the 15-19 age group sample showed sharp differences of AORs when compared to the full sample. Having non-agricultural occupations decreased the odds of adolescent pregnancy by 70 % [AOR: 0.32; 95% CI: 0.13, 0.82] when compared to not working. As for spousal age gap, older teenagers who had 10-14 years older partners were 2.5 times [AOR: 2.49; 95% CI: 1.12, 5.50] more likely to experience adolescent pregnancy compared to those who had partners under 5 years older.

A limited number of community-level factors were found to be significant in adolescent pregnancy ($p<.05$) as shown in Model 3. Living in Province 6, compared to Province 1, decreased the odds of adolescent pregnancy by 50 % [AOR: 0.50; 95% CI: 0.27, 0.90] for 15-19 aged girls. Living in rural areas, compared to urban areas, increased the odds by 54 % [AOR: 1.54; 95% CI: 1.07, 2.22]. None of the aggregated community-level variables were significant.

Model 4 is the full model, including both the individual- and community-level factors. Much similar to Model 2, the full model showed age at first marriage as an important individual-level factor on adolescent ($p<.001$). The values of AOR were slightly higher than Model 2. Having a non-agricultural occupation, compared to not working, was also associated with not experiencing pregnancy in adolescence. Community-level factors were also similar with Model 3. In the full model, individuals living in Province 6 were 66 % less [AOR: 0.34; 95% CI: 0.15, 0.80] likely to be pregnant during adolescence, compared to those living in Province 1 ($p<.05$). Place of residence was no longer statistically significant. Unlike the full sample, further multilevel analysis of subgroup 1 does not indicate significant associations of ethnicity or education level on adolescent pregnancy (Table 14 in

Appendix D). Yet, larger spousal age difference significantly affected the experience of early pregnancy, holding other factors fixed ($p<.05$).

The random effects are explained by ICC and PCV values. The null model's ICC was 0.1685, which means that about 16.85 % of the total variation on adolescent pregnancy occurred at the community (cluster)-level. The ICC values of Model 2-4 were 18.63 %, 12.26 %, and 17.58 %, respectively. The value of PCV in Model 4 was –4.31 %; the proportion of community-level variance of the full model was actually larger than that of the null model. Model 3 had the largest PCV, with 27.3 %, which suggests that, for subgroup 1, community-level variables in Model 3 explain more of the cluster-level variations than individual-level variables. As for the AIC values, Model 2 and 4 had similar values: 1034 and 1031. The PCV value for each community-level variable, in regard to the null model, is shown in Table 19 (Appendix F). Although the 15-19 age group had the largest ICC value of the null model (16.85 %) out of all three samples, neither province nor community education level affected much change in ICC values, with PCV values of 11.9 % and 12.2 %, respectively.

Table 8. Multilevel logistic regression results (15-19 age group).

MULTI-LEVEL	Model 1		Model 2			Model 3		Model 4		
SUBGROUP 1	**AOR**	**95% CI**	**AOR**	**95% CI**		**AOR**	**95% CI**	**AOR**	**95% CI**	
Individual Level										
Age at first marriage										
Not married as a child			Reference	.	.			Reference	.	.
Married before 15			17.13***	4.703	62.38			18.20***	4.988	66.43
Married at 15-17			4.798*	1.328	17.33			5.129*	1.433	18.35
Ethnicity										
Hill Brahmin			Reference	.	.			Reference	.	.
Hill Chhetri			0.690	0.249	1.910			0.817	0.267	2.502
Terai Brahmin/Chhetri			2.847	0.185	43.93			2.206	0.130	37.32
Other Terai caste			0.810	0.281	2.335			0.622	0.166	2.334
Hill Dalit			0.849	0.282	2.554			1.058	0.304	3.685
Terai Dalit			0.843	0.260	2.732			0.644	0.153	2.720
Newar			1.729	0.492	6.078			1.532	0.358	6.560
Hill Janajati			0.737	0.273	1.986			0.806	0.279	2.331
Terai Janajati			1.511	0.509	4.487			1.262	0.368	4.325
Muslim			1.352	0.295	6.186			1.063	0.191	5.926
Other			*(omitted)*					*(omitted)*		
Education Level										
Secondary or higher			Reference	.	.			Reference	.	.
No education			0.981	0.373	2.579			0.868	0.310	2.425
Primary or less			0.885	0.510	1.535			0.804	0.453	1.427
Media Exposure										
No access			Reference	.	.			Reference	.	.
Both at least once a week			0.847	0.365	1.968			0.745	0.313	1.777
Only one at least once a week			0.750	0.465	1.209			0.690	0.420	1.133

MULTI-LEVEL	Model 1		Model 2			Model 3			Model 4		
SUBGROUP 1	**AOR**	**95% CI**	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Occupation											
Not working			Reference	.	.				Reference	.	.
Agricultural			1.020	0.630	1.653				1.062	0.648	1.741
Non-agricultural			0.323*	0.128	0.818				0.300*	0.118	0.763
Sex of the household head											
Male			Reference	.	.				Reference	.	.
Female			1.363	0.795	2.335				1.353	0.785	2.332
Spousal age gap											
Under 5 years			Reference	.	.				Reference	.	.
5-9 years			1.492	0.960	2.318				1.425	0.904	2.246
10-14 years			2.487*	1.124	5.501				2.278	0.994	5.221
15-19 years			4.390	0.355	54.29				4.038	0.313	52.04
20 years or more			0.457	0.012	16.97				0.542	0.007	44.71
Not in union			0.006***	0.001	0.040				0.006***	0.001	0.037
Wealth index											
Poor			Reference	.	.				Reference	.	.
Middle			1.139	0.612	2.120				1.405	0.693	2.851
Rich			0.877	0.464	1.656				0.874	0.464	1.644
Community Level											
Province											
Province 1						Reference	.	.	Reference	.	.
Province 2						1.734	0.977	3.079	0.932	0.383	2.270
Province 3						0.666	0.320	1.386	1.057	0.378	2.957
Province 4						0.890	0.493	1.608	0.865	0.316	2.369
Province 5						0.757	0.442	1.297	0.706	0.295	1.687

MULTI-LEVEL SUBGROUP 1	Model 1			Model 2			Model 3			Model 4		
	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Province 6							0.495*	0.272	0.903	0.343*	0.146	0.802
Province 7							0.717	0.416	1.234	1.395	0.425	4.579
Place of residence												
Urban							Reference	.	.	Reference	.	.
Rural							1.543*	1.073	2.220	1.524	0.936	2.481
Community education level												
Low							Reference	.	.	Reference	.	.
High							0.757	0.519	1.102	0.739	0.425	1.285
Community media exposure												
Low							Reference	.	.	Reference	.	.
High							0.764	0.516	1.131	1.429	0.777	2.628
Community wealth index												
Low							Reference	.	.	Reference	.	.
High							0.735	0.483	1.117	1.720	0.829	3.566
Community-level Variance	0.667	0.481	0.924	0.753	0.532	1.066	0.460	0.342	0.618	0.702	0.489	1.006
Observations	2622			2614			2622			2614		
ICC(%)	16.85%			18.63%			12.26%			17.58%		
PCV(%)	Reference			-10.56%			27.26%			-4.31%		
AIC	2029			1034			2014			1031		
BIC	2041			1211			2085			1266		

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001, ** p<.01, * p<.05*

2) Subgroup 2

The second subgroup had a total of 4,400 women and 383 clusters. Table 9 presents the two-level mixed-effects logistic regression analysis results for subgroup 2 with four models.

First, fixed effects are explained. Results of Model 2 show that age at first marriage, ethnicity, education level, and spousal age gap to be statistically significant. Just like the full sample and subgroup 1, analysis of subgroup 2 showed the highest AOR for the age at first marriage variable (p<.001). Women who got married before 15 were 55 times [AOR: 55.39; 95% CI: 37.27, 82.32] more likely to be pregnant as adolescence compared to those who were not married before 18 or were never in union (p<.01). Those married at 15-17 were 24.8 times [AOR: 24.77; 95% CI: 19.15, 32.04] more likely to be pregnant during adolescence, compared to the same reference group (p<.01). As for ethnicity, compared to Hill Brahmins, Hill Dalits had 1.9 times [AOR: 1.89; 95% CI: 1.14, 3.14] higher odds of adolescent pregnancy (p<.05). Women with no education were 1.6 times [AOR: 1.55; 95% CI: 1.12, 2.15] (p<.01) and those with primary or less education level were 1.5 times [AOR: 1.48; 95% CI: 1.06, 2.05] (p<.05) more likely to experience adolescent pregnancy, when compared to those with secondary or higher level. Regarding spousal age gap, when compared with those with under 5 years age difference, spousal age gap of 5-9 years increased the odds of adolescent pregnancy by 49 % [AOR: 1.49; 95% CI: 1.16, 1.91] (p<.01). Not being in union decreased the odds by 84 % compared to the reference group [AOR: 0.16; 95% CI: 0.10, 0.26] (p<.001). Women in the middle wealth index were 1.4 times [AOR: 1.43; 95% CI: 1.05, 1.94] more likely experience adolescent

pregnancy compared to those in poor households.

Model 3 included only the community-level factors. Compared to those living in Province 1, women living in both Provinces 2 and 6 were more than two times [AOR: 2.20; 95% CI: 1.56, 3.09 and AOR: 2.13; 95% CI: 1.51, 3.02, respectively] more likely to become pregnant as adolescents. Also, those living in Provinces 7 were about 1.4 times [AOR: 1.38; 95% CI: 1.00, 1.89] more likely to experience adolescent pregnancy. Those living in rural areas were 1.3 times [AOR: 1.29; 95% CI: 1.10, 1.51] more likely to be pregnant in adolescence, compared to those in urban areas. Among the aggregated community-level variables, living in a community that has higher education level[24] decreased the odds by 42 % [AOR: 0.58; 95% CI: 0.48, 0.70] compared to living in a community with lower education level. Women who live in a community with higher level of media exposure[25] were 24 % less [AOR: 0.76; 95% CI: 0.62, 0.92] likely to be pregnant as adolescence.

Model 4, similar to Model 2, showed age at first marriage as an important individual-level factor on adolescent pregnancy at $p<.001$ significance level, with similar values of AORs. The ethnicity factor showed stronger association in the full model than Model 2. Those who were Hill Dalits were 1.9 times [AOR: 1.93; 95% CI: 1.16, 3.21] and Hill Janajatis 1.6 times [AOR: 1.61; 95% CI: 1.01, 2.58] more likely to experience adolescent pregnancy. Results of the education level and spousal age gap variables in the full model were similar to Model 2. Wealth index also showed similar results, with slightly higher value of odds ratios for those in the

[24] Higher education level in this context refers to having one's highest educational attainment as secondary or higher. More explained in Chapter 3.3.2

[25] Higher media exposure as community level refers to listening to the radio and/or watching television at least once a week. More explained in Chapter 3.3.2

middle wealth index [AOR: 1.47; 95% CI: 1.06, 2.06] compared to those in the poor wealth index. The estimates of community-level variables changed drastically in Model 4, compared to Model 3. In Model 3, women living in Provinces 2, 6, and 7 all had higher odds than Province 1. In the final model, however, all provinces did not have statistically significant values of AOR and also had much lower values.

Similar to the full sample, the additional multilevel models of subgroup 2 show that caste/ethnicity and individual educational level significantly influence adolescent pregnancy (Table 15 in Appendix D). Holding other factors fixed, certain caste/ethnicity groups were more likely to experience pregnancy as adolescents ($p<.001$). In Model 6, Hill Dalits had 3.4 times [AOR: 3.43; 95% CI: 2.28, 5.16], other Terai caste had 2.8 times [AOR: 2.81; 95% CI: 1.65, 4.81], and Hill Janajatis had 2.6 times [AOR: 2.56; 95% CI: 1.75, 3.74] higher odds of adolescent pregnancy compared to Hill Brahmins. Unlike the full sample, Hill Chhetri women also had higher possibility of adolescent pregnancy, with an AOR value of 1.59 [95% CI: 1.11, 2.29], despite Chhetri being one of the higher caste groups. Individual education level for the 20-29 age group was also found to be a significant factor associated with teenage pregnancy, when other factors were fixed ($p<.001$). Those with no education were 2.4 times [AOR: 2.42; 95% CI: 1.90, 3.08] and those with primary or less education were 2.5 times [AOR: 2.52; 95% CI: 1.98, 3.21] more likely to be pregnant during adolescence, compared to the reference group.

The random effects are explained ICC and PCV. For Model 1, the between-group variance was estimated as 0.36. The null model's ICC was 0.0989, which means that about 9.89 % of the total variation on adolescent pregnancy occurred at the community (cluster)-level. The ICC values of Model 2-4 were 6.97 %, 4.33 %,

and 6.77 %, respectively. As for the AIC values, Model 2 and 4 had similar values: 3350 and 3356. In subgroup 2, the PCV value for each model with one community-level variable is similar with the full sample (Table 19 in Appendix F). The province and community education level variables were found to have large PCV values, both with 36.7 %.

Table 9. Multilevel logistic regression results (20-29 age group).

MULTI-LEVEL	Model 1			Model 2			Model 3			Model 4		
SUBGROUP 2	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Individual Level												
Age at first marriage												
Not married as a child				Reference	.	.				Reference	.	.
Married before 15				55.39***	37.27	82.32				54.85***	36.80	81.73
Married at 15-17				24.77***	19.15	32.04				24.69***	18.99	32.11
Ethnicity												
Hill Brahmin				Reference	.	.				Reference	.	.
Hill Chhetri				1.245	0.797	1.944				1.179	0.747	1.860
Terai Brahmin/Chhetri				1.416	0.518	3.868				1.376	0.475	3.983
Other Terai caste				1.217	0.725	2.042				1.147	0.584	2.251
Hill Dalit				1.891*	1.140	3.135				1.932*	1.164	3.208
Terai Dalit				1.064	0.524	2.162				0.990	0.470	2.085
Newar				0.548	0.279	1.077				0.574	0.288	1.143
Hill Janajati				1.555	0.965	2.507				1.611*	1.005	2.583
Terai Janajati				1.377	0.823	2.303				1.247	0.714	2.180
Muslim				1.294	0.270	6.196				1.123	0.237	5.309
Other				3.259	0.501	21.18				3.123	0.493	19.78
Education Level												
Secondary or higher				Reference	.	.				Reference	.	.
No education				1.553**	1.120	2.152				1.472*	1.049	2.066
Primary or less				1.475*	1.061	2.050				1.424*	1.014	2.000
Media Exposure												
No access				Reference	.	.				Reference	.	.
Both at least once a week				0.900	0.625	1.297				0.948	0.652	1.379
Only one at least once a week				1.008	0.776	1.309				1.037	0.793	1.356
Religion												

MULTI-LEVEL SUBGROUP 2	Model 1 AOR	Model 1 95% CI		Model 2 AOR	Model 2 95% CI		Model 3 AOR	Model 3 95% CI		Model 4 AOR	Model 4 95% CI	
Buddhist				Reference	.	.				Reference	.	.
Hindu				1.659	0.958	2.872				1.694	0.982	2.921
Muslim				2.072	0.437	9.828				2.203	0.465	10.44
Other				1.729	0.880	3.396				1.768	0.886	3.526
Occupation												
Not working				Reference	.	.				Reference	.	.
Agricultural				1.239	0.949	1.617				1.243	0.946	1.634
Non-agricultural				1.163	0.820	1.651				1.156	0.812	1.646
Sex of the household head												
Male				Reference	.	.				Reference	.	.
Female				1.085	0.853	1.381				1.090	0.856	1.387
Spousal age gap												
Under 5 years				Reference	.	.				Reference	.	.
5-9 years				1.487**	1.160	1.906				1.507**	1.171	1.938
10-14 years				1.511	0.892	2.561				1.524	0.901	2.577
15-19 years				2.861	0.991	8.260				2.978*	1.008	8.801
20 years or more				1.021	0.215	4.843				1.075	0.220	5.257
Not in union				0.159***	0.096	0.264				0.157***	0.094	0.262
Wealth index												
Poor				Reference	.	.				Reference	.	.
Middle				1.428*	1.051	1.939				1.473*	1.055	2.057
Rich				1.353	0.965	1.897				1.330	0.941	1.879
Community Level												
Province												
Province 1							Reference	.	.	Reference	.	.
Province 2							2.195***	1.561	3.087	0.791	0.473	1.323
Province 3							1.021	0.755	1.380	1.011	0.614	1.665

MULTI-LEVEL SUBGROUP 2	Model 1			Model 2			Model 3			Model 4		
	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Province 4							1.283	0.941	1.751	0.929	0.560	1.542
Province 5							1.163	0.853	1.584	0.888	0.563	1.400
Province 6							2.132***	1.505	3.021	1.302	0.744	2.276
Province 7							1.379*	1.003	1.894	1.281	0.794	2.067
Place of residence												
Urban							Reference	.	.	Reference	.	.
Rural							1.289**	1.102	1.509	0.952	0.743	1.219
Community education level												
Low							Reference	.	.	Reference	.	.
High							0.578***	0.479	0.697	0.745	0.532	1.044
Community media exposure												
Low							Reference	.	.	Reference	.	.
High							0.755**	0.622	0.917	0.920	0.647	1.309
Community wealth index												
Low							Reference	.	.	Reference	.	.
High							1.171	0.943	1.456	1.390	0.923	2.093
Community-level Variance	0.361	0.289	0.451	0.247	0.190	0.319	0.149	0.120	0.185	0.239	0.183	0.312
Observations	4400			4400			4400			4400		
ICC(%)	9.89%			6.97%			4.33%			6.77%		
PCV(%)	Reference			29.50%			56.25%			31.55%		
AIC	5860			3350			5673			3356		
BIC	5873			3548			5750			3618		

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Chapter 5. Discussion

5.1 Implications of the Study

This study investigated the individual- and community-level factors associated with adolescent pregnancy in Nepal using a nationally representative survey. The study consisted of three samples: full sample (15-49 aged women), subgroup 1 (15-19), and subgroup 2 (20-29). Such stratification was done due to the possibility of recall bias for those older than 29 and the differences in the degree of risk exposure for individuals in the 15-19 age group. Taking a multilevel approach, this study used the mixed-effects two-level logistic regression with adolescent pregnancy as the outcome variable. Independent variables were either individual- or community-level. A random intercept model was fitted to allow the intercept to vary in each group (cluster), applying the sample weights of both levels in analysis.

Results of the descriptive statistics indicate that among women aged 15-49 in Nepal, about 38 % had experienced or was currently experiencing adolescent pregnancy. The percentages were lower for 15-19 aged women (13 %), but higher for 20-29 aged women (40 %). The much lower prevalence of adolescent pregnancy in subgroup 1, compared to subgroup 2 or the full sample, may imply that, as noted in Chapter 3.1, respondents aged 15 to 19 are not yet fully exposed to the risk of adolescent pregnancy, unlike those who have passed their adolescence. The proportion of 15-19 aged women who experienced adolescent pregnancy is slightly higher in another study in Nepal (17 %) (Poudel et al, 2018), but this may be because they pooled Nepal DHS data from 2006, 2011, and 2016. Nepal has seen some

improvements in adolescent childbearing; the number of annual births per 1000 women aged 15-19 decreased from 129 (1995-2000) to 103 (2005-2010) (WHO ROSEA, 2015), so aggregating three different 15-19 age group samples from three periods would result a higher percentage. Another study on 15-19 aged Nepali women computed prevalence of adolescent pregnancy to be much higher (56 %) (Poudel et al, 2018), but they selected adolescents who were married. Such results additionally suggest the importance in addressing child marriage in reducing adolescent fertility rates in Nepal.

Compared to studies in other countries that used the DHS, the prevalence rate for Nepali 15-19 age group in this study (13 %) was similar with Ethiopia (12.5 %) (Kefale et al, 2020), but was much lower than many other African countries: Uganda (25 %), Tanzania (27 %), Zambia (28.5 %), Malawi (29 %) (Wado et al, 2019), Western Africa (26 %)[26], and Southern Africa (30 %)[27] (Odimegwu & Mkwananzi, 2016).

This study aimed to identify factors associated with adolescent pregnancy in Nepal context. In particular, this study aimed to find the ceteris paribus associations of caste/ethnicity and individual education level with adolescent pregnancy in Nepal. The following discusses the key findings of the multilevel analysis results regarding the determinants of early pregnancy, along with further implications on the additional analyses. It concludes with some suggestions on future research.

One important finding of this study was the substantial influence of the age at first marriage on the outcome. This study found that, for all three samples, being

[26] Western Africa region includes Senegal, Nigeria, Niger, and Cote d'Ivoire.
[27] Southern Africa region includes Malawi, Mozambique, and Zimbabwe.

married as a child[28] was significantly and largely associated with pregnancy during adolescence. Such results are consistent with previous studies (Devkota et al, 2018; WHO ROSEA, 2015; Plan Nepal et al, 2012). The association was particularly strong for the 20-29 age group, who are the youngest generation to have been fully exposed to the risk of adolescent pregnancy. Compared to the 20-24 age group in Ethiopia, the 20-29 age group in this study showed higher AORs for those who were married before 15 (AOR: 30.1 vs 54.9) and for those married at 15-17 (AOR: 15.1 vs 24.7) (Birhanu et al, 2019). As for the 15-19 age group in this study, age at first marriage was one of very few statistically significant predictors, reinforcing the current evidence that child marriage is one precondition of adolescent pregnancy in Nepal (WHO ROSEA, 2015; Alejos, 2015; HRW, 2016; Bajracharya et al, 2019).

Ethnicity variable was another essential predictor specific to the Nepal context, but was found to be relevant in only the full sample and 20-29 age group. For the general population of Nepal, represented by the full sample in this study, the Hill Dalits (AOR: 1.7), Hill Janajatis (AOR: 1.4), and Muslims (AOR: 2.7) had higher odds of adolescent pregnancy than Hill Brahmins. Although they used different categorization of the caste/ethnicity factor[29], the results of Poudel et al (2018) and Pradhan et al (2018) are similar to that of this study. Poudel et al (2018) found that the Dalit (AOR: 1.9) and Madhesi (i.e., Terai) (AOR: 1.7) groups were more likely become pregnant as adolescents, compared to Brahmin/Chhetri. In a similar way, Pradhan et al (2018) found that Janajati (AOR: 1.5) group had higher

[28] The age at first marriage variable was recoded to married before 15 and married at 15-17, both of which refer to incidence of child marriage.
[29] The two studies categorized caste/ethnicity into four groups (excluding others): Brahmin/Chhetri, Dalit, Janajati, and Madhesi.

odds than the reference group, Brahmin/Chhetri. While these two studies used the Nepal DHS, another study using primary data also showed consistent results. Devkota et al (2018) found that, though not statistically significant, compared to Dalit women, Brahman/Chhetri (AOR: 0.6) women were less likely to experience adolescent pregnancy.

Results of this study further suggests that ethnicity may affect adolescent pregnancy through child marriage. Previous studies on child marriage in Nepal have found that Madhesi and low caste Hindu women have greater odds of marrying before the age 16 compared to high caste Hindu women (Bajracharya & Amin, 2012). Descriptive statistics in the 2016 NDHS also show that certain caste/ethnicity groups, such as other Terai caste, Terai Dalit, and Muslim, have higher prevalence of child marriage (Appendix G). In Model 5 to 7, which excluded the age at first marriage variable from the full model, the AOR values of ethnicity were higher than the full model and more statistically significant. Such results suggest that certain caste/ethnicity groups are more likely to experience adolescent pregnancy through child marriage. The difference between the full model and additional models (i.e., Model 5-7) was stronger in subgroup 2 than the full sample. For instance, other Terai caste individuals were 1.7 times in the full sample and 2.5 times in the subgroup 2 more likely to experience adolescent pregnancy than the reference group.

Education level, along with the issue of child marriage, was another essential factor in adolescent pregnancy revealed in this study. It is worth noting that education level for individuals was found to significantly affect adolescent pregnancy while community-level educational attainment showed non-significant AOR estimates on

the outcome.[30] Such finding corresponds with previous studies that used multilevel models, including both the individual- and community-level variables on education attainment (Wado et al, 2019; Kefale et al, 2020; Birhanu et al, 2019). In particular, Wado et al (2019) found that the individual-level effects of educational attainment were statistically significant in all five East African countries, with the AORs for women with secondary or higher level of education between 0.32 - 0.37, compared with those without any education. Community-level educational attainment, however, was not significant and were estimated to have AOR values closer to one, also for all five countries (Wado et al, 2019). Islam et al (2017), using a single-level logistic regression model, also revealed strong effects of educational level on early childbearing for both 15-19 and 20-49 age groups.

Although the community-level of educational attainment was not identified, this study strengthens evidence on the association between schooling and teenage pregnancy. Many previous studies have shown that education level is closely linked to adolescent pregnancy in Nepal (Islam et al, 2017; Poudel et al, 2018; Sharma et al, 2002; Devkota et al, 2018). Sekine and Hodgkin (2017) also specified that seventh and eighth grades in secondary school are the periods when Nepali girls drop out of school the most due to child marriage and that married girls were 10 times more likely to discontinue their education compared to unmarried girls. The mechanism of education, early pregnancy, and child marriage is complex, mixed, and observational (Bajracharya et al, 2019). Previous studies taking the account of the endogeneity problem have revealed that schooling can be both the cause (Ferre, 2009;

[30] This applies only to the full sample and 20-29 age group. The 15-19 age group showed both levels of education level to be not significant.

Glick et al, 2015) and effect of teenage pregnancy (Field & Ambrus, 2008).

Moreover, education level may influence adolescent pregnancy through child marriage, similar to the caste/ethnicity factor. Nepali women who received higher level of education were more likely to marry after the age 20 than those with lower educational attainment (Bajracharya & Amin, 2012). Many other studies have also found that schooling is associated with later age at marriage (Raj et al, 2014; Sekine & Hodgkin, 2017; Field & Ambrus, 2008). In this study, results of Model 5-7 for the full sample and subgroup 2 show an increase in AOR values for individual education level compared to Model 4 (full model), which may indicate that education is associated with child marriage, thus adolescent pregnancy.

Being Hindu was found to be significantly associated with adolescent pregnancy in this study, which is similar to previous studies. One systematic review found that South Asian teenagers who are Hindu were more likely to experience pregnancy than those who are Buddhists (Raj et al, 2010). In a similar way, Nepali women who were married as a child were often Hindu or Muslim, which have traditions of dowry (UNNCT, 2020b). However, unlike ethnicity and individual education level factors, the AOR values of the religion in models excluding child marriage variable were slightly lower than the full model.[31]

Spousal age gap had significant effect on adolescent pregnancy in the full sample and 20-29 age group. In the full sample, the AORs of each category were found to grow as the spousal age gap increased. This trend was also visible in the 20-29 age group. Such results are consistent with the findings in Islam et al (2017),

[31] The AOR values of Hindu individuals were 1.65 in Model 4, but 1.57 and 1.54 in Models 5 and 6 (Table 13 in Appendix D).

where smaller age difference meant less risk of adolescent pregnancy, and Pradhan et al (2018), where age disparities increased the risk. Spousal age difference, often men being older than women, may imply the unequal power relations between partners. Such relations would cause younger females to feel pressure from older males, thus become incapable of exercising one's control over sexual decisions such as using condoms (Yakubu & Salisu, 2018; McCleary-Sills et al, 2013; McHunu et al, 2012). As one can easily expect, the AOR values of spousal age gap were higher in Models 5-7, which excluded the age at first marriage variable, than the full model. In Nepal, and other LMICs, as girls are more disproportionately married as children than boys (UNICEF, 2016; Mathur et al, 2003), child marriage may have been reflected in the larger AOR values of spousal age gap in models excluding age at first marriage variable, compared to the full model.

Regarding wealth, this study included variables in two levels, individual- and community-level. Individual level middle wealth index was significantly associated with higher odds of adolescent pregnancy in subgroup 2, compared to those in the poor wealth index (AOR: 1.47), but not in the other two samples. This was inconsistent with previous studies (Poudel et al, 2018; Islam et al, 2017; Wado et al, 2019; Pradhan et al, 2015). Both fitting single-level logistic models in DHS data, Poudel et al (2018), based in Nepal, and Islam et al (2017), based in Bangladesh, found that 15-19 aged individuals in the middle and poor households were more likely to become pregnant as adolescents, compared to those in rich households. Wado et al (2019), using a multilevel model, also found that being in the richest households decreased the odds by more than 50 % in all five East African countries. Similar results were found in a systematic review study (Pradhan et al, 2015). Such

inconsistent results may be because these studies (Poudel et al, 2018; Islam et al, 2017; Wado et al, 2019), unlike this study, did not include age at first marriage variable in their analysis. Yet, in Model 5 of the full sample and subgroup 1, the wealth index was not statistically significant. In this study, the wealth factor might have been reflected in other variables, such as caste/ethnicity. Much of the past literature reveals that poverty is one of the drivers of child marriage (McCleary-Sills et al, 2015; Brown, 2012; Bajracharya & Amin, 2012; Sekine & Hodgkin, 2017; Bajracharya et al, 2019), because daughters bring financial burden to poor families and younger brides have lower amounts of dowry (Brown, 2012; ICRW & PARO, 2013). Child marriage then leads to adolescent pregnancy, as revealed by this study and previous studies (WHO ROSEA, 2015; Alejos, 2015; HRW, 2016). Therefore, it may be possible that, in this study, the effect of individual wealth status was reflected on the age at first marriage and/or ethnicity variable(s).

As for community level wealth index, this study found that living in a community with higher wealth status had, in fact, higher odds of adolescent pregnancy in the full sample (AOR: 1.3). Previous studies that used multilevel models and categorized community wealth status as high and low showed mixed results. In Uganda, Wado et al (2019) found that individuals nested in communities with higher levels of poverty had lower odds of adolescent pregnancy than the reference group (AOR: 0.70), similar to this study. However, Kefale et al (2020) found that living in a community with higher proportion of poor households had significantly much higher odds (AOR: 3.9), although individual wealth level had insignificant results. Also, although none were statistically significant, four East African countries were shown to have mixed results with community level poverty

on adolescent pregnancy in the values of AORs: Kenya (0.82) and Zambia (0.83) had AOR values lower than one, unlike Tanzania (1.33) (Wado et al, 2019). Another multilevel analysis study found an insignificant AOR value of 1 for those living in a community with higher proportion of poor households, but the crude odds ratio (COR) was 2.5 and statistically significant (Birhanu et al, 2019). These mixed results on wealth, on both levels, show that wealth status may rely on whether the researcher included particular variables in the model or not, suggesting the possibility of underlying factors that influence wealth status, thus adolescent pregnancy.

Comparing the full model with additional models that excluded the age at first marriage variable, the largest difference was shown in the province variable (Tables 13-15 in Appendix D). These supplementary models further demonstrate significant associations of both caste/ethnicity and individual education level, ceteris paribus, with adolescent pregnancy, but only in the full sample and 20-29 age group. Nevertheless, larger spousal age gap was found to be significant determinant of adolescent pregnancy in all three samples, holding other factors fixed.

This study applied a rigorous multilevel analysis, including community-level factors and fitting a mixed-effects model. For the random effects, the results indicate that there is not much variance between groups (clusters). The ICC values of null models were 4.93 %, 16.85 %, and 9.89 % for the full sample, 15-19 age group, and 20-29 age group, respectively. Results of the multilevel models show that group effects are more visible in the two subgroups than the full sample. In the two subgroups, about 17 % and 10 % of the variability of the outcome occurs between groups (clusters), respectively. Previous studies on Ethiopia and Zambia had much larger values of ICC in their null models: 42 % (Birhanu et al, 2019) and 34 %

(Kefale et al, 2020) for Ethiopia, and 21.5 % (Wado et al, 2019) for Zambia. Other countries had similar ICC values, with 12 % in Kenya, 7.4 % in Malawi, and 7.2 % in Uganda (Wado et al, 2019), or even smaller value, with 1 % in Colombia[32] (Aguia-Rojas et al, 2020). Overall, compared to some previous studies that used multilevel models and found large ICC values, this study suggests that Nepal may not have large community effects on adolescent pregnancy.

Such results may also be because the size of a country is different from one another. Ethiopia and Zambia, which had larger ICCs, are approximately 8 times and 5 times bigger than Nepal. Another possible reason may be the difference in the numbers of clusters and of nested individuals in each cluster. Even within this study, the ICC values of the two subgroups, which had 2,622 and 4,400 women as the sample sizes, were larger than that of the full sample, which had 12,862 women. In the study by Birhanu et al (2019), where the largest ICC was computed, the sample had 2,134 individuals and 648 clusters. Another explanation can be Nepal's increased rates of internal migrations. The number of people living in areas other than their origin has increased by six folds in the last four decades, mostly from hills to Terai areas and rural to urban regions (UNFPA Nepal, 2017). This would result in weaker heterogeneous characteristics across communities. Nevertheless, although larger ICC values indicate stronger justifications of multilevel models (Liu, 2015), even a very small ICC value can largely deflate the standard errors (Bickel, 2007). Also, there is a continued need to investigate the contextual effects on adolescent sexual and reproductive health (Gausman et al, 2019).

[32] The authors of this study did not compute the ICC, only the group-level variance (0.038). So, the ICC value was computed by the author, using the individual-level variance of 3.29; ICC = 0.038/(0.038 + 3.29) ≒ 0.011

As for the fixed-effects, when comparing the multilevel logistic model with the conventional single-level logistic model, the coefficient estimates (i.e., the fixed-effects) of the independent variables were not much different. Such similarity between single- and multi-level models is often seen, but typically with larger standard errors for the estimates in the multilevel model (Bickel, 2007). In this study, most of the AOR values in the single-level logistic model were only slightly lower than the multilevel logistic regression, in all three samples.

The following explains the study implications and suggests future research. One key predictor of adolescent pregnancy found in this study was age at first marriage. The result of the 15-19 age subgroup revealed that age at first marriage is one of very few statistically significant predictors of adolescent pregnancy. Although child marriage has been illegal in Nepal since 1963,[33] Human Rights Watch (2016) found that there was little evidence of the government effectively trying to end or alleviate the harms of child marriage, despite the government's commitment to end child marriage by 2030. The UN Country Team established the Harmful Practices Working Group (HPWG) in 2018 to address harmful practices[34] in a coordinated approach across regions of the UN Development Assistance Framework 2018-2022. A report by the United Nations Nepal Country Team (2020a) found that these harmful practices, which includes child marriage, are predominant in certain regions, Province 2, 6, and 7[35], suggesting the need to focus on girls who are the most

[33] Under Civil Code 2074 (2017) (implemented in 2018), marriage under the age of 20, for both boys and girls, is illegal and is a punishable offense (UNNCT, 2020b).
[34] Harmful practices are defined as 'the persistent behaviors that discriminate on the basis of sex, gender, age, caste/ethnicity, language, and religion' (UNNCT, 2020a, p.2). In Nepal, those were caste-based discrimination, menstrual restrictions like chhaupadi, child marriage, dowry, and witchcraft accusations (UNNCT, 2020a).
[35] Karnali Province is the new name for Province 6 and Sudurpashchim Province for 7.

vulnerable. Yet, evidence on the impacts of specific policies and programs designed to reduce child marriage and increase educational attainment is very limited (UNNCT, 2020b; Barjracharya et al, 2019). For instance, cash transfer programs have been promising in overcoming poverty and financial burden that drives school dropout and child marriage (McCleary-Sills et al, 2015). While some cash transfer programs targeting girls in LMICs has recently seen positive results on their overall development and health (Ayuku et al, 2014; Darney et al, 2013; Kilburn et al, 2018), there are still little evidence on specific effects on child marriage, adolescent pregnancy, and education, especially in South-East Asian setting. In Nepal, there has been cash transfer programs on improving child malnutrition (Renzaho et al, 2019), promoting institutional delivery (Jehan et al, 2012; Pandey, 2018), and assisting those affected by the 2015 earthquake (Oxfam Country Office, 2017), but those targeting teenagers on school enrollment were limited. Therefore, more investments focusing on education for adolescents and further studies that evaluate different policies and interventions in ending child marriage are required.

Under the current population pattern of Nepal presenting a “demographic window of opportunity” that could bring long-term development (Rabi, 2014, p.8), investing on education is needed more than ever. Education not only protects young girls from child marriage and early childbearing, but also contributes to the increase of national productivity, spurring economic growth. Rabi (2014) found that, if Nepali girls delay their marriage until 20 years of age, the possible increase of cash flow is estimated to be 3.87 % of the GDP. As child marriage is considered to be one precondition of adolescent pregnancy (WHO ROSEA, 2015; Alejos, 2015; HRW, 2016; Bajracharya et al, 2019), investments on promoting education level on the

younger population of Nepal potentially would have a number of positive outcomes regarding early marriage and childbearing on the individual level and economic growth on the national level.

Regarding educational attainment in general, it is critical to keep girls in secondary schools. In Nepal, the percentage of women who have no education is relatively low (14 %) than some neighboring countries like Pakistan (36 %), but the percentage of those who have entered but not completed secondary school is high (30 %) compared to other countries (i.e., Pakistan: 13 %) (Bajracharya et al, 2019). Grade seven and eight[36] are the peak periods when Nepali girls drop out of school due to marriage (Sekine & Hodhkin, 2017), thus education and development policies should focus on keeping them in secondary schools.

In doing so, shift in social norms is equally important. In some countries, such as Nepal, religious and traditional justifications on child marriage still perpetuate in their societies, so widespread education may not be enough in reducing child marriage (Lemmon & ElHarake, 2014). Nepal also has a long tradition of dowry, which is still practiced today, and has identified it as one of the harmful practices that discourage national development (UNNCT, 2020b). However, authoritative approach in changing social norms is neither fair nor successful. Religious traditional leaders and community stakeholders have been found to be effective advocates in ending child marriage and shifting social norms (ICRW & PARO, 2013; Lemmon & ElHarake, 2014), as they are the main influencing parties for early marriage in Nepal (Bhandari, 2019). In such approach, involving their local

[36] The education system of Nepal consists of primary (grades 1-5), lower secondary (grades 6-8), and secondary (grades 9-10). Grades 1-8 are compulsory in Nepal (Nuffic, 2015).

leaders and governments to stop dowry practices and to raise awareness about the value of girls' education are essential in reducing child marriage, thus adolescent pregnancy, which will also help younger generations of Nepal to continue their education and boost national economic growth in the next decades.

5.2 Limitations of the Study

This study has limitations. First, as the DHS data only selects women aged between 15 to 49, girls under 15 who have experienced or was experiencing pregnancy were not included in analysis. Although Neal et al (2012) estimated that about 2.5 million births occur each year to adolescents under 16 in LMICs, there is limited research that explicitly focus on childbearing of younger adolescents. Younger adolescents also face more risks of maternal morbidity and mortality than older adolescents (Phipps & Sowers, 2002; Conde-Agudelo, 2005; Gausman et al, 2019). To account for these vulnerable populations in large-scale quantitative analysis, using primary data that specifically addresses this age group is recommended. Qualitative research to investigate more deeply on the situation for each country or community is also suggested. An alternative would be taking a retrospective approach when using the DHS data, similar to Neal et al (2012), using the age at first birth variable, but with limitations such as recall bias and age misreporting issues.

Another limitation is the possibility of unmeasured confounders. Despite their effects to the outcome, they may not be reflected properly in the data and the model. For instance, practice of dowry is closely linked with child marriage in Nepal (UNNCT, 2020b; Bajracharya et al, 2019), thus is likely to be related with adolescent

pregnancy. Similarly, gender norms within families or communities, pressure that adolescents feel regarding marriage and/or pregnancy, or gender power relations are all elements that may result in adolescent pregnancy (Alejos, 2015; Mishra, 2017; Vogel et al, 2015). Unfortunately, such cultural factors are difficult to measure in the DHS. They can, however, be indirectly acknowledged by including community-level variables and separately estimating community effects. In the issue of dowry, examining the community factor is key, because it is practiced more in certain regions, such as the eastern Terai region, than others (UNNCT, 2020b; Bajracharya & Amin, 2012).

Although this study could not identify large community effects on adolescent pregnancy, multilevel analysis using different models such as three or more-level model or random coefficients model can be applied in future studies. Three-level models in Nepal can be consisted by individual-, community (cluster)-, and district-level[37]. In cases where the number of individuals (level 1) nested in a cluster (level 2) and/or district (level 3) are considered too small, pooling different surveys from different years is also an option, just as the two previous studies in Nepal setting.[38] Another suggestion is to use random coefficient models, which allows the level-1 slopes to be random according to clusters (Liu, 2015). These models are especially useful when the researcher wants to examine each sub-population separately (Snijders & Bosker, 2012). Future research may also pool additional information on district level from different types of data to include factors

[37] Here, district-level specifically refers to the levels of 75 districts in Nepal, which are distributed across the ecological zones (i.e., hill, mountain, and Terai) and development regions (i.e., eastern, central, western, mid-western, and far-western).
[38] Poudel et al (2018) and Pradhan et al (2018)

that were not considered in this study, such as adolescents' access to health facilities. Applying such multilevel designs on future studies is crucial in filling the current research gap in South-East Asia and Nepal on adolescent pregnancy.

Chapter 6. Conclusion

This study sought to fill the research gap in the little evidence of multilevel analysis regarding determinants of adolescent pregnancy in Nepal. As the two-level model used in this study did not find much community effect, further research using more rigorous multilevel models, such as three-level models or random coefficient models, are recommended to examine the multilevel structure of the social determinants of health on early pregnancy. Nevertheless, to the author's knowledge, this study was the first study to investigate factors associated with adolescent pregnancy in the Nepal that explicitly fitted a multilevel model. Moreover, because such analysis has not been conducted in many other South-East Asian countries with high prevalence of early childbearing, such as Bangladesh, more research in this regional setting is needed.

Furthermore, this study reinforced the current literature emphasizing the importance of ethnicity and education level in the issue of adolescent pregnancy. Thus, future research is suggested to effectively stratify the different caste/ethnic groups of Nepal to accommodate the heterogeneous characteristics and to design, implement, and evaluate policies targeting each distinct group. More generally, to examine the caste-based discrimination, which is one of the harmful practices identified (UNNCT, 2020b), more in-depth research is needed to better understand the element of caste/ethnicity for the adolescent sexual and reproductive health and rights in Nepal. Equally important is allowing Nepali girls to stay at their school and continue their education, because it would help reduce child marriage, thus adolescent pregnancy.

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Appendix

Appendix A. Caste/ethnicity groups in Nepal with details on specific social groups.

Main Caste/Ethnic Groups (7)		Caste/Ethnic Groups with Regional Divisions (11) and Social Groups (103) from 2001 Census	
Caste Groups	*1. Brahaman/Chhetri*	1.1	**Hill Brahman** Hill Brahman
		1.2	**Hill Chhetri** Chhetri, Thakuri, Sanyasi
		1.3	**Tarai/Madhesi Brahman/Chhetri** Madhesi Brahman, Nurang, Rajput, Kayastha
	2. Tarai/Madhesi Other Castes	2.1	**Tarai/Madhesi Other Castes** Kewat, Mallah, Lohar, Nuniya, Kahar, Lodha, Rajbhar, Bing, Mali Kamar, Dhuniya, Yadav, Teli, Koiri, Kurmi, Sonar, Baniya, Kalwar, Thakur/Hazam, Kanu, Sudhi, Kumhar, Haluwai , Badhai, Barai, Bhediyar/ Gaderi
	3. Dalits	3.1	**Hill Dalit** Kami, Damai/Dholi, Sarki, Badi, Gaine, Unidentified Dalits
		3.2	**Tarai/Madhesi Dalit** Chamar/Harijan, Musahar, Dushad/Paswan, Tatma, Khatwe, Dhobi, Baantar, Chidimar, Dom, Halkhor
Adivasi/Janajatis	*4. Newar*	4	**Newar** Newar
	5. Janajati	5.1	**Hill/Mountain Janajati** Tamang, Kumal, Sunuwar, Majhi, Danuwar, Thami/Thangmi, Darai, Bhote, Baramu/Bramhu, Pahari, Kusunda, Raji, Raute, Chepang/Praja, Hayu, Magar, Chyantal, Rai, Sherpa, Bhujel/Gharti, Yakha, Thakali, Limbu, Lepcha, Bhote, Byansi, Jirel, Hyalmo, Walung, Gurung, Dura
		5.2	**Tarai Janajati** Tharu, Jhangad, Dhanuk, Rajbanshi, Gangai, Santhal/Satar, Dhimal, Tajpuriya, Meche, Koche, Kisan, Munda, Kusbadiya/Patharkata, Unidentified Adibasi/Janajati
Other	*6. Muslim*	6	**Muslim** Madhesi Muslim, Churoute (Hill Muslim)
	7. Other	7	**Other** Marwari, Bangali, Jain, Punjabi/Sikh, Unidentified Others

Appendix B. Result of the correlation test.

	Age at first marriage	Ethnicity	Education level	Media exposure	Religion	Occupation	Sex of the household head	Spousal age gap	Education level of partner	Wealth index	Age at first sex	Province	Place of residence	Community education level	Community media exposure	Community wealth index
Age at first marriage	1.00															
Ethnicity	0.00	1.00														
Education level	0.43	-0.13	1.00													
Media exposure	0.00	0.04	0.02	1.00												
Religion	-0.01	0.16	-0.04	0.01	1.00											
Occupation	0.08	0.00	0.17	0.05	0.07	1.00										
Sex of the household head	-0.01	-0.02	0.01	0.00	-0.03	-0.03	1.00									
Spousal age gap	0.68	0.01	0.33	0.00	0.02	0.07	0.05	1.00								
Education level of partner	0.69	0.01	0.34	0.00	0.01	0.07	0.05	1.00	1.00							
Wealth index	0.09	-0.09	0.20	0.05	-0.02	0.24	0.00	0.03	0.04	1.00						
Age at first sex	0.96	0.00	0.43	0.00	-0.01	0.08	-0.01	0.68	0.69	0.09	1.00					
Province	-0.02	-0.23	-0.02	-0.01	-0.09	-0.15	0.05	0.02	0.02	-0.05	-0.03	1.00				
Place of residence	-0.07	0.00	-0.14	-0.03	0.00	-0.13	-0.04	-0.04	-0.04	-0.18	-0.07	0.01	1.00			
Community education level	0.15	-0.09	0.33	0.02	-0.03	0.10	0.08	0.06	0.07	0.26	0.15	-0.02	-0.24	1.00		
Community media exposure	0.13	-0.11	0.26	0.05	-0.04	0.18	0.06	0.06	0.06	0.29	0.13	-0.18	-0.28	0.49	1.00	
Community wealth index	0.03	0.13	0.09	0.03	0.08	0.30	0.00	0.01	0.01	0.22	0.03	-0.27	-0.28	0.27	0.34	1.00

Appendix C. Results of single-level logistic regression

Table 10. Single-level logistic regression results (Full sample).

SINGLE-LEVEL	Model 1			Model 2			Model 3			Model 4		
FULL SAMPLE	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Individual Level												
Age at first marriage												
Not married as a child				Ref.	.	.				Ref.	.	.
Married before 15				50.36***	40.50	62.63				49.97***	40.23	62.08
Married at 15-17				20.99***	18.21	24.20				20.92***	18.13	24.14
Ethnicity												
Hill Brahmin				Ref.	.	.				Ref.	.	.
Hill Chhetri				1.072	0.870	1.322				1.071	0.863	1.330
Terai Brahmin/Chhetri				0.992	0.543	1.813				0.994	0.525	1.883
Other Terai caste				1.023	0.759	1.380				0.995	0.703	1.410
Hill Dalit				1.529**	1.184	1.975				1.532**	1.186	1.979
Terai Dalit				0.889	0.625	1.265				0.871	0.608	1.248
Newar				0.926	0.667	1.284				0.966	0.705	1.324
Hill Janajati				1.375*	1.072	1.765				1.427**	1.107	1.839
Terai Janajati				1.440*	1.081	1.918				1.379*	1.027	1.852
Muslim				2.422	0.894	6.560				2.407	0.898	6.449
Other				1.273	0.445	3.640				1.291	0.454	3.672
Education Level												
Secondary or higher				Ref.	.	.				Ref.	.	.
No education				1.532***	1.265	1.854				1.510***	1.246	1.829
Primary or less				1.735***	1.474	2.043				1.720***	1.456	2.032
Media Exposure												
No access				Ref.	.	.				Ref.	.	.
Both at least once a week				1.259*	1.026	1.544				1.254*	1.024	1.536
Only one at least once a week				1.131	0.988	1.294				1.124	0.983	1.286

SINGLE-LEVEL FULL SAMPLE	Model 1 AOR	Model 1 95% CI		Model 2 AOR	Model 2 95% CI		Model 3 AOR	Model 3 95% CI		Model 4 AOR	Model 4 95% CI	
Religion												
Buddhist				Ref.	.	.				Ref.	.	.
Hindu				1.422*	1.036	1.952				1.459*	1.072	1.987
Muslim				0.625	0.223	1.755				0.627	0.225	1.743
Other				1.324	0.884	1.984				1.347	0.897	2.022
Occupation												
Not working				Ref.	.	.				Ref.	.	.
Agricultural				1.046	0.911	1.200				1.055	0.920	1.211
Non-agricultural				1.132	0.941	1.362				1.138	0.943	1.374
Sex of the household head												
Male				Ref.	.	.				Ref.	.	.
Female				1.127	0.984	1.290				1.119	0.973	1.288
Spousal age gap												
Under 5 years				Ref.	.	.				Ref.	.	.
5-9 years				1.298***	1.128	1.495				1.297***	1.125	1.495
10-14 years				1.454**	1.148	1.841				1.447**	1.141	1.834
15-19 years				2.047**	1.262	3.319				2.020**	1.244	3.281
20 years or more				0.785	0.405	1.523				0.781	0.400	1.524
Never in union				0.242***	0.197	0.297				0.241***	0.196	0.297
Wealth index												
Poor				Ref.	.	.				Ref.	.	.
Middle				1.070	0.899	1.274				1.119	0.923	1.358
Rich				1.099	0.922	1.310				1.096	0.920	1.306
Community Level												
Province												
Province 1							Ref.	.	.	Ref.	.	.
Province 2							2.037***	1.665	2.493	0.987	0.760	1.280

SINGLE-LEVEL FULL SAMPLE	Model 1			Model 2			Model 3			Model 4		
	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Province 3							1.011	0.788	1.298	0.956	0.705	1.297
Province 4							1.415***	1.191	1.680	1.107	0.875	1.400
Province 5							1.276**	1.079	1.508	0.976	0.791	1.204
Province 6							1.611***	1.291	2.010	1.056	0.821	1.358
Province 7							1.479***	1.225	1.785	1.175	0.916	1.508
Place of residence												
Urban							Ref.	.	.	Ref.	.	.
Rural							1.134*	1.013	1.269	0.995	0.863	1.147
Community education level												
Low							Ref.	.	.	Ref.	.	.
High							0.659***	0.586	0.741	0.896	0.755	1.064
Community media exposure												
Low							Ref.	.	.	Ref.	.	.
High							0.896	0.788	1.020	1.062	0.889	1.268
Community wealth index												
Low							Ref.	.	.	Ref.	.	.
High							1.059	0.926	1.210	1.160	0.935	1.441
Constant	0.606***	0.561	0.654	0.044***	0.027	0.070	0.531***	0.430	0.657	0.039***	0.023	0.064
Observations	12862			12862			12862			12862		
AIC	17211			9910			16842			9912		
BIC	17218			10133			16924			10211		

AOR; adjusted odds ratio, CI; confidence interval, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Table 11. Single-level logistic regression results (15-19 age group).

SINGLE-LEVEL	Model 1		Model 2			Model 3		Model 4		
SUBGROUP 1	**AOR**	**95% CI**	**AOR**	**95% CI**		**AOR**	**95% CI**	**AOR**	**95% CI**	
Individual Level										
Age at first marriage										
Not married as a child			Ref.	.	.			Ref.	.	.
Married before 15			12.24***	4.427	33.86			12.85***	4.679	35.28
Married at 15-17			3.836**	1.446	10.17			4.088**	1.549	10.79
Ethnicity										
Hill Brahmin			Ref.	.	.			Ref.	.	.
Hill Chhetri			0.996	0.429	2.313			1.131	0.455	2.810
Terai Brahmin/Chhetri			2.013	0.266	15.23			1.488	0.167	13.28
Other Terai caste			1.039	0.439	2.459			0.749	0.259	2.163
Hill Dalit			1.044	0.416	2.620			1.224	0.437	3.425
Terai Dalit			0.785	0.296	2.081			0.576	0.187	1.778
Newar			1.219	0.371	4.001			1.008	0.282	3.603
Hill Janajati			0.960	0.415	2.221			0.922	0.381	2.229
Terai Janajati			1.929	0.794	4.685			1.605	0.592	4.349
Muslim			1.633	0.528	5.053			1.238	0.336	4.557
Other			(omitted)					(omitted)		
Education Level										
Secondary or higher			Ref.	.	.			Ref.	.	.
No education			1.162	0.571	2.361			1.012	0.457	2.239
Primary or less			0.957	0.617	1.483			0.877	0.549	1.401
Media Exposure										
No access			Ref.	.	.			Ref.	.	.
Both at least once a week			1.063	0.550	2.056			0.922	0.470	1.807
Only one at least once a week			0.866	0.587	1.277			0.797	0.536	1.187

SINGLE-LEVEL	Model 1			Model 2			Model 3			Model 4		
SUBGROUP 1	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Occupation												
Not working				Ref.	.	.				Ref.	.	.
Agricultural				1.047	0.708	1.548				1.159	0.783	1.715
Non-agricultural				0.496	0.239	1.029				0.437*	0.205	0.928
Sex of the household head												
Male				Ref.	.	.				Ref.	.	.
Female				1.168	0.759	1.800				1.158	0.745	1.799
Spousal age gap												
Under 5 years				Ref.	.	.				Ref.	.	.
5-9 years				1.267	0.892	1.800				1.201	0.833	1.730
10-14 years				1.878*	1.019	3.463				1.642	0.874	3.083
15-19 years				4.127	0.602	28.28				3.814	0.553	26.30
20 years or more				0.270	0.0135	5.416				0.267	0.005	13.53
Never in union				0.009***	0.002	0.044				0.008***	0.002	0.0395
Wealth index												
Poor				Ref.	.	.				Ref.	.	.
Middle				1.126	0.690	1.840				1.560	0.882	2.759
Rich				0.793	0.482	1.304				0.791	0.481	1.299
Community Level												
Province												
Province 1							Ref.	.	.	Ref.	.	.
Province 2							1.439	0.880	2.354	0.942	0.456	1.945
Province 3							0.640	0.343	1.194	1.076	0.456	2.541
Province 4							0.982	0.603	1.600	0.952	0.432	2.100
Province 5							0.709	0.446	1.126	0.660	0.325	1.338
Province 6							0.690	0.409	1.165	0.453*	0.224	0.914
Province 7							0.805	0.501	1.292	1.048	0.420	2.618
Place of residence												

SINGLE-LEVEL	Model 1			Model 2			Model 3			Model 4		
SUBGROUP 1	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Urban							Ref.	.	.	Ref.	.	.
Rural							1.553**	1.160	2.079	1.481*	1.022	2.145
Community education level												
Low							Ref.	.	.	Ref.	.	.
High							0.660*	0.456	0.954	0.752	0.486	1.163
Community media exposure												
Low							Ref.	.	.	Ref.	.	.
High							0.777	0.532	1.135	1.323	0.814	2.149
Community wealth index												
Low							Ref.	.	.	Ref.	.	.
High							0.860	0.593	1.248	2.050**	1.198	3.507
Constant	0.148***	0.126	0.173	0.194*	0.049	0.768	0.189***	0.116	0.307	0.116*	0.022	0.606
Observations	2622			2614			2622			2614		
AIC	2040			1032			2016			1029		
BIC	2046			1184			2081			1240		

AOR; adjusted odds ratio, CI; confidence interval, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Table 12. Single-level logistic regression results (20-29 age group).

SINGLE-LEVEL	Model 1			Model 2			Model 3			Model 4		
SUBGROUP 2	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Individual Level												
Age at first marriage												
Not married as a child				Ref.	.	.				Ref.	.	.
Married before 15				46.35***	32.01	67.09				45.88***	31.60	66.61
Married at 15-17				20.55***	16.29	25.92				20.39***	16.07	25.86
Ethnicity												
Hill Brahmin				Ref.	.	.				Ref.	.	.
Hill Chhetri				1.252	0.842	1.862				1.174	0.783	1.760
Terai Brahmin/Chhetri				1.317	0.558	3.111				1.238	0.503	3.050
Other Terai caste				1.324	0.850	2.062				1.173	0.669	2.054
Hill Dalit				1.757*	1.132	2.728				1.758*	1.131	2.730
Terai Dalit				1.167	0.632	2.155				1.060	0.562	1.997
Newar				0.444**	0.261	0.755				0.501*	0.289	0.868
Hill Janajati				1.443	0.923	2.256				1.514	0.979	2.342
Terai Janajati				1.547*	1.001	2.391				1.366	0.855	2.183
Muslim				1.317	0.318	5.453				1.036	0.248	4.319
Other				2.811	0.505	15.64				2.704	0.522	14.00
Education Level												
Secondary or higher				Ref.	.	.				Ref.	.	.
No education				1.466*	1.079	1.992				1.365	0.994	1.876
Primary or less				1.489*	1.097	2.021				1.421*	1.035	1.950
Media Exposure												
No access				Ref.	.	.				Ref.	.	.
Both at least once a week				0.949	0.677	1.329				1.002	0.710	1.412
Only one at least once a week				1.032	0.805	1.324				1.066	0.829	1.372
Religion												

SINGLE-LEVEL	Model 1		Model 2			Model 3			Model 4		
SUBGROUP 2	AOR	95% CI	AOR	95% CI		AOR	95% CI		AOR	95% CI	
Buddhist			Ref.	.	.				Ref.	.	.
Hindu			1.353	0.807	2.270				1.367	0.830	2.251
Muslim			1.738	0.402	7.509				1.883	0.431	8.228
Other			1.385	0.734	2.615				1.406	0.742	2.662
Occupation											
Not working			Ref.	.	.				Ref.	.	.
Agricultural			1.247	0.981	1.586				1.243	0.974	1.586
Non-agricultural			1.050	0.762	1.445				1.058	0.768	1.458
Sex of the household head											
Male			Ref.	.	.				Ref.	.	.
Female			1.102	0.875	1.389				1.106	0.876	1.396
Spousal age gap											
Under 5 years			Ref.	.	.				Ref.	.	.
5-9 years			1.423**	1.128	1.797				1.451**	1.144	1.840
10-14 years			1.445	0.886	2.356				1.470	0.900	2.401
15-19 years			2.329	0.967	5.608				2.440	0.994	5.991
20 years or more			0.961	0.205	4.512				1.043	0.212	5.141
Never in union			0.174***	0.110	0.277				0.174***	0.109	0.277
Wealth index											
Poor			Ref.	.	.				Ref.	.	.
Middle			1.490**	1.123	1.977				1.497*	1.079	2.077
Rich			1.215	0.903	1.636				1.276	0.939	1.735
Community Level											
Province											
Province 1						Ref.	.	.	Ref.	.	.
Province 2						2.090***	1.562	2.798	0.883	0.569	1.371
Province 3						0.829	0.603	1.140	0.865	0.571	1.312
Province 4						1.352*	1.019	1.795	0.981	0.661	1.454
Province 5						1.075	0.825	1.402	0.861	0.598	1.238

SINGLE-LEVEL	Model 1			Model 2			Model 3			Model 4		
SUBGROUP 2	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Province 6							1.945***	1.436	2.635	1.196	0.758	1.887
Province 7							1.319	0.990	1.756	1.195	0.815	1.754
Place of residence												
Urban							Ref.	.	.	Ref.	.	.
Rural							1.210*	1.027	1.425	0.888	0.699	1.128
Community education level												
Low							Ref.	.	.	Ref.	.	.
High							0.566***	0.471	0.679	0.745*	0.558	0.993
Community media exposure												
Low							Ref.	.	.	Ref.	.	.
High							0.723**	0.592	0.881	0.864	0.634	1.179
Community wealth index												
Low							Ref.	.	.	Ref.	.	.
High							0.860	0.593	1.248	2.174**	1.246	3.795
Constant	0.668***	0.607	0.736	0.0494***	0.0237	0.103	0.748	0.550	1.018	0.0596***	0.0267	0.133
Observations	4400			4400			4400			4400		
AIC	5977			3348			5678			3354		
BIC	5984			3540			5748			3609		

AOR; adjusted odds ratio, CI; confidence interval, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Appendix D. Results of additional multilevel logistic regression (1)

Table 13. Additional multilevel logistic regression results (Full sample): Model 5-7.

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
FULL SAMPLE	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Individual Level												
Age at first marriage												
Not married as a child	Ref.	.	.									
Married before 15	54.65***	43.72	68.31									
Married at 15-17	22.87***	19.59	26.70									
Ethnicity												
Hill Brahmin	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
Hill Chhetri	1.070	0.855	1.339	1.090	0.905	1.312	1.075	0.897	1.289	1.083	0.902	1.300
Terai Brahmin/Chhetri	1.027	0.501	2.106	1.008	0.619	1.643	1.011	0.625	1.633	0.967	0.596	1.568
Other Terai caste	1.033	0.709	1.504	1.686***	1.279	2.224	1.698***	1.306	2.208	1.601***	1.221	2.100
Hill Dalit	1.664***	1.244	2.226	2.004***	1.622	2.477	1.970***	1.596	2.433	2.005***	1.632	2.463
Terai Dalit	0.885	0.588	1.330	1.680**	1.201	2.349	1.726**	1.247	2.388	1.627**	1.163	2.276
Newar	0.969	0.692	1.357	0.884	0.603	1.296	0.888	0.607	1.300	0.888	0.603	1.306
Hill Janajati	1.441**	1.123	1.849	1.403**	1.121	1.755	1.370**	1.099	1.708	1.275*	1.034	1.571
Terai Janajati	1.264	0.922	1.732	1.174	0.903	1.527	1.196	0.944	1.516	1.148	0.887	1.486
Muslim	2.703*	1.069	6.837	2.793	0.888	8.787	2.699	0.855	8.520	1.401	0.974	2.013
Other	1.523	0.448	5.177	1.342	0.613	2.936	1.355	0.617	2.977	1.234	0.566	2.690
Education Level												
Secondary or higher	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
No education	1.572***	1.304	1.896	2.304***	1.998	2.657	2.284***	1.993	2.618	2.285***	1.999	2.611
Primary or less	1.688***	1.424	2.002	2.481***	2.156	2.854	2.477***	2.152	2.853	2.479***	2.157	2.848

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
FULL SAMPLE	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Media Exposure												
No access	Ref.	.	.	Ref.	.	.						
Both at least once a week	1.206	0.976	1.489	1.038	0.887	1.214						
Only one at least once a week	1.096	0.952	1.262	1.082	0.972	1.204						
Religion												
Buddhist	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Hindu	1.649**	1.192	2.283	1.569***	1.228	2.005	1.535***	1.197	1.968			
Muslim	0.583	0.221	1.533	0.823	0.267	2.531	0.824	0.265	2.561			
Other	1.590*	1.009	2.508	1.554**	1.141	2.116	1.540**	1.130	2.099			
Occupation												
Not working	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Agricultural	1.027	0.880	1.199	1.116	0.981	1.269	1.101	0.966	1.256			
Non-agricultural	1.150	0.945	1.399	1.173*	1.011	1.360	1.175*	1.011	1.365			
Sex of the household head												
Male	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Female	1.139	0.993	1.307	1.138*	1.024	1.265	1.143*	1.028	1.270			
Spousal age gap												
Under 5 years	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
5-9 years	1.302***	1.128	1.501	1.620***	1.439	1.823	1.622***	1.441	1.825	1.609***	1.432	1.809
10-14 years	1.522***	1.190	1.946	2.037***	1.658	2.502	2.048***	1.668	2.516	2.036***	1.658	2.499
15-19 years	2.079**	1.234	3.503	2.263***	1.497	3.422	2.273***	1.513	3.417	2.255***	1.492	3.409
20 years or more	0.792	0.405	1.551	0.822	0.502	1.348	0.838	0.510	1.377	0.805	0.494	1.312
Never in union	0.223***	0.180	0.275	0.0904***	0.0730	0.112	0.0911***	0.0737	0.113	0.0913***	0.0737	0.113
Wealth index												
Poor	Ref.	.	.	Ref.	.	.				Ref.	.	.
Middle	1.098	0.907	1.328	1.112	0.955	1.296				1.111	0.956	1.292

MULTI-LEVEL FULL SAMPLE		Model 4			Model 5			Model 6			Model 7		
		AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
	Rich	1.134	0.935	1.375	1.004	0.864	1.167				0.998	0.856	1.164
Community Level													
Province													
	Province 1	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
	Province 2	0.884	0.658	1.187	1.716***	1.264	2.331	1.726***	1.279	2.331	1.728***	1.280	2.332
	Province 3	1.150	0.894	1.479	1.427**	1.146	1.778	1.427**	1.134	1.795	1.398**	1.131	1.729
	Province 4	1.204	0.918	1.580	1.482***	1.184	1.854	1.500**	1.173	1.918	1.476***	1.193	1.826
	Province 5	0.953	0.744	1.221	1.327*	1.045	1.684	1.316*	1.033	1.675	1.358*	1.074	1.715
	Province 6	1.081	0.817	1.429	1.828***	1.386	2.410	1.671***	1.261	2.214	1.813***	1.381	2.380
	Province 7	1.253	0.936	1.677	1.924***	1.503	2.463	1.793***	1.389	2.315	1.940***	1.529	2.462
Place of residence													
	Urban	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
	Rural	1.091	0.946	1.258	1.135*	1.009	1.277	1.101	0.980	1.236	1.133*	1.007	1.274
Community education level													
	Low	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
	High	0.882	0.739	1.052	0.860*	0.746	0.992	0.923	0.811	1.050	0.893	0.778	1.024
Community media exposure													
	Low	Ref.	.	.	Ref.	.	.				Ref.	.	.
	High	1.136	0.954	1.354	1.142	0.996	1.309				1.141	0.997	1.305
Community wealth index													
	Low	Ref.	.	.	Ref.	.	.				Ref.	.	.
	High	1.289*	1.003	1.656	1.196	0.987	1.449				1.188	0.985	1.433
Community-level Variance		0.103	0.080	0.132	0.076	0.060	0.098	0.077	0.060	0.099	0.075	0.058	0.096
ICC (%)		3.03%			2.26%			2.29%			2.22%		

MULTI-LEVEL	Model 4		Model 5		Model 6		Model 7	
FULL SAMPLE	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
PCV(%)	38.53%		54.08%		53.61%		55.06%	
AIC	9911		14076		14081		14086	
BIC	10217		14367		14327		14317	

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001, ** p<.01, * p<.05*

Table 14. Additional multilevel logistic regression results (15-19 age group): Model 5-7.

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
SUBGROUP 1	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Individual Level												
Age at first marriage												
Not married as a child	Ref.	.	.									
Married before 15	18.20***	4.988	66.43									
Married at 15-17	5.129*	1.433	18.35									
Ethnicity												
Hill Brahmin	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
Hill Chhetri	0.817	0.267	2.502	0.826	0.251	2.724	0.852	0.257	2.820	0.880	0.270	2.869
Terai Brahmin/Chhetri	2.206	0.130	37.32	2.253	0.131	38.62	2.518	0.154	41.24	1.980	0.0735	53.31
Other Terai caste	0.622	0.166	2.334	0.795	0.201	3.140	0.819	0.239	2.808	0.891	0.235	3.380
Hill Dalit	1.058	0.304	3.685	1.179	0.335	4.143	1.217	0.354	4.185	1.287	0.382	4.332
Terai Dalit	0.644	0.153	2.720	0.726	0.159	3.323	0.812	0.198	3.325	0.779	0.174	3.492
Newar	1.532	0.358	6.560	0.954	0.192	4.735	0.995	0.219	4.523	1.043	0.218	4.985

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
SUBGROUP 1	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Hill Janajati	0.806	0.279	2.331	0.799	0.264	2.418	0.770	0.256	2.311	0.815	0.270	2.453
Terai Janajati	1.262	0.368	4.325	1.136	0.320	4.040	1.242	0.377	4.092	1.308	0.386	4.434
Muslim	1.063	0.191	5.926	0.926	0.161	5.330	0.848	0.167	4.303	1.017	0.191	5.416
Other	*(omitted)*			*(omitted)*			*(omitted)*			*(omitted)*		
Education Level												
Secondary or higher	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
No education	0.857	0.308	2.388	1.034	0.401	2.669	1.190	0.465	3.040	1.152	0.463	2.866
Primary or less	0.842	0.469	1.509	1.102	0.635	1.913	1.268	0.760	2.116	1.188	0.689	2.046
Media Exposure												
No access	Ref.	.	.	Ref.	.	.						
Both at least once a week	0.745	0.313	1.777	0.749	0.317	1.772						
Only one at least once a week	0.690	0.420	1.133	0.742	0.465	1.186						
Occupation												
Not working	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Agricultural	1.062	0.648	1.741	1.188	0.736	1.916	1.217	0.764	1.937			
Non-agricultural	0.300*	0.118	0.763	0.350*	0.144	0.848	0.360*	0.146	0.889			
Sex of the household head												
Male	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Female	1.353	0.785	2.332	1.314	0.821	2.101	1.323	0.824	2.123			
Spousal age gap												
Under 5 years	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
5-9 years	1.425	0.904	2.246	1.624*	1.054	2.501	1.650*	1.082	2.518	1.647*	1.069	2.538
10-14 years	2.278	0.994	5.221	2.330*	1.012	5.365	2.371*	1.055	5.328	2.282*	1.020	5.108
15-19 years	4.038	0.313	52.04	4.100	0.525	31.99	3.968	0.481	32.75	4.349	0.549	34.46
20 years or more	0.542	0.007	44.71	0.423	0.009	20.84	0.536	0.018	16.36	0.501	0.013	20.08
Never in union	0.006***	0.001	0.037	0.002***	0.000	0.006	0.002***	0.000	0.006	0.002***	0.000	0.006

MULTI-LEVEL		Model 4			Model 5			Model 6			Model 7		
SUBGROUP 1		AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Wealth index													
	Poor	Ref.	.	.	Ref.	.	.				Ref.	.	.
	Middle	1.405	0.693	2.851	1.490	0.723	3.070				1.558	0.767	3.167
	Rich	0.874	0.464	1.644	0.846	0.473	1.512				0.782	0.444	1.379
Community Level													
Province													
	Province 1	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
	Province 2	0.932	0.383	2.270	0.919	0.373	2.261	0.860	0.343	2.153	0.888	0.371	2.127
	Province 3	1.057	0.378	2.957	0.911	0.338	2.453	0.887	0.341	2.308	0.904	0.345	2.368
	Province 4	0.865	0.316	2.369	0.816	0.335	1.990	0.828	0.346	1.978	0.874	0.368	2.072
	Province 5	0.706	0.295	1.687	0.677	0.289	1.583	0.650	0.279	1.516	0.709	0.314	1.599
	Province 6	0.343*	0.146	0.802	0.340**	0.155	0.746	0.315**	0.145	0.682	0.339**	0.159	0.725
	Province 7	1.395	0.425	4.579	1.045	0.391	2.794	0.928	0.340	2.532	1.075	0.426	2.712
Place of residence													
	Urban	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
	Rural	1.524	0.936	2.481	1.612*	1.018	2.554	1.498	0.972	2.308	1.520	0.980	2.356
Community education level													
	Low	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
	High	0.739	0.425	1.285	0.831	0.497	1.389	0.907	0.552	1.491	0.889	0.544	1.455
Community media exposure													
	Low	Ref.	.	.	Ref.	.	.				Ref.	.	.
	High	1.429	0.777	2.628	1.391	0.767	2.525				1.209	0.702	2.083
Community wealth index													
	Low	Ref.	.	.	Ref.	.	.				Ref.	.	.
	High	1.720	0.829	3.566	1.583	0.792	3.163				1.388	0.696	2.765

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
SUBGROUP 1	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Community-level Variance	0.702	0.489	1.006	0.689	0.495	0.958	0.698	0.505	0.964	0.616	0.439	0.863
Observations	2614			2614			2614			2614		
ICC(%)	17.58%			17.50%			17.50%			15.77%		
PCV(%)	-4.31%			-3.86%			-3.86%			6.42%		
AIC	1031			1085			1090			1078		
BIC	1266			1308			1278			1254		

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Table 15. Additional multilevel logistic regression results (20-29 age group): Model 5-7.

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
SUBGROUP 2	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Individual Level												
Age at first marriage												
Not married as a child	Ref.	.	.									
Married before 15	54.85***	36.80	81.73									
Married at 15-17	24.69***	18.99	32.11									
Ethnicity												
Hill Brahmin	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
Hill Chhetri	1.179	0.747	1.860	1.575*	1.092	2.273	1.594*	1.110	2.288	1.539*	1.071	2.211
Terai Brahmin/Chhetri	1.376	0.475	3.983	1.567	0.630	3.894	1.676	0.682	4.118	1.445	0.590	3.540
Other Terai caste	1.147	0.584	2.251	2.538**	1.452	4.437	2.812***	1.646	4.805	2.310**	1.311	4.070
Hill Dalit	1.932*	1.164	3.208	3.390***	2.256	5.092	3.429***	2.279	5.161	3.356***	2.220	5.075

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
SUBGROUP 2	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Terai Dalit	0.990	0.470	2.085	2.187*	1.125	4.251	2.492**	1.288	4.819	2.019*	1.050	3.880
Newar	0.574	0.288	1.143	0.860	0.417	1.774	0.875	0.426	1.799	0.860	0.409	1.807
Hill Janajati	1.611*	1.005	2.583	2.514***	1.721	3.672	2.557***	1.749	3.738	2.236***	1.533	3.262
Terai Janajati	1.247	0.714	2.180	1.497	0.926	2.419	1.630*	1.035	2.566	1.466	0.904	2.378
Muslim	1.123	0.237	5.309	0.796	0.0550	11.51	0.889	0.0586	13.50	1.993*	1.021	3.891
Other	3.123	0.493	19.78	4.650	0.856	25.26	5.223	0.932	29.27	4.480	0.961	20.89
Education Level												
Secondary or higher	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
No education	1.472*	1.049	2.066	2.283***	1.798	2.899	2.418***	1.900	3.077	2.333***	1.831	2.973
Primary or less	1.424*	1.014	2.000	2.435***	1.906	3.110	2.522***	1.978	3.214	2.482***	1.943	3.171
Media Exposure												
No access	Ref.	.	.	Ref.	.	.						
Both at least once a week	0.948	0.652	1.379	0.851	0.641	1.130						
Only one at least once a week	1.037	0.793	1.356	0.991	0.799	1.229						
Religion												
Buddhist	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Hindu	1.694	0.982	2.921	1.674*	1.122	2.498	1.684*	1.127	2.516			
Muslim	2.203	0.465	10.44	4.721	0.358	62.19	4.691	0.342	64.27			
Other	1.768	0.886	3.526	1.717	0.957	3.083	1.726	0.947	3.148			
Occupation												
Not working	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Agricultural	1.243	0.946	1.634	1.422**	1.141	1.771	1.406**	1.133	1.745			
Non-agricultural	1.156	0.812	1.646	1.308*	1.017	1.682	1.294*	1.006	1.664			
Sex of the household head												
Male	Ref.	.	.	Ref.	.	.	Ref.	.	.			
Female	1.090	0.856	1.387	1.057	0.883	1.265	1.063	0.888	1.273			

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
SUBGROUP 2	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Spousal age gap												
Under 5 years	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
5-9 years	1.507**	1.171	1.938	1.855***	1.541	2.234	1.856***	1.539	2.238	1.832***	1.519	2.210
10-14 years	1.524	0.901	2.577	1.993***	1.346	2.949	2.013***	1.354	2.993	1.950***	1.318	2.884
15-19 years	2.978*	1.008	8.801	3.313**	1.456	7.542	3.313**	1.470	7.464	3.388**	1.497	7.671
20 years or more	1.075	0.220	5.257	1.245	0.423	3.668	1.258	0.435	3.638	1.154	0.388	3.428
Never in union	0.157***	0.0944	0.262	0.0692***	0.0414	0.116	0.0706***	0.0424	0.118	0.0697***	0.0417	0.116
Wealth index												
Poor	Ref.	.	.	Ref.	.	.				Ref.	.	.
Middle	1.473*	1.055	2.057	1.377*	1.068	1.775				1.434**	1.108	1.854
Rich	1.330	0.941	1.879	1.112	0.853	1.450				1.055	0.813	1.369
Community Level												
Province												
Province 1	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
Province 2	0.791	0.473	1.323	1.598*	1.044	2.447	1.669*	1.080	2.579	1.547*	1.013	2.362
Province 3	1.011	0.614	1.665	1.237	0.839	1.824	1.218	0.821	1.808	1.202	0.834	1.732
Province 4	0.929	0.560	1.542	1.315	0.898	1.924	1.286	0.868	1.907	1.298	0.901	1.871
Province 5	0.888	0.563	1.400	1.177	0.806	1.720	1.211	0.821	1.786	1.203	0.829	1.746
Province 6	1.302	0.744	2.276	2.453***	1.557	3.863	2.320***	1.478	3.642	2.387***	1.555	3.666
Province 7	1.281	0.794	2.067	2.047***	1.348	3.107	1.992**	1.301	3.052	2.148***	1.431	3.224
Place of residence												
Urban	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
Rural	0.952	0.743	1.219	1.086	0.906	1.301	1.068	0.895	1.274	1.072	0.894	1.284
Community education level												
Low	Ref.	.	.	Ref.	.	.	Ref.	.	.	Ref.	.	.
High	0.745	0.532	1.044	0.754*	0.577	0.984	0.808	0.644	1.012	0.788	0.607	1.022

MULTI-LEVEL	Model 4			Model 5			Model 6			Model 7		
SUBGROUP 2	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Community media exposure												
Low	Ref.	.	.	Ref.	.	.				Ref.	.	.
High	0.920	0.647	1.309	0.979	0.769	1.247				0.924	0.737	1.158
Community wealth index												
Low	Ref.	.	.	Ref.	.	.				Ref.	.	.
High	1.390	0.923	2.093	1.517**	1.117	2.059				1.480*	1.095	1.999
Community-level Variance	0.239	0.183	0.312	0.163	0.125	0.212	0.161	0.125	0.209	0.158	0.121	0.205
Observations	4400			4400			4400			4400		
ICC(%)	6.77%			4.72%			4.67%			4.58%		
PCV(%)	31.55%			52.26%			52.74%			53.72%		
AIC	3356			4847			4851			4847		
BIC	3618			5096			5062			5045		

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Appendix E. Results of additional multilevel logistic regression (2)

Table 16. Additional multilevel logistic regression results (Full sample): Model 3A-C.

MULTI-LEVEL	Model 3			Model 3A			Model 3B			Model 3C		
FULL SAMPLE	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Community Level												
Province												
Province 1	Ref.	.	.	Ref.	.	.				Ref.	.	.
Province 2	2.192***	1.720	2.795	2.712***	2.155	3.413				2.252***	1.769	2.867
Province 3	1.222*	1.017	1.469	1.203	0.964	1.500				1.193	0.979	1.454
Province 4	1.462***	1.216	1.758	1.391**	1.124	1.721				1.454***	1.194	1.770
Province 5	1.335**	1.101	1.618	1.443***	1.171	1.778				1.349**	1.103	1.650
Province 6	1.648***	1.293	2.100	1.645***	1.281	2.112				1.657***	1.297	2.117
Province 7	1.506***	1.223	1.855	1.552***	1.243	1.937				1.515***	1.216	1.888
Place of residence												
Urban	Ref.	.	.	Ref.	.	.						
Rural	1.196**	1.075	1.331	1.240***	1.105	1.391						
Community education level												
Low	Ref.	.	.				Ref.	.	.	Ref.	.	.
High	0.702***	0.630	0.781				0.604***	0.530	0.688	0.680***	0.602	0.767
Community media exposure												
Low	Ref.	.	.				Ref.	.	.			
High	0.966	0.859	1.085				0.841**	0.739	0.956			
Community wealth index												
Low	Ref.	.	.				Ref.	.	.	Ref.	.	.
High	1.135	0.998	1.292				1.318***	1.163	1.493	1.098	0.962	1.252
Community-level Variance	0.063	0.049	0.081	0.078	0.059	0.102	0.097	0.073	0.129	0.068	0.052	0.088

MULTI-LEVEL	Model 3		Model 3A		Model 3B		Model 3C	
FULL SAMPLE	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
Observations	12862		12862		12862		12862	
ICC(%)	1.88%		2.30%		2.86%		2.02%	
PCV(%)	61.84%		53.29%		41.93%		59.09%	
AIC	16811		16851		16897		16815	
BIC	16901		16918		16934		16890	

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Table 17. Additional multilevel logistic regression results (15-19 age group): Model 3A-C.

MULTI-LEVEL		Model 3			Model 3A			Model 3B			Model 3C		
SUBGROUP 1		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Community Level													
Province													
	Province 1	Ref.	.	.	Ref.	.	.				Ref.	.	.
	Province 2	1.734	0.977	3.079	1.832*	1.100	3.053				1.958*	1.078	3.554
	Province 3	0.666	0.320	1.386	0.710	0.339	1.485				0.593	0.291	1.210
	Province 4	0.890	0.493	1.608	0.853	0.486	1.497				0.821	0.455	1.482
	Province 5	0.757	0.442	1.297	0.809	0.469	1.395				0.790	0.455	1.372
	Province 6	0.495*	0.272	0.903	0.631	0.361	1.104				0.498*	0.274	0.906
	Province 7	0.717	0.416	1.234	0.880	0.522	1.483				0.725	0.407	1.293

MULTI-LEVEL	Model 3			Model 3A			Model 3B			Model 3C		
SUBGROUP 1	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Place of residence												
Urban	Ref.	.	.	Ref.	.	.						
Rural	1.543*	1.073	2.220	1.776**	1.261	2.503						
Community education level												
Low	Ref.	.	.				Ref.	.	.	Ref.	.	.
High	0.757	0.519	1.102				0.602**	0.421	0.862	0.665*	0.464	0.954
Community media exposure												
Low	Ref.	.	.				Ref.	.	.			
High	0.764	0.516	1.131				0.623*	0.420	0.925			
Community wealth index												
Low	Ref.	.	.				Ref.	.	.	Ref.	.	.
High	0.735	0.483	1.117				1.143	0.803	1.627	0.644*	0.424	0.979
Community-level Variance	0.460	0.342	0.618	0.495	0.358	0.684	0.540	0.393	0.741	0.511	0.380	0.687
Observations	2622			2622			2622			2622		
ICC(%)	12.26%			13.08%			14.10%			13.44%		
PCV(%)	27.26%			22.38%			16.33%			20.23%		
AIC	2014			2018			2013			2018		
BIC	2085			2071			2042			2076		

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. *** *p<.001,* ** *p<.01,* * *p<.05*

Table 18. Additional multilevel logistic regression results (20-29 age group): Model 3A-C.

MULTI-LEVEL	Model 3			Model 3A			Model 3B			Model 3C		
SUBGROUP 2	**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**		**AOR**	**95% CI**	
Community Level												
Province												
Province 1	Ref.	.	.	Ref.	.	.				Ref.	.	.
Province 2	2.195***	1.561	3.087	3.271***	2.326	4.602				2.427***	1.717	3.430
Province 3	1.021	0.755	1.380	0.981	0.695	1.384				0.958	0.694	1.323
Province 4	1.283	0.941	1.751	1.138	0.818	1.582				1.223	0.882	1.696
Province 5	1.163	0.853	1.584	1.379	0.980	1.940				1.221	0.869	1.714
Province 6	2.132***	1.505	3.021	2.368***	1.661	3.377				2.263***	1.575	3.253
Province 7	1.379*	1.003	1.894	1.582**	1.126	2.222				1.468*	1.044	2.064
Place of residence												
Urban	Ref.	.	.	Ref.	.	.						
Rural	1.289**	1.102	1.509	1.442***	1.205	1.724						
Community education level												
Low	Ref.	.	.				Ref.	.	.	Ref.	.	.
High	0.578***	0.479	0.697				0.480***	0.394	0.585	0.516***	0.422	0.630
Community media exposure												
Low	Ref.	.	.				Ref.	.	.			
High	0.755**	0.622	0.917				0.617***	0.504	0.756			
Community wealth index												
Low	Ref.	.	.				Ref.	.	.	Ref.	.	.
High	1.171	0.943	1.456				1.341**	1.112	1.617	1.071	0.849	1.350
Community-level Variance	0.149	0.120	0.185	0.194	0.155	0.244	0.193	0.155	0.240	0.165	0.131 0.207	
Observations	4400			4400			4400			4400		

MULTI-LEVEL	Model 3		Model 3A		Model 3B		Model 3C	
SUBGROUP 2	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
ICC(%)	4.33%		5.57%		5.53%		4.77%	
PCV(%)	56.25%		43.67%		44.03%		51.76%	
AIC	5673		5732		5741		5687	
BIC	5750		5789		5773		5751	

AOR; adjusted odds ratio, CI; confidence interval, ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion. **** p<.001, ** p<.01, * p<.05*

Appendix F. ICC values for different models and samples.

Table 19. ICC values for models with each community-level variable.

Community Level Variables Included	ICC (%)	PCV (%)	AIC	BIC
Full Sample				
Null model	4.93	Reference	16995	17010
Province	2.57	47.92	16860	16919
Place of residence	4.46	9.46	16987	17009
Community education level	3.24	34.39	16912	16934
Community media exposure	4.23	14.25	16949	16971
Community wealth index	4.78	3.10	16997	17019
Subgroup 1				
Null model	16.85	Reference	2029	2041
Province	14.85	11.88	2024	2071
Place of residence	14.58	13.48	2024	2041
Community education level	14.80	12.19	2015	2033
Community media exposure	15.06	10.62	2017	2034
Community wealth index	16.91	-0.37	2031	2049
Subgroup 2				
Null model	9.89	Reference	5860	5873
Province	6.26	36.71	5748	5799
Place of residence	8.79	11.16	5844	5863
Community education level	6.25	36.76	5764	5783
Community media exposure	7.45	24.69	5783	5802
Community wealth index	9.91	-0.21	5852	5871

ICC; intraclass correlation coefficient, PCV; proportional change in variance, AIC; Akaike information criterion, BIC; Bayesian information criterion.

Table 20. ICC values for samples subdivided by experience of child marriage.

Child Marriage	Adolescent Pregnancy		Total	ICC (%)
	No	Yes		
Full Sample				
Yes	1374	4283	5657	5.26
	24.29%	75.71%	100%	
No	6635	570	7205	8.22
	92.09%	7.91%	100%	
Subgroup 1				
Yes	306	313	619	16.88
	49.41%	50.59%	100%	
No	1958	21	1979	61.90
	98.93%	1.07%	100%	
Subgroup 2				
Yes	176	713	890	12.06
	19.81%	80.19%	100%	
No	1207	155	1361	18.03
	88.64%	11.36%	100%	

ICC; intraclass correlation coefficient of the null model

Appendix G. Descriptive statistics on child marriage depending on ethnicity.

Table 21. Descriptive statistics results on child marriage depending on ethnicity.

Ethnicity	Child Marriage		Total
	No	Yes	
Hill Brahmin	1058	454	1512
	69.99%	30.01%	100%
Hill Chhetri	1449	894	2343
	61.83%	38.17%	100%
Terai Brahmin/Chhetri	140	77	217
	64.42%	35.58%	100%
Other Terai caste	647	1262	1908
	33.88%	66.12%	100%
Hill Dalit	525	517	1042
	50.37%	49.63%	100%
Terai Dalit	149	405	554
	26.86%	73.14%	100%
Newar	490	150	639
	76.61%	23.39%	100%
Hill Janajati	1690	1005	2694
	62.72%	37.28%	100%
Terai Janajati	766	501	1266
	60.45%	39.55%	100%
Muslim	259	384	643
	40.33%	59.67%	100%
Other	33	9	43
	78.47%	21.53%	100%
Total	7205	5657	12862
	56.02%	43.98%	100%

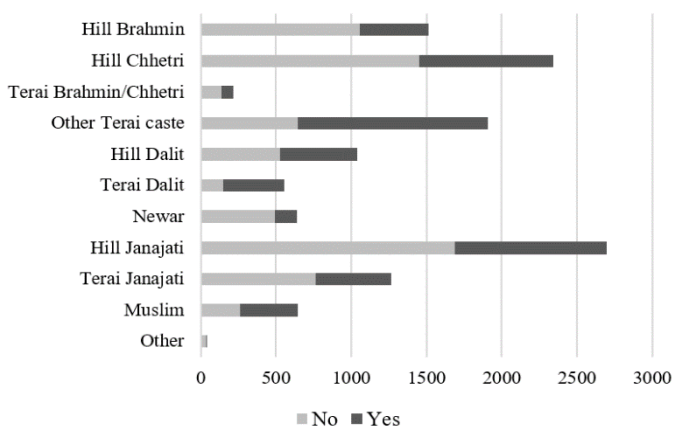

Figure 12. Prevalence of child marriage in each ethnicity.

Abstract (Korean)

국 문 초 록

정 유 진
서울대학교 보건대학원
보건학과 보건정책관리학 전공

전세계 개발도상국에서 15-19세의 청소년 임신은 매년 약 2100만 건이 발생한다. 청소년(10-19세)들은 20세 이상의 성인에 비해 임신과 관련된 사망 위험에 더 많이 노출되어 있고, 학교 자퇴로 이어져 경제적 독립성이 제한되기도 하는 등 전세계 어린 여성들의 삶에 부정적인 영향을 끼친다. 네팔은 국가 수준에서 청소년 임신율이 높을 뿐만이 아니라, 국가 내에서도 지역별 편차가 큰 나라 중 하나이다. 그럼에도 불구하고, 네팔을 대상으로 한 연구는 주로 개인수준 변수만을 확인하였고, 지역별 요인을 고려하여 다수준 분석을 수행한 연구는 부족한 실정이었다. 따라서 본 연구에서는 네팔 청소년 임신에 영향을 미치는 개인 및 지역수준 요인을 다수준 분석방법을 활용하여 확인하고자 하였다.

분석 때 사용한 자료는 위계적 속성이 반영된 2016년 네팔 인구보건조사 (Demographic and Health Survey, DHS) 자료이며, 전체 표본은 383개의 지역(cluster)에 속한 12,862명의 15-49세 여성이었다. 또한, 본 연구에서는 15-19세 여성 (N = 2,622) 집단과 20-29세 여성 (N = 4,400) 집단의 두 하위그룹을 추가적으로 분석하였다. 분석 방법으로는 개인 및 지역수준 변수를 포함하고 지역별로 구분할 수 있는 혼합효과 2-수준 로지스틱 회귀분석 (mixed-effects two-level logistic regression)을 실시하였다.

종속변수는 청소년 임신, 즉 한 개인이 10-19세일 때 첫 출산 여부

혹은 15-19세 현재 임신 여부로 정의되었다. 설명변수는 개인 및 지역수준으로 구분되었으며, 세계보건기구의 건강의 사회적 결정요인 (Social Determinants of Health) 모형을 적용하였다. 통계 분석은 기술 통계, 카이제곱 검정, 그리고 다수준 로지스틱 회귀분석으로 이루어졌다. 다수준 분석시에는 수준-1과 수준-2의 가중치가 적용된 임의 절편 모형(random intercept model)을 총 4개의 모형 -종속변수만 포함한 모형 1 (영모형), 개인수준 변수만을 포함한 모형 2, 지역수준 변수만을 포함한 모형 3, 그리고 개인 및 지역수준 변수들을 모두 포함한 모형 4-으로 적합하였다

분석 결과, 네팔의 청소년 임신 비율은 전체 표본에서 38 %, 15-19세 집단에서 13 %, 그리고 20-29세 집단에서 40 %로 나타났다. 고정효과에 대해서는 세 표본 모두에서 청소년 임신에 영향을 미치는 유의한 요인으로 첫 결혼 나이로 나타났다. 특히, 첫 결혼 나이는 다른 요인과 비교했을 때 조정된 오즈비(AOR)가 가장 높은 요인으로 나타났다. 또한, 전체 표본과 20-29세 표본에서는 추가로 인종, 개인 교육수준, 파트너와의 나이 차이 등이 유의한 영향 요인이었다. 임의효과에 대해서는 다수준 분석 결과, 전체 표본의 급내 상관계수(ICC)는 불과 4.93 %로 산출되어, 본 연구에서는 청소년 임신에 대한 지역의 영향은 작은 것으로 확인되었다. 그리고 15-19세와 20-29세 집단에서 ICC값은 각각 16.85 %, 9.89 %로 나타나, 전체 표본과 두 하위집단 간 지역의 영향에는 차이를 보였다.

청소년 임신의 영향요인과 관련하여, 본 연구의 주요 결과 중 하나는 네팔에서 조혼이 청소년 임신에 끼치는 영향이 강하다는 것이었다. 또한, 본 연구는 네팔에서 카스트/인종과 개인 교육수준의 요인이 조혼을 통해 청소년 임신에 영향을 끼칠 수 있음을 보여주었다. 네팔은 청소년 임신뿐만이 아니라 조혼이 성행하는 국가 중 하나이고, 네팔 정부는 지속가능 발전목표 (Sustainable Development Goals)를 달성하기 위해 2030년까지 조혼을 없애기로 약속한 바 있다. 따라서, 조혼과 청소년 임신을 줄이기 위해서는 네팔 여성들의 학교 교육이 끊기지 않도록 해야 할 것이다.

또한, 본 연구의 다수준 분석 결과에 비추었을 때, 네팔에서는 청소년 임신에 대한 지역별 영향이 크지는 않은 것으로 보이고, 이는 전체 표본에서 더욱 그러했다. 따라서, 추후 연구로는 3-수준 모델이나 임의 기울기 모형 등 보다 더 엄밀한 다수준 분석 모델을 사용해볼 수 있을 것이다. 한편, 본 연구는 기존 연구가 부족했던 네팔을 대상으로 처음으로 청소년 임신의 영향요인을 다수준으로 분석했다는 시사점을 갖는다.

주요어 : 청소년 임신, 청소년 성생식 건강, 조혼, 네팔, 동남아시아, 다수준 분석

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