博士論文

A mixed methods study on effects and a mechanism in the relationship between child marriage and reproductive health outcomes in Nepal

（ネパールにおける児童婚のリプロダクティブヘルスアウトカムへの効果とそのメカニズムについての混合研究）

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ネパールにおける児童婚のリプロダクティブヘルスアウトカムへの効果とそのメカニズムについての混合研究

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Abstract

Introduction

My Ph.D. research aimed to investigate whether child marriage had effects on unmet needs for modern contraception and unintended pregnancy. It also aimed to identify the multilevel and interacting factors that influence contraceptive use and childbearing among married adolescent girls.

Methods

This thesis used an explanatory sequential mixed methods design. A quantitative study relied on secondary data from the Nepal Demographic and Health Survey 2016. Using propensity score matching analysis, women married before the age of 18 were matched with similar women who were married at 18 or above. Qualitative data were collected from three different groups through in-depth interviews and other three groups through key informant interviews.

Results

Propensity score matching analysis showed that women married as children had a 14.3 percentage point and a 10.1 percentage point higher risk of unmet needs for modern contraception and unintended pregnancy, respectively, than among women married as adults. The qualitative study revealed the multidimensionality and interaction of the factors at different levels that limit women's family planning knowledge, undermine their autonomy in decision making, reduce contraceptive use, and increase the risk of adolescent pregnancy.

Conclusions

The quantitative and qualitative studies converge on the conclusion that child marriage has impacts on unmet needs for modern contraception and unintended pregnancy. The present research provided a detailed account of how married adolescent girls' access to contraceptives was impeded by a complex myriad of barriers.

Keywords: child marriage, reproductive health, unmet needs for modern contraception, unintended pregnancy, propensity score matching, socio-ecological model, mixed methods

Acknowledgments

First of all, I would like to sincerely thank Professor Masamine Jimba, my supervisor, who provided insightful guidance and thoughtful inputs for completing my thesis. It has been a great privilege to learn from him over the past years.

I would like to show my deep appreciation to the faculty members of the Department of Community and Global Health at The University of Tokyo, including Dr. Akira Shibanuma, Dr. Ken I.C. Ong, Dr. Rogie Royce Carandang, and Dr. Junko Kiriya, for their substantial comments and useful suggestions for revisions.

I am grateful to the secretary members at the department for kindly offering help throughout my study.

I would like to express my gratitude to the participants for their valuable contribution to my qualitative research in Bara district, Nepal.

I would like to gratefully acknowledge the contribution of Mr. Anand Tamang and local research assistants to data collection and of Mr. Nirajan Khadka to data analysis.

I would like to thank ICF Macro International for providing me with free access to the Nepal Demographic and Health Survey 2016 dataset.

I would like to appreciate the Foundation for Advanced Studies on International Development for financially supporting my study.

Finally, I would like to thank my wife, daughter, and parents for their heartfelt encouragement and support throughout my study.

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List of abbreviations

ATT: average treatment effect on the treated

CI: confidence interval

COREQ: consolidated criteria for reporting qualitative studies

DHS: demographic and Health Survey

FCHVs: female community health volunteers

FP: family planning

IDIs: in-depth interviews

IQR: interquartile range

KII: key informant interviews

LMIC: low- and middle-income countries

NDHS: Nepal Demographic and Health Survey

PSM: propensity score matching

SE: standard error

SEM: socio-ecological model

1. Overall introduction

1.1 Background

1.1.1 Child marriage

In many societies, marriage marks the onset of a socially acceptable institution for offspring production. Women's age at first marriage has implications for their education, reproductive behaviors, and social status [1]. Early marriage involves shifting adolescent girls' focus from education and personal development to family life and motherhood [2]. Marriage and childbearing during adolescence can greatly alter young women's life prospects [3]. Early marriage and pregnancy often deprive girls of opportunities to complete their education and develop the life skills required to ensure a decent livelihood and well-being [4].

Worldwide, more than 650 million women alive today were married before their 18th birthday [5], although the practice of child marriage is illegal in most of the countries where it is prevalent. Of them, more than one in three (about 250 million) entered into union before age 15 [6]. South Asia is home to 44 % of all girl brides worldwide [5] and 30 % of 20 to 24-year-old women in the region were married or in union before age 18 [5]. Girls who are poor, uneducated, living in rural areas with high levels of gender inequality are at higher risk for child marriage [7]. Remarkable progress in reducing child marriage has been made in all regions. In South Asia, the risk of girl child marriage has declined by more than a third, from nearly 50 % to 30 % between 2008

and 2018 [5]. Yet, global rates of child marriage remain alarmingly high at 21 percent [5].

In South Asia, female child marriage is a vastly complex traditional practice. Marrying off a daughter at a young age is often an economic decision. In extreme poverty, raising a young girl is considered to be a financial burden on her family. Impoverished parents perceive marrying off a pubescent daughter as a strategy to end their economic responsibility for their daughter and to alleviate the burden of having one more child to feed, clothe, and educate [8]. It also relieves the parental family of investment in their daughter's education, the benefit of which cannot be reaped by the family [9]. As dowry demanded by the groom at the time of marriage typically increases with the age of the bride, parents choose to marry off their daughter at an early age [10–12].

Community perception also plays a vital role in parents' decisions to marry off their daughter early. Parents have a concern that their unmarried daughter could disgrace the family by either becoming pregnant outside marriage or reaching an age where they would be looked down upon for not marrying her off [13–15]. As such, child marriage is considered to be a means of protecting a daughter's chastity and the family honor [16]. Girls who are not familiar with their rights and have no peer support often have little power to challenge an arranged marriage, feeling obliged to obey their parents [17].

Moreover, child marriage is often upheld and perpetuated by a sense of insecurity. Safeguarding daughter's virginity until she marries is a parents' primary concern as it is

linked to her marriageability and family's honor [18]. Parents commonly believe that marriage provides security against premarital sex, pregnancy, and sexual abuse [19]. Thus, parents force their daughter into early marriage to protect her from premarital sex and childbearing.

The timing of marriage is a proximate determinant of fertility [20]. Early entry into a formal union almost always leads to early age at first childbirth. Approximately 16 million adolescent girls aged between 15 and 19, and two million girls under the age of 15, become pregnant each year [21]. Almost 90 % of these pregnancies occur within marriage [22]. It is well-documented that age at first marriage affects fertility, as previous studies have found consistent associations between child marriage and high fertility [23–27].

While most child marriage in Nepal is arranged or forced marriage, elopement for love marriage is emerging as a rising trend in recent years. The couples who decide to marry after having a love affair choose to elope as the girl's parents would not give consent. When rumors about the relationship spread, the couples often feel they have no choice but to marry immediately. In some cases, even mistaken rumors prompt a rushed marriage. They elope because they knew that they were about to be forced into an arranged marriage with someone else. Some girls run away and elope as a means to escape an abusive parent or extreme poverty. Elopement occurs without the knowledge of the parents, who only hear about it once their children have already eloped. Some elopements are prompted by connection and communication via mobile phones; the boy

and girl do not even meet each other face to face before deciding to run away together [28].

A substantial body of evidence shows that child marriage has consequences for sexual and reproductive health. It is not only a human right violation but also a hindrance to progress toward individual and social development. For example, child marriage is associated with contraceptive nonuse before first pregnancy [29,30], unintended pregnancy [23–25,29], pregnancy termination [23–25,29,30], and rapid repeat births [23,24,29] in India, Bangladesh, Nepal, and Pakistan. Women married as children were also less likely to complete the fourth visit for antenatal care and receive skilled care during pregnancy and at birth in these countries [29–33].

Moreover, child marriage is a known risk factor for intimate partner violence. Associations of child marriage and intimate partner violence are established in the literature. In cross-sectional studies from 34 countries, Kidman [34] found that women married before the age of 18 were at increased risk of physical and/or sexual violence by their partner in 19 countries. Other researchers have also reported similar findings in Nepal [35], India [36,37], Pakistan [38], Bangladesh [39], and Viet Nam [40].

1.1.2 Unmet needs for family planning

Access to family planning is recognized globally as a serious public health and human rights issue [41]. The Sustainable Development Goals Target 3.7 calls for universal access to family planning methods, information, and education by 2030. Family

planning improves women's health and saves lives by reducing high-risk pregnancy, unintended pregnancy, and associated unsafe abortions [42]. More than half of all women of reproductive age in low- and middle-income countries (LMICs), approximately 867 million, want to avoid pregnancy [43]. In these countries, however, an estimated 214 million women had an unmet need for family planning in 2017. Most of them (115 million) did not use any contraceptive methods. Unmet needs for family planning accounted for 84 % of all unintended pregnancies [44]. If an unmet need for modern contraception in LMICs was fully satisfied, it could prevent 67 million unintended pregnancies, 23 million unplanned births, and 36 million abortions, and 76,000 maternal deaths each year [44]. The cost of meeting the need for modern contraception in LMICs is estimated to be USD 1.20 per capita per year [45].

1.1.3 Unintended pregnancy

In LMICs, unintended pregnancy, a pregnancy that happens when a woman does not want children or does not more any more children (unwanted pregnancy), or pregnancy that happens sooner than desired (mistimed pregnancy), is a major public health problem [46]. Unintended pregnancy has a variety of detrimental health, economic, social, and psychological consequences for women and children [47]. Therefore, reducing unintended pregnancy is an integral component of the Global Sustainable Development agenda in 2030. The global vision is that every mother will be able to celebrate a desired, healthy pregnancy and safe birth of a child who will survive and thrive to their full potential [48,49].

In 2015–19, there were 121 million unintended pregnancies on average each year, equating to a global rate of 64 unintended pregnancies per 1000 women aged 15–49 years. Unintended pregnancies accounted for about half of all pregnancies (48 %). In 1990–94, the global unintended pregnancy rate was 79 pregnancies per 1000 women aged between 15–49 years. Between 1990–94 and 2000–04, it fell by 12 points to 67 unintended pregnancies per 1000 women [50]. However, despite the overall rate declining, the yearly number of unintended pregnancies grew by 13 % between 1990–94 and 2015–19, from 107 million to 121 million due to global population expansion [50].

The most common reason for abortion around the world is unintended pregnancy. About 20 % of the unintended pregnancies end in unsafe abortions in Asia, whereas in Latin America, the Caribbean and Africa, about 50 % of the unintended pregnancies end in unsafe abortions. It harms women's health and occasionally leads to death [3]. Adolescents, in particular, are more inclined than older women to seek abortions from unskilled providers or self-induced abortions [51].

Nonuse, inconsistent use or inappropriate use of effective family planning methods are the causes of unintended pregnancy. In 35 LMICs, about 80 % of adolescent women who had an unwanted pregnancy were non-users or used traditional methods. Prior to unintended pregnancy, about three fourth of adolescent women did not use any form of contraceptives. 74 % of girls who had previously used a traditional method stopped due to failure. 63 % of girls who had used a long-acting modern method stopped due to health concerns and side effects [52]. Two-thirds of sexually active women aged 15-49

who did not want another pregnancy stopped using contraceptives because of fear of side effects, health concerns, and underestimating the risk of conception. Discontinuation owing to side effects may suggest that better counseling and communication are required. Access to contraceptives, cost of family planning services, resistance and religious views, as well as ignorance of how to use contraceptives have all been cited as causes for cessation among sexually active women [52].

Numerous studies found that multifaceted factors, including individual, household, community, and structural factors, have a role in unintended pregnancies. The high prevalence of unintended pregnancy is associated with a lack of contraceptive awareness and contraceptive inaccessibility [53–55]. Unintended pregnancy is also linked to poverty, a lack of family support, parent deaths, a lack of communication with parents about sexual and reproductive health, and a single-parent family structure [56,57]. Societal poverty, rural residency, cultural practices that promote gender inequality and violence against women are a strong predictor of an increased risk of unintended pregnancy [56]. Restrictive regulations such as laws on age of consent for contraception services, healthcare systems failures, insufficient contraceptive access, and poor availability and access to reproductive healthcare services are all structural factors linked to an increase in early unintended pregnancy [58,59] In addition, research suggests that low autonomy among women is associated with unintended pregnancy. Women's autonomy refers to their authority and capacity to manage their own resources, make their own decisions, improve and maintain their health, and seek the knowledge they need to make informed reproductive decisions [60,61].

1.1.4 Nepal government's program to reduce child marriage

The Nepal government ratified 'the Convention of the Rights of the Child' and 'the Convention on the Elimination of All Forms of Discrimination against Women' in 1990 and 1991, respectively, demonstrating the national commitments to eliminating violence and harmful practices against women and girls [62]. The government enacted the National Civil Code and National Penal Code in 2017, establishing the minimum marriage age of 20 years for both men and women. Marriages between people below the age of 20 are not legally recognized under the law. The government also passed the Children's Act in 2018, opening the path for Nepal to respect, protect and fulfill children's rights [63]. The landmark Act specifically prohibits and criminalizes child marriage and the act of arranging the engagement of young children, which is a common practice in some Nepali communities. The legislation also compels health professionals, teachers, and other professionals working with children to report cases of child marriage. In the same year, the Ministry of Health endorsed the Adolescent Health and Development Strategy, which included ending child marriage as a primary goal [64].

At a local level, municipalities and districts across the country implement activities to reduce child marriage, utilizing a budget allocated by the federal government. One of these activities is supporting the social and life skills of adolescent girls through a comprehensive training package called Rupantaran so they can better express and exercise their rights and choices [65]. Another activity is outreach to raise awareness on

issues affecting children, such as rape, attempted rape, child marriage, domestic violence, and trafficking [66].

International organizations work in conjunction with the Nepal government to support their effort to end child marriage. United Nations Children's Fund (UNICEF) supports capacity building for law enforcement officials such as police personnel, and caseworkers associated with schools so that they are sensitized to crimes against women and children. It contributed to child marriage intercepted by caseworkers and reporting the crime to police for prosecution [66]. The UN agency also supports the provision of non-formal education, including literacy and numerical skills, to out-of-school girls and boys who subsequently enrolled or re-enrolled in formal education [66]. With the support from United Nations Population Fund (UNFPA), the Nepal government is increasing the number of health facilities providing adolescent-friendly health services [65].

1.2 Research overview

1.2.1 Research questions

The research questions that I address in this thesis is concerned with the impact of child marriage on reproductive health outcomes. These research questions are as below:

- Does child marriage increase the risk of unmet needs for modern contraception and unintended pregnancy?

- If child marriage increases these risks, how does it happen?

1.2.2 Aims and objectives

The overarching aim of this research is to identify the effects of child marriage on reproductive health outcomes and the underlying process of decision making regarding contraceptive use among women married as children. This will be achieved through two objectives:

1. To examine whether child marriage has effects on unmet needs for modern contraception and unintended pregnancy;
2. To determine the multilevel factors that influence contraceptive use and childbearing decisions in Nepal and examine relationships among emergent factors.

1.2.3 Research hypotheses

Following were the two research hypotheses for this research:

1. Child marriage increases the risk of unmet needs for modern contraception and unintended pregnancy.
2. Multilevel and interacting factors prevent married adolescent girls from seeking contraceptives and delaying childbearing.

1.2.4 Research approach

Overall, this thesis is based on an explanatory sequential mixed methods design. This research adopts a three-phase approach (Figure 1).

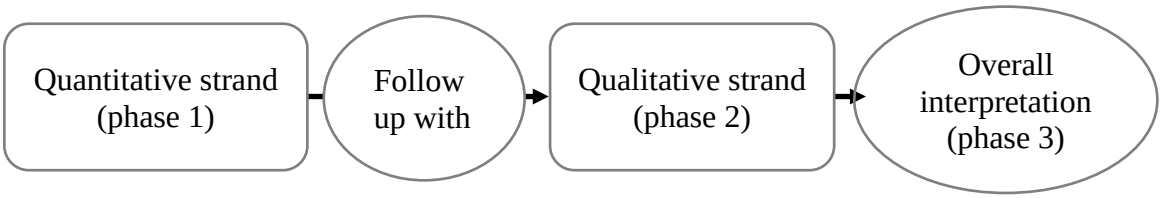


Figure 1. Flowchart of a mixed methods study with an explanatory sequential design Source: Creswell and Plano Clark (2011) [67]

I implemented the two strands in three distinct interactive phases, with a quantitative study occurring before a qualitative study. I addressed the first research question through a quantitative approach and the second through a qualitative approach. A strand is a study component that encompasses the necessary process of conducting quantitative or qualitative research: posing a question, collecting data, analyzing data, and interpreting results based on that data [68]. I started with the data analysis for the quantitative study, followed by the subsequent collection and analysis of qualitative data. I utilized qualitative results to help explain and elaborate relationships found in quantitative research. For instance, I analyzed qualitative data to identify the mechanism by which the effects of child marriage occur. This sequential timing was due to two reasons; the research hypotheses and the availability of data required for both quantitative and qualitative studies. Conducting quantitative analyses to address the first research question was a prerequisite for the qualitative strand to ensure the logic of the overall research procedures. In this sense, the implementation of the qualitative research depended on the results of data analysis of the quantitative study. I had access to the secondary data for the quantitative analyses since the beginning of this Ph.D. research, while data for the qualitative analysis was not available in the initial phase. Thus, once

preliminary results from the quantitative research were obtained, I used them to guide the development of qualitative research and the collection and analysis of qualitative data. In this thesis, qualitative results are positioned to infer pathways of the results found in the quantitative research.

In the final phase of the overall research process, I combined and synthesized results from the two studies during the overall interpretation, rather than treating them being independent from each other. The final phase involved drawing final conclusions and recommendations that reflect what was found from the combination of results of the two studies.

The strategy of using the mixed methods design was adopted:

- to triangulate findings for greater credibility and validity;
- to gain richer, more comprehensive understanding of the area of inquiry that this thesis is concerned with;
- to draw on the complementary strengths of both quantitative and qualitative approaches; and
- to offset the weaknesses of both quantitative and qualitative methods.

The qualitative results provide a contextual understanding of how the impact of child marriage on reproductive health outcomes emerges. In-depth accounts yielded from the qualitative study are used to illustrate the quantitative results and put meat on the bones of dry quantitative findings. The triangulation of both quantitative and qualitative

studies also helps improve usefulness of the findings. A mixed-method design has rarely been adopted with respect to adolescent sexual and reproductive health.

1.3 Thesis structure

This thesis is organized into four sections with two interlinked studies prepared for publication. Chapter 1 outlines background knowledge regarding child marriage, research questions and hypotheses, aims and objectives, and research approach. In Chapter 2, I present Study I "I: Identifying the effect of child marriage on unmet needs for modern contraception and unintended pregnancy in Nepal: a cross-sectional study using propensity score matching." In Chapter 3, I present Study II "Multilevel factors influencing contraceptive use and childbearing among adolescent girls in Bara district of Nepal: a qualitative study using the socio-ecological." Finally, Chapter 4 triangulates and converges the findings of the two studies to expand and strengthen the breadth and range of overall interpretation and conclusions.

2. Study I: Identifying the effect of child marriage on unmet needs for modern contraception and unintended pregnancy in Nepal: a cross-sectional study using propensity score matching

2.1 Introduction

Nepal has made impressive progress in family planning. The country has shown a remarkable decline in the total fertility rate from 4.6 children per woman to 2.3 between 1996 and 2016 [69,70]. Modern contraceptive use among Nepali women increased from 26 % to 43 % in the same period [69,70]. However, half of all pregnancies in the country were unintended in 2014 [71]. Moreover, the adolescent fertility rate remains high at 88 per 1000 women, and 17 % of adolescents aged 15-19 years bore a child during adolescence. Unmet needs for family planning among adolescent married girls are considered to be a major driver for early pregnancy and unintended pregnancy [72]. The contraceptive prevalence rate among adolescent married girls in Nepal is disproportionately low compared to married women aged 20 to 49 (15 % versus 45 %) [70].

Child marriage, defined as a formal marriage or informal union before the age of 18 [7], is pervasive in Nepal. In the country, almost all adolescent pregnancies and childbirths occur within the context of child marriage. About one in two married girls have their first child by the age of 19, usually soon after marriage [70]. Despite the minimum legal marriage age of 20 years, approximately 40 % of Nepali women aged 20-24 had been married before they reached the age of 18 [70]. In Nepal, a range of demographic and

socioeconomic factors (e.g., religion, ethnicity, ecological zone, economic status, education, place of residence) are associated with child marriage [73].

Evidence suggests that child marriage may play a role in reproductive health. Several cross-sectional studies have found associations of child marriage with contraceptive nonuse before first pregnancy [29], unintended pregnancy [24,25,29], rapid repeat births [23,24], and terminated pregnancy [23–25,29,74]. However, the effect of child marriage on these reproductive health outcomes appears inconclusive for two reasons. First, the model specification in previous studies may be considered inadequate. Researchers typically used a single set of control variables for several outcome variables, including fertility, in their regression models [23–25,29,74]. As a result, parity that affects short birth intervals, unintended pregnancy, and terminated pregnancy was not controlled for in their analyses. Therefore, the results of previous studies could be biased due to residual confounding. Second, previous evidence is inconsistent. For instance, Kamal [25] and Nasrulla [24] reported positive associations between child marriage and unintended pregnancy in Bangladesh and Pakistan, whereas Raj [23] and Godha [29] did not find significant associations in India and Bangladesh. Moreover, causal relationships have been overlooked due to methodological limitations. Researchers claim that causality cannot be assumed in their regression analyses [23,24,29]. Hence, the causal effects of child marriage on reproductive health outcomes are unclear in the literature. Furthermore, to the best of my knowledge, no researchers have examined the effect of child marriage on unmet needs for modern contraception.

This study aimed to investigate whether child marriage had effects on unmet needs for modern contraception and unintended pregnancy, by estimating the marginal (population-averaged) treatment effect of child marriage.

2.2 Methods

2.2.1 Study design and data

This study used secondary data from the Nepal Demographic and Health Survey (NDHS) 2016, which was a cross-sectional study. The survey provides detailed information about socio-demographic characteristics, the levels and determinants of fertility, family planning, infant and child mortality, maternal and child health, and women's empowerment [70]. The survey sample represented the national and provincial levels. The sample was stratified and selected, using two-stage random sampling in rural areas and three-stage random sampling in urban areas. Complete interviews were conducted with 12,862 women of reproductive age (15 to 49 years) from the pre-selected households. No replacements were allowed to reduce bias. The response rate was 98 %. In this study, 7,833 women aged 15-49 years who were married for more than five years were included for analysis. For women who gave birth to more than one child, only the most recent pregnancy was analyzed to minimize recall bias and missing data. The sample had no missing data except for 15 women who did not know their husband’s educational attainment.

2.2.2 Measures

The outcome variables were unmet needs for modern contraception and unintended pregnancy. Unmet needs for modern contraceptive methods were defined as fecund, married women who had sex in the last three months and want to limit or delay childbearing at least two years, but who are not using any modern contraceptive methods. Modern methods of contraception include female and male sterilization, oral hormonal pills, the intra-uterine contraceptive device, male and female condoms, injectables, implants, vaginal barrier methods, standard days method, lactational amenorrhea method, and emergency contraception [75,76]. The operational definition and measurement of infecundity that is used in the DHS program can be found in elsewhere [77]. Unintended pregnancy was defined as an unwanted or mistimed pregnancy or an unwanted or mistimed birth. This outcome was assessed by the question “At the time you became pregnant, did you want to become pregnant then, did you want to wait until later, or did you not want to have any (more) children at all?” Analysis using this variable was restricted to pregnant women at the time of the survey and women who gave birth to a child in the five years preceding the survey.

The treatment variable was a formal marriage or informal union before the age of 18. This represents non-randomized self-selection into treatment and control groups. A dichotomous variable was created for child marriage, based on self-reported age at first marriage. The respondents were coded as '1' if they were married or in a union before the age of 18, and '0' if otherwise.

The demographic and socioeconomic variables known to be associated with child marriage and the outcome variables were selected as covariates. These were used to estimate the propensity score, which is the conditional probability of marrying before the age of 18, given covariates considered in this study. A directed acyclic graph was also drawn to depict the hypothesis of relationships relevant to this research and find a minimal sufficient adjustment set (Appendix 1). The selected covariates were the women's and husbands' age (15-24, 25-34, >34); residence in urban areas; ecological zone (mountain, hill, lowlands); ethnic group (advantaged, disadvantaged); religion (Hindu, other); household economic status (poor, middle income, rich); the women's and husbands' levels of educational attainment (no education or primary level, secondary or higher level); the women's occupation (no job or low skilled jobs, paid skilled jobs); and parity (0 or 1, 2 or 3, ≥4). The women's occupation was categorized into two groups: (i) 'no job or low skilled jobs' (e.g., agricultural job, and unskilled manual jobs), and (ii) 'paid skilled jobs' (e.g., professional, clerical or services job, and skilled manual jobs). Ethnic groups, such as Dalit, Janajati, and Muslims, were categorized as 'disadvantaged' and other groups as 'advantaged.'

2.2.3 Data analysis

This study used propensity score matching (PSM) [78] to draw inferences about the effect of child marriage on unmet needs for modern contraception and unintended pregnancy. PSM is a way to reduce selection bias in treatment effect estimates due to confounding factors by creating and matching treatment and control groups that are as similar as possible on the observed background characteristics [79]. PSM analysis in

this study was comprised of five steps. First, the propensity scores were estimated, using the *pscore* Stata module [79] while controlling for all the covariates mentioned above. In the second step, treatment and control units were matched by the closeness of their propensity scores, and units that without a match or with missing data were excluded. One-to-one nearest-neighbor matching with replacement within a caliper range of ±0.01 was performed using the *psmatch2* Stata module [80]. The third step was to compute mean differences in outcomes between the two groups, which represents the average treatment effect on the treated (ATT). To enhance accuracy, bootstrapping with 1000 replications was carried out to estimate confidence intervals. In the fourth step, overlap and common support of propensity score distributions were checked through visual inspection. Using a kernel density plot, balance between the treatment and control groups was evaluated to identify the overlap of propensity scores. In the fifth step, balancing tests were performed in three different ways, using the *pstest* command. For each covariate included in the propensity score estimation model, standardized percentage bias before and after matching were assessed [81]. Arbitrary cut-offs for balance diagnostics (e.g., < ±10 % for the standardized percentage difference) are commonly used in the medical literature [82]. Furthermore, t-test was used to compare each covariate distribution across the treatment and control groups. The overall measures of covariate imbalances before and after matching were also analyzed, using the pseudo-R^2 statistic [83]. After matching, pseudo-R^2 should be reasonably low (i.e., below 0.05) to establish that there are no systematic differences in the covariate distributions between the two groups. All analyses were carried out, using Stata 16 (StataCorp LP, College Station, TX).

2.2.4 Sensitivity analysis for hidden bias

Sensitivity analysis was undertaken to assess the robustness of estimated treatment effects to an unmeasured confounder as PSM rests on the unconfoundedness (no confounding) assumption, which is untestable [84]. This analysis was carried out, using a Mantel-Haenszel bounds procedure [85].

2.2.5 Ethical considerations

The study used a de-identified secondary dataset of the NDHS 2016, which was freely and publicly available (Appendix 2). The research protocol, data collection tools, and procedures of the NDHS were approved by the Nepal Health Research Council, Kathmandu, and the ICF Macro Institutional Review Board in Calverton, Maryland, USA. Written informed consent to carry out the interviews was obtained from the heads of households before participation. Ethical approval was obtained for this study from the Research Ethics Committee of the University of Tokyo (2019032NI) (Appendix 3).

2.3 Results

2.3.1 Characteristics of the participants

The NDHS 2016 dataset generated a sample of 4,731 currently married women who married before the age of 18 and 3,102 currently married women who married at a later age. In this sample, the prevalence of child marriage was 58.9 %. Table 1 shows the

distribution of demographic and socioeconomic characteristics of the participants. The background characteristics differed between women married as children and those married as adults. The women who married as children were, on average, poorer, less educated, and more disadvantaged in terms of ethnicity. They were also more likely to reside in lowland and rural areas and have either no job or a low-skilled job, and higher parity.

Table 1. Background characteristics of currently married Nepali women aged 15-49

Variable	Participants (n = 7,833)		Child marriage (n = 4,731)		Adult marriage (n = 3,102)	
Unmet need for modern contraception	7,833	(21.3)	996	(21.1)	695	(22.4)
Unintended pregnancy [a]	557	(19.4)	360	(21.8)	197	(16.0)
Woman's age						
15-24 years	742	(9.5)	649	(13.7)	93	(3.0)
25-34 years	3,332	(42.5)	1,920	(40.6)	1,412	(45.5)
>34 years	3,759	(48.0)	2,162	(45.7)	1,597	(51.5)
Husband's age						
15-24 years	200	(2.6)	165	(3.5)	35	(1.1)
25-34 years	2,583	(33.0)	1,576	(33.3)	1,007	(32.5)
>34 years	5,050	(64.5)	2,990	(63.2)	2,060	(66.4)
Urban	4,980	(63.6)	2,888	(61.0)	2,092	(67.4)
Ecological zone						
Mountain	552	(7.1)	319	(6.7)	233	(7.5)
Hill	3,445	(44.0)	1,917	(40.5)	1,528	(49.3)
Lowland	3,836	(49.0)	2,495	(52.7)	1,341	(43.2)
Advantaged ethnic group	4,036	(51.5)	2,361	(49.9)	1,675	(54.0)
Disadvantaged ethnic group	3,797	(48.5)	2,370	(50.1)	1,427	(46.0)
Religion						
Hindu	6,888	(87.9)	4,130	(87.3)	2,758	(88.9)
Other religion	45	(12.1)	601	(12.7)	344	(11.1)
Economic status						
Poor	2,243	(28.6)	1,394	(29.5)	849	(27.4)
Middle income	2,609	(33.3)	1,740	(36.8)	869	(28.0)
Rich	2,981	(38.1)	1,597	(33.8)	1,384	(44.6)
Woman's educational level						

No education or primary education	5,353	(68.3)	3,621	(76.5)	1,732	(55.8)
Secondary or higher education	2,480	(31.7)	1,110	(23.5)	1,370	(44.2)
Husband's educational level[b]						
No education or primary education	3,339	(42.7)	2,287	(48.4)	1,052	(34.0)
Secondary or higher education	4,479	(57.3)	2,438	(51.6)	2,041	(66.0)
Occupation						
No job or low skilled job	6,573	(83.9)	4,118	(87.0)	2,455	(79.1)
Paid skilled job	1,260	(16.1)	613	(13.0)	647	(20.9)
Parity						
0 or 1	1,058	(13.5)	458	(9.7)	600	(19.3)
2 or 3	4,344	(55.5)	2,521	(53.3)	1,823	(58.8)
4 or above	2,431	(31.0)	1,752	(37.0)	679	(21.9)

Data are n (%).
[a] n = 2,802
[b] 15 women who did not know the level of their husband education were excluded.

2.3.2 Estimated propensity scores

Overall, the mean propensity score was 0.60 (SD = 0.18). The mean propensity score was 0.66 (SD = 0.17) for the treatment group and 0.52 (SD = 0.18) for the control group. The region of common support was vast, ranging from 0.14 to 0.99 of the propensity score. The number of blocks was 10. Figure 2 illustrates the balance of the propensity score distributions between the treatment and control groups. The bars below the line show propensity scores for the women in the control group and ones above the line for the women in the treated group. The figure demonstrates adequate overlap in the propensity score distributions between the two groups, which included a total of 7,761 observations. Off support in Figure 2 represents 57 treated observations that are outside of common support, and thus were discarded in the final analysis.

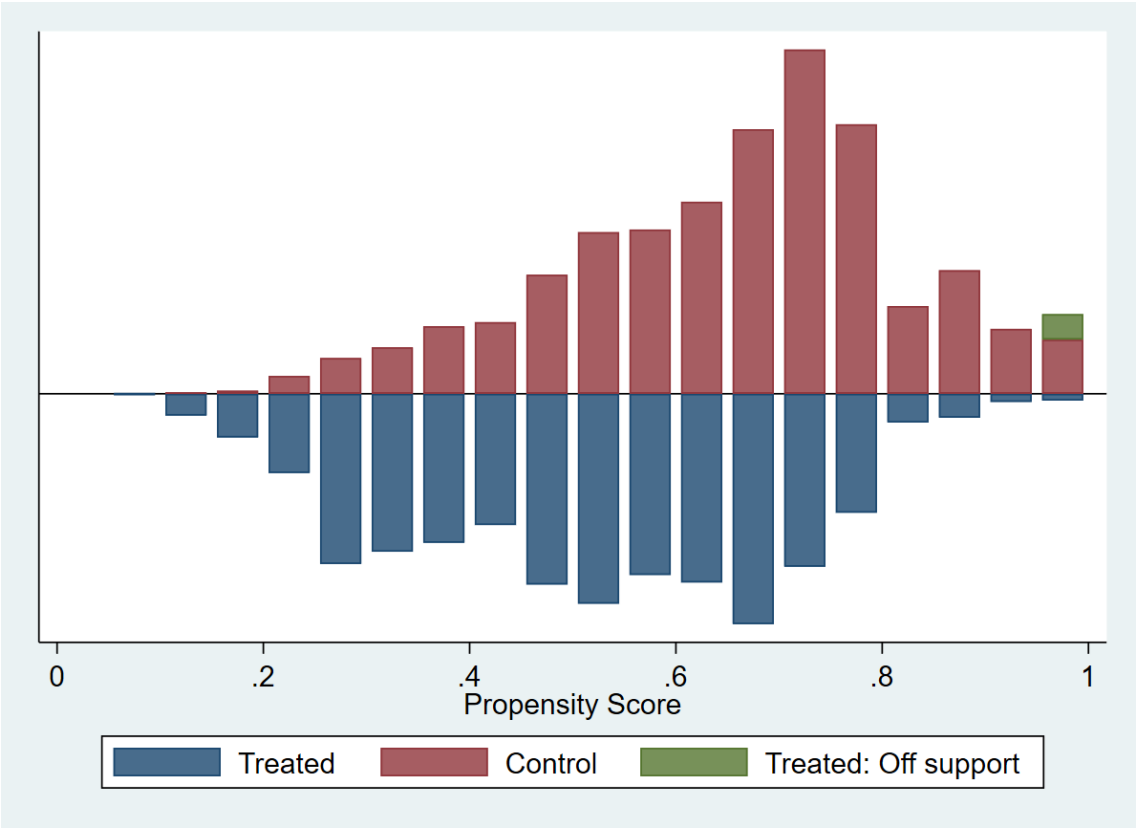


Figure 2. Histogram of propensity score distribution for women married as children (treated) and women married as adults (control)

2.3.3 Impact assessment

Table 2 shows the unmatched and matched estimates of the marginal effect of child marriage on each outcome of interest with the corresponding standard errors, t-statistic, and 95 % confidence intervals. The unmatched analysis showed women married as children were 1.4 % less likely to have unmet needs for modern contraception. Using the matching method, an ATT for unmet needs for modern contraception was estimated to be 0.143. That is, unmet needs for modern contraception among women married as children was a 14.3 percentage point (95 % CI 9.8, 18.7) higher than among women married as adults. The unmatched analysis showed that the treated women were 4.8 % more likely to have unintended pregnancy. The matched analysis found that unintended

pregnancy among women married as children was 10.1 a percentage point (95 % CI 4.2, 15.9) higher than among women married as adults. The ATTs for both of the outcomes were significant, as measured by the corresponding 95 % confidence intervals. Comparisons between matched and unmatched analyses indicate that the unmatched analysis underestimated the effect size due to selection bias.

Table 2. Impact assessment of child marriage

	Treated	**Control**	**Difference**	**SE**	**t-statistic**	**95 % CI[a]**
Unmet need for modern contraception						
Unmatched (n = 7,833)	0.211	0.224	-0.014	0.010	-1.47	-0.032, 0.005
Matched (n = 7,761)	0.209	0.066	0.143	0.021	6.80	0.098, 0.187
Unintended pregnancy						
Unmatched (n = 2,808)	0.218	0.170	0.048	0.015	3.10	0.018, 0.078
Matched (n = 2,747)	0.219	0.119	0.101	0.025	4.02	0.042, 0.159

[a] Based on the bootstrap.

2.3.4 Balancing test

The matching method achieved balance in measured covariate between treated and control groups with the same propensity score (Table 3). After matching, the standardized percentage bias between the two groups was less than 10 % for nearly all covariates. Figure 3 shows a graphical representation of the comparisons of the standardized percentage bias before and after matching. The results of the t-tests showed no systematic differences between the two groups in nearly all covariate distributions at the 5 % significance level. Furthermore, the matching method reduced

the pseudo-R^2 value from 0.114 to 0.006. The distributions of the propensity scores adequately overlapped after matching (Figure 4).

Table 3. Covariate balance check and absolute bias reduction

Variable		Mean		% bias	% reduction bias	t-test	
		Treated	Control			t	p-value
Woman's age (15-24 years)	Unmatched	0.14	0.03	39.4	79.6	16.06	<0.001
	Matched	0.13	0.10	8.0		3.30	0.001
Woman's age (25-34 years)	Unmatched	0.41	0.46	-10.0	56.8	-4.34	<0.001
	Matched	0.41	0.43	-4.3		-2.10	0.036
Woman's age (>34 years)	Unmatched	0.46	0.51	-11.5	99.3	-4.98	<0.001
	Matched	0.46	0.46	-0.1		-0.04	0.967
Husband's age (15-24 years)	Unmatched	0.03	0.01	15.6	32.2	6.44	<0.001
	Matched	0.03	0.02	10.6		5.12	<0.001
Husband's age (25-34 years)	Unmatched	0.33	0.32	1.8	42.8	0.79	0.428
	Matched	0.33	0.33	1.0		0.51	0.612
Husband's age (>34 years)	Unmatched	0.63	0.66	-6.7	35.1	-2.89	0.004
	Matched	0.64	0.66	-4.4		-2.10	0.036
Urban	Unmatched	0.61	0.67	-13.4	98.3	-5.77	<0.001
	Matched	0.61	0.61	-0.2		-0.11	0.915
Mountain	Unmatched	0.07	0.08	-3.0	58.9	-1.32	0.187
	Matched	0.07	0.07	-1.2		-0.61	0.543
Hill	Unmatched	0.40	0.49	-17.5	75.8	-7.60	<0.001
	Matched	0.41	0.39	4.2		2.07	0.038
Lowland	Unmatched	0.53	0.43	19.0	81.2	8.23	<0.001
	Matched	0.52	0.54	-3.6		-1.72	0.085
Advantaged ethnic group	Unmatched	0.50	0.54	-8.3	56.6	-3.59	<0.001
	Matched	0.50	0.52	-3.6		-1.74	0.082
Hindu	Unmatched	0.87	0.89	-5.0	96.0	-2.14	0.033
	Matched	0.87	0.87	0.2		0.09	0.926
Poor	Unmatched	0.29	0.27	4.8	49.5	2.07	0.039
	Matched	0.30	0.29	2.4		1.16	0.246
Middle income	Unmatched	0.37	0.28	18.7	82.1	8.04	<0.001
	Matched	0.36	0.35	3.4		1.58	0.114
Rich	Unmatched	0.34	0.45	-22.4	75.6	-9.76	<0.001
	Matched	0.34	0.37	-5.5		-2.69	0.007
Woman's	Unmatched	0.77	0.56	45.0	91.6	19.77	<0.001

educational level (lower)	Matched	0.76	0.78	-3.8		-1.99	0.046
Woman's educational level (higher)	Unmatched	0.23	0.44	-45.0	91.6	-19.77	<0.001
	Matched	0.24	0.22	3.8		1.99	0.046
Husband's educational level (lower)	Unmatched	0.48	0.34	29.5	91.2	12.71	<0.001
	Matched	0.48	0.47	2.6		1.22	0.221
Husband's educational level (higher)	Unmatched	0.52	0.66	-29.5	91.2	-12.71	<0.001
	Matched	0.52	0.53	-2.6		-1.22	0.221
No job or low skilled job	Unmatched	0.87	0.79	21.3	87.3	9.38	<0.001
	Matched	0.87	0.88	-2.7		-1.47	0.142
Parity (0 or 1)	Unmatched	0.10	0.19	-27.8	67.3	-12.38	<0.001
	Matched	0.10	0.07	9.1		5.59	<0.001
Parity (2 or 3)	Unmatched	0.53	0.59	-11.2	37.2	-4.82	<0.001
	Matched	0.53	0.57	-7.0		-3.37	0.001
Parity (4 or above)	Unmatched	0.37	0.22	33.9	98.0	14.42	<0.001
	Matched	0.37	0.37	0.7		0.30	0.764

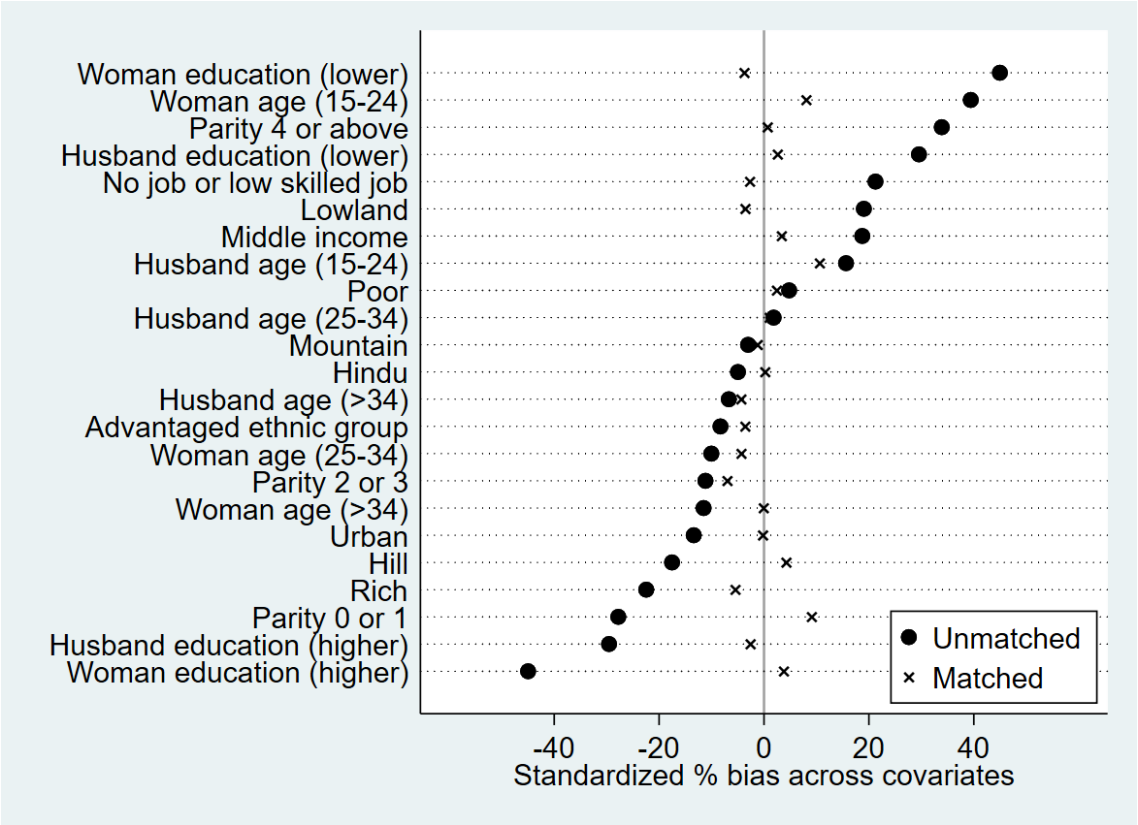


Figure 3. Standardized percent bias in the distribution of confounders before and after matching

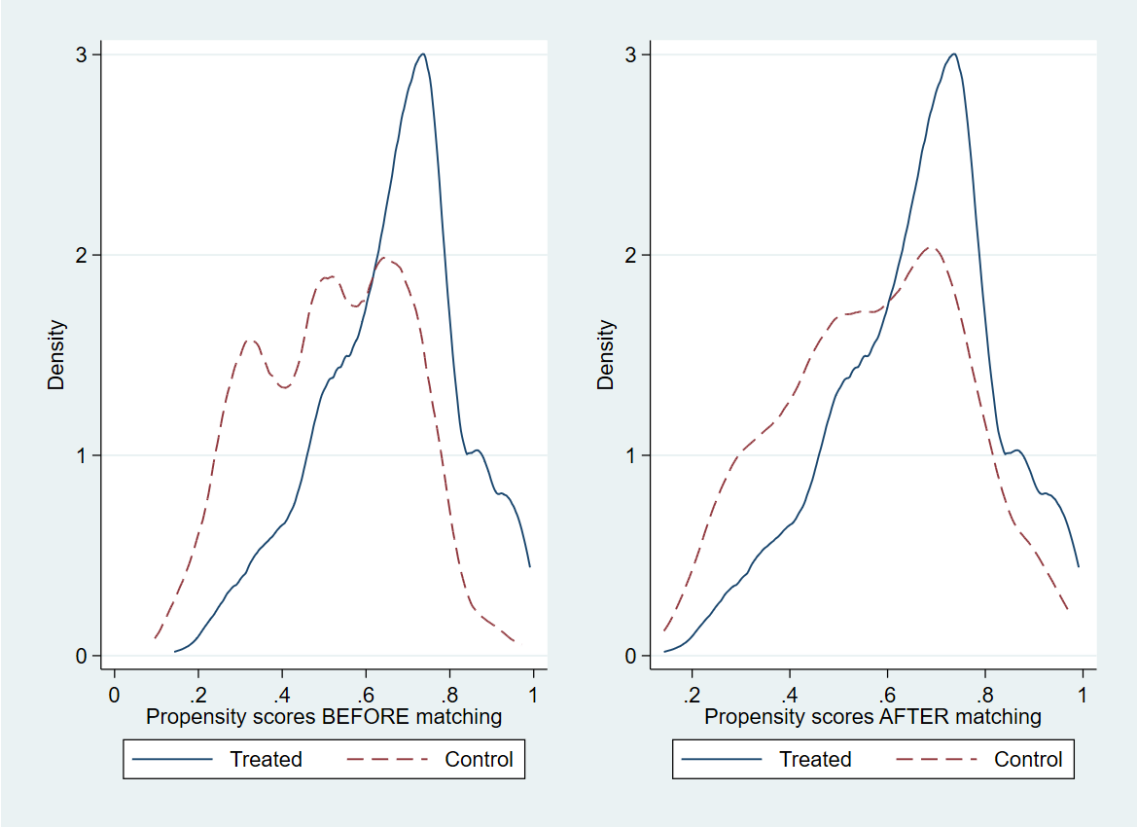


Figure 4. Kernel density plot of estimated propensity scores before and after matching

2.3.5 Sensitivity analysis for hidden bias

The results of the sensitivity analysis showed the following gamma values for unmet needs for modern contraception (gamma = 1.5) and unintended pregnancy (gamma = 2.0). The confidence interval would include zero at the 5% significance level if an unmeasured confounder caused the odds of treatment assignment to differ by 1.5. That is, the estimated effect on the former outcome would no longer be significant if hidden bias increase or decrease the odds of treatment assignment by 1.5.

2.4 Discussion

Using observational data, the PSM analysis in the present study showed that child marriage was associated with a higher risk of unmet needs for modern contraception and unintended pregnancy among married women aged 15-49 in Nepal. The results of the balancing test indicated that successful matching of the propensity scores achieved exchangeability between the treated and control groups conditional on the measured covariates. Imbalance of a few of the covariates was minuscule. Therefore, overt biases are unlikely to have been introduced. With reference to gamma threshold values based on sensitivity analysis [86], the gamma values obtained in the present study can be interpreted as an evidence suggesting that the effect is very robust to residual confounding.

In this study, there was a strong, positive association between child marriage and unmet needs for modern contraception. Women who were married as children often face multifaceted barriers to adopting and continuing contraception. For instance, unmet needs for modern contraception might result from individual factors including limited knowledge and awareness about family planning [87–90], the fear of adverse side effects [87,91], and shyness to discuss contraceptive use with husbands and health care providers [90,91]. Partner and family-related factors include the husband's refusal to use contraceptives [87,88,90], and the in-laws' pressure to prove fertility soon after marriage [90]. Service-providers-related factors include a lack of confidentiality and privacy, and unfriendliness of health care providers [92]. As it was unknown whether child marriage has any effects on unmet needs for modern contraception, this study added to the paucity of empirical evidence on this issue.

In the present study, the effect of child marriage on the risk of unintended pregnancy remained significant after controlling for parity and other important confounders. The strength of confounding by parity was relatively weak. It is plausible that the higher risk of unintended pregnancy was driven by the same set of factors that are mentioned above, as unmet needs for modern contraception is the leading cause of unintended pregnancy [44]. This finding provides added value to the literature as previous studies have reported contradictory results on the effect of child marriage on unintended pregnancy.

The methodological novelty of this study is a departure from the traditional regression-based approach, which is used to estimate conditional or stratum-specific effects. To the best of my knowledge, the present study is the first analysis to estimate the effect of child marriage using PSM analysis of observational data while addressing selection bias more robustly than previous studies. In the literature on the effect of child marriage, regression adjustment is the dominant approach for adjusting for confounding effects. However, one of its drawbacks is that it sometimes relies on untrustworthy extrapolation if covariate distributions are not balanced between treatment and control groups [93–97]. Indeed, regression adjustment has proven to be unreliable when there is insufficient overlap in these covariate distributions [94,95,97,98]. This may be of concern as this study included disproportionately fewer young observations in the control group. In previous studies, this issue possibly generated untrustworthy extrapolation and produced biased estimates. It is challenging to assess the covariate balance between treatment groups, using regression-based approaches. Standard

diagnostics of regression adjustment do not involve assessing the degree of overlap between covariate distributions for the two groups [98,99].

As stated in the introduction, my main aim was to address the issue of causation. I discuss rival explanations to strengthen the inference that the association observed in this study actually have a cause-effect basis. Hulley et al. [100] provided five possible explanations for an observed association between an exposure and an outcome in an observational study: chance (random error), bias (systematic error), effect-cause (reverse causality), confounding, and cause-effect. The confidence intervals obtained in this study show that the observed effects are very unlikely to be due to chance. The NDHS relied on self-reported data, which are prone to recall bias and social desirability bias, especially regarding the intendedness and wantedness of pregnancies [101]. There is uncertainty with regards to whether this potential error is at random or differential between the treatment and control groups. Although observational studies like the NDHS, cannot provide evidence for the direction of causality, marriage chronologically precedes childbearing in Nepal. Thus, a temporal sequence between the treatment and the outcomes can be assumed, and the findings leave little room for reverse causality interpretation. It is possible that unmeasured predictors of the outcome variables (e.g., contraceptive access) might play a role in the relationship that the present study investigated; however, the sensitivity analysis indicated that the estimated effects were robust to unmeasured covariates.

This study had several limitations. First, the PSM estimates rely on the unconfoundedness assumption meaning that no critical predictors of the treatment and

outcome are left out of the model. As discussed above, while unmeasured predictors may exist, sensitivity analysis showed that the estimated effects are insensitive to violation of the unconfoundedness assumption. Also, unmeasured confounders tend to be related to measured covariates. Therefore, distribution of unmeasured covariates is expected to be balanced between the treatment and control groups. Second, a few of the covariates used to estimate the propensity scores (i.e., education levels, occupation of women, parity) may not be pre-treatment variables. However, most of the covariates in the present study were pre-treatment variables. Third, while the exclusion of 57 unmatched observations from analysis might have some influence on the generalizability of the findings to the entire population in Nepal, its magnitude would be very limited. Finally, as discussed above, recall bias and social desirability bias may be a concern in the study methodology. However, only the most recent pregnancy was analyzed to minimize recall bias. Despite these caveats, the strengths of this study include the use of nationally representative data with a high response rate, and minimization of selection bias through a rigorous matching method.

2.5 Conclusions

Overall, this study provided insights into the effect of child marriage on unmet needs for modern contraception and unintended pregnancy. The findings underscored the impacts of child marriage, which require more attention from policymakers in the policy dialogue on ending child marriage and improving reproductive health. A holistic approach should be adopted to reduce the multidimensional vulnerabilities faced by women married as children. Such an approach includes educating the public about

reproductive rights, influencing wide social norms, and increasing demand for adolescent-friendly reproductive health services, including family planning. Further research is needed to elucidate the pathway between child marriage and the increased risk of unmet needs for modern contraception and unintended pregnancy. As the results of this study are not generalizable to other countries, future studies using PSM should be conducted for other populations.

3. Study II: Multilevel factors influencing contraceptive use and childbearing among adolescent girls in Bara district of Nepal: a qualitative study using the socio-ecological model

3.1 Introduction

Adolescent pregnancies and childbirths are a global concern. Each year, 21 million 15 to 19-year-old girls in low- and middle-income countries (LMIC) become pregnant, of which 12 million girls give birth [3]. Births to adolescents of this age group account for 11 % of all childbirths worldwide [102]. Approximately 5.6 million and 3 million pregnancies in the same population segment result in abortion and miscarriage, respectively. In LMIC, about half (49 %) of all pregnancies among 15 to 19-year-old girls are unintended, and more than half of them end in abortion or miscarriage [3]. Among adolescent girls who require family planning, 23 million have an unmet need for modern contraception [3]. Addressing this need might lower the rate of unintended pregnancy by six million annually [3].

Global and national policies often assume that the primary reason for contraceptive nonuse among adolescent girls is their personal choice (or the choice of couples). However, several other factors also prevent them from seeking family planning services and delaying childbearing in LMIC. Researchers have noted a number of barriers that hinder married adolescent girls from using contraceptive methods and postponing childbearing. These barriers can be classified into five categories: individual-level (e.g., limited knowledge, the fear of adverse side effects) [87–90,103], partner-related (e.g.,

refusal to use contraceptives) [87,88,90], family-related (e.g., influence of mothers-in-law and sisters-in-law) [87,90], social acceptability (e.g., community expectations to prove one's fertility) [90,103], and service delivery-related factors (e.g., confidentiality and privacy issues) [92]. However, a shortcoming of the previous qualitative research is narrow focuses on each level without examining interactions among factors at different levels. Few in-depth investigations have been conducted to promote the nuanced understanding of a complex interplay of multilayered barriers that hinder contraceptive use [104]. Therefore, it is necessary to identify a host of the factors that impede contraceptive use and promote early childbearing.

In Nepal, the adolescent birth rate remains high at 88 births per 1000 adolescent girls aged 15 to 19 in 2016 [70], and this figure is the second-highest in South Asia after Bangladesh [105]. A national survey showed that 17 % of 15 to 19-year-old adolescent girls were pregnant in the same year [70]. Among Nepali adolescents, pregnancy are related to a lower economic status, membership to a disadvantaged ethnic group, and unemployment [106]. The prevalent practice of child marriage also contributes to the high rate of adolescent pregnancy and is associated with contraceptive nonuse before the first childbirth in Nepal [29], India [23,29], and Bangladesh [25]. In a nationally representative survey, 40 % of 20 to 24-year-old Nepali women were married before the age of 18 [70]. About one in two married adolescent girls aged 15 to 19 years give birth to her first child before turning 20, typically soon after marriage [70]. Although the Nepali government and its development partners have taken efforts to improve access to family planning services and information, contraceptive use remains disproportionately low among adolescent girls. Only 15 % of married adolescent girls use contraceptive

methods; in contrast, the corresponding figure is 41 % among adult women aged 20 or above [70]. Therefore, this study aimed to identify the multilevel factors that influence contraceptive use and childbearing decisions in Nepal and to examine relationships among these factors.

3.2 Methods

3.2.1 Study setting

I conducted this study in an urban municipality (Mahagadimai Nagarpalika) and a rural municipality (Prasauni Gaunpalika) in Bara district in Province 2 of Southern Nepal. The province has the highest child marriage prevalence rate (65 %) among women aged 20 to 24 years in 2016 [70]. I purposively selected these two municipalities from five urban municipalities and nine rural municipalities based on consultation with respective municipality officials. Then, I randomly selected one ward out of nine wards in each selected municipality.

Province 2 where Bara district is considered as least developed region in Nepal, with the lowest human development index value [107]. Gender disparity of the region in terms of education and income is the most pronounced, with the lowest gender development index value [107]. The district is home to 108,655 households (i.e., an average of 6.33 people members per household) [108]. The most dominant religion is Hinduism, followed by Islam and Buddhism. The men who live in these areas were primarily farmers, laborers, and small-scale business owners or employees. Married women were

mostly involved in household work and farming. Most households have electricity, but power outages are frequent. Few houses have a latrine [108]. Using solid fuel such as firewood and charcoal is common. Each municipality has at least one health post where only primary health care services are provided.

3.2.2 Study participants

This study relied on multiple sources to collect rich and diverse data and triangulated results. I recruited three different groups for in-depth interviews (IDIs) to cover a wide range of perspectives of household members. The first group was 15 to 19-year-old adolescent girls who had been married for at least six months and were living with their husbands (n=20) at the time of data collection. The second group was husbands of married adolescent girls (n=20). The last group was mothers-in-law of married adolescent girls (n=20). I did not match IDIs participants by family for recruitment or analysis. As a complementary method, I also conducted key informant interviews (KIIs) with those who possessed first-hand knowledge about community perceptions of and barriers to adolescent pregnancy. Participants for KIIs were healthcare providers working in a government healthcare facility (n=4), health coordinators working in the district health office or municipality office (n=4), and female community health volunteers (FCHVs) working in the study areas (n=3). Table 4 shows the focuses of IDIs and KIIs.

I purposively recruited those who met the aforementioned inclusion criteria with the help of local research assistants (the details regarding the assistants are provided below).

As sampling frames were not available in the study areas, I used convenience sampling (i.e., door-to-door visits) to recruit participants of the study. I included minors aged 15 to 17 years for this study because they were disproportionately underserved by family planning programs in Nepal. Vulnerabilities that are specific to this age group may account for the lower uptake of family planning services. I did not consider birth history or contraceptive use history for recruitment.

3.2.3 Data collection

From July 5-15, 2019, I conducted semi-structured IDIs and KIIs, using topic guides. These interviews focused on the knowledge, attitudes, beliefs, perceptions, and experiences that pertain to contraceptive use and childbearing (Table 4). I adopted these data collection methods because they afford greater flexibility in navigating the interview and depth of exploration in qualitative research [109]. I developed the topic guides based on the socio-ecological model (SEM) [110], literature reviews, and the research team's field observations to include previously identified key issues. The SEM offers a theoretical framework that can be used to examine the multilevel, interacting factors determining health behaviors [111]. McLeroy et al. [110] identified five levels of influence that are specific to health behaviors: intrapersonal factors, interpersonal factors, community factors, institutional factors, and policy factors. Based on literature reviews, I developed a conceptual framework (Figure 5), which was adapted from the SEM. I developed and used a separate topic guide for each group. Prior to data collection, I pretested one of the topic guides on two married adolescent girls to

determine the feasibility of this strategy and refine the questions. The topic guides in English are available in Appendix 4.

Table 4. Focuses of IDIs and KIIs

Type of participants	Focus of IDIs and KIIs
Married adolescent girls	Knowledge about and access to FP information and services, perceived needs, decision-making power, influences of in-laws, social and gender norms, religious beliefs, privacy and confidentiality, attitude of healthcare providers, policy restrictions, and political priorities
Husbands	Knowledge about and access to FP information and services, perceived needs, decision-making power, influences of in-laws, social and gender norms, religious beliefs, privacy and confidentiality, attitude of healthcare providers, policy restrictions, and political priorities
Mothers-in-law	Knowledge about and access to FP information and services, perceived needs, decision-making power, influences of in-laws, social and gender norms, and religious beliefs
Healthcare providers/health coordinators/FCHVs	Access to FP information and services, social and gender norms, religious beliefs, challenges in providing FP services, policy restrictions, and political priorities

IDIs: in-depth interviews; KII: key informant interviews; FP: family planning; FCHVs: female community health volunteers

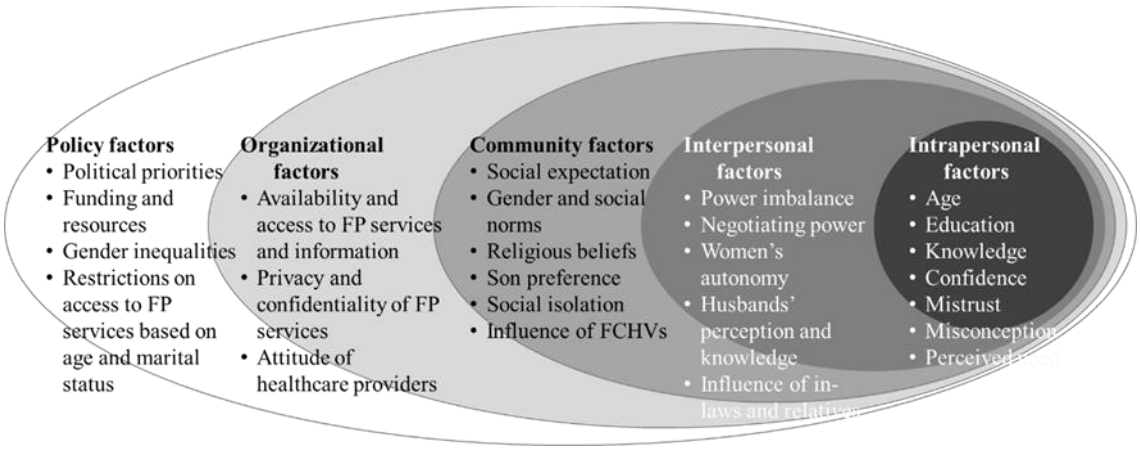


Figure 5. Conceptual framework adapted from on the socio-ecological model to identify the causes of contraceptive nonuse and adolescent pregnancy
Note: adapted from McLeroy et al. (1988) [104]

FP: family planning; FCHVs: female community health volunteers

Five Nepali research assistants (four women and one man) collected data. They speak the local language (i.e., Bhojpuri) and are experienced in qualitative research. I trained them for three days to avoid the biases that typically interfere with the collection of qualitative data (e.g., friendliness bias, social desirability, confirmation bias, question-order bias) and to address ethical considerations. All of the assistants have a bachelor's degree in public health or sociology. They conducted individual face-to-face IDIs and KIIs in a private space chosen by the participants and at a time convenient to them. The sex of the interviewer matched the sex of the participant. The interviewers established rapport with the participants before commencing the interviews. They began the interview with general questions and moved onto more specific questions, including open-ended questions about their experiences of and perceptions about contraceptive use. The interviews lasted for approximately one hour and were audio-recorded to help verify descriptive data. The interviewers transcribed verbatim both the IDIs and KIIs within 24 hours of each interview. Subsequently, the joint researcher translated the transcribed interviews into English. The interviewers checked the translated text for errors and omissions (including context and content accuracy).

3.2.4 Data analysis

I analyzed the data using a directed approach to content analysis, which is described by Graneheim and Lundman [112] and Hsieh and Shannon [113], and in accordance with the conceptual framework. Two researchers (myself and Nirajan Khadka) read English transcripts several times to immerse into the data and gained a sense of the whole. We

coded and analyzed the meaning units, which were embedded within the transcripts. We also highlighted all texts, which, on the first impression, appear to represent factors influencing contraceptive use and adolescent childbearing. The next step in the analysis was to code all highlighted passages using predetermined codes based on the conceptual framework (Figure 5). We gave new codes to any texts that could not be categorized with the initial coding scheme, and then reviewed and revised these codes during the entire coding process. When inconsistencies emerged, we further refined the codes through discussion until we reached consensus. We grouped emergent codes into categories, and further classified into themes in accordance with the conceptual framework: intrapersonal, interpersonal, community, organizational, and policy-level factors. We translated relevant participant quotations and used them to illustrate themes. We adopted various measures to ensure that the publication of these responses does not violate the code of confidentiality. For instance, we used unique reference numbers to protect the identity of the participants. Finally, we constructed linkages among emergent categories and themes through axial coding. Respondent validation could not be conducted due to logistical constraints, and lack of personal information of the respondents. We used NVivo 9 (QSR International, Cambridge, MA) to facilitate coding, organization, searching for meaning units embedded within the English transcripts, and systematically compare the emergent categories and themes both within and across the cases. The qualitative methods and reporting of results in the present study adhered to the Consolidated Criteria for Reporting Qualitative Research (COREQ) [114] and Standards for Reporting Qualitative Research [115]. I filled and provided the COREQ in Appendix 5.

3.2.5 Strategies to deal with validity threats

I employed various strategies for establishing three types of threats to validity that are pertinent to qualitative research [116]. The measures taken to reduce threats to descriptive and interpretative validity included using verbatim transcripts of the interviews, presenting participant quotations without shortening, asking open-ended questions, peer debriefing, collecting and analyzing rich data, and providing the thick description of the setting, participants, and themes. The research design of triangulation from a range of individuals and two data collection approaches helped handle threats to both interpretative and theoretical validity.

3.2.6 Ethical considerations

The present study was approved by the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo (2019030NI) (Appendix 6), and the Nepal Health Research Council (3001) (Appendix 7) in Kathmandu. I secured written informed consent (Appendix 8) from the participants after they were informed about the aim, objectives, and procedures of the study, using the information sheet (Appendix 9 and Appendix 10). For those who were younger than 18 years, I obtained written informed consent from their parents. If the parent was inaccessible, I obtained it from minor participants. Participation in the present study was voluntary, and the participants were free to skip interview questions or withdraw their participation at any time without penalty. They were not required to provide any personal information (e.g., name,

address, phone number) during the interviews. I used unique reference numbers to protect the identity of the participants.

3.3 Results

3.3.1 Participant characteristics

Table 5 summarizes participants' characteristics. The mean age of the participating adolescent girls was 17.8 years (interquartile range (IQR) 17.0 to 18.3). A majority of them were married before the age of 18. Approximately half of them had at least one child, and several others were pregnant. Almost all of them had become full-time housewives living with their in-laws after marriage. All the adolescent girls had already discontinued their education. The mean age of the husbands and mothers-in-law was 23.5 (IQR 21.0 to 25.3) and 48.4 (IQR 41.5 to 52.3), respectively. More than a half of the participants for IDIs were Hindu. Most of the husbands were farmers or casual laborers. The mothers-in-law had limited educational attainment. As providing the demographic characteristics of the KII participants might allow for their identification, I did not include such information in this article.

Table 5. Demographic characteristics of the participants for in-depth interviews

	Married adolescent girls (n=20)			Husbands (n=20)			Mothers-in-law (n=20)	
	Mahaga dimai	Prasauni		Mahaga dimai	Prasauni		Mahaga dimai	Prasauni
Age (years)			**Age (years)**			**Age (years)**		
15–17	1	5	15–19	3	0	30–39	2	0
18–19	9	5	20–24	3	8	40–49	4	5
Age at marriage (years)			25–29	2	3	50–59	3	3
12–14	3	3	30–34	1	0	60–69	1	2
15–17	5	7	**Religion**			**Religion**		
18–19	2	0	Hinduism	6	6	Hinduism	6	7
Religion			Islam	3	5	Islam	4	3
Hinduism	6	7	**Ethnicity**			**Ethnicity**		
Islam	4	3	Madhesi	1	2	Madhesi	4	4
Ethnicity			Muslim	3	5	Muslim	4	3
Madhesi	4	0	Terai Dalit	5	4	Terai Dalit	2	3
Muslim	4	4	**Educational level**			**Educational level**		
Terai Dalit	1	5	No education or some level of primary education	1	0	No education or some level of primary education	9	10
Teli	1	0	Completed primary school	1	2	Completed primary school	1	0
Unknown	0	1	Some level of secondary education	3	6	**Occupation**		
Educational attainment			Completed secondary school	0	0	Unemployed	2	4

No education or some level of primary education	4	4	Higher education	4	3	Farmer	3	6
Completed primary school	1	3	**Occupation**			Laborer	3	0
Some level of secondary education	2	3	Farmer	4	0	Community health volunteer	1	0
Completed secondary school	1	0	Laborer	3	4	Businessperson	1	0
Higher education	2	0	Businessperson	2	4			
Occupation			Teacher	0	1			
Unemployed	10	9	Helper	0	1			
Tailor	0	1	Tailor	0	1			
Number of children								
0	3	8						
1	4	2						
2	3	0						

3.3.2 Intrapersonal factors

Fear of and misconceptions about side effects on health

Both the married adolescent girls and husbands considered their fear of the side effects of contraceptive methods to be a factor that influences their decisions about family planning. They were concerned that the use of such tools would adversely affect their physical health. They also held misconceptions about the side effects of contraceptives. The following characteristic responses illustrate this observation:

> *I have heard that if we use an implant, there will be a lot of bleeding. Pills will harm the body, and it will feel hot if you use them.* (Ref. #122, married adolescent girl, 18 years)

> *There is a chance of becoming infertile if contraceptives are used for a long time.* (Ref. #992, husband, 21 years)

Lack of access to information

Several married adolescent girls were unaware that they could avail of family planning services free of charge at public healthcare facilities. All the three groups demonstrated poor knowledge about family planning services.

> *I think there is a need for family planning services and information. However, no one provided us with such information about free family planning services.* (Ref. #630, married adolescent girl, 17 years)

Shyness and embarrassment

Most of the married adolescent girls cited shyness and embarrassment as barriers that prevented them from discussing the timing of childbearing and contraceptive use with their husbands. Both the married adolescent girls and husbands were not inclined to seek family planning information and services, especially from healthcare providers of the opposite sex.

> *I will feel very shy to ask about family planning methods. It was only a year of my marriage, and they [healthcare providers] told me not to use contraceptives. If I must ask anybody about it, I will feel very shy.* (Ref. #460, married adolescent girl, 17 years)

However, a few of the married adolescent girls responded they did not feel shy to discuss contraceptive use with their husbands.

Low awareness about the risks involved in adolescent or multiple pregnancy

Low awareness and misinformation about the risks involved in adolescent childbearing emerged as a contributor to contraceptive nonuse. While only a few married adolescent girls were aware that adolescent pregnancy was associated with an increased risk of obstetric complications, several respondents had low levels of knowledge about the risk.

If a woman gives birth before 18 years of age, she will suffer from weakness, stomachache, and vomiting and will not be able to work much and always feel sleepy. (Ref. #122, married adolescent girl, 18 years)

3.3.3 Interpersonal factors

Limited autonomy in making decisions about family planning

The respondents were governed by strong cultural norms, which empower husbands to make all household decisions and disallow wives from making independent decisions. Such patriarchal values, wives' financial dependence, and power imbalances between spouses had restricted women's decisions about contraceptive use. A few married adolescent girls reported that their husbands had refused to access contraceptives. They also noted that defying their husband's decisions would lead to family feuds.

If I use it [contraceptives] and if I start having its side effects, then my husband will scold me. That is why he takes all the decisions. He makes major decisions because he earns and governs the family. (Ref. #122, married adolescent girl, 18 years)

In our community, men make all decisions. I want to use contraceptives, but he does not want me to. He does not agree on the use of contraceptives. According to him, it will harm my body. (Ref. #335, married adolescent girl, 17 years)

We [young wives] must live on another person's income to live and have to do whatever the other person says. That is why we do not have the right to make decisions. (Ref. #460, married adolescent girl, 17 years)

However, a few of the married adolescent girls responded they had equal decision-making power regarding contraceptive use.

Influence of mothers-in-law

The mothers-in-law undermined their daughter-in-law's autonomy in making decisions about contraception. Most of the married adolescent girls reported that their mothers-in-law had pressurized them into not using contraceptives until they had an ideal number of children.

My mother-in-law influenced my decision. She has the right to make decisions regarding my contraceptive use and childbearing. (Ref. #241, married adolescent girl, 16 years)

Limited mobility

Most of the Hindu and Muslim wives considered limited mobility to be a barrier that hindered them from accessing family planning information and services because their husbands and mothers-in-law restricted their rights to travel.

If I do not take permission to go out, there is a chance of fighting with my husband. (Ref. #241, married adolescent girl, 16 years)

Women must seek permission to go out not only from their husbands but also from their parents-in-law and other elders in the family. Only a few disobey such norms and go to a health facility for service. Discrimination and violence against women are a common consequence if they disobey family norms. (Ref. #587, FCHV, 35 years)

3.3.4 Community factors

Social pressure to give birth soon after marriage and fear of infertility

Most of the married adolescent girls, husbands, and mothers-in-law cited the extreme pressures to give birth soon after marriage as a reason for contraceptive nonuse and adolescent pregnancy. The married adolescent girls noted that, if a woman does not give birth within the first three years of her marriage, others will make fun of the woman and gossip about her infertility. They were afraid of abandonment and the stigmatization of childless married couples. Their family and community members had intimidated them into becoming pregnant. The married adolescent girls believed that their communities expected them to deliver their first child within the first year of marriage. In contrast, most of the husbands believed their community members expected couples to have their first child between the second and fifth year of marriage. The wives seemed to be more sensitive to social pressures to give birth.

My community believes that women should give birth in the first year of their marriage. If they do not, people will start gossiping about their infertility. (Ref. #29, married adolescent girl, 19 years)

If a couple does not have a child after 4-5 years of marriage, people have negative thoughts about it. They ask, "Why doesn't she have a child?" [and] "Is she having a problem with her reproductive capacity?" If she does not have a child after 3 to 4 years, parents will decide to arrange another marriage for the son. (Ref. #230, husband, 22 years)

Concerns about child health and development contribute to the pressures to which women are subjected.

They [my family] also think that giving birth soon after marriage will contribute to the early development of the baby. (Ref. #630, married adolescent girl, 17 years)

As illustrated by the following response provided by a mother-in-law, the fear of elopement can also exacerbate social pressures.

Community members think that getting pregnant soon after marriage is good as women cannot elope with another guy if they have a child. They can better take care of a child and give birth to a healthy baby. (Ref. #756, mother-in-law, 55 years)

Role of religious beliefs in contraceptive use

Religious beliefs were a major barrier that prevented Muslim women from seeking contraceptives. However, Hindu women did not share the same perspective.

> *Our religion [Islam] teaches that the use of contraceptives is a sinful act.* (Ref. #930, married adolescent girl, 19 years)

> *In Islam, we believe that if we use contraceptives, God becomes unhappy and punishes us.* (Ref. #241, married adolescent girl, 16 years)

Lack of engagement with FCHVs

FCHVs, who are responsible to disseminate reproductive health information, conduct family planning counseling and distribute condoms and oral pills in their communities, did not actively engage with married adolescent girls and involve them in family planning activities. Women's restricted mobility impeded their access to FCHVs and opportunities to learn about contraceptive methods.

> *I never met a female health volunteer since I never go out of my home. I do not think there is a discussion about this [family planning issues] in our community.* (Ref. #892, married adolescent girl, 18 years)

I know that there are mothers' group meetings regularly in this municipality, but I haven't noticed or heard that FCHVs discuss with young couples about family planning issues. (Ref. #352, mother-in-law, 48 years)

3.3.5 Organizational factors

Lack of privacy and confidentiality

A few of the husbands and healthcare providers reported that concerns about confidentiality deterred married couples from visiting healthcare facilities to obtain contraceptives.

Confidentiality is not maintained in some private clinics because my single friend went to a private clinic to buy condoms, and, later, this information was spread among their professional network. (Ref. #992, husband, 21 years)

Couples themselves do not feel comfortable going to government health facilities owing to a lack of privacy and confidentiality. This is because there is no separate space for family planning counseling and services in health facilities. (Ref. #729, health care provider, 31 years)

Attitudes of healthcare providers

A few of the married adolescent girls complained about the attitudes of healthcare providers.

> *When seeking antenatal check-up during my pregnancy at a private clinic, the staff members were not friendly to me. They spoke only to my husband and asked him about my problem.* (Ref. #335, married adolescent girl, 17 years)

Healthcare providers reported other health systems-related barriers that prevented them from accessing family planning services, including (i) stockouts of contraceptives at healthcare facilities, (ii) the unavailability of female health workers who could provide family planning counseling and services to female clients, and (iii) overlap between the working hours (10 am to 3 pm) of healthcare facilities and the time at which the housewives tended to be busy with their household duties.

3.3.5 Policy-level factors

None of the participants reported policy-level factors.

3.4 Discussion

This study is one of the first qualitative studies to identify the multilevel, interacting factors that influence contraceptive use and childbearing among married adolescent girls. It extended the evidence base by illustrating the multidimensionality and interaction of the factors that limit young married women's family planning knowledge, undermine their autonomy in decision making, reduce contraceptive use, and increase the risk of adolescent pregnancy. The barriers were intertwined and influenced each other across different levels of the SEM (Figure 6). The barriers were identified across

the intrapersonal, interpersonal, community, and organizational levels. Barriers at the intrapersonal level were reluctance to seek family planning information and services, the fear of and misconceptions about side effects of contraceptives, low awareness about the risks involved in adolescent pregnancy, and a lack of access to information. Barriers at the interpersonal level were limited autonomy in making decisions about family planning, restricted mobility, power imbalances between spouses, and mothers-in-law's influence. Barriers at the community level were the fear of infertility and abandonment, the stigmatization of childless married couples, normative gender roles, and social pressures to give birth soon after marriage, which emerged as root causes of contraceptive nonuse. Barriers at the organizational level were a lack of privacy and confidentiality, and the unfriendliness of healthcare providers. The hypothetical relationships in Figure 6 are depicted based on the findings from the present study.

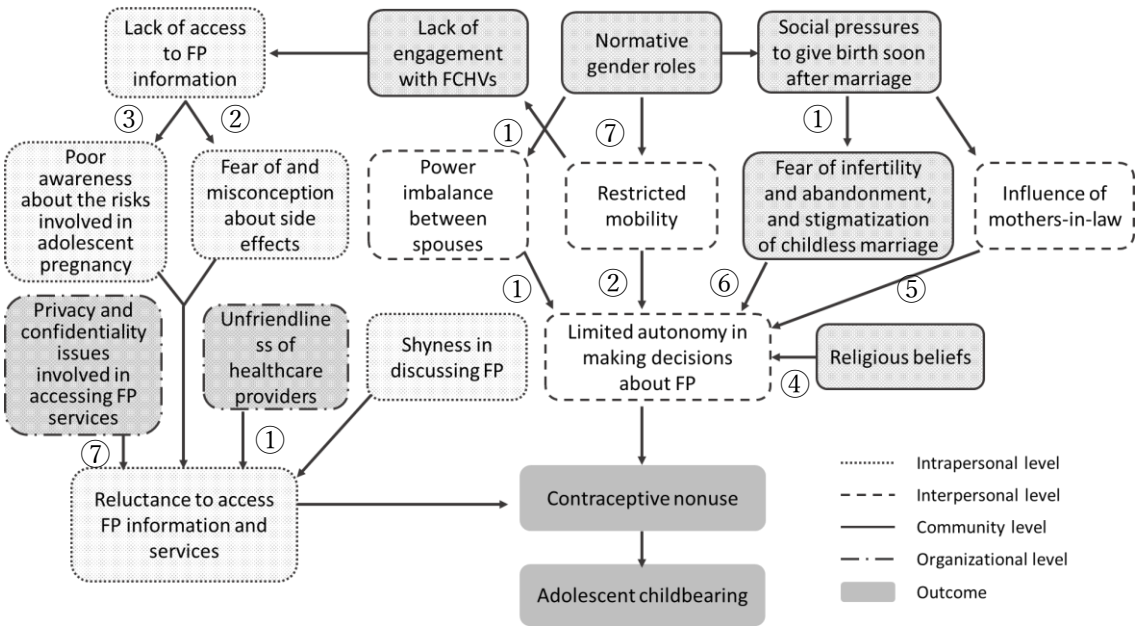


Figure 6. A diagram of hypothetical relationships among the emergent factors

The women who participated in this study were not empowered to make independent decisions about contraceptive use. Their husbands and mothers-in-law were deeply involved in this decision-making process. Adolescent married girls, their husbands, and mothers-in-law keenly felt the pressure to bear a child within the first few years of marriage. None of the participating husbands and in-laws supported the idea of delaying the first pregnancy. Disapproval of contraceptive use before having an ideal number of children in the family was prevalent among them. Newly married adolescent girls had often become pregnant before they were ready to fulfill familial expectations to bear a child and prove their fertility. Patriarchal norms and power imbalances between spouses made married adolescent girls hesitate or refrain from talking to their husbands about family planning and limited their decision-making power regarding contraception (Arrow 1). The present findings corroborate with previous studies that have found social pressures to give birth soon after marriage in India [87,89], Bangladesh [90,103], and Iran [91] and limited autonomy in making decisions about family planning in Nepal [104], Bangladesh [90], and Iran [91] and among Syrian refugees in Lebanon [88].

The married adolescent girls felt insecure, presumably because newly married women are not considered to be a valuable member of their in-law's family until they prove their fertility. Similar to the findings of previous studies in Iran [91] and Bangladesh [103], delivering a healthy child soon after marriage was perceived as a means to establishing her identity and consolidating her position within her husband's family. Additionally, labor migration to India, Malaysia, and the Middle East was common in

the study areas. As such, having a child may be perceived as a way to cement the bond between a husband and his wife before his departure [103].

Married adolescent girls' views on family planning were shaped by their mothers-in-law (Arrow 3). They exerted considerable influence over couples' decisions regarding contraceptive use as they were perceived as the most experienced household member in relation to family planning. Their pressure on daughters-in-law to prove fertility within the first few years of marriage was identified as a strong reason for contraceptive nonuse. Given the restricted mobility of married adolescent girls, mothers-in-law and sisters-in-law were their primary sources of information about contraception. Similar findings regarding the influence of mothers-in-law have been identified in Nepal [104], Bangladesh [90], and Lao People's Democratic Republic [92].

Social pressures to give birth soon after marriage, normative gender roles, and religious beliefs emerged as the root causes of contraceptive nonuse. Social pressures to have a child soon after marriage drove the fear of infertility, abandonment, and the stigmatization of childless married couples, which impeded the married adolescent girls' access to family planning services (Arrow 2). Mothers-in-law may amplify the social pressure to have a child soon after marriage. Normative gender roles were related to restricted mobility among married adolescent girls (Arrow 1). Furthermore, religious beliefs substantially limited their autonomy in making decisions about contraceptive use (Arrow 4). This finding of religious restrictions is in agreement with a previous study in Bangladesh [90]. In contrast, in another study conducted in Syria, religious beliefs did not emerge as a barrier to reproductive decisions [117].

Limited access to information about the benefits and methods of family planning had multiple intrapersonal-level effects. It contributed to fear of and misconception about the side effects of contraceptives (Arrow 5). It also led to low awareness about the risks involved in adolescent pregnancy (Arrow 6). Some married adolescent girls were unaware of the free family planning services, which were provided at government healthcare facilities. Fear of the side effects has been recognized as a barrier to contraceptive use in India [87], Bangladesh [90,103,118], and Iran [91]. Dropping out of school may have limited their opportunities to learn about sexual and reproductive health issues and to expand their social networks. The findings of this study support the existing evidence that shyness in discussing family planning with husbands and healthcare providers impedes access to family planning services in Asian countries [87,90,92,119].

In addition to the intrapersonal-level factors, supply-side barriers (e.g., a lack of privacy and confidentiality, the unfriendliness of healthcare providers) may have rendered them reluctant to seek contraceptives (Arrow 7). Issues related to commodity insecurity, distance, and transport did not seem to influence contraceptives-seeking behaviors. Health systems-level factors (e.g., a lack of privacy and confidentiality, the unfriendliness of health care providers) have been found to be contributing factors for contraceptive nonuse among married adolescent girls in Lao People's Democratic Republic [92].

The convergent results from triangulation across multiple sources (i.e., six different groups) and two data collection methods painted a complex and comprehensive portrait of the barriers to contraceptive use and causes of adolescent childbearing. However, the findings should be interpreted within the confines of several limitations of this study. First, a convenience sample was recruited from a single district in Nepal. Therefore, the findings may not be transferable to broader populations. Second, the participants may have felt inhibited to candidly share their experiences and perspectives, especially those that pertain to sensitive subjects, in the presence of an interviewer. For example, they may have felt uncomfortable reporting other prevalent, albeit extremely stigmatized experiences (e.g., abuse and neglect) that influence contraceptive use. In the present study, efforts were made to obtain in-depth data by interviewing in a private space, establishing rapport with the participants, and maintaining confidentiality. Third, due to lack of respondent validation, the possibility of misinterpreting the meaning of what the respondent says could not be ruled out. Fourth, there remain the possibility of confirmation bias where researchers collected and analyzed data in a way that is consistent with preexisting beliefs. Finally, the relationships shown in Figure 6 are intended to be an illustrative set of relationships, rather than an exhaustive set. Minor linkages are not necessarily reflected in the diagram. Finally, the meanings embedded within participants' responses might have been lost or distorted during translation from Nepali to English. To minimize this problem, the interviewers checked the accuracy of the translated texts for errors and omissions. Despite these limitations, the strengths of this study include its comprehensive approach guided by the SEM, triangulation across multiple sources and methods, which enabled the collection of rich and detailed data, and other strategies for establishing validity.

3.5 Conclusions

The present findings delineate the mechanism of contraceptive nonuse and adolescent pregnancy in the study setting. In-depth accounts of a range of individuals demonstrated that the decision to postpone childbearing is not merely the personal choice of an individual or a couple, highlighting the importance of targeting families and communities in addition to adolescent girls and couples. Expanding access to comprehensive sexuality education to enhance girls' knowledge and demand for sexual and reproductive health may not be enough to prevent adolescent pregnancy. Instead, the present findings underscore the need to challenge restrictive socio-cultural norms so that adolescent girls are empowered to exercise greater control over contraceptive use. Community support and collective actions are needed to address the root causes that have been identified in this study. Reproductive health programs and interventions should be culturally sensitive and context-specific and aim to reinforce women's reproductive rights and gender equality.

4. Overall discussion and conclusions

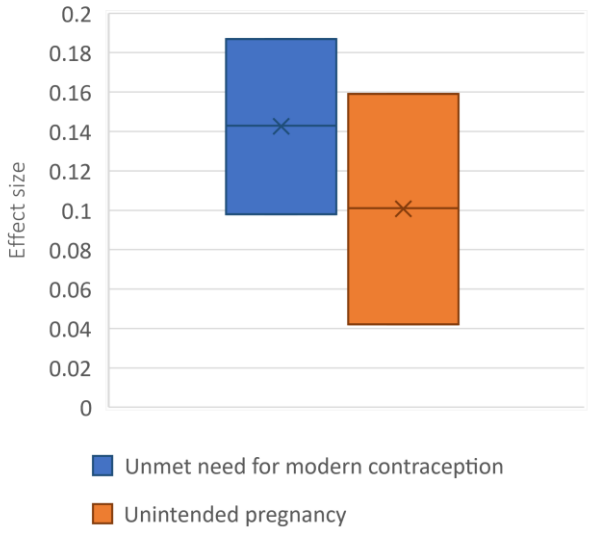
4.1 Overall discussion

In this section, I combined and synthesized the results from both the quantitative and qualitative studies presented above, rather than outlining the sum of individual studies. Regarding how the results were mixed, I used the results from the qualitative research to make the final interpretation of what I found in the quantitative analyses and draw overall conclusions. In particular, the triangulation was designed to provide a richer, more comprehensive explanation of how child marriage impacts reproductive health of married adolescent girls in Nepal. The qualitative results provided a contextual understanding of how the impact of child marriage on reproductive health outcomes emerged. In-depth accounts from the qualitative study were used to illustrate the quantitative results and put meat on the bones of dry quantitative findings. The triangulation of both the quantitative and qualitative studies also helped improve usefulness of the findings.

I used a joint display as a visual means to integrate and represent mixed methods results. Figure 7 shows the integration of both quantitative and qualitative data. The integrated results of the quantitative and qualitative studies supported each other, suggesting complementary relationships between these studies. A broader and deeper perspective of the impact of child marriage on reproductive health outcomes and rights was gained through this explanatory sequential mixed methods design. Together, combined results of the two studies shed light on the adverse impacts of child marriage

on the risk of unmet needs for modern contraception and unintended pregnancy. Rich accounts from the qualitative research helped explain and elaborate a mechanism between child marriage and contraceptive nonuse and adolescent pregnancy. Despite a lack of generalizability of the qualitative results to the entire population in Nepal, it provided a detailed account of how married adolescent girls' access to contraceptives was impeded by a complex myriad of barriers. Key barriers that were identified in this research included, but not limited to, familial and social pressures to give birth soon after marriage, fear of infertility and abandonment, stigmatization of childless marriage, normative gender roles, restricted mobility, limited autonomy in making decisions about family planning, and lack of access to information regarding family planning. These barriers were intertwined and influenced each other at the intrapersonal, interpersonal, community, and organizational levels. As the two studies provide coherent conclusions, the results have a greater credibility. The quantitative analysis speaks to the strength of associations while the qualitative analysis speaks to contextual factors for those associations.

The quantitative results The qualitative results



Contextual factors for unmet need for modern contraception and unintended pregnancy among Nepali women married as children include:

- familial and social pressures to give birth soon after marriage
- fear of infertility and abandonment
- stigmatization of childless marriage
- normative gender roles
- restricted mobility
- limited autonomy in making decisions about family planning
- lack of access to information regarding family planning.

Note: The lower and upper bounds indicate 95% intervals of the effect size.

Figure 7. A joint display of the integrated results

To my best knowledge, this is the first mixed methods study focusing on the impact of child marriage. While there have been studies that examined the effect of child marriage on reproductive health and fertility in the low- and middle-income countries [23–27,29–33,74], prior to this study, there was a lack of studies that have elucidated the pathway between child marriage and the increased risk of unmet needs for modern contraception and unintended pregnancy.

The contribution of this mixed methods study is the first study that has identified the effect of child marriage on reproductive health outcomes by using propensity score matching. The matching method was instrumental in significantly reducing selection bias and imbalances between treatment groups. It is one of the first qualitative studies to identify the multilevel, interacting factors that influence contraceptive use and childbearing among married adolescent girls. It extended the evidence base by

illustrating the multidimensionality and interaction of the factors that limit women's family planning knowledge, undermine their autonomy in decision making, reduce contraceptive use, and increase the risk of adolescent pregnancy.

4.2 Overall conclusions

Both the quantitative and qualitative studies presented in this thesis converge on the conclusion that child marriage has impacts on reproductive health and rights. The results have implications for reproductive health policy and programs. Interventions to inform and empower girls should be intensified to increase knowledge and understanding of the importance of preventing adolescent or unintended pregnancy and to reduce unmet needs for contraception. Information and empowerment approaches can take many forms, which include building life skills such as communication and negotiation, and reproductive health information sessions.

Men and boys must be engaged to challenge and transform gender norms and stereotypes relating to childbearing and family planning and to address negative effects that these norms and stereotypes can have on women, girls, families, and communities. Interventions should be undertaken with the aim of improving community members' knowledge and attitude regarding potential dangers of child marriage and adolescent childbearing. These interventions may have direct and indirect effects on adolescent boys' attitudes and behaviors relating to contraception. Adolescent and adult males should be part of the process of respecting and fulfilling reproductive autonomy of women.

Detailed accounts from a range of individuals demonstrated that the decision to postpone childbearing is not merely the personal choice of an individual or a couple, highlighting the importance of targeting families and communities in addition to adolescent girls and couples. These findings underscore the need to challenge restrictive socio-cultural norms so that adolescent girls are empowered to exercise greater control over contraceptive use. Community support and collective actions are needed to address the root causes that have been identified in this study. Reproductive health programs and interventions should take account of the context and aim to reinforce women's reproductive rights and gender equality. Adopting human rights-based approaches to adolescent sexual and reproductive health is essential to ensure women's autonomy in exercising their reproductive rights by determining when to have a child and how many children to have. Quantitative analysis of the magnitude of contribution of each identified factor to unmet needs for modern contraception and unintended pregnancy warrant further research.

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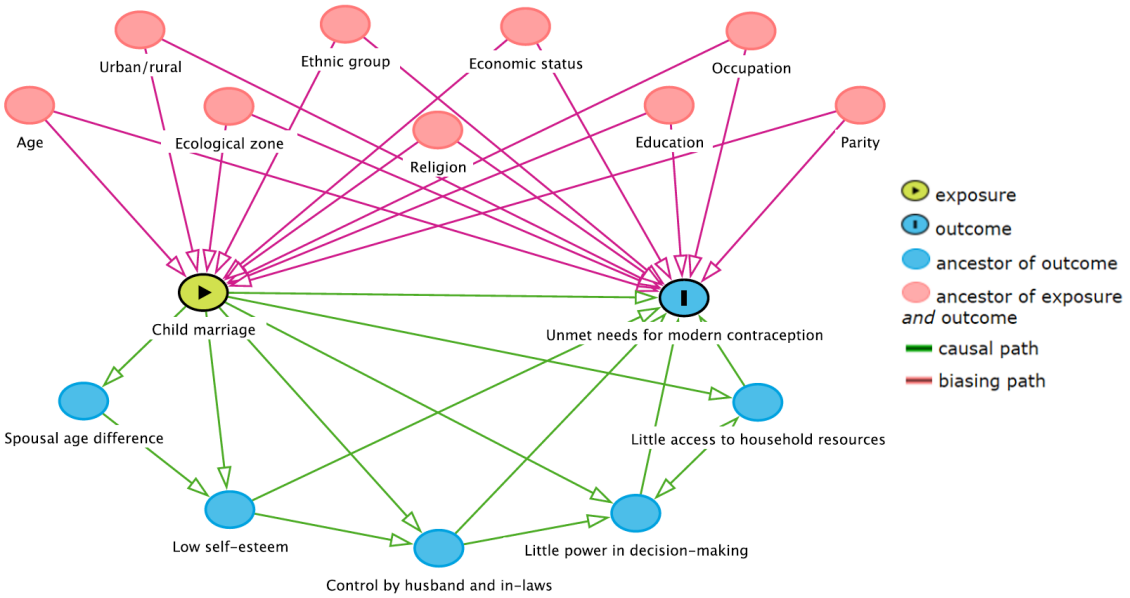
Appendices

Appendix 1. Directed acyclic graph



Note: The variables with a biasing path were treated as covariates in this propensity score matching analysis.

Appendix 2. Approval for using the Nepal Demographic and Health Survey dataset

Apr 18, 2019

Kazutaka Sekine
UNICEF
Pakistan
Phone: +92 3455006542
Email: kazutaka_sekine@hotmail.com
Request Date: 04/18/2019

Dear Kazutaka Sekine:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Equity analysis":

Myanmar, Nepal, Pakistan, Sierra Leone, Timor-Leste

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. Users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: archive@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

530 Gaither Road, Suite 500, Rockville, MD 20850 USA +1.301.407.6500 +1.301.407.6501 fax icf.com

Appendix 3. Ethical approval from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo (a quantitative study)

（医）

審査番号	2019032NI

西暦　2019年06月07日

審　査　結　果　通　知　書
実　施　許　可　通　知　書

倫理委員会の設置者、実施機関の長
東京大学大学院医学系研究科・医学部長　殿

倫理委員会委員長
東京大学大学院医学系研究科・医学部倫理委員会
非介入等研究倫理委員会

赤林　朗

審査依頼のあった件についての審査結果を下記のとおり通知いたします。

記

研究課題名	ネパールにおける児童婚によるリプロダクティブヘルスへの影響：傾向スコアマッチング
審査結果	■承認する　□条件付きで承認する　□変更を勧告する　□承認しない □該当しない　□既承認事項の取り消し
審査事項 （審査資料）	＜新規案件＞ ■研究の新規実施 ＜継続案件＞ □研究に関する変更 □その他（　　）
審査区分	■委員会審査（審査日：西暦2019年06月03日） □迅速審査（審査日：西暦　　年　月　日）
指摘事項および 理由・条件等	
備考	・利益相反アドバイザリー機関の判断を仰ぐこと

研究責任者　　神馬 征峰　殿

依頼のあった研究に関する審査事項について上記のとおり決定しましたので通知いたします。
倫理委員会での審査結果が承認となりましたので、研究の実施を許可いたします。

西暦　2019年06月07日

倫理委員会の設置者、実施機関の長
東京大学大学院医学系研究科・医学部長
齊藤　延人（公印省略）

Appendix 4. Topic guides

Topic guide for married adolescent girls

Intrapersonal factors	• Do you know that free family planning services are available in your municipality? • Do you know where to access free family planning services? • Which contraceptive methods do you know? • How do you perceive family planning services? • Have you ever used any contraceptive method? • Do you perceive the need for family planning services and information? • Do you feel shy to seek family planning services and information? • What challenges do you face in seeking family planning services? • Do you fear side effects of contraceptive use?
Interpersonal factors	• Do you discuss with your husband when to have a child and how many children to have? • Do you feel comfortable to negotiate contraceptive use with your husband? • Who has the power to make decision regarding whether to use contraceptives? • Does your husband agree or disagree to use contraceptives? • Do you have a final say on contraceptive use? • Do you perceive that there is power imbalance in terms of decision-making regarding family planning between you and your husband? • Do your mother-in-law or sisters-in-law influence your decision-making about contraceptive use? • Have you heard of your mother-in-law's or sisters-in-law's experience of using family planning services?
Community factors	• Is there social consensus in your community that women should become pregnant soon after marriage? • Did you feel pressure to become pregnant soon after marriage? If so, who did you feel pressure from? • Has your religion something to do with non-use of contraceptives after marriage? • Do you sometimes exchange information about family planning with your friends? • Do FCHVs in this municipality discuss family planning services with young women like you?
Organizational factors	• Are local health care providers supportive of providing contraceptives to young women like you? • Are they friendly to young women like you?

	• Do you feel your privacy and confidentiality are maintained at a nearby health facility? • How long does it take to get to a nearby health facility providing family planning services? • Is there local transportation available to get to a nearby health facility providing family planning services? • Would you need a permission from your husband if you go out to a health facility?
Policy factors	• Is there any restriction of family planning services on age? • Is there any restriction of family planning services on marital status?

Topic guide for husbands of married adolescent girls

Intrapersonal factors	• Do you know that free family planning services are available in your municipality? • Do you know where to access free family planning services? • Which contraceptive methods do you know? • How do they perceive family planning services? • Do you perceive the need for family planning services and information? • Do you feel shy to seek family planning commodity (condom) and information? • What challenges do you face in seeking family planning services? • Do you fear side effects of contraceptive use?
Interpersonal factors	• Do you discuss with your wife when to have a child and how many children to have? • Do you feel comfortable to discuss contraceptive use with your wife? • Who has the power to make decision regarding whether to use contraceptives? • Do you have a final say on contraceptive use? • Do you perceive that there is power imbalance between you and your wife? • Do your parents or anyone else influence your decision-making about contraceptive use? • Have you heard of anyone's experience of using family planning services?
Community factors	• Is there social consensus in your community that women should become pregnant soon after marriage? • Did you feel pressure to get your wife pregnant soon after marriage? If so, who did you feel pressure from? • Has your religion something to do with non-use of contraceptives after marriage? • Do you sometimes exchange information about family planning with your friends? • Do FCHVs in this municipality discuss family planning services with men like you?
Organizational factors	• Are local health care providers supportive of providing condoms? • Are they friendly to you when you go there to seek condoms? • Do you feel your privacy and confidentiality are maintained at a nearby health facility? • How long does it take to get to a nearby health facility providing condoms?

	• Is there local transportation available to get to a nearby health facility providing family planning services?

Topic guide for mothers-in-law of married adolescent girls

Intrapersonal factors	• Do you know that free family planning services are available in your municipality? • Do you know where to access free family planning services? • Which contraceptive methods do you know? • How do they perceive family planning services? • What challenges do you think young couples face in seeking family planning services?
Interpersonal factors	• Do you think your daughter-in-law should discuss family planning with her husband? • Did you feel comfortable to negotiate contraceptive use with your husband? • In your opinion, who should decide when to have a child and how many children to have • In your opinion, who should decide whether to use contraceptives? • Do you think your daughter-in-law should use contraceptives? • Are you influential in decision making about contraceptive use of your daughter-in-law? • Have you ever shared with your daughter-in-law your experience of using family planning services?
Community factors	• Is there social consensus in your community that women should become pregnant soon after marriage? • When you were young, did you feel pressure to become pregnant soon after marriage? If so, who did you feel pressure from? • Do FCHVs in this municipality discuss family planning services with young couples?

Topic Guide for health care providers, health coordinators, and FCHVs

Community factors	• Is there social consensus in this community that women should become pregnant soon after marriage? • Has your religion something to do with non-use of contraceptives after marriage? • Do FCHVs in this municipality discuss family planning services with young couples?
Organizational factors	• What is a major challenge for local women especially when seeking family planning services in this municipality? • Do women in this municipality have to seek permission from their husband if they go out to a health facility? • What is a major challenge in providing family planning services in your municipality or health facility? (Availability of commodities and equipment, training for nurses/ANM) • What is your concern in family planning programme in this municipality? (budget, planning, leadership/governance, health information, supplies, availability and capacity of health workers) • Are there any other issues that one should be aware of when understanding access to family planning services in this municipality?
Policy factors	• Is there any restriction of family planning services on age? • Can young people below the age of 18 receive family planning services in this municipality or facility as they wish? • Is there any restriction of family planning services on marital status? • Can unmarried couples receive family planning services in this municipality or facility as they wish?

Appendix 5. The consolidated criteria for reporting qualitative studies (COREQ) checklist

Topic	Guide questions/description	Response
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Interviewer/facilitator	Which author/s conducted the interview or focus group?	Five research assistants (four women and one man) hired for this research conducted the interviews. KS and NK supervised the data collection process.
2. Credentials	What were the researcher's credentials? E.g., Ph.D., MD	Ph.D., MSc, MA, MD
3. Occupation	What was their occupation at the time of the study?	PhD student, Professor, Assistant Professor, and Director of an NGO
4. Gender	Was the researcher male or female?	All the concerned researchers are male. Four of the local research assistants involved in data collection are female and one male.
5. Experience and training	What experience or training did the researcher have?	KS, RRC, AT, and MJ have experiences in qualitative research.
Relationship with participants		
6. Relationship established	Was a relationship established before study commencement?	None of the concerned researchers had relationships with the participants until study commencement.
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g., personal goals, reasons for doing the research	None of the participants had contact with the concerned researchers before this study. The aim, objectives, and procedures of the study was explained to the participants before participation.
8. Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g., bias, assumptions, reasons, and interests in the research topic	All of the assistants have a bachelor’s degree in public health or sociology. They speak the local language (i.e., Bhojpuri) and are experienced in qualitative research. Before data collection, they were trained to avoid the biases that typically interfere with the collection

		of qualitative data and to address ethical considerations.
Domain 2: Study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis	The socio-ecological model was adopted as the theoretical framework that guided the development of research tools. Also, a directed approach to content analysis was employed for data analysis in this study.
Participant selection		
10. Sampling	How were participants selected? e.g., purposive, convenience, consecutive, snowball	Convenience sampling
11. Method of approach	How were participants approached? e.g., face-to-face, telephone, mail, email	Door-to-door visits.
12. Sample size	How many participants were in the study?	70 participants (60 for IDIs and 10 for KIIs)
13. Non-participation	How many people refused to participate or dropped out? Reasons?	None of the participants refused to participate or dropped out in the study.
Setting		
14. The setting of data collection	Where was the data collected? e.g., home, clinic, workplace	IDIs and KIIs were conducted in a private space that was chosen by the participants and at a time that was convenient to them.
15. Presence of nonparticipants	Was anyone else present besides the participants and researchers?	Nobody
16. Description of sample	What are the important characteristics of the sample? e.g., demographic data, date	Characteristics of the IDI participants are provided in Table 2.
Data collection		

17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Based on literature reviews, the authors developed the conceptual framework (Figure 5) that guided the development of research tools. For each group of the participants, a separate topic guide was developed and used. Prior to data collection, a topic guide was pretested on two married adolescent girls to determine the feasibility of the tool and refine the questions.
18. Repeat interviews	Were repeat interviews carried out? If yes, how many?	No.
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	All the IDIs and KIIs were audio-recorded and transcribed verbatim.
20. Fieldnotes	Were field notes made during and/or after the interview or focus group?	Field notes were made during the interviews.
21. Duration	What was the duration of the interviews or focus group?	The interviews lasted for about one hour.
22. Data saturation	Was data saturation discussed?	Yes. The sample size allowed the researchers to reach thematic saturation that is when no new information emerges.
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No.

Domain 3: Analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Two researchers (KS and NK) were responsible for coding.
25. Description of the coding tree	Did authors provide a description of the coding tree?	No.
26. Derivation of themes	Were themes identified in advance or derived from the data?	Themes were identified in advance based on the social-ecological model and literature reviews.

		However, new codes were given to any texts that could not be categorized with the initial coding scheme.
27. Software	What software, if applicable, was used to manage the data?	I used NVivo 9 (QSR International, Cambridge, MA) to facilitate coding, organization, searching for meaning units embedded within the English transcripts, and systematically compare the emergent categories and themes both within and across the cases.
28. Participant checking	Did participants provide feedback on the findings?	Respondent validation could not be conducted due to logistical constraints, and lack of personal information of the respondents.
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g., participant number	Participant quotations are presented to illustrate themes.
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Consistency between the data presented and the findings is ensured in the article.
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes, in the results section.
32. Clarity of minor themes	Is there a description of diverse cases or a discussion on minor themes?	Relatively minor themes that are supported by a few participant quotations are included in the result section.

Appendix 6. Ethical approval from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo (a qualitative study)

（医）

審査番号	2019030NI

西暦　2019年06月07日

審　査　結　果　通　知　書
実　施　許　可　通　知　書

倫理委員会の設置者、実施機関の長
東京大学大学院医学系研究科・医学部長　殿

倫理委員会委員長
東京大学大学院医学系研究科・医学部倫理委員会
非介入等研究倫理委員会

赤林　朗

審査依頼のあった件についての審査結果を下記のとおり通知いたします。

記

研究課題名	ネパールのバラ県に住む既婚思春期女性の避妊具使用と妊娠に影響を与える要因：質的研究
審査結果	■承認する　□条件付きで承認する　□変更を勧告する　□承認しない □該当しない　□既承認事項の取り消し
審査事項 （審査資料）	＜新規案件＞ ■研究の新規実施 ＜継続案件＞ □研究に関する変更 □その他（　　）
審査区分	■委員会審査（審査日：西暦2019年06月03日） □迅速審査（審査日：西暦　　年　月　日）
指摘事項および理由・条件等	
備考	・利益相反アドバイザリー機関の判断を仰ぐこと

研究責任者　　神馬 征峰　殿

依頼のあった研究に関する審査事項について上記のとおり決定しましたので通知いたします。
倫理委員会での審査結果が承認となりましたので、研究の実施を許可いたします。

西暦　2019年06月07日

倫理委員会の設置者、実施機関の長
東京大学大学院医学系研究科・医学部長
齋藤　延人（公印省略）

Appendix 7. Ethical approval from the Nepal Health Research Council

Government of Nepal

Nepal Health Research Council (NHRC)

Estd. 1991

Ref. No.: 3001

15 May 2019

Mr. Kazutaka Sekine
Principal Investigator
University of Tokyo, Japan

Ref: **Approval of thesis proposal** entitled **Factors influencing contraceptive use and childbearing among adolescent girls in Bara district of Nepal: A qualitative study**

Dear Mr. Sekine,

It is my pleasure to inform you that the above-mentioned proposal submitted on **27 March 2019** (**Reg. no. 189/2019)** please use this Reg. No. during further correspondence) has been approved by Nepal Health Research Council (NHRC) Ethical Review Board on **17 April 2019**.

As per NHRC rules and regulations, the investigator has to strictly follow the protocol stipulated in the proposal. Any change in objective(s), problem statement, research question or hypothesis, methodology, implementation procedure, data management and budget that may be necessary in course of the implementation of the research proposal can only be made so and implemented after prior approval from this council. Thus, it is compulsory to submit the detail of such changes intended or desired with justification prior to actual change in the protocol. Expiration date of this proposal is **November 2019.**

If the researcher requires transfer of the bio samples to other countries, the investigator should apply to the NHRC for the permission. The researchers will not be allowed to ship any raw/crude human biomaterial outside the country; only extracted and amplified samples can be taken to labs outside of Nepal for further study, as per the protocol submitted and approved by the NHRC. The remaining samples of the lab should be destroyed as per standard operating procedure, the process documented, and the NHRC informed.

Further, the researchers are directed to strictly abide by the National Ethical Guidelines published by NHRC during the implementation of their project proposal and **submit progress report in between and full or summary report upon completion.**

As per your thesis proposal, the total research amount is **Rs 5,15,300** and accordingly the processing fee amounts to **Rs 20,000.** It is acknowledged that the above-mentioned processing fee has been received at NHRC.

If you have any questions, please contact the Ethical Review M & E Section at NHRC.

Thanking you,

Prof. Dr. Anjani Kumar Jha
Executive Chairperson

Cc:
Mr. Anand Tamang
Principal Investigator, CREHPA, Lalitpur

Tel: +977 1 4254220, Fax: +977 1 4262469, Ramshah Path, PO Box: 7626, Kathmandu, Nepal
Website: http://www.nhrc.gov.np, E-mail: nhrc@nhrc.gov.np

Appendix 8. Informed consent

Informed Consent Form for Participants

To: The Dean of Graduate School of Medicine, The University of Tokyo

Study Title: Factors influencing contraceptive use and childbearing among married adolescent girls in Bara district of Nepal: a qualitative study using the social-ecological model

Investigator: Professor Masamine Jimba, Department of Community and Global Health, the University of Tokyo; paper review

Joint Researcher: Anand Tamang, Director, Center for Research on Environment Health and Population Activities (Nepal), Data collection and analysis and paper review

After being explained using the information sheet, I fully understand what is expected of me if I participate in the study.

I understand:

1. the overview and procedure of the study
2. the consent of the in-depth interview
3. that I will not be placed under any harm
4. that I may refuse to answer any question
5. that I may withdraw from the study at any time without giving a reason
6. that I may withdraw from the study at any time (during or at the end of the interview) without any harm and without in any way affecting my access to health care
7. that I cannot withdraw from the study after the interview
8. that any information I provide will be strictly confidential and anonymous, and that my name will not appear in any report or publication about the study.

I agree that data collected from me may be used in future research, and agree to take part in the above study.

……	…….	…….
Name	Date	Signature or fingerprint

<u>In case of the proxy such as a parent or guardian:</u>

I declare that I have read the information sheet to the participant and he/she has agreed completely voluntarily to participate in the study.

……	…….	…….
Name of witness	Date	Signature of witness

Appendix 9. Information sheet for married adolescent girls

Information Sheet for Participants

Study Title: Factors influencing contraceptive use and childbearing among married adolescent girls in Bara district of Nepal: a qualitative study using the social-ecological model

Investigator: Professor Masamine Jimba, Department of Community and Global Health, the University of Tokyo; paper review

Joint Researcher: Anand Tamang, Director, Center for Research on Environment Health and Population Activities (Nepal), Data collection and analysis and paper review

Duration of data collection: May-June, 2019
Duration of research: up to 31 December 2023

The objective of this study is to identify multilevel factors influencing contraceptive use and childbearing in Nepal and to explore relationships of these factors. Qualitative analysis in the study is expected to offer insights into vulnerabilities that married adolescent girls face in using contraceptives and delaying childbearing, and into reproductive health policy and strategy aimed at preventing adolescent pregnancy.

Data collection will be conducted by well-trained and experienced Nepali research assistants in Nepali, the local language. Semi-structured, in-depth interviews will be carried out individually and face-to-face in a private space chosen by the participants at their preferred time. The interviews will last approximately one hour and digitally recorded. A transcription of your answer will be stored in a secured PC protected with a password and exclusively used for the purpose of this study. All information from this study will be confidential. We do not ask your name during the interview; therefore, the information will be strictly anonymous and your identity will not be revealed. Your name will not appear in any report or publication about the study. Each participant will receive NPR 500 as an honorarium for their time and travel.

Your participation in the study is completely voluntary. You may take time to seek approval for your participation from your husband if you feel it is necessary. During the interview, you may refuse to answer any question if you feel uncomfortable. You may withdraw from the study at any time without giving a reason. It will not affect your normal access to health care or other services. However, you cannot withdraw from the study after the interview as we will not record your personal information.

This study has been approved by Research Ethics Committee of the University of Tokyo, Japan, and the Nepal Health Research Council, Kathmandu. If you have any questions later, you are welcome to contact one of the researchers below.

18 March 2019

Anand Tamang
Director, Center for Research on Environment Health and Population Activities (CREHPA),
Ekantakuna Kushunti, Lalitpur, Nepal. TEL: 01-5193017; 01-5193087

Kazutaka Sekine
Department of Community and Global Health, Graduate School of Medicine, the University of Tokyo. Address: Medical Building No.3, 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-0033, Japan. Tel: 03(5841)3698. Email: email2kazu@gmail.com

Appendix 10. Information sheet for husbands, mothers-in-law, health workers, health coordinators, and FCHVs

Information Sheet for Participants

Study Title: Factors influencing contraceptive use and childbearing among married adolescent girls in Bara district of Nepal: a qualitative study using the social-ecological model

Investigator: Professor Masamine Jimba, Department of Community and Global Health, the University of Tokyo; paper review

Joint Researcher: Anand Tamang, Director, Center for Research on Environment Health and Population Activities (Nepal), Data collection and analysis and paper review

Duration of data collection: May-June, 2019
Duration of research: up to 31 December 2023

The objective of this study is to identify multilevel factors influencing contraceptive use and childbearing in Nepal and to explore relationships of these factors. Qualitative analysis in the study is expected to offer insights into vulnerabilities that married adolescent girls face in using contraceptives and delaying childbearing, and into reproductive health policy and strategy aimed at preventing adolescent pregnancy.

Data collection will be conducted by well-trained and experienced Nepali research assistants in Nepali, the local language. Semi-structured, in-depth interviews will be carried out individually and face-to-face in a private space chosen by the participants at their preferred time. The interviews will last approximately one hour and digitally recorded. A transcription of your answer will be stored in a secured PC protected with a password and exclusively used for the purpose of this study. All information from this study will be confidential. We do not ask your name during the interview; therefore, the information will be strictly anonymous and your identity will not be revealed. Your name will not appear in any report or publication about the study. Each participant will receive NPR 500 as an honorarium for their time and travel.

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18 March 2019

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Director, Center for Research on Environment Health and Population Activities (CREHPA),
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