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An Analysis of Fertility Determinants in Pakistan. "The Role of Education and Intimate Partner Violence."

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Appendix A

Introduction

The manuscript consists of three chapters. Each chapter has its own introduction, theoretical background, empirical background, data and methods, analysis, results, and discussion sections, emphasizing an analysis of fertility determinants in Pakistan and the role of education and intimate partner violence. Firstly, education has been an important factor influencing the outcome of fertility behavior; secondly, the effect of female education on fertility is examined by using changes in secondary and primary school law as the source of exogenous variations in schooling. Finally, the role of intimate partner violence increases the risk of high fertility behavior in Pakistan.

The initial chapter stems from the need to understand the association between women's education and fertility in Pakistan. Pakistan is one of those nations that have been facing the problem of high fertility and low levels of education. One of the important components is education, which affects the success of a nation. Backing this reason, we build the pillars of our research to concretize the evidence on the relationship between fertility and education. Although there is substantial research on the association between female education and fertility, researchers have yet to investigate this relationship in Pakistan. Our study fills this gap by investigating the link between female education and fertility in Pakistan. We investigate the case of Pakistan using the data from the recent wave of the Pakistan Demographic Health Survey (PDHS) micro-level information 2017–2018, which is the base of this study. All household members (usual residents) are covered by the survey; ever-married men and women aged 15–49 years are household residents. The study sample included 12,364 women, who were randomly selected from all of Pakistan’s provinces. Due to the nature of the response variable, children ever born, which is a count variable, Poisson regression was used. The results provide evidence that women with secondary and higher education have a negative and significant association with fertility. Women with secondary and higher education have fewer children compared to women with no education, while female education at the primary level did not significantly affect fertility in the research. Furthermore, the age of first cohabitation, age at first birth, and wealth index were revealed to be significant determinants of fertility. This chapter has been published in the Journal of Economies. Afreen, Khawar, Patrizia Ordine, and Giuseppe Rose. 2024. Association between Education and Fertility:

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The focal point of the second chapter revolves around the use of Pakistan's Article 25(A), an amendment of secondary and primary schooling law, as a source of exogenous variation in education to examine the causal effects of education on fertility in Pakistan and explain the mechanism through which education affects fertility. Previous research focused on a specific program called the Conditional Cash Assistance Program (CCAP) for secondary school girls in Punjab, Pakistan; this research focuses on national-level changes in secondary and primary school law that were implemented in different time periods in different regions of Pakistan. This policy change affected all individuals born on or after May 2014, February 2013, June 2013, and December 2012 in Punjab, Sindh, Balochistan, and the Islamabad region, respectively. Using cross-sectional data from August 1994 to December 2002, May 1992 to September 2002, September 1991 to January 2003, and August 1990 to February 2002 for Punjab, Sindh, Balochistan, and Islamabad, respectively. We compare the education and fertility of women born just before and right after April 1998, January 1997, May 1997, and November 1996 for Punjab, Sindh, Balochistan, and Islamabad, respectively. This study employs data from the Pakistan Demographic and Health Survey (PDHS) 2017-18. Applying the local randomization technique, we create a natural framework for analyzing a regression discontinuity design with a discrete running variable and few mass points. The findings show that there is a discontinuity in the running variable (women's year-month of birth) and outcome variable (total number of children ever born and women's age at first birth) at the cutoff point and indicate a clear jump in the observed values for all regions. As a result of national reform, increases in education do not reduce the number of children born per woman in Punjab and Balochistan, and the implementation of compulsory primary and secondary schools does not improve educational attainment in Sindh and Islamabad, while fertility decreases due to family planning practices. This chapter was presented at the conference “Gender Inequalities, Fertility, and the Future of Family Demography: Intersectionality in an Era of Family Complexity” at the Max Planck Institute for Demographic Research (MPIDR).

The final chapter aims to extend the literature about how intimate partner violence increases the risk of high fertility behavior in Pakistan. Domestic violence against women is a

major public health problem and an infringement of women's human rights. Domestic violence is typically defined as a partner's behavior that causes physical, sexual, or psychological harm, including physical aggressiveness, sexual assault, psychological assault, and controlling behaviors. Pakistan has a high fertility rate due to a number of contributing factors. Hence, this research examines whether women's exposure to domestic violence is a contributing factor to increased fertility in Pakistan. Therefore, the goal of this study is to examine a causal relationship between women's IPV and fertility and investigate whether this relationship explains Pakistan's continually high fertility rates. While there is substantial research on the association between intimate partner violence and fertility, there is no study that has examined the causal relationship between IPV and fertility. Furthermore, researchers have yet to investigate this issue in Pakistan. Our research fills this gap by looking into the complex and bidirectional relationship between intimate partner violence and fertility in Pakistan. We used data from the Pakistan Demographic Health Survey (PDHS) 2017-2018. A weighted sample of 3,416 currently married women in Pakistan was analyzed. The dependent variable is the total number of children ever born, which is the proxy of fertility, and the main explanatory variable is intimate partner violence (physical, emotional, and sexual). An instrumental variable Poisson generalized method of moments estimator was used in estimating the model. This helped us deal with the significant endogeneity among our primary variables of interest. The findings support the hypothesis that women who have experienced domestic violence have greater fertility rates compared to those who have not. The IV Poisson generalized method of moments analysis revealed a causal link between increased fertility and violence in Pakistan after controlling for background characteristics.

Chapter 1

Association between Education and Fertility: New Evidence from the Study in Pakistan

Abstract

Pakistan is one of those nations that is suffering from the complications of higher fertility and lower levels of education and struggling to improve these demographic factors. In any country, education is considered the reason to control fertility levels. To shed some light on the importance of this fact, educational attainment and total children ever born have been considered by taking micro-level data from the Pakistan Demographic Health Survey (PDHS) of 2017–2018 to examine the relationship of education with fertility for women. Due to the nature of the response variable, children ever born, which is a count variable, Poisson regression was used. The results provide evidence that women with secondary and higher education have a negative and significant association with fertility and thus support the hypothesis that educated women have lower fertility. Women with secondary and higher education have fewer children compared to women with no education, while female education at the primary level did not significantly affect fertility in the research. Furthermore, the age of first cohabitation, age at first birth, and wealth index were revealed to be significant determinants of fertility. It interprets that the increase in education is related to greater opportunities and facilitates the participation of women in other activities of the economy.

Keywords: Education, Fertility, Demographic Health Survey, Poisson Model, Pakistan.

1.1 Introduction

Education has been considered for many centuries to be the most important influence in shaping the attitudes and behaviors of both men and women. It has been recognized as an important factor influencing the behavior and outcomes of fertility (Barakat and Blossfeld, 2010; Shapiro and Gebreselassie, 2008). More specifically, female education significantly affects their reproductive health behaviors. Educated women exhibit unconventional reproductive behaviors, for example, delayed age at first marriage and first birth, and are likely to have fewer children than those without formal education (Bongaarts, 2010; Gayawan and Adebayo, 2013; Grant, 2015). Developing countries have adopted these strategies to promote female education as a means of combating high fertility rates. One of the key factors affecting

fertility is regarded as education. Studies have found various ways in which education influences fertility, both within and among countries. One important aspect is that when women receive education, it increases their income through better earnings, which helps them make informed choices about having children while considering the well-being of their families (Becker, 1960; Becker and Lewis, 1973; Mincer, 1963; Willis, 1973). In addition, education can increase an individual's consciousness of appropriate reproductive choices, healthy pregnancy practices, and other socioeconomic behavior (Grossman, 1972). Therefore, socioeconomic factors are crucial for accurate birth rate predictions as well as the research of fertility disparities in different regions and even in countries.

Considering the numerous connections between family behavior and education, this might significantly affect fertility (Bavel, 2012). In fact, according to the World Bank, "there is no investment more effective for achieving development goals than educating girls."

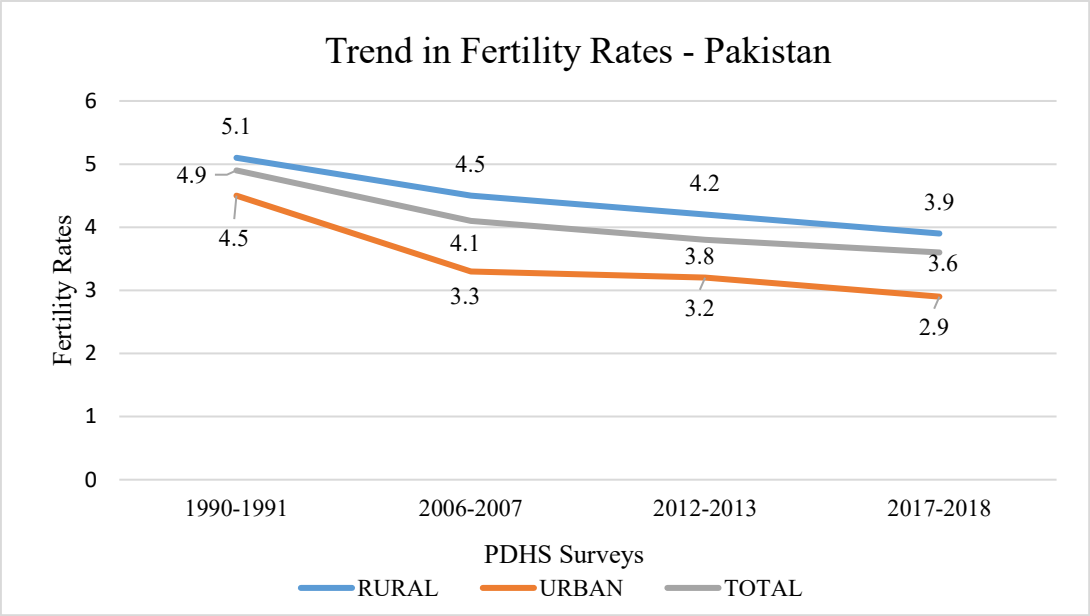
The Sustainable Development Goals (SDGs) were established by the United Nations (UN) in 2015 as an initiative to eradicate poverty and enhance well-being. The fourth of the seventeen Sustainable Development Goals (SDGs) is aimed at enabling all children to finish their primary and secondary education (UN DESA, 2016), and Goal 3 has given the shift in demographic factors like fertility and also has its own significance in other Sustainable Development Goals (SDGs) (O'Sullivan, 2013; Wietzke, 2020).

This paper investigates the relationship between fertility and education in Pakistan by analyzing the data taken from PDHS 2017–2018. Pakistan is one of the nations that has experienced rapid population expansion since its founding because of a high fertility rate that continued into the middle of the 1980s at more than six births per woman. In 1984–1985, the average number of children per woman fell to fewer than 6, and the first trend of declining fertility was seen (Government of Pakistan, 1987).

In 1985–1990, the total rate of fertility was 5.4 births per woman, which was reduced to 3.8 births per woman (PDHS, 2012–2013). The government of Pakistan has taken some initiatives to overcome the problem of higher fertility rates. During 2006–2007, the total fertility rate dropped to 4.1 births per woman, which was further dropped to 3.8 births per woman during 2013. According to PDHS (2017–2018), the fertility rate was found to be 3.6 births per woman. Between 2006 and 2013, the total fertility rate decreased significantly, with rural areas seeing a greater rate than urban regions: 0.3 births against 0.1 births. However, this pattern has

subsequently shifted in both urban and rural regions; there was a decrease of 0.3 births per woman between 2013 and 2018. Figure 1.1 provides a quick overview of the trend in fertility rate in Pakistan.

Figure 1.1: Trend in fertility rates by residence.

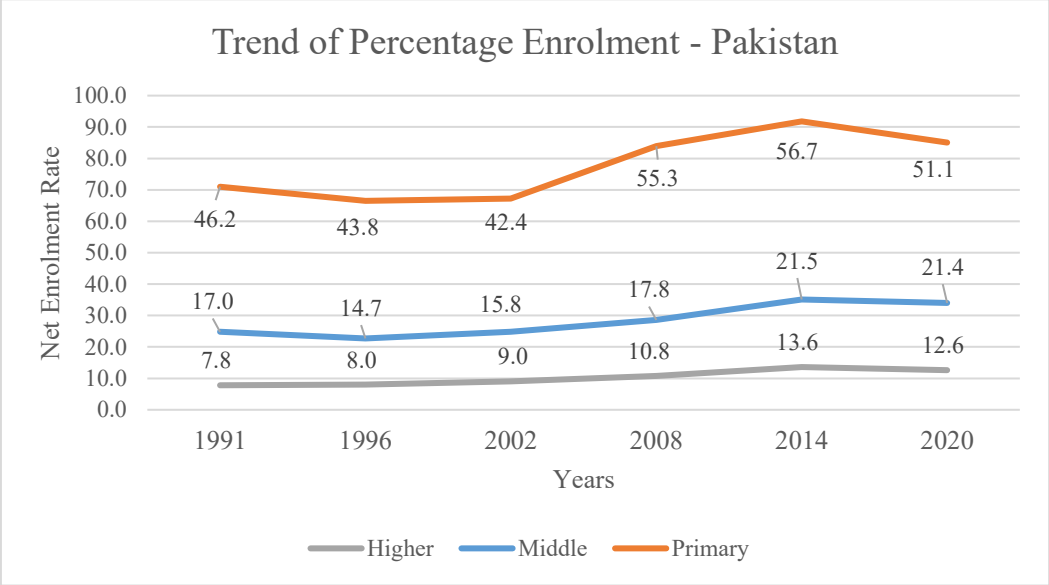


Source: Pakistan Demographic Health Survey (PDHS) 2017–2018.

Although considering education levels, it is also important to note that elementary, middle, and higher education enrollment trends indicate a steady rise. The net enrollment rate for elementary education in Pakistan fluctuated between 1991 and 2020, according to the data from the PSLMS survey. Figure 2 shows that enrollment in primary schools has been generally rising, reaching 56.7% before slightly declining. Enrollment in middle schools has steadily increased, achieving 21.5%. Furthermore, enrollment in higher education has been steadily increasing, reaching a peak of 13.6%.

These patterns show that Pakistan's educational system has generally become better over time, with more people participating and having access to education at different levels.

Figure 1.2: Trend of percentage enrolment—Pakistan.



Source: Pakistan Social and Living Standards Measurement Survey (PSLMS).

As per UNICEF, Pakistan is struggling to make sure that all children, especially the most underprivileged, attend, remain in, and gain knowledge in school. Although the enrollment rate is increasing as shown in Figure 1.2, Pakistan's educational metrics have been very slow and have not changed much. Pakistan is one of those nations that have been facing the problem of high fertility and low levels of education since its independence. Most of the families are left behind in acquiring the necessary needs of life. According to research on demographic factors, one of the important components is education that affects the success of a nation. Backed with this reason, we build the pillars of our research on concrete evidence on the relationship between fertility and education.

The importance of education was emphasized in several micro-level studies after breaking the ground by Cochrane (1979), who specifically explained the decline in fertility for females (Bongaarts, 2010; Kravdal, 2002; Martin, 1995). It is also highlighted, by neoclassical theories of fertility, that having more educated families results in a trade-off between child quantity and child quality (Becker, 1960; Becker and Lewis, 1973). As fertility research is strongly influenced by economic paradigms, education typically coincides with other indicators of development and income. According to the model of neoclassical economic predictions, with the increase in earlier income, women's fertility preference is negatively affected by their education (Becker, 1981a). Moreover, for old age support and economic gain, well-educated women barely rely on children (Mason, 1987). The remarkable proliferation of tertiary

education, along with the late marriages and planning to have children (Sobotka, 2004; Van de Kaa, 1987), and the appearance of unconventional family structures and trajectories (Elzinga and Liefbroer, 2007; Raab and Struffolino, 2020), gives rise to new inquiries concerning the association between fertility and education. One of the most persistent relationships in the social sciences shows a negative association between women's educational attainment and childbearing. This association has been observed in wealthy and developing countries in contexts with low and high fertility, in both rural and urban areas, and over the course of more than a century's worth of demographic data. However, there is less information on men's fertility and a negative association between education and fertility for males in many situations. The inverse relationship between education and fertility has received multiple interpretations, including the inconsistency of having children and attending school or the kind of occupation that more educated individuals are more likely to have, improved independence or effectiveness associated with education (particularly for women), and changing values and objectives as a consequence of education (Axinn and Barber, 2001; Basu, 2002; Musick et al., 2009). Individuals who choose to pursue higher education are probably already predisposed to having smaller families, which might account for some of the negative association between fertility and education (Brand and Davis, 2011). Increased educational attainment and greater involvement of women in the workforce are frequently cited as causes of fertility reduction in the later decades of the 20th century (Basu, 2002; Cleland, 2002; Liefbroer and Corijn, 1999).

To shed some light on this topic, we investigate the case of Pakistan using the data from the recent wave of the Pakistan Demographic Health Survey (PDHS) micro-level information 2017–2018, which is the base of this study. All household members (usual residents) are covered by the survey; ever-married men and women aged 15–49 years are household residents. The study sample included 12,364 women, who were randomly selected from all of Pakistan's provinces.

The purpose of this paper is to assess the association between education and fertility by considering the socioeconomic demographic factor in Pakistan. Although there is extensive literature on the relationship between female education and fertility, scholars have not yet explored this relationship in Pakistan. Our study fills this gap by investigating the relationship between female education and fertility in Pakistan.

The paper is organized as follows: Section 1.2 contains a review of the literature, Section 1.3 discusses methodology and data description, Section 1.4 presents our econometric strategy,

Section 1.5 discusses the results, Section 1.6 presents discussion and conclusion, and Section 1.7 presents recommendation and policy implication.

1.2 Review of Literature

There have been many studies from developed and developing countries that have investigated the relationship between female education and fertility.

1.2.1 Empirical Evidence for Developed Countries

In various developed countries, relationships about fertility reduction due to education have been observed in recent studies.

Jalovaara et al. (2019) investigated the Nordic countries' gender, education, and fertility cohort. Considering information from the harmonized register, the researchers compare total cohort fertility and utmost childlessness regarding gender and educational accomplishments for cohorts born in four Nordic countries at the beginning of 1940. At the initial level, the cohort fertility declined in four countries, but in the cohorts born in the 1950s and later, the stability or modest decline in cohort total fertility was observed. Women with the least education bear the highest childlessness in Sweden, Norway, and Denmark. Overall, the quantity of low-educated people has remarkably decreased over time. Nisén et al. (2021) deduced the association between educational differences in the fertility of cohorts in sub-national European regions. The research records the association between cohort fertility rate and educational level by exploiting a negative gradient. Requena (2022) investigated the educational gradient in fertility behavior. The result revealed that the negative gradient of education in fertility proceeded in Spain. Brzozowska et al. (2022) considered the era of the last half-century around the whole of Europe and non-European English-speaking countries. The research conveyed that the desire for one or two children decreased and a third birth increased; this bias was strongest due to less education in women. Lazzari et al. (2021) evaluated the association between educational attainment and the level of fertility by disintegrating the comprehensive change in fertility into education-specific fertility and composition of education for the birth cohort for the period of 1940–1970. This study revealed that some cohorts are significantly affected by educational frameworks despite variations, usually in fertility aptitude, that cause the reduction in fertility. The first- and second-birth transitional effect varies substantially, while the reduction in third- and higher-order births among all educational groups is the key essence of the decline of fertility. Colleran and Snopkowski (2018) analyzed 45 countries,

encountering variations in wealth and educational drivers of fertility decline. The research found that the relationship between fertility and education is negative.

Early research in developed countries finds that increased levels of female education have a significant role in the shift from high to low fertility, as well as in overall family and reproductive changes (Breton and Prioux, 2005; Hoem et al., 2006; Perelli-Harris et al., 2010). Other research in Europe has found an adverse relationship between fertility behavior (e.g., birth timing) and female education due to the high opportunity cost of childbirth among these women (Becker et al., 2011; Grönqvist and Hall, 2013).

1.2.2 Empirical Evidence for Developing Countries

The association between fertility reduction due to education in various developing countries has been observed in recent studies.

Utomo et al. (2021) investigated the importance of education and fertility relationships in Greater Jakarta. The findings revealed that the desired number of children gradient is slightly negative. A positive and significant association between education and the probability of bearing more than two children. Kebede et al. (2022) analyzed that higher levels of desired family size in rural areas of sub-Saharan Africa (SSA) are mostly due to lower education levels. Angko et al. (2022) analyzed how the fertility of Ghana is affected by education and child mortality. The result of the study revealed that education reduced fertility, while a high fertility rate was observed due to child mortality in Ghana. Furthermore, the results revealed that women experience lower fertility rates, which hold average higher education. Wusu and Isiugo-Abanihe (2019) investigated the constancy of the relationship between fertility and education over the demographic divide of north-south Nigeria. Analysis revealed that female education was consistently found to be adversely associated with fertility in both the north and south of Nigeria. Samari (2019) investigated the analysis based on the empowerment of women to disengage from the associations of education, fertility, and women's agency in Egypt. The study revealed an adverse relationship between education and fertility. Bora et al. (2022) analyzed the reason for decreasing fertility in Bangladesh and the respective significance of planned parenthood programs and women's education. Results indicate that women's education significantly reduces their desire for fertility, prevailing over all other effects. Sheikh and Loney (2018) examined the association between South Asian women's decisions about reproduction and education. South Asian females counter the negative association between

literacy levels and aggregate fertility rates. Alcaraz et al. (2022) examined the three different contexts of life beginning for the association between fertility and education aspirations. Results found that adolescents have an adverse relationship between their desire for education and fertility.

Early studies in Asia and the Middle East indicate that female education is crucial for reducing fertility rates. A Mongolian study found that female education significantly contributed to the reduction in fertility in about 2000 (Aassve and Altankhuyag, 2002). Martin (1995) found an adverse relationship between increasing female education and fertility in developing nations in Africa, Asia, and South America, but a positive relationship at lower levels of education in the less developed countries (LDCs). Güneş (2013) found an adverse association between completed elementary education and fertility and adolescent birth rates in Turkey. In Taiwan, maternal education was a more important factor in fertility than paternal education (Chen, 2016). Similar to the results for adult females in Europe, the study in Turkey found that female education had a detrimental association with adolescent fertility, leading to the postponement of marriage and childbirth.

Several studies in Africa have explored the association between female education and fertility rates. In the latter stages of the 1980s, Kritz and Gurak (1989) found that African countries with more gender equality in education witnessed lower fertility rates. According to Ainsworth et al. (1996), female education at the middle or higher level has an adverse association with fertility in all nations. However, primary-level female education has a favorable association in many countries (Ainsworth et al. 1996). In addition, female education has no significant association with the number of children born in Mali; however, it has a crucial role in fertility regulation in Cote d'Ivoire (Guillaume et al., 2002; Madhavan et al., 2003).

On the other hand, with a relative focus on Pakistan, there is no study that specifically focuses on the relationship between education and fertility.

1.3 Methodology

The aim of this paper is to analyze the association between education and fertility with consideration of socioeconomic and demographic factors. The relationship between fertility and education depends on the perspective of life course and on the concept that women's childbearing and additional life decisions are associated (Elder, 1998). As for women's time and resources, the demands are competing, and choices of women relying on such constraints,

with other life-course experiences, are made about children, like considering education. Educational attainment can lead to increased labor force participation as a childbearing competitive behavior (Martin, 2000). The risk of conception is directly affected little by socioeconomic variables, but subsequent employment and education raise the cost of fertility, which affects fertility outcomes directly (Balk, 1994; Mason, 1987).

The hypothesis under consideration regarding this study is to analyze the relationship between education and fertility, which is as follows:

H_0. Education encourages women to have less fertility.

H_1. Education does not encourage women to have less fertility.

1.3.1 Data Description

The recent wave of the Pakistan DHS micro-level information 2017–2018 is the base for this study. Household surveys are nationally represented by the Pakistan Demographic and Health Survey (PDHS), which equips data for monitoring a broad range of effect evaluation indicators in the perimeters of health, maternal, nutrition, and population. The ultimate source of information on social, behavioral, and demographic indicators, including the status of women and men, fertility, and the number of children desired, as well as many other problems, is included in the Pakistan Demographic Health Survey. To understand demographic and health indicators, fundamental information about women's and men's characteristics like marital status, age, literacy, education, employment, and wealth status is essential. All household members (usual residents) are covered by the survey; ever-married men and women aged 15–49 years are household residents. At the national level, the outcomes of the PDHS 2017–2018 are representative, separately for rural and urban areas. The sample size of the data for women is 12,364 in PDHS 2017–2018 and was randomly selected from Pakistan's four provinces: Sindh, Punjab, Balochistan, and Khyber Pakhtunkhwa (KPK), with other regions like Federally Administrated Tribal Areas (FATA) and the capital of the country, Islamabad Capital Territory (ICT). The PDHS for 2017–2018 used a two-stage stratified sample design. Gilgit Baltistan and Azad Jammu and Kashmir are not included in the table (PDHS 2017–2018). In the education system of Pakistan, primary education usually refers to classes 1–5, whereas secondary education refers to classes 6–10. Class 11 and above are referred to as higher education.

To analyze the fertility as affected by education, the educational attainment of married women by age group 15–49 of the household population is the primary explanatory variable classified into four categories: higher education, secondary education, primary education, and no education. Data were analyzed using univariate, bivariate, and multivariate methods. The univariate analysis established the percentage distribution of respondents based on women's education, age cohort (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49), husband/partner education (no education, primary, secondary, higher), region, wealth status, place of residence, age at first birth, and age at first cohabitation/marriage. The bivariate analysis assessed the relationship between the study's major explanatory variable (women's educational attainment) and the fertility indicator (Children Ever Born, CEB). The number of children ever born creates fertility history for the dependent variable. We utilized Poisson regression in the generalized linear model to create bivariate and multivariate models for the 2017–2018 surveys.

1.4 Analytical Technique

To conduct the analysis with the count variable (total children ever born), the statistical process of Poisson regression is used (Winkelmann and Zimmermann, 1995). The Poisson model outperforms the ordinary least squares model and other linear models for the distribution of count variables, like total children ever born (CEB), which is highly skewed with a long right tail.

1.4.1 Poisson Model

The Poisson distribution with probability function represents a true statistical model for counts data.

$$P\,(Y\ =\ y) =\ f\,(y) = \frac{exp\,(-\lambda)\lambda^{y}}{y!}, \lambda \in \mathrm{R}^{+}, y = 0, 1, 2, \ldots \qquad (1)$$

Where;

$$E(Y) = Var(Y) = \lambda \text{ (Equidispersion)} \qquad (2)$$

Settings can introduce observed heterogeneity as follows:

$$\lambda_i = exp(x_i\beta)\ i = 1, \ldots, n, \qquad (3)$$

Where the $(1 \times k)$ vector of non-stochastic covariates is x_i and a conformable vector of coefficients is β. The non-negativity of λ ensured by the exponential form of (3). Regression is established by both (2) and (3).

$$E(Y_i/x_i) = exp(x_i\beta) \quad (4)$$

Moreover, (1) and (3) together produce a completely specified parametric model. The range of the dependent variable is unrestricted, as the linear specification $E(Y_i/x_i) = \lambda_i = x_i\beta$ is a common choice. As is the case with variables that are normally distributed, the log-linear or multiplicative regression accounts naturally for the Poisson-distributed dependent variable non-negativity. The following shape has been taken by the log-linear model of a Poisson regression:

$$ln(\lambda(X) = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \ldots + \beta_nX_n \quad (5)$$

Here, the intercept term is α, the Poisson regression coefficients are β's, and an exponential function is λ of the independent variables, so that

$$\lambda = e(\alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \ldots + \beta_nX) \quad (6)$$

The coefficient of regression, known as the incidence rate ratio (IRR), can also be represented as Exp(β). The multiplicative effect represented by the IRR, like a unit increase in X, directs to increase the dependent variable mean by the exp(β) factor.

1.4.2 Research Model

In this study, a model from Kebede et al. (2022) and Wusu and Isiugo-Abanihe (2019) has been taken. To verify the hypotheses, we adopt the following model to investigate the association between education and fertility:

$$CEB_i = \alpha + \beta_1WE_1 + \beta_2Age_2 + \beta_3RE_3 + \beta_4WI_4 + \beta_5PR_5 + \beta_6HE_6 + \beta_7AFB_7 + \beta_8AFC_8 + \mu i \quad (7)$$

Where *CEB*, *WE*, *Age*, *RE, WI, PR, HE, AFB*, and *AFC* indicate the total children ever born, women's educational attainment, age in 5-year groups (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49), region, wealth index, place of residence, husband's educational attainment, age at first birth, and age at first cohabitation/marriage correspondingly, and the error term is μ_i. The significant fertility predictors that are confounding variables, such as wealth index, place of residence, age in five-year groups, region, husband education, age at first birth, and

age at first cohabitation reported in the literature, were also a part of the model of multivariate Poisson regression (Angko et al., 2022; Gayawan and Adebayo, 2013; Shapiro and Gebreselassie, 2008; Wusu and Isiugo-Abanihe, 2019). The models incorporated factors to compensate for differential effects and isolate the effect of female education on fertility.

1.5 Results

A two-step processing approach has been used on the data. In the first step, univariate analysis provides the socioeconomic and demographic characteristic profiles of the survey respondents. The econometric findings using the Poisson model present the impact on the outcome variable by fertility decisions in the second step.

1.5.1 Descriptive Analysis

Table 1.1 shows the comprehensive background of the demographic characteristics of all variables for women. Approximately 49.18, 16.47, 21.21, and 13.14 percent of women have no education, primary education, secondary education, or higher education, respectively. However, the ratio of no education to secondary education is higher than that of primary and higher education. The percentage distribution of women among the age groups 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49 is 4.85, 15.28, 20.61, 19.52, 17.49, 11.62, and 10.64 percent, respectively. Similarly, the proportion of the respondents in the 20–49 age group is higher than that of the 15–19 age group. The percentages of women living in Punjab, Sindh, KPK, Balochistan, and ICT are 53.62, 23.05, 15.37, 5.19, 0.87, and 1.89, respectively. Most of the respondents reside in Punjab. The statistics also reveal that 18.26, 19.65, 20.25, 20.98, and 20.86 percent of the women fall under the wealth index of poorest, poorer, middle, richer, and richest, respectively. The percentage distribution for the poorest, poorer, middle, richer, and richest is almost identical. The data also shows that 63.20% of the women live in rural regions; on the other hand, 36.80% live in urban areas. According to the survey data, 47.96% of women are below 21 years of age at first birth, while 52.04% of women are above 20 years of age at first birth. In summary, fewer women had their first birth at age 21 or older compared to those who had their first birth at age 20 or younger. The percentage distribution of respondents in the 15–20 age range is less than the percentage distribution of those in the 21–49 age range. The percentage distribution of age at first cohabitation/marriage below 15 years is 8.43, 15–19 years is 48.03, and above 19 years is 43.55 percent. Furthermore, the majority of the women married after the age of 15.

1.5.2 Estimates from Econometric Analysis

Table 1.2 shows unadjusted Poisson regression coefficients of women's educational attainment with total children ever born at the national level. Women with secondary education reported lower CEB relative to those with primary education. Similarly, women with higher education reported lower CEB relative to those with secondary education.

1.5.3 Results for Econometric Analysis

Table 1.3 shows adjusted Poisson regression coefficients of women's education attainment on total children ever born after adjusting for confounding variables in Pakistan 2017–2018 at the national level. The adjusted association between women's educational attainment and children ever born (CEB) shows that women's educational attainment with secondary education ($p < 0.01$) and higher education ($p < 0.01$) is significant and negatively associated with CEB. While primary education is not significant with CEB. No education is a reference category in the regression. The coefficient value of ever-married women's educational attainment suggests that women with secondary education reported a 6.5% lower CEB, while those with higher education reported a 10.4% lower CEB. The pattern shows that women with secondary and higher education have a larger negative effect on fertility. The fertility rate drops as the level of education increases, with higher education exhibiting the greatest decline in fertility. Results provide a clear understanding that increasing education has a definite and strong adverse effect on childbearing for women.

Also, the confounding factors considered, age in the 5-year group ($p < 0.01$) reported a positive and significant association with CEB. The Balochistan region reported a positive association, while Sindh and ICT reported a negative association with CEB. Women living in Sindh and ICT reported 3.5% and 4% lower CEB, respectively, while women living in Balochistan reported 6.3% higher CEB. The wealth index ($p < 0.01$) reported a significant negative relationship with CEB. Similarly, the adjusted association between husband's educational attainment and children ever born shows that primary education has a positive association, while secondary education has a negative association with CEB. No education is a reference category in the regression. The findings also suggest that fertility declines with household wealth. Furthermore, the age at first cohabitation/marriage and age at first birth have a significant inverse relationship with CEB ($p < 0.01$).

1.6 Discussion and Conclusion

This study adds substantially to the literature of existing research by recognizing the relation of education with fertility. The results propose strong evidence that fertility is significant and inversely affected by women's education. The results from both unadjusted and adjusted regression models support this affirmation. The hypothesis holds up the association of education with a lower number of births. This fact also confirms the result that education is inclined towards fewer children. According to the study findings, secondary or higher education has a more substantial negative impact on fertility compared to no education. While female education at the primary level did not significantly reduce fertility in the research. Research suggests that women with secondary or higher education have fewer children compared to those with no education. The results are also consistent and predictable with the literature that reveals that educated women possess lower fertility (Angko et al., 2022; Bora et al., 2022; Lazzari et al., 2021; Requena, 2022; Samari, 2019; Sheikh and Loney, 2018; Wusu and Isiugo-Abanihe, 2019). Previous studies have shown that female education affects fertility globally by delaying marriage (Bongaarts, 2010; Martin, 1995). Furthermore, the evidence shows that age at first cohabitation/marriage, age at first birth, and wealth index are significant predictors of fertility in the country. This implies that as household wealth rises, they will desire fewer children, and women who married later in life reported having fewer children, which is in line with the literature (Angko et al., 2022; Wusu and Isiugo-Abanihe, 2019).

The fertility neoclassical theory based on the quality–quantity framework by Becker (1981b) supports the results, and Becker and Lewis (1973) would lead to fertility reduction by years of increase in women's education. They interpret that years of increase in education are related to greater opportunities and facilitate the participation of women in other activities of the economy; thus, they prioritize the quality of children over the quantity of children by favoring fewer children. Our findings highlight the essential relationship between reproduction patterns, education, and overall socioeconomic advancement. To promote a future workforce that is healthier, better educated, and economically resilient, it is critical to acknowledge the importance of investing in women's education. Resolving the association of education with fertility can result in a population that is healthier and better educated, increased competitiveness in the global economy, and general socioeconomic advancement for a nation.

1.7 Recommendation and Policy Implications

Based on the study's empirical data, we propose that greater efforts are required to educate women in general. However, secondary school education standards for women in Pakistan are insufficient to address the enduring issue of overcarriage. Since the government's actions alone are insufficient, public–private cooperation might assist in achieving this. A proactive approach toward reducing fertility would be for the government to implement sufficient policies to expand free and compulsory education for primary and secondary levels. In addition, to achieve sustained fertility drops in Pakistan, policy should prioritize improving female education and addressing physical, social, environmental, and cultural elements that influence marriage age.

From these findings, several policy implications can be drawn. Some of the important implications are parental commitment to the well-being and academic achievement of their kids. This could be encouraged by government schemes that motivate parents to have fewer kids, like expanding the use of contraception. It is suggested that policymakers must create more initiatives that concentrate on education, including a special focus on educating women through greater understanding and educational possibilities. Governments and administrators of programs should concentrate on the societal, ecological, physical in nature, and cultural elements that affect the survival of children and the age of marriage as primary goals, which are important contributors to the ongoing fall in fertility. Enhancing reproductive wellness appears to be significantly impacted by empowering females by increasing education levels. As a result, it could assist in closing the gender disparity along with improving female responsibilities and social standing, including general well-being in the community.

Table 1.1 Percentage distribution of women aged 15–49 by selected characteristics from the Pakistan 2017–2018 PDHS.

Variables	Frequency	Percent
Women's education attainment		
No education	6080	49.18
Primary education	2037	16.47
Secondary education	2623	21.21
Higher education	1624	13.14
Women age cohorts		
15–19	600	4.85
20–24	1889	15.28
25–29	2548	20.61
30–34	2413	19.52
35–39	2162	17.49
40–44	1437	11.62
45–49	1315	10.64
Husband/ Partner Education		
No education	3480	29.42
Primary	1840	15.56
Secondary	4165	35.21
Higher	2310	19.53
Region		
Punjab	6630	53.62
Sindh	2850	23.05
KPK	1901	15.37
Balochistan	642	5.19
ICT	107	0.87
FATA	234	1.89
Wealth status		
Poorest	2257	18.26
Poorer	2430	19.65
Middle	2504	20.25
Richer	2594	20.98
Richest	2579	20.86
Place of residence		
Urban	4550	36.80
Rural	7814	63.20
Age at first birth		
≤20	5133	47.96
≥21	5569	52.04
Age at first cohabitation/marriage		
≤14	1042	8.43
15–19	5938	48.03
≥20	5384	43.55
Total	12,364	100

Table 1.2 Unadjusted Poisson regression estimates (with 95% CI) of the effects of women's education on children ever born (CEB).

CEB	IRR	St. Err.	t-value	*p*-value	(95% Conf Interval)		Significance
Education attainment of women							
Primary	0.805	0.02	−8.66	0	0.766	0.845	***
Secondary	0.641	0.015	−19.31	0	0.613	0.671	***
Higher	0.543	0.015	−22.76	0	0.515	0.572	***
Constant	3.971	0.046	120.20	0	3.883	4.061	***

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 1.3 Adjusted Poisson regression estimates (95% CI) of the association between women's education and total children ever born by selected characteristics of women aged 15–49 from the Pakistan 2017–2018 PDHS.

CEB	IRR	St. Err.	t-value	*p*-value	(95% Conf Interval)		Significance
Women's education attainment							
Primary	0.974	0.016	−1.59	0.111	0.944	1.006	
Secondary	0.935	0.016	−4.04	0	0.905	0.966	***
Higher	0.896	0.02	−4.89	0	0.858	0.937	***
Age in 5-year groups							
20–24	1.696	0.054	16.74	0	1.594	1.804	***
25–29	2.621	0.09	28.05	0	2.45	2.803	***
30–34	3.471	0.142	30.43	0	3.204	3.761	***
35–39	3.814	0.191	26.76	0	3.458	4.207	***
40–44	4.087	0.249	23.09	0	3.627	4.606	***
45–49	4.151	0.295	20.01	0	3.61	4.771	***
Region							
Sindh	0.965	0.013	−2.63	0.008	0.939	0.991	***
KPK	1.008	0.014	0.56	0.575	0.98	1.036	
Balochistan	1.063	0.021	3.17	0.002	1.024	1.104	***
ICT	0.96	0.017	−2.26	0.024	0.926	.995	**
FATA	1.017	0.019	0.90	0.368	0.98	1.056	
Wealth index							
Poorer	0.94	0.015	−3.75	0	0.911	0.971	***
Middle	0.922	0.016	−4.61	0	0.89	0.954	***
Richer	0.844	0.017	−8.30	0	0.811	0.879	***
Richest	0.802	0.019	−9.23	0	0.765	0.841	***
Place of residence							
Rural	1.023	0.014	1.75	0.081	0.997	1.05	*

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 1.3 Adjusted Poisson regression estimates 95% CI of the association between women's education and total children ever born by selected characteristics of women aged 15–49 from the Pakistan 2017–2018 PDHS (Continued).

CEB	IRR	St. Err.	t-value	*p*-value	(95% Conf Interval)		Significance
Husband/partner's education attainment							
Primary	1.032	0.016	2.01	0.045	1.001	1.065	**
Secondary	0.959	0.013	−3.00	0.003	0.933	0.986	***
Higher	0.999	0.018	−0.04	0.967	0.965	1.035	
Age at first birth	0.955	0.002	−20.36	0	0.95	0.959	***
Age at first cohabitation/marriage (years)	0.985	0.002	−6.82	0	0.981	0.989	***
Constant	6.092	2.722	7.11	0	9.604	3.865	***

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.*

1.8 Bibliography

Aassve, A., & Altankhuyag, G. (2002). Changing patterns of Mongolian fertility at a time of social and economic transition. *Studies in Family Planning*, *33*(2), 165–172. https://doi.org/10.1111/j.1728-4465.2002.00165.x

Ainsworth, M., Beegle, K., & Nyamete, A. (1996). The impact of women's schooling on fertility and contraceptive use: A study of fourteen Sub-Saharan African countries. *World Bank Economic Review*, *10*(1), 85–122. https://doi.org/10.1093/wber/10.1.85

Alcaraz, M., Hayford, S. R., & Glick, J. E. (2022). Desired fertility and educational aspirations: Adolescent goals in rapidly changing social contexts. *Journal of Marriage and Family*, *84*(1), 7–31. https://doi.org/10.1111/jomf.12815

Ali, F. R. M., & Gurmu, S. (2018). The impact of female education on fertility: a natural experiment from Egypt. *Review of Economics of the Household*, *16*(3), 681–712. https://doi.org/10.1007/s11150-016-9357-6

Angko, W., Arthur, E., & Yussif, H. M. (2022). Fertility among women in Ghana: Do child mortality and education matter? *Scientific African*, *16*, e01142. https://doi.org/10.1016/j.sciaf.2022.e01142

Axinn, W. G., & Barber, J. S. (2001). Mass education and fertility transition. *American Sociological Review*, *66*(4), 481–505. https://www.jstor.org/stable/3088919

Balk, D. (1994). Individual and community aspects of women's status and fertility in rural Bangladesh. *Population Studies*, *48*(1), 21–45. https://doi.org/10.1080/0032472031000147456

Barakat, B., & Blossfeld, H. P. (2010). The search for a demography of education: Some thoughts. *Vienna Yearbook of Population Research*, *8*, 1–8.

Basu, A. M. (2002). Why does education lead to lower fertility? A critical review of some of the possibilities. *World Development*, *30*(10), 1779–1790.

Bavel, J. Van. (2012). The reversal of gender inequality in education, union formation and fertility in Europe. *Vienna Yearbook of Population Research*, *10*, 127–154. https://doi.org/10.1553/populationyearbook2012s127

Becker, G. S. (1960). An economic analysis of fertility. In *Demographic and economic change*

in developed countries. colambia university press.

Becker, G. S. (1981a). A Treatise on the family. *Cambridge, MA: Harvard University Press*.

Becker, G. S. (1981b). Altruism in the family and selfishness in the market place. *Economica*, *48*(189), 1–15.

Becker, G. S., & Lewis, H. G. (1973). Interaction between quantity and quality of children. *J.Piolit.Econ*, 81–90.

Becker, S. O., Cinnirella, F., & Woessmann, L. (2011). Does Parental Education Affect Fertility? Evidence from Pre-Demographic Transition Prussia. *Economics of Education, University of Munich, and Leibniz Institute for Economic Research*.

Bongaarts, J. (2010). The causes of educational differences in fertility in Sub-Saharan Africa. *Vienna Yearbook of Population Research*, *8*, 31–50.

Bora, J. K., Saikia, N., Kebede, E. B., & Lutz, W. (2022). Revisiting the causes of fertility decline in Bangladesh: the relative importance of female education and family planning programs. *Asian Population Studies*, *19*(1), 81–104. https://doi.org/10.1080/17441730.2022.2028253

Brand, J. E., & Davis, D. (2011). The Impact of college education on fertility: Evidence for heterogeneous effects. *Demography*, *48*(3), 863–887.

Breton, D., & Prioux, F. (2005). Two children or three? Influence of family policy and sociodemographic factor. *Population*, *60*(4), 415–446. https://doi.org/10.2307/4148181

Brzozowska, Z., Beaujouan, E., & Zeman, K. (2022). Is two still best? change in parity-specifc fertility across education in low-fertility countries. *Population Research and Policy Review*, *41*(5), 2085–2114. https://doi.org/10.1007/s11113-022-09716-4

Chen, I. C. (2016). Parental Education and Fertility: An Empirical Investigation Based on Evidence from Taiwan. *Journal of Family and Economic Issues*, *37*(2), 272–284. https://doi.org/10.1007/s10834-015-9448-1

Cleland, J. (2002). Education and future fertility trends, with special reference to mid-transitional countries. *Population Bulletin of the United Nations, Special Issue: Completing the*

Fertility Transition, 183–194.

Cochrane. (1979). Fertility and Education: what Do We Really Know? In *Susan Hill*.

Colleran, H., & Snopkowski, K. (2018). Variation in wealth and educational drivers of fertility decline across 45 countries. *Population Ecology*, *60*, 155–169. http://dx.doi.org/10.1007/s10144-018-0626-5

Desa, U. N. (2016). Transforming our world: The 2030 agenda for sustainable development. *United Nations*.

Elder, G. H. (1998). The life course as developmental theory. *Child Development*, *69*(1), 1–12.

Elzinga, C. H., & Liefbroer, A. C. (2007). De-standardization of family-life trajectories of young adults: A cross-national comparison using sequence analysis. *European Journal of Population*, *23*, 225–250.

Gayawan, E., & Adebayo, S. B. (2013). A Bayesian semiparametric multilevel survival modelling of age at first birth in Nigeria. *Demographic Research*, *28*(June), 1339–1372. https://doi.org/10.4054/DemRes.2013.28.45

Government of Pakistan. (1987). Pakistan Contraceptive Prevalence Survey. *Population Welfare Division, Ministry of Planning and Development, Islamabad, Pakistan.*

Grant, M. J. (2015). The Demographic Promise of Expanded Female Education: Trends in the Age at First Birth in Malawi. *Population and Development Review*, *41*(3), 409–438. https://doi.org/10.1111/j.1728-4457.2015.00066.x

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy*, *80*(2), 223–255.

Guillaume, A., Desgrées, A., Guillaume, B., & Guillaume, A. (2002). Fertility regulation among women in Abijan, Cote d'lvoire: contraception, abortion or both. *International Family Planning Perspectives*, *28*(3), 159–166.

Güneş, P. M. (2013). The Impact of Female Education on Fertility: Evidence from Turkey. Grand Challenges Canada Economic Returns to Mitigating Early Life Risks Project,. *University of Pennsylvania Population Studies Centre.* url:

http://repository.upenn.edu/gcc_economic_returns/%0A1

Hoem, J. M., Neyer, G., & Andersson, G. (2006). Educational attainment and ultimate fertility among Swedish women born in 1955-59. *Demographic Research*, *14*(June), 381–404. https://doi.org/10.4054/DemRes.2006.14.16

Jalovaara, M., Neyer, G., Andersson, G., Dahlberg, J., Dommermuth, L., Fallesen, P., & Lappegård, T. (2019). Education, gender, and cohort fertility in the Nordic countries. *European Journal of Population*, *35*, 563–586. https://doi.org/10.1007/s10680-018-9492-2

Jar, A., Aung, R., & Wong, C. Y. (2020). *Mortality : Evidence from the free secondary education policy in the Philippines*. 0–25.

Kattan, Bentaouet;, R., & Burnett, N. (2004). Education For All Working Paper No. 30108, Education Sector, Human Development Network. *World Bank,Washington, DC.*

Kebede, E., Striessnig, E., & Goujon, A. (2022). The relative importance of women's education on fertility desires in sub-Saharan Africa: A multilevel analysis. *Population Studies*, *76*(1), 137–156. https://doi.org/10.1080/00324728.2021.1892170

Kravdal, Ø. (2002). Education and fertility in sub-Saharan Africa: Individual and community effects. *Demography*, *39*(2), 233–250. https://doi.org/10.1353/dem.2002. 0017

Kritz, M. M., & Gurak, D. T. (1989). Women's status, education and family formation in Sub-Saharan Africa. *International Family Planning Perspectives*, *15*(3), 100–105.

Lazzari, E., Mogi, R., & Canudas-Romo, V. (2021). Educational composition and parity contribution to completed cohort fertility change in low-fertility settings. *Population Studies*, *75*(2), 153–167. https://doi.org/10.1080/00324728.2021.1895291

Liefbroer, A. C., & Corijn, M. (1999). Who, what, where, and when? Specifying the impact of educational attainment and labour force participation on family formation. *European Journal of Population*, *15*, 45–75. https://doi.org/10.1023/A:1006137104191

Madhavan, S., Adams, A., & Simon, D. (2003). Women ' s Networks and the Social World of Fertility Behavior Women ' s Networks and the Social Of Fertility Behavior. *International Family Planning Perspectives*, *29*(2), 58–68.

Martin, S. P. (2000). Diverging Fertility among U . S . Women Who Delay Childbearing Past Age 30. *Demography*, *37*(4), 523–533. https://www.jstor.org/stable/2648078

Martin, T. C. (1995). Women's education and fertility: results from 26 demographic and health surveys. *Studies in Family Planning*, *26*(4), 187–202. https://doi.org/10.2307/2137845

Mason, K. O. (1987). The Impact of Women' s Social Position on Fertility in Developing Countries. *Socioogical Forum*, *2*(4), 718–745. https://doi.org/https://doi.org/10.1007/BF01124382

Mincer, J. (1963). Market prices, opportunity costs, and income effects. *Measurement in Economics*, 67–82.

Musick, K., England, P., Edgington, S., & Kangas, N. (2009). Education differences in intended and unintended fertility. *Social Forces*, *88*(2), 543–572.

Nisén, J., Klüsener, S., Dahlberg, J., Dommermuth, L., Jasilioniene, A., Kreyenfeld, M., Lappegård, T., Li, P., Martikainen, P., Neels, K., Riederer, B., te Riele, S., Szabó, L., Trimarchi, A., Viciana, F., Wilson, B., & Myrskylä, M. (2021). Educational differences in cohort fertility across Sub-national regions in Europe. *European Journal of Population*, *37*, 263–295. https://doi.org/10.1007/s10680-020-09562-0

O'Sullivan, J. N. (2013). Revisiting demographic transition: correlation and causation in the rate of development and fertility decline. *27th IUSSP International Population Conference*, 22.

Pakistan Demographic and Health Survey. (2012). *Islamabad, Pakistan: National Institute of Population Studies and Macro International Inc.*

Pakistan Demographic and Health Survey. (2017). *Islamabad, Pakistan: National Institute of Population Studies and Macro International Inc.*

Perelli-Harris, B., Sigle-Rushton, W., Kreyenfeld, M., Lappegård, T., Keizer, R., & Berghammer, C. (2010). The educational gradient of childbearing within cohabitation in Europe. *Population and Development Review*, *36*(4), 775–801. https://doi.org/10.1111/j.1728-4457.2010.00357.x

Raab, M., & Struffolino, E. (2020). The heterogeneity of partnership trajectories to childlessness in Germany. *European Journal of Population*, *36*, 53–70.

https://doi.org/10.1007/s10680-019-09519-y

Requena, M. (2022). Spain's persistent negative educational gradient in fertility. *European Journal of Population*, *38*(1), 1–13. https://doi.org/10.1007/s10680-021-09599-9

Samari, G. (2019). Education and fertility in Egypt: Mediation by women's empowerment. *SSM - Population Health*, *9*, 100488. https://doi.org/10.1016/j.ssmph.2019.100488

Shapiro, D., & Gebreselassie, T. (2008). Fertility transition in sub-Saharan Africa: Falling and stalling. *African Population Studies*, *23*(1). http://aps.journals.ac.za/pub/article/view/310/276

Sheikh, S. M., & Loney, T. (2018). Is educating girls the best investment for South Asia? Association between female education and fertility choices in South Asia: A systematic review of the Literature. *Frontiers in Public Health*, *6*, 172. https://doi.org/10.3389/fpubh.2018.00172

Sobotka, T. (2004). Is lowest-low fertility in Europe explained by the postponement of childbearing? *Population and Development Review*, *30*, 195–220.

Utomo, A., McDonald, P., Utomo, I., & Hull, T. (2021). Do individuals with higher education prefer smaller families? Education, fertility preference and the Value of children in Greater Jakarta. *Child Indicators Research*, *14*, 139–161. https://doi.org/10.1007/s12187-020-09752-6

Van de Kaa, D. J. (1987). Europe's second demographic transition. *Population Bulletin*, *42*(1).

Wietzke, F. B. (2020). Poverty, inequality, and fertility: The contribution of demographic change to global poverty reduction. *Population and Development Review*, *46*(1), 65–99. https://doi.org/10.1111/padr.12317

Willis, R. J. (1973). A new approach to the economic theory of fertility behavior. *Journal of Political Economy*, *81*(2), S65–S69.

Winkelmann, R., & Zimmermann, K. F. (1995). Recent Developments in Count Data Modelling: Theory and Application. *Journal of Economic Surveys*, *9*(1), 1–24. https://doi.org/10.1111/j.1467-6419.1995.tb00108.x

Wusu, O., & Isiugo-Abanihe, U. C. (2019). Consistency of the effects of female education on fertility across the north-south demographic divide in Nigeria, 2003-2013. *Journal of Biosocial Science*, *51*(1), 138–153. https://doi.org/10.1017/S0021932018000111

Chapter 2

The Causal Effect of Education on Fertility: A Local Randomization Regression Discontinuity Approach

Abstract

This research gives new evidence on the effect of female education on fertility in Pakistan, focusing on changes in secondary and primary school law as the source of exogenous variations in education. This policy change affected all individuals born on or after May 2014, February 2013, June 2013, and December 2012 in Punjab, Sindh, Balochistan, and the Islamabad region, respectively. This study employs data from the Pakistan Demographic and Health Survey (PDHS) 2017-18. Applying the local randomization technique, we create a natural framework for analyzing a regression discontinuity design with a discrete running variable and few mass points. Our findings show that there is a discontinuity in outcome variable (total number of children ever born and women's age at first birth) at the cutoff point and indicate a clear jump in the observed values for all regions. As a result of national level reforms, increases in education do not reduce the number of children born per woman in Punjab and Balochistan, and the adoption of compulsory primary and secondary schools does not increase educational attainment while fertility decreases due to family planning practices in Sindh and Islamabad. Due to the limitation of data availability, we were unable to see the role of delayed marriage as a mechanism to explain the effect of education on fertility reduction in all regions.

Keywords: Female Education, Fertility, Regression Discontinuity, Local Randomization, Demographic Health Survey, Pakistan.

2.1 Introduction

Universal elementary education is one of the main objectives of the Sustainable Development Goals and has grown to be an essential component of global development initiatives. The easiest governmental instrument to encourage enrollment has been the elimination of school fees since the 1970s. During 2000, many countries eliminated school fees, demonstrating the vigorous pursuit of this policy by international development agencies as an essential tool in accomplishing the objective of universal primary education (Kattan et al., 2004; World Bank, 2009). Recent decades have seen an increased number of fee removal schemes, which emphasizes the significance of better comprehending the effects of these changes. However, the International Initiative for Impact Evaluation (3ie) found in the latest systematic study

(Snilstveit et al., 2016) that there is little information available about the long-term effects of lowering school fees.

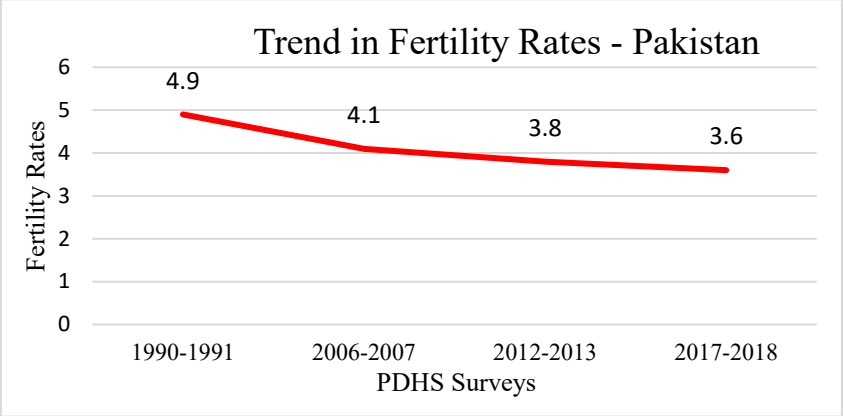
Particularly for women, higher levels of education are linked to decreased fertility, an increase in the labor force of women, more negotiating power within the household, and higher levels of education for children (Attanasio and Kaufmann, 2017; Black et al., 2008; Keats, 2018; Lam and Duryea, 1999; Mccrary and Royer, 2011; Osili and Long, 2008). Increasing education is one of the frequently discussed aspects contributing to low fertility.

Neoclassical economic fertility models imply a trade-off between the quantity and quality of children as a result of higher levels of education among women (Becker, 1960; Becker and Lewis, 1973). Empirically, it is widely recognized that higher levels of education among women are associated with reduced fertility and betterment of human capital and child health. Cochrane (1979), Strauss and Thomas (1995), and Grossman (2006) establish a foundation to emphasize women's education in developing countries as a way to accomplish a variety of societal goals. In fact, according to the World Bank, “There is no investment more effective for achieving development goals than educating girls.” Moreover, even though the reduction in fertility rates has been caused by a surge in female education. Previous studies have demonstrated a strong inverse relationship between women's fertility and educational attainment (Björklund, 2006). However, it is challenging to demonstrate a causal relationship due to potential reverse causality and selection for unobservable factors. After taking into consideration the endogeneity of education, more recent research for many developed nations shows that the correlation between education and fertility either disappears or even turns positive (Fort et al., 2021; Mccrary and Royer, 2011; Monstad et al., 2008). Nevertheless, various countries have different and inconsistent evidence about the impact of education on fertility.

Pakistan is one of the nations that has experienced rapid population expansion since its founding because of a high fertility rate that continued into the middle of the 1980s at more than 6 births per woman. In 1984–85, when the average number of children per woman fell down to 6, the first trend of declining fertility was seen (Government of Pakistan, 1987). Around 1985–90, the total rate of fertility was 5.4 births per woman, which was much higher as compared to neighboring countries. The government of Pakistan has taken several initiatives and launched different programs to control this issue, and as a result, the total fertility rate dropped to 3.8 births per woman (PDHS, 2012–13). According to PDHS (2017–18), the

fertility rate was found to be 3.6 births per woman. Figure 2.1 provides a quick overview of the trend in the fertility rate of Pakistan.

Figure 2.1: Trend in fertility rates by residence.



Source: Pakistan Demographic Health Survey (PDHS) 2017-18.

Education is supposed to be the key element that helps nations build human capital by reducing the rate of fertility and benefiting from the demographic dividend to achieve economic prosperity. But the question arises, how to get a sufficient level of education to accelerate fertility decline? This is an open challenge for underdeveloped and least developed countries. According to the information provided by the International Development Organization, several developing nations are still lacking in the field of education. Pakistan is the second-largest country facing this problem. Although the government is designing such policies that support reducing this number, the point is how effectively these policies or reforms are being implemented, which supports better education and helps in stabilizing the fertility rate. This study provides an in-depth analysis of the application of recent education reform and shows the after-effects of education on fertility.

The foundation of our identification approach is a natural experiment conducted in the context of Pakistan's Article 25(A) implementation of reform about free and compulsory education for primary and secondary levels across different regions in varied periods to estimate the causal effect of education on fertility. Our identification technique aligns with recent research in developing countries that employ educational policy changes to produce exogenous differences in schooling and assess their impact on fertility (Ali and Gurmu, 2018; Keats, 2018).

This study is innovative in investigating the causal effect of education on fertility in Pakistan and significantly contributes to the existing literature in this field of research. Our paper uses a

change in secondary and primary schooling law as a source of exogenous variation in education to examine the causal effects of education on fertility in Pakistan and explain the mechanism through which education affects fertility. Prior research focused on a specific program called the Conditional Cash Assistance Program (CCAP) for secondary school girls in Punjab, Pakistan, and found that each possible year of participation in the program had a positive effect on education outcomes. Furthermore, program exposure is associated with a reduction in early marriage (Musaddiq and Said, 2023). Adding to this earlier study, this research focuses on national-level changes in secondary and primary school law that were implemented in different time periods in different regions of Pakistan, and, controlling for endogeneity, it identifies their causal effect on fertility.

The paper is organized as follows: Section 2.2 describes an institutional background and education reform in Pakistan; section 2.3 contains a review of the literature; section 2.4 presents our analytical technique; section 2.5 provides the result; section 2.6 discusses the discussion and conclusion; and section 2.7 presents the recommendations.

2.2 Background of the Pakistan's Education System and Education Reform

In the education system of Pakistan, primary education usually refers to classes 1–5, whereas secondary education refers to classes 6–10. Classes 11 and above are referred to as higher education. The majority of children start elementary school at age five, and they usually complete secondary school around the age of sixteen.

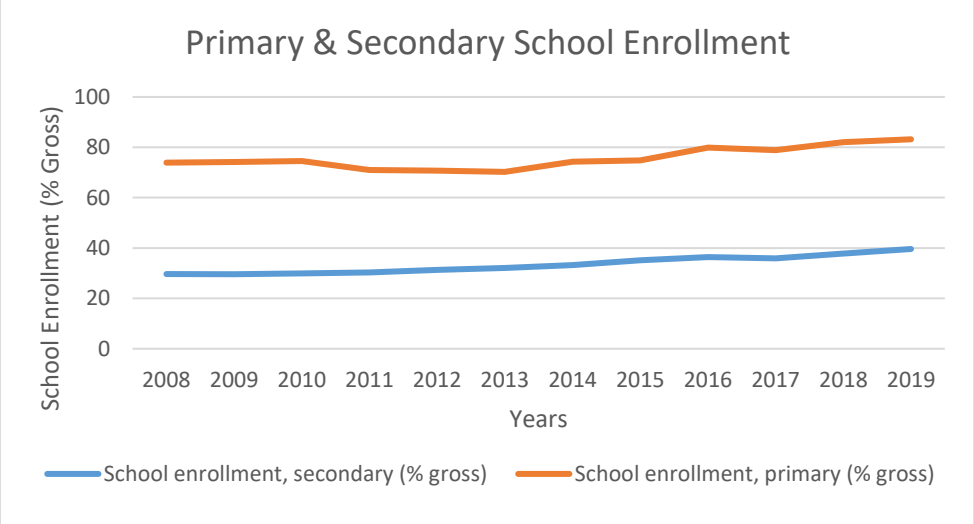
The Islamic Republic of Pakistan's 1973 Constitution stipulates that "the state shall be responsible for the eradication of illiteracy and the provision of free and compulsory education up to secondary level, within the minimum possible time" (Article 37-B, 1973 Constitution of Pakistan). Article 25(A) of the Constitution, as amended by the 18th amendment, specifies that "The State shall provide free and compulsory education to all children of the age of five to sixteen years in such manner as may be determined by law." Due to the significance and necessity of free and obligatory primary and secondary education, the government of Pakistan has taken constitutional measures to address these issues. The possibility of making primary and secondary education entirely free and mandatory and bringing all out-of-school children into school has been made possible by this new constitutional clause.

The government of Pakistan has enacted this policy, which guarantees free and compulsory education, implemented at different times in different regions. For instance, this policy change affected all individuals born on or after May 2014, February 2013, June 2013, and December

2012 in Punjab, Sindh, Balochistan, and the Islamabad region, respectively. Therefore, April 1998, January 1997, May 1997, and November 1996 for Punjab, Sindh, Balochistan, and Islamabad, respectively, represent a cutoff, which implies that women born before that had not received a free and compulsory education at the age of five to sixteen than women born on or after that. For instance, in a decentralized strategy for implementing educational policies across the country, Khyber Pakhtunkhwa enacted Article 25-A in 2017. Our analysis is restricted to Punjab, Balochistan, Sindh, and Islamabad. Due to the unavailability of data, Khyber Pakhtunkhwa is not included in the research.

The government of Pakistan has developed several policies to raise the nation's literacy rate (Farooq, 2018). The country's general literacy rate has increased because of persistent efforts by the government in a positive direction (Haque, 2018). The number of children who are not in school has decreased over time, whereas the new enrollment rate has climbed. As seen in figure 2.2, the data charts from the World Bank index indicate a somewhat favorable trend. The orange line represents the primary school enrollment. While the blue line represents the secondary school enrollment. Both primary and secondary school enrollment are showing an upward trend. The problem of children who are not in school is still a recurring concern in the nation, even though things are progressively getting better.

Figure 2.2: Primary and secondary school enrollment



Source: World Bank Indicator (WDI)

2.3 Literature Review of the Links between Education and Fertility

Several studies have examined changes in compulsory education laws in developed countries to determine the causal relationship between education and fertility. There have been mixed findings about whether total fertility is also declining. For example, Monstad et al. (2008) examined the 1959 expansion of Norway's mandatory schooling from seven to nine years and reported there was no evidence that higher levels of education led to a higher percentage of childless or less childbearing women. Mccrary and Royer (2011) discovered no evidence that education influenced fertility. In contrast, Black et al. (2008) examined how increasing mandatory schooling decreased the prevalence of pregnancies among adolescents in both the US and Norway by taking advantage of regional and temporal variances in these laws. Based on a similar policy change that occurred in West Germany between 1958 and 1969 that increased the mandatory schooling duration from 8 to 9 years. Cygan-Rehm and Maeder (2013) discovered that this policy decreased women's fertility while increasing their level of education. Grönqvist and Hall (2013) analyzed the Swedish education reform that extended the upper secondary school vocational programs from two to three years. They observed that the adoption of this reform has significantly reduced the number of adolescent pregnancies. Fort et al. (2016) conclude that the increased education caused by such reforms does not result in a decrease in the number of children born per woman or an increase in childlessness, using the variation caused by compulsory schooling reforms in Continental Europe. DeCicca and Krashinsky (2022) analyzed Canadian data to observe variations in laws of compulsory schooling and found that education decreases fertility, and women are more likely to have at least one child rather than multiple children.

Numerous studies have measured exogenous changes in education through the implementation of education reforms in developing nations and have discovered a negative association between education and fertility. For example, Osili and Long (2008) applied Nigeria's implementation of universal primary education as a model to demonstrate that a one-year increase in female education lowers adolescent fertility by 0.26 births. Chicoine (2012) applied the Kenyan policy shift from 1985 to generate an exogenous variable and discovered that higher education dramatically lowers fertility. Duflo et al. (2015) carried out a field study in western Kenya where girls in grade 6 get free school uniforms. The results show that the program reduces the probability of pregnancies among adolescents. Grépin and Bharadwaj (2015) demonstrated that higher education lowers the number of offspring born per woman by utilizing the 1980 expansion of secondary schools in Zimbabwe. Chicoine (2021) found that increasing education

reduces fertility by removing school fees, which leads to engaging women's activities in the labor market. Keats (2018) analyzed the effects across all grade levels by secondary school completion; the reforms improved educational attainment at the cutoff by over a year on average and found that women having greater education both postpone and decrease total fertility. Chen and Guo (2022) analyzed the causal effects of female education on fertility by applying China's compulsory schooling reform and found that increasing female education permanently reduces fertility.

The studies also looked at changes in compulsory education law to determine the causal relationship between education and fertility in the Middle East, North Africa, and Arab nations. For example, Dinçer et al. (2014) applied the 1997 education law in Turkey, which raised the mandatory schooling duration from five to eight years, and discovered that completing elementary school lowers the rate of births. Lavy and Zablotsky (2015) found that women's education has a significant and adverse impact on reproduction by considering Israel's 1966 abolition of mobility prohibitions. Ali and Gurmu (2018) examined the effect of Egyptian women's education on fertility by considering the change in the length of primary schooling as the source of exogenous educational variation. The analysis significantly revealed that female education reduces the birth rate per woman.

Musaddiq and Said (2023) utilized differences in program exposure among cohorts and regions to evaluate the long-term impacts of the conditional cash assistance program for secondary school girls in Punjab, Pakistan. The finding revealed that each prospective year of participation in the program impacts positively on the outcomes of education, with an increase of 1.9 percent probability of completing secondary school. Furthermore, the program exposure is associated with a decrease of 3.5 percent in the probability of early marriage. The key role is also played by the program in early childbirth delay and the probability of seeking prenatal care at a later stage of life. This research focuses on a specific program, called the Conditional Cash Assistance Program (CCAP), for secondary school girls in a particular region (Punjab) of Pakistan. Our research focuses on national-level changes in secondary and primary school legislation that have been implemented at different times in different regions of Pakistan and identifies their effects on education and fertility.

2.4 Analytical Technique

This section describes the regression discontinuity design (RDD) to investigate the effect of education on fertility. After the 18th Amendment, Pakistan's Constitution was implemented,

requiring compulsory primary and secondary education for children between the ages of five and sixteen. This change in the compulsory education law necessitates the evaluation of its impact, for which we propose implementing the regression discontinuity design (RDD).

This study employs data from the Pakistan Demographic and Health Survey (PDHS) 2017-18. The PDHS survey is a nationally representative household survey that provides a variety of information on family and health. Every household with ever-married women aged 15-49 is being interviewed to gain information about their health and reproductive history. We examine the effect of female education on fertility on two fertility outcomes: the number of children born per woman and women's age at first birth.

The survey provides information on the educational attainment of females between the ages of five and sixteen, providing levels of education in the following categories: no education, primary, secondary, and higher. The year-month of birth of the women is the running variable in this study. The survey plays a vital role in our study by providing valuable information regarding women's years and months of birth, which enables us to distinguish between those young women who are under the reform and those who are not. The study uses an RDD strategy to examine the effects of interventions on education and fertility in Pakistan across various regions and periods. For example, this policy change affected all individuals born on or after May 2014, February 2013, June 2013, and December 2012 in Punjab, Sindh, Balochistan, and the Islamabad region, respectively. Using cross-sectional data, we focus our analysis on August 1994 to December 2002, May 1992 to September 2002, September 1991 to January 2003, and August 1990 to February 2002 for the Punjab, Sindh, Balochistan, and Islamabad regions, respectively, to define the windows before and after the cut-off in a way that balances the woman's age between the treatment and control groups[1]. Therefore, we compare the education and fertility of women born just before and right after April 1998, January 1997, May 1997, and November 1996 for Punjab, Sindh, Balochistan, and Islamabad, respectively, representing a cutoff point such that women born on or after that had received a free and compulsory education between the ages of five and sixteen, while women born before that have not benefited from the reform.

Our identification strategy relies on the natural experiment that applied to the policy change and defines the women who did not benefit from the free and compulsory education and the women who benefited from the free and compulsory education as the control and treatment

[1] Detailed descriptions of the sample size before and after the cutoff are provided in the supplementary note.

groups, respectively. This design helps control for potential biases by exploiting the discontinuity in treatment assignment at the policy implementation date. To deal with this potential bias, we use a local randomization approach to regression discontinuity (Cattaneo et al. (2015); Cattaneo et al. (2020a; 2020b; 2020c)). We use a natural framework for the analysis of a regression discontinuity design with a discrete running variable and few mass points, established by Cattaneo et al. (2023). The running variable in our RD design is the women's year-month of birth, which is discrete with few mass points, and our main goal is to examine the effect of education on fertility in Pakistan, focusing on changes in primary and secondary school law that occur near the exogenous shock. Three elements make up the RD design: a score (also known as a forcing or running variable), a treatment, and a cutoff. Since we apply a sharp RD design, each unit that has a score that exceeds the cutoff is allocated to the treatment condition. Considering that the cutoff is the only point at which the conditional probability of treatment changes discontinuously, the difference between the observed fertility rate of respondents immediately before and immediately after the education reforms can be used to determine the average treatment effect (ATE). In the RD design, continuity means that as the two limits of the running variable approach the cutoff, their average potential outcomes grow increasingly more similar. It is thus justifiable to infer the counterfactual using observations in a relatively small neighbourhood around the cutoff. Here, we are not performing an empirical analysis to test the impact of education on fertility, as we are determining the average treatment effect (ATE) in this study.

The local randomization approach to RD presupposes that the average potential outcomes are independent of unit position on either side of the cutoff. On the contrary, the score has a small positive range, which explains the size of the predefined randomization window. According to the local randomization assumption, regression functions explaining average probable outcomes must be flat within a window because they are independent of the running variable's values. Because the regression functions inside the window are constant, the ATE under local randomization could be estimated by the difference in average observed outcomes for all units in the treatment and control groups within the window. According to the randomization assumption, there may be a small pre-specified window when respondents' treatment status does not depend on their traits. As a consequence, the randomization-based method makes a stronger identification assumption. For categorical running variables, mass points will be presented at each level of the running variable. For instance, consider a categorical variable with a small number of levels on either side of the cutoff (e.g., rating levels, days, years).

Irrespective of sample size, observations will be collapsed at the running variable level. This is, even if the sample size is large enough, any observation will be paired to one of the running variable's levels. Every mass point of the categorical running variable will consequently act as a single observation. The key advantage of the randomization-based method is that a discrete running variable keeps the estimate method from focusing on observations arbitrarily near the threshold.

Finally, the window within which randomization holds is necessary for both RD inference techniques and randomization-based estimation. Nevertheless, as opposed to real randomized experiments, situations that needed to be identified using local randomization RD designs would unavoidably involve some uncertainty regarding the group of observations that got the as-if randomly assigned treatment. Thus, the most important stage in using local randomization RD techniques is choosing the window within which causation can be reasonably identified. Usually, the basis for window selection processes is nested balance testing on the pertinent predefined covariates (Cattaneo et al., 2015). The window selection process, in its entirety, chooses the largest window in which all covariates are balanced, both inside that window and throughout all of its smaller windows. Once the window of randomization is identified, the data falling inside that window may be examined in the same way as an experiment. We apply a sharp RD design to account for the policy change implemented for all individuals born on or after May 2014, February 2013, June 2013, and December 2012 in the Punjab, Sindh, Balochistan, and Islamabad regions, respectively. Therefore, there is a clear cutoff point for April 1998, January 1997, May 1997, and November 1996 for Punjab, Sindh, Balochistan, and Islamabad, respectively. The sharp RD design is more appropriate in this case as it allows researchers to conduct treatments based on specified thresholds and draw causal relationships from comparisons around these cutoffs.

2.5 Results

2.5.1 Randomization-Based Falsification Tests and Window Selection

We used the approach based on predefined covariates to choose our window. To increase the validity of the identification assumption of the randomization-based strategy, we applied window selection processes inside that window. We determined the frame within which the assumption of randomized identification is probable to hold. To maintain the principle of integrity, units in the treatment or control arms must show similarity in observable and non-observable features around the cutoff point. For respondents with identical running variable

values, that is, no significant variations should be seen in the predefined covariates. In order to perform these falsification tests, the null RD impact of the predefined covariates for units inside a selected window is tested. We used the window selection procedure, beginning with the smallest window that could be used. We employed the automated data-driven window selection process suggested by Cattaneo et al. (2015) to choose the most suitable window and selected the largest window such that all of the smaller windows inside of it, along with our predefined covariates (husband's educational attainment, women's wealth status, and women's place of residence), are balanced. More precisely, for every window taken into consideration, we evaluated the null hypothesis that there would be no differences in specified covariates between the treatment and the control groups. Table 2.1 shows p-values from balancing tests for several windows, based on randomization for 10 windows for Punjab, Sindh, Balochistan, and Islamabad, respectively. For the Punjab region, we looked at the largest window of [-13.00, 13.00], which included our running variable's whole support. We decided to examine a minimum window of [-4, 4] based on power considerations. For windows less than [-5, 5], the p-value is greater than 0.15; however, as the windows are larger than [-5, 5], the p-value decreases. Because of this, we have chosen the window [-5, 5] with $\alpha = 0.15$ for our analysis. The output indicates that every window between the lowest window [-4, 4] and the window [-5, 5] is above 0.15. Similarly for Sindh, in our selected window [-6.00, 6.00], the minimum p-value is 0.138 with $\alpha=0.10$, marginally bigger than our final selection, illustrating the minimal p-value's sharp fall when we consider observations that are further away from the cutoff; however, in the next biggest window [-7.00, 7.00], the minimum p-value is 0.032. When the window exceeds [-6.00, 6.00], p-values drop quickly. Comparably for Balochistan, our window of choice has a minimum p-value of 0.194, the lowest p-value in that window, which is more than 0.15. We suggest using a window of [-6.00, 6.00] with $\alpha=0.15$. Nevertheless, when the windows exceed [-6.00, 6.00], the p-value decreases. Therefore, we have chosen to examine the window [-6.00, 6.00]. Furthermore, our window of choice for Islamabad has a minimum p-value of 0.313, which is the lowest p-value in that window that is higher than 0.15. Our recommended window is [-18.00, 18.00] with $\alpha=0.15$. However, the p-value drops when the windows are bigger than [-18.00, 18.00]. As a result, we have decided to analyze the window [-18.00, 18.00].

2.5.2 Main Results

We start the RD analysis with a graphical representation of educational attainment, fertility, and age at first birth outcomes with the support of the forcing variable (year-month of birth).

A graphical representation of the estimated RD effect of year-month of birth on fertility, education, and age at first birth is shown in Figures 2.3, 2.4, and 2.5, respectively. We provide a range of windows surrounding the cutoff point (0), where the treatment is supposed to occur, on the horizontal axis. The left and right limits of the selected window are shown by dotted lines, whereas this cutoff is depicted by a solid vertical line. We show our measure of fertility rate, educational attainment, and age at first birth on the vertical axis. Finally, the average fertility rate, education attainment, and age at first birth reported in a given interval of time are represented by each dot inside the graph. Dots to the left of the cutoff tend to be above those to the right of it within the 5.00, 6.00, 6.00, and 18.00 windows for Punjab, Sindh, Balochistan, and Islamabad, respectively. The ATE should be determined by interpreting the vertical difference between the two horizontal lines, which show the average fertility, education attainment, and age at first birth level immediately before and after the cutoff. Using R and Stata rdrandinf packages, Cattaneo et al. (2016) utilized local randomization methods (Imbens and Rubin, 2015) to estimate the ATE. Figure 2.3 shows that there is a discontinuity in the outcome variable (total children ever born) at the cutoff point and indicates a clear jump in the observed values for all regions. Particularly, there is a decrease in the overall number of children among the women under the reform at the cutoff in the Sindh and Islamabad regions and an increase in Punjab and Balochistan. According to the downward-sloping line to the right of the cutoff, the treatment group, or the women getting the intervention, has more favorable results than the control group. It means that after the cut-off point, females who were under the reform experienced declining fertility across Sindh and Islamabad and an increase in fertility across Punjab and Balochistan.

Figure 2.4 shows that there is a discontinuity in the education attainment at the cutoff point and indicates a clear jump in the observed values for all regions. Particularly, this figure shows a discontinuity increase in educational attainment in Punjab and Balochistan, while discontinuity decreases in Sindh and Islamabad. It means that after the cut-off point, females who were under the reform experienced an increase in education in Punjab and Balochistan and a decrease in education in Sindh and Islamabad.

Figure 2.5 shows that there is a discontinuity in age at first birth at the cutoff. This figure also shows a discontinuity increase in the age at first birth in Sindh, while there is a discontinuity decrease in the age at first birth for Punjab, Balochistan, and Islamabad. It maens that after the cut-off point, women in Sindh experienced a delay in age at first birth, and women in Punjab, Balochistan, and Islamabad experienced a decrease in age at first birth.

2.5.3 Sensitivity of Results to Window Choice and Test Statistics

We have used falsification tests of the predefined covariates to assess the robustness of our findings. The result is, in fact, quite robust for window selection and the average treatment effect in the 10 windows for Sindh reported in Table 2.2. While results for the Punjab, Balochistan, and Islamabad regions are not robust to window selection and the average treatment effect in the 10 windows. Sensitivity analysis was performed by comparing the outcomes of two distinct window sizes: the selected window and the less-than-selected window.

2.5.4 Placebo Cutoffs

We have used a falsification test to choose artificial cutoff values at which the probability of treatment assignment does not change. The Fisherian p-values are above the conventional significance level of 0.05 across all regions in Table 2.3. Our results suggest that there is no evidence of treatment effect on the artificial cutoffs.

2.6 Discussion and Conclusion

This research effort is unique as it analyzes the causal effect of education on fertility in Pakistan and makes substantial contributions to the current knowledge. The prior research dealt with a specific program termed the conditional cash assistance program (CCAP) targeting secondary school girls in specific areas (Punjab) of Pakistan. In addition, the basis of our identification approach is a natural experiment carried out within the framework of Article 25(A) of Pakistan, which offers a structure for the implementation of mandatory and free schooling reforms in different periods across regions to determine the causal effect of education on fertility. We conducted RD analysis using a local randomization strategy because of the nature of our running variable. The observation of a discontinuity in the outcome variable at the cutoff point indicates a clear jump in the observed values for all regions. This shows that after the cut-off point, women who are under the reform experience a decrease in fertility across Sindh and Islamabad and an increase in Punjab and Balochistan. It indicates that the increased education caused by reform does not decrease the number of children born per woman in Punjab and Balochistan; this result is consistent with Fort et al. (2016). Furthermore, the adoption of compulsory primary and secondary schools does not increase education levels while fertility decreases due to family planning practices in the Sindh and Islamabad regions; this result is

consistent with McCrary and Royer (2011). This study adds to the literature showing the importance of compulsory schooling laws in changing the outcomes for women in a developing country context. The compulsory schooling law would have important implications for the economic welfare of women in Pakistan. In terms of distributive implications, we show that compulsory schooling has the potential to improve the well-being of the poor, which is the after-effect of reduced fertility rates (Keats, 2018).

The results are not robust in the randomization-based RD's sensitivity in Punjab, Balochistan, and Islamabad. This may be due to frequent government changes and political instability (Nawaz et al., 2021); these have had a significant impact on the consistency and efficacy of educational policy. Each new administration frequently changes or deprioritizes current education policies, resulting in inconsistent implementation of Article 25(A) among provinces. However, there are several challenges to the implementation of Article 25(A); a key concern is the insufficient allocation of educational resources. Many provinces struggle with insufficient finances that do not cover the costs of developing schools, recruiting skilled teachers, and providing fundamental materials for education. One of the most major obstacles is the high dropout rate for students, particularly in rural regions. Child labor, poverty, and early marriages frequently lead youngsters to abandon school and participate in labor-intensive activities. The high dropout rates are due to a lack of knowledge about the need for education as well as a scarcity of schools in remote areas. Furthermore, the quality of education is still an issue. Although attempts are made to enhance the syllabus and training for educators, the quality of education in urban and rural regions remains significantly different. Inadequate infrastructure, limited resources, and a scarcity of competent instructors all impede the delivery of quality education in many regions around the country. Moreover, gender discrepancies remain in the education sector. Although Article 25(A) aims to promote equal educational prospects, females in Pakistan frequently confront cultural and societal obstacles that hinder their access to school. Gender stereotypes, early marriages, and safety concerns stop many females from attending school, promoting gender inequality (Pakistan Lawyer, 2024). The problems with implementing Article 25(A) in Pakistan are multiple and deeply embedded in economic and political instability and social situations. Overcoming these difficulties would need a collaborative effort by government agencies at all levels, civil society groups, and communities in order to ensure that all children have an opportunity for quality education as mandated by the constitution. For placebo cutoffs, our analysis using randomization-based inference supports the validity of our RD design by showing no significant treatment effect on

the artificial cutoff. While these findings are encouraging, we acknowledge the limitations due to our small sample size. Future studies with larger datasets would be beneficial to confirm these results and provide more robust estimates of treatment effects. Despite these limitations, our work contributes to the understanding of the effect of education on fertility and highlights the importance of rigorous validation in RD designs.

However, in Figure 2.4, educational attainment for women has increased under reforms in Punjab and Balochistan. One of the main effects of Article 25(A) is an increase in enrollment rates, particularly among underprivileged populations. The availability of free and compulsory education has encouraged parents to take their children to school because they no longer have to endure the financial burden of education costs. As a result, more children are attending school and gaining formal schooling (Pakistan Lawyer, 2024). In Punjab and Balochistan, the fertility rate is increasing, and the age at first birth is decreasing at the cut-off points in Figures 2.3 and 2.5, respectively. There are many factors that may impede the expected outcomes of low fertility rates and increased age at first birth. Whenever women, rather than men, make decisions regarding family planning, the number of children born per woman drops (Gabrielson, 2010). In contrast, women in Pakistan are rarely permitted to think about and make decisions regarding family planning, and also, their position in comparison to males is lower than in other societies (Sathar et al., 1988). According to Ferrant and Kolev (2016), males are regarded as dominant in Pakistani society. In summary, this servitude of women has an adverse consequence for several phases of women's lives. In Pakistani society, women do not have the right to make family planning decisions and are dominated by men. The question arises, how does education play a positive role in increasing women's age at first birth and reducing fertility? Cultural expectations about family size and early marriage might remain even with increased education levels. In many societies, societal norms may continue to favor early pregnancy, resulting in lower ages at first birth regardless of educational achievement.

In addition, cultural and religious influences have contributed to increased fertility in developing countries like India, Pakistan, and Bangladesh. Muslims often have greater fertility rates than other religious groups (Zuehlke, 2009). The religious factor is the main reason to increase the fertility rate in Pakistan. Young people in Pakistan confront multiple challenges in terms of comprehending sexual and reproductive health (SRH) problems (Ali et al., 2006; Farid-ul-Hasnain et al., 2013; Hennink et al., 2005; Shaikh and Rahim, 2006). Typically, there is little or no education concerning SRH issues in Pakistani schools (Ali et al., 2016). To summarize, the absence of reproductive health education in Pakistan's formal education system

relates to increased fertility rates, because young people have limited knowledge regarding their reproductive rights and options. Early marriage increases fertility rates and lowers the age of first birth in Punjab and Balochistan, which is culturally acceptable and frequently anticipated. This practice results in a lower age of first birth since women marry off in their teens, which significantly influences greater fertility rates. Quality of education at primary and secondary levels is also a major problem across the country; it may hamper the expected results of lower fertility and increased age at first birth. Focus on higher education levels may affect fertility and delay women's age at marriage. Furthermore, the results are robust to randomization based on sensitivity to RD in Sindh, but the RD effect for the education attainment in figure 2.4 shows that there is a decrease in education at the cutoff point; this is due to school dropout rates among young children in Sindh continuing to climb despite several government initiatives to address the problem. According to studies, economic challenges, insufficient educational resources, and limited access to schools are major contributors to these high rates of dropping out (Idrees and Sarwar, 2023). Also, there is a decline in fertility in Figure 2.3 and an increase in age at first birth in Figure 2.5 at the cutoff point in Sindh. Many regions of Pakistan, especially Sindh, have cultural norms that promote early marriage for women. While educational reforms aim to improve educational opportunities, social norms support early marriage despite education level. The Sindh government has taken measures to increase family planning and modern contraceptive methods to reduce the birth rate (UNFPA, 2019); this may result in a paradox in which women marry at a younger age but have lower fertility due to economic constraints or family planning practices. Furthermore, in Islamabad, fertility, education, and age at first birth decrease. The patterns seen in Islamabad related to the lowering age of first birth, dropping fertility rates, and educational attainment are linked phenomena impacted by growing female education, changing economic situations, and political instability, affecting societal standards and continuing socioeconomic constraints. Overcoming these difficulties necessitates a comprehensive strategy that involves improving educational quality, promoting gender equity in school, and guaranteeing access to family planning services.

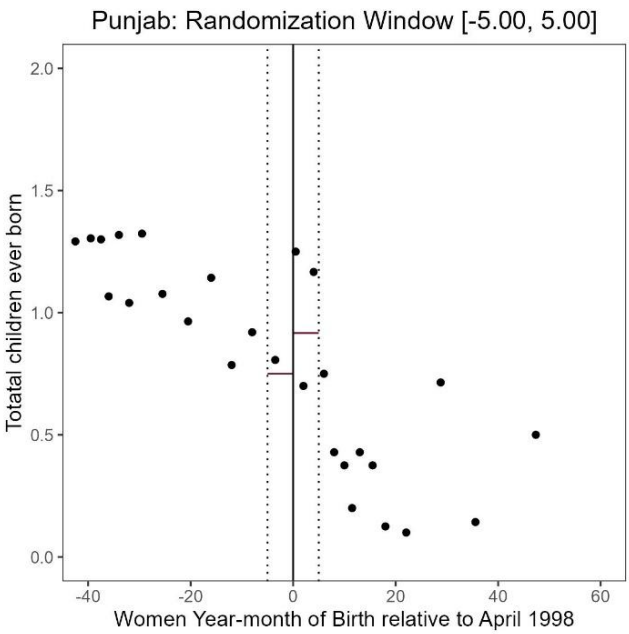
Previous research in Pakistan on a conditional cash assistance program for girls studying in secondary schools in Punjab highlights how educational interventions can affect school outcomes. The initiative was limited to one province and focused on a financial assistance program rather than broader reforms, and the program was found to increase secondary school completion and reduce early marriage and fertility (Musaddiq and Said, 2023). This type of

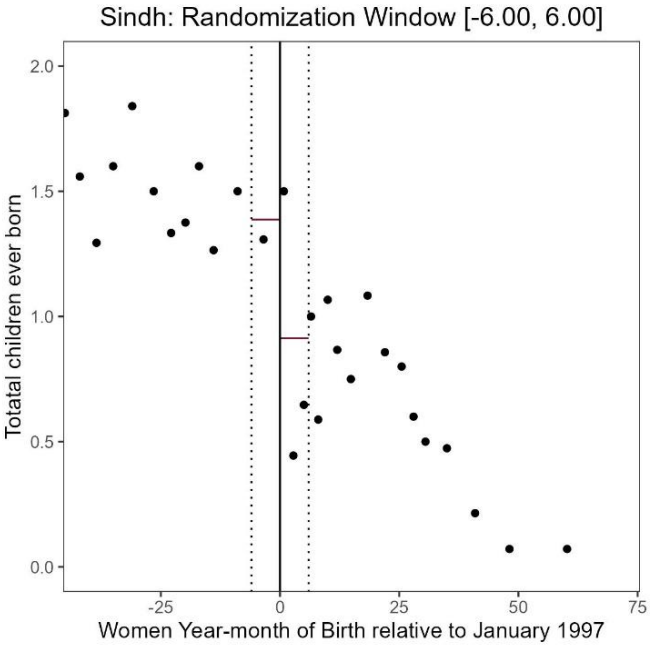
initiative is a strategy to promote education and can be part of a broader education reform at the national level. Additionally, studies of developing countries that have focused on education reforms at the country level have found that the reforms increased education at all grade levels through the end of secondary school, and they reduced fertility. It is a consequence of delaying maternal age rather than changing women's fertility preferences (Ali and Gurmu, 2018; Keats, 2018). While our analysis focuses on Pakistan, similar findings from other contexts point to potential pathways by which education reform can impact fertility rates. Education reforms increase education, and increased education leads to delayed births, and delayed maternal age results in decreased fertility. Due to the limitation of data availability, we were unable to see the role of delayed marriage as a mechanism to explain the effect of education on fertility reduction in all regions as well as robust results across regions. It may be too early to fully capture the hypothetical impact of the policy on fertility due to lag effects. Cohorts' effect may also play a role.

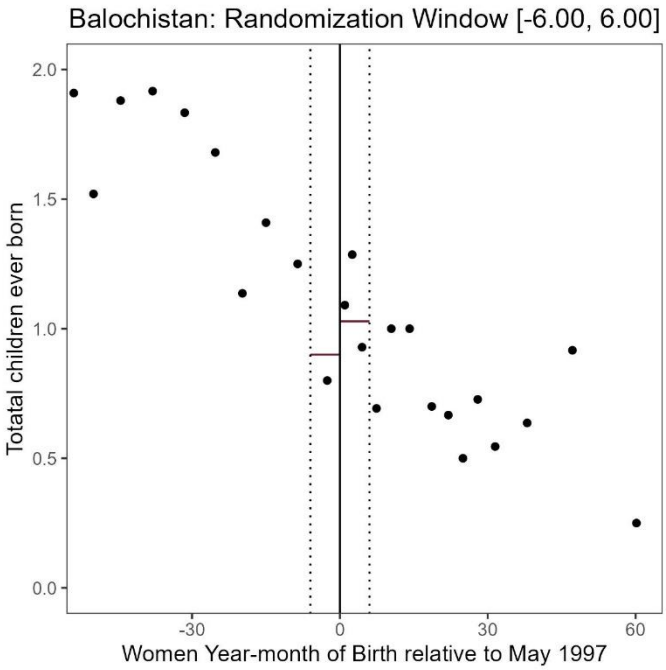
2.7 Recommendations

For future studies, longitudinal research that follows individuals over time would be important to fully understand the link between school reform and fertility changes. This would assist in demonstrating causal relationships between schooling, marriage time, and fertility. A well-established body of evidence suggests that greater education levels, particularly among women, offer long-term advantages for economic growth, health outcomes, and gender equality. Consequently, policymakers should continue to invest in education reforms while constantly monitoring their broader socioeconomic implications. Furthermore, each region of Pakistan demonstrates different patterns in terms of fertility rates, age at first birth, and educational attainment. The study suggests tailoring education plans to regional and local requirements rather than implementing a single strategy at the provincial level. By applying these individualized suggestions, policymakers may address the particular obstacles that each province faces while capitalizing on opportunities to enhance education and reproductive health outcomes. A collaborative strategy combining government agencies, non-governmental organizations (NGOs), community leaders, and families will be required to achieve long-term development in these regions. Further research in similar circumstances is recommended to provide a robust grasp of these challenges.

Figure 2.3 RD effect for fertility rate.







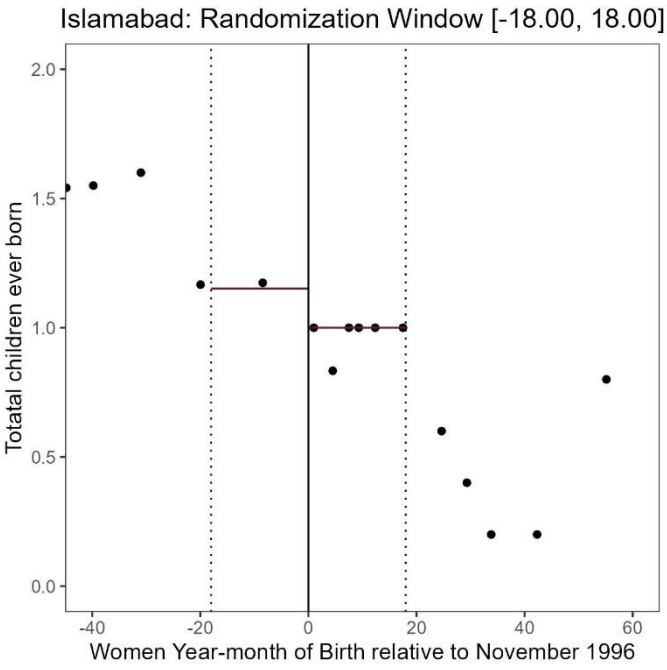


Figure 2.4: RD effect for education attainment.

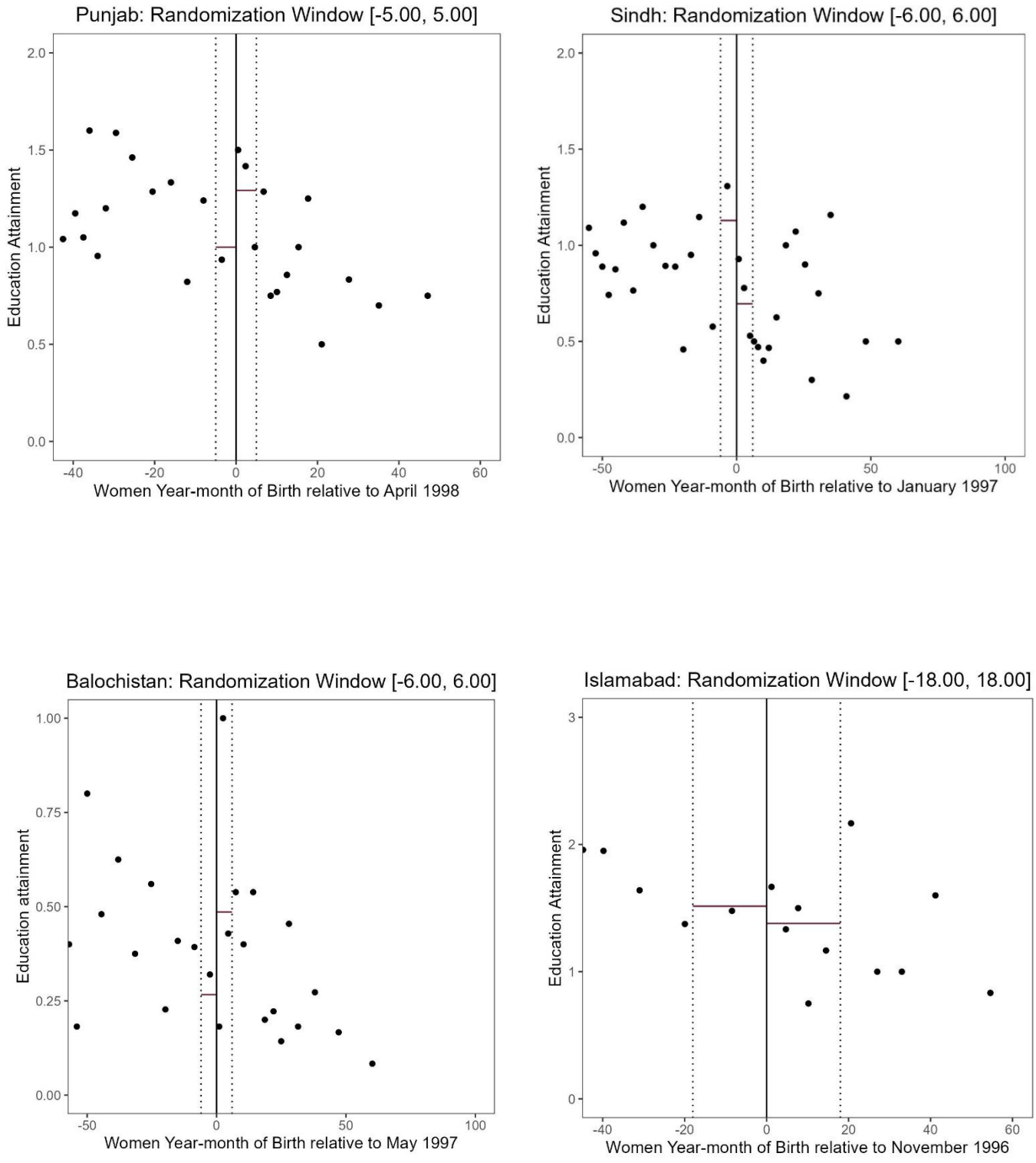


Figure 2.5: RD effect for age at first birth.

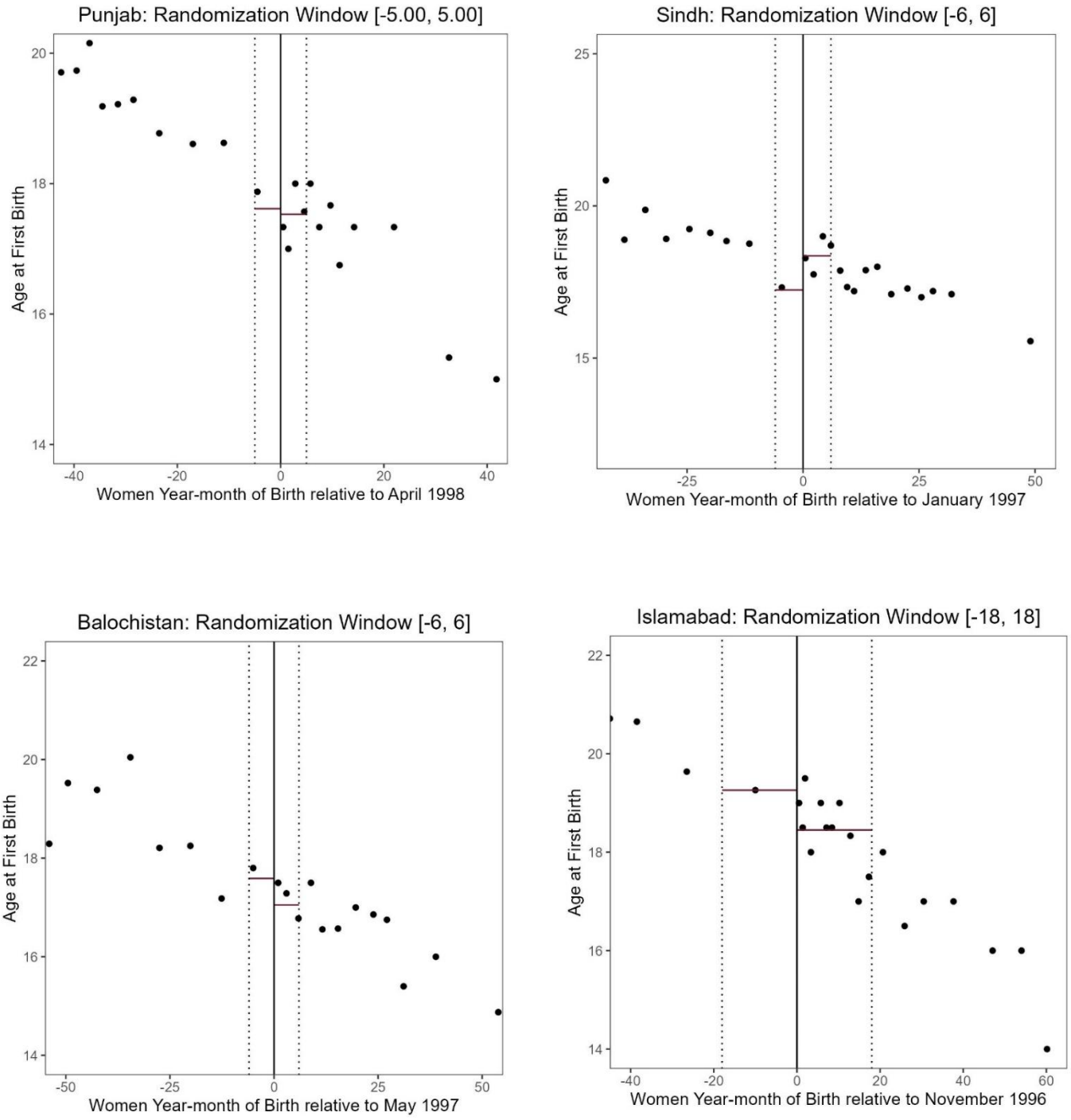


Table 2.1 Pretreatment covariate-based window selector: p-values from balancing tests for ten windows, based on randomization.

Window	Minimum p-value	Covariate with minimum p-value
Punjab region		
[-4.000, 4.000]	0.327	Women wealth status
[-5.000, 5.000]	0.242	Husband education attainment
[-6.000, 6.000]	0.095	Husband education attainment
[-7.000, 7.000]	0.099	Husband education attainment
[-8.000, 8.000]	0.355	Husband education attainment
[-9.000, 9.000]	0.153	Husband education attainment
[-10.00, 10.00]	0.118	Husband education attainment
[-11.00, 11.00]	0.222	Husband education attainment
[-12.00, 12.00]	0.184	Husband education attainment
[-13.00, 13.00]	0.167	Husband Education attainment
Sindh region		
[-3.000, 3.000]	0.438	Women wealth status
[-4.000, 4.000]	0.563	Women wealth status
[-5.000, 5.000]	0.070	Women wealth status
[-6.000, 6.000]	0.138	Women wealth status
[-7.000, 7.000]	0.032	Women wealth status
[-8.000, 8.000]	0.060	Women wealth status
[-9.000, 9.000]	0.047	Women wealth status
[-10.00, 10.00]	0.038	Women wealth status
[-11.00, 11.00]	0.100	Women wealth status
[-12.00, 12.00]	0.018	Women wealth status

Table 2.1 Pretreatment covariate-based window selector: p-values from balancing tests for ten windows, based on randomization (Continued).

Window	Minimum p-value	Covariate with minimum p-value
Balochistan region		
[-3.000, 3.000]	0.304	Husband education attainment
[-4.000, 4.000]	0.559	Husband education attainment
[-5.000, 5.000]	0.307	Husband education attainment
[-6.000, 6.000]	0.194	Husband education attainment
[-7.000, 7.000]	0.085	Husband education attainment
[-8.000, 8.000]	0.130	Husband education attainment
[-9.000, 9.000]	0.253	Women wealth status
[-11.00, 11.00]	0.350	Women wealth status
[-12.00, 12.00]	0.156	Husband education attainment
[-13.00, 13.00]	0.152	Husband education attainment
Islamabad Region		
[-8.000, 8.000]	0.317	Women place of residence
[-10.00, 10.00]	0.376	Women wealth status
[-12.00, 12.00]	0.439	Women wealth status
[-15.00, 15.00]	0.467	Husband education attainment
[-18.00, 18.00]	0.313	Husband education attainment
[-23.00, 23.00]	0.133	Husband education attainment
[-28.00, 28.00]	0.166	Husband education attainment
[-30.00, 30.00]	0.474	Husband education attainment
[-34.00, 34.00]	0.526	Husband education attainment
[-37.00, 37.00]	0.526	Husband education attainment

Table 2.2 Randomization-based results of RD's sensitivity.

	Diff- in means statistics	Fisherian p-value	Sample size treated	Sample size control
Punjab region				
[-4.000, 4.000]	0.185	0.692	20	17
[-5.000, 5.000]	0.167	0.634	24	24
[-6.000, 6.000]	0.086	0.836	28	31
[-7.000, 7.000]	0.089	0.798	31	40
[-8.000, 8.000]	0.022	0.998	35	45
[-9.000, 9.000]	-0.067	0.826	41	51
[-10.00, 10.00]	-0.136	0.528	43	56
[-11.00, 11.00]	-0.139	0.406	48	67
[-12.00, 12.00]	-0.142	0.360	53	71
[-13.00, 13.00]	-0.169	0.292	55	77
Sindh region				
[-3.000, 3.000]	-0.113	0.856	23	15
[-4.000, 4.000]	-0.535	0.190	31	17
[-5.000, 5.000]	-0.408	0.194	40	26
[-6.000, 6.000]	-0.474	0.066	46	31
[-7.000, 7.000]	-0.564	0.020	56	35
[-8.000, 8.000]	-0.580	0.016	63	37
[-9.000, 9.000]	-0.611	0.006	70	40
[-10.00, 10.00]	-0.477	0.026	78	43
[-11.00, 11.00]	-0.542	0.006	87	52
[-12.00, 12.00]	-0.468	0.008	93	59

Table 2.2 Randomization-based results of RD's sensitivity (Continued).

	Diff- in means statistics	Fisherian p- value	Sample size treated	Sample size control
Balochistan region				
[-3.000, 3.000]	0.070	0.960	25	20
[-4.000, 4.000]	0.236	0.520	28	25
[-5.000, 5.000]	0.174	0.618	32	27
[-6.000, 6.000]	0.129	0.708	35	30
[-7.000, 7.000]	0.059	0.934	38	34
[-8.000, 8.000]	-0.044	0.916	45	36
[-9.000, 9.000]	-0.062	0.878	48	40
[-11.00, 11.00]	-0.123	0.590	55	46
[-12.00, 12.00]	-0.155	0.484	59	48
[-13.00, 13.00]	-0.102	0.608	62	53
Islamabad region				
[-8.000, 8.000]	-0.041	1.000	17	10
[-10.00, 10.00]	0.027	1.000	20	13
[-12.00, 12.00]	-0.211	0.612	24	19
[-15.00, 15.00]	-0.150	0.708	26	27
[-18.00, 18.00]	-0.152	0.574	29	33
[-23.00, 23.00]	-0.230	0.364	33	40
[-28.00, 28.00]	-0.218	0.360	35	53
[-30.00, 30.00]	-0.311	0.184	40	56
[-34.00, 34.00]	-0.334	0.150	43	61
[-37.00, 37.00]	-0.542	0.014	45	72

Table 2.3 Falsification test for placebo cutoffs

Cutoff	Mean of controls	Mean of treated	Diff-in-means statistics	Fisherian p-value	Number of observations
Punjab region					
Cutoff at -1	0.739	1.200	0.461	0.468	28
Cutoff at 1	1.250	0.850	-0.400	0.490	24
Sindh region					
Cutoff at -1	1.462	1.385	-0.077	1.000	39
Cutoff at 1	1.625	0.800	-0.825	0.128	23
Balochistan region					
Cutoff at -1	0.760	1.333	0.573	0.170	37
Cutoff at 1	1.143	1.000	-0.143	0.888	35
Islamabad region					
Cutoff at -1	1.152	1.000	-0.152	1.000	28
Cutoff at 1	1.000	0.960	-0.040	1.000	26

Supplementary note:

Table: Balance sample selection criteria

	PUNJAB		SINDH		BALOCHISTAN		ISLAMABAD	
Data start (sample size start)	Aug-94		May-92		Sep-91		Aug-90	
Cutoff	Apr-98		Jan-97		May-97		Nov-96	
Data end (sample size end)	Dec-2002		Sep-2002		Jan-2003		Feb-2002	
Date of policy change	May-14		Feb-13		Jun-13		Dec-12	
Age at policy change	5 to 16-years		5 to 16-years		5 to 16-years		5 to 16-years	
	Years of Birth	Age	Years of Birth	Age	Years of Birth	Age	Years of Birth	Age
Age before the cutoff at the time of data collection (Data collected in 2017-18) (in years). Date of birth also included.	1994	23	1992	25	1991	26	1990	27
	1995	22	1993	24	1992	25	1991	26
	1996	21	1994	23	1993	24	1992	25
	1997	20	1995	22	1994	23	1993	24
	Jan-March-1998	19	1996	21	1996	21	1994	23
	-	-	-		Jan-April-1997	20	1995	22
	-	-	-	-	-	-	Jan-oct-96	21
Cutoff	April-1998	-	Jan-1997	-	May-1997	-	Nov-1996	-
Age after the cutoff at the time of data collection (Data collected in 2017-18) (in years). Date of birth also included.	May-1998	19	Feb-1997	20	Jun-1997	20	Dec-1996	21
	1999	18	1998	19	1998	19	1997	20
	2000	17	1999	18	1999	18	1998	19
	2001	16	2000	17	2000	17	1999	18
	2002	15	2001	16	2001	16	2000	17
	-	-	2002	15	2002	15	2001	16
	-	-	-	-	-		2002	15
	Years of Birth	Age	Years of Birth	Age	Years of Birth	Age	Years of Birth	Age
Age before cutoff at the time of policy Change (in years). Date of birth also included	1994	20	1992	21	1991	22	1990	22
	1995	19	1993	20	1992	21	1991	21
	1996	18	1994	19	1993	20	1992	20
	1997	17	1995	18	1994	19	1993	19
	Jan-March-1998	16	1996	17	1995	18	1994	18
	-	-	-	-	1996	17	1995	17
	-	-	-	-	Jan-April-1997	16	Jan-Oct-96	16
Cutoff	April-1998	-	Jan-1997	-	May-1997	-	Nov-1996	-
Age after cutoff at the time of policy change (in years). Date of birth also included.	May-1998	16	Feb-1997	16	Jun-1997	16	Dec-1996	16
	1999	15	1998	15	1998	15	1997	15
	2000	14	1999	14	1999	14	1998	14
	2001	13	2000	13	2000	13	1999	13
	2002	12	2001	12	2001	12	2000	12
	-	-	2002	11	2002	11	2001	11
	-	-	-	-	-	-	2002	10

Source: Author's calculation from PDHS 2017-2018.

Description of balance sample selection criteria

For the balance sample size, we took data for the Punjab region from August 1994 to December 2002. According to the policy implementation date, i.e., May 2014, our cutoff point is April 1998. Before the cutoff point, the ages of women were 19 to 23, while after the cutoff point, the ages of the women were 15 to 19 at the time of data collection. The policy was implemented for ages 5 to 16; therefore, we are comparing women aged 12 to 16, who were born from May 1998 to 2000, with women aged 16 to 20, who were born from 1994 to March 1998.

For the Sindh region, we are taking data from May 1992 to September 2002 for the balance sample. According to the policy implementation date, i.e., February 2013, our cutoff point is January 1997. Before the cutoff point, the ages of the women were 21 to 25, while after the cutoff point, the ages of the women were 15 to 20 at the time of data collection. The policy was implemented at the ages of 5 to 16; therefore, we are comparing the women aged 11 to 16, who were born from February 1997 to 2002, with women aged 17 to 21, who were born from 1992 to 1996.

For the Balochistan region, we are taking data from September 1991 to January 2003 for the balance sample. According to the policy implementation date, i.e., June 2013, our cutoff point is May 1997. Before the cutoff point, the ages of the women were 20 to 26, while after the cutoff point, the ages of the women were 15 to 20 at the time of data collection. The policy was implemented for ages 5 to 16; therefore, we are comparing the women aged 11 to 16, who were born from June 1997 to 2002, with women aged 16 to 22, who were born from 1991 to April 1997.

For the Islamabad region, we are taking data from August 1990 to February 2002 for the balanced sample. According to the policy implementation date, i.e., December 2012, our cutoff point is November 1996. Before the cutoff point, the ages of the women were 21 to 27, while after the cutoff point, the ages of the women were 15 to 21 at the time of data collection. The policy was implemented for ages 5 to 16; therefore, we are comparing the women aged 10 to 16, who were born from December 1996 to 2002, with women aged 16 to 22, who were born from 1990 to October 1996.

2.8 Bibliography

Ali, F. R. M., & Gurmu, S. (2018). The impact of female education on fertility: a natural experiment from Egypt. *Review of Economics of the Household*, *16*(3), 681–712. https://doi.org/10.1007/s11150-016-9357-6

Ali, T. S., Waheed, H., & Memon, A. A. (2006). Understanding of puberty and related health problems among female adolescents in Karachi, Pakistan. *Journal of the Pakistan Medical Association*, *56*(2), 68–72.

Attanasio, O. P., & Kaufmann, K. M. (2017). Education choices and returns on the labor and marriage markets: Evidence from data on subjective expectations. *Journal of Economic Behavior and Organization*, *140*, 35–55. https://doi.org/10.1016/j.jebo.2017.05.002

Becker, G. S. (1960). An economic analysis of fertility. In *Demographic and economic change in developed countries*. colambia university press.

Becker, G. S., & Lewis, H. G. (1973). Interaction between quantity and quality of children. *J.Piolit.Econ*, 81–90.

Björklund, A. (2006). Does family policy affect fertility?: Lessons from Sweden. *Journal of Population Economics*, *19*(1), 3–24. https://doi.org/10.1007/s00148-005-0024-0

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2008). Staying in the classroom and out of the maternity ward? The effect of compulsory schooling laws on teenage births. *Economic Journal*, *118*(530), 1025–1054. https://doi.org/10.1111/j.1468-0297.2008.02159.x

Cattaneo, M. D., Frandsen, B. R., & Titiunik, R. (2015). Randomization Inference in the Regression Discontinuity Design: An Application to Party Advantages in the U.S. Senate. *Journal of Causal Inference*, *3*(1), 1–24. https://doi.org/10.1515/jci-2013-0010

Cattaneo, M. D., Idrobo, N., & Titiunik, R. (2023). A Practical Introduction to Regression Discontinuity Designs. *A Practical Introduction to Regression Discontinuity Designs*. https://doi.org/10.1017/9781108684606

Cattaneo, M., N. Idrobo, and R. Titiunik. 2020a. A Practical Introduction to Regression Discontinuity Designs: Extensions. Cambridge: Cambridge University Press.

Cattaneo, M., N. Idrobo, and R. Titiunik. 2020b. A Practical Introduction to Regression Discontinuity Designs: Foundations. Cambridge: Cambridge University Press.

Cattaneo, M., R. Titiunik, and G. Vazquez-Bare. 2016. “Inference in Regression Discontinuity Designs Under Local Randomization.” Stata Journal 16(2):331–367.

Cattaneo, M., R. Titiunik, and G. Vazquez-Bare. 2020c. “The Regression Discontinuity Design.”Chap 44 in The *SAGE Handbook of Research Methods in Political Science and International Relations, edited by L. Curini and R.Franzese*, 835-857. NewYork: Sage.

Chen, J., & Guo, J. (2022). The effect of female education on fertility: Evidence from China’s compulsory schooling reform. *Economics of Education Review*, *88*(October 2020), 102257. https://doi.org/10.1016/j.econedurev.2022.102257

Chicoine, L. (2012). Education and Fertility: Evidence from a Policy Change in Kenya. *SSRN Electronic Journal*, *6778*. https://doi.org/10.2139/ssrn.2157920

Chicoine, L. (2021). Free Primary Education, Fertility, and Women’s Access to the Labor Market: Evidence from Ethiopia. *The World Bank Economic Review*, *35*(2), 480–498. https://doi.org/10.1093/wber/lhz042

Cygan-Rehm, K., & Maeder, M. (2013). The effect of education on fertility: Evidence from a compulsory schooling reform. *Labour Economics*, *25*, 35–48. https://doi.org/10.1016/j.labeco.2013.04.015

DeCicca, P., & Krashinsky, H. (2022). The effect of education on overall fertility. In *Journal of Population Economics*. Springer Berlin Heidelberg. https://doi.org/10.1007/s00148-022-00897-y

Dinçer, M. A., Kaushal, N., & Grossman, M. (2014). Women’s education: Harbinger of another spring? Evidence from a natural experiment in Turkey. *World Development*, *64*, 243–258. https://doi.org/10.1016/j.worlddev.2014.06.010

Duflo, E., Dupas, P., & Kremer, M. (2015). Education, HIV, and early fertility: Experimental evidence from Kenya. *American Economic Review*, *105*(9), 2757–2797. https://doi.org/10.1257/aer.20121607

Farid-ul-Hasnain, S., Johansson, E., Gulzar, S., & Krantz, G. (2013). Need for multilevel strategies and enhanced acceptance of contraceptive use in order to combat the spread of HIV/AIDS in a Muslim society: a qualitative study of young adults in urban Karachi, Pakistan. *Global Journal of Health Science*, *5*(5), 57–66. https://doi.org/10.5539/gjhs.v5n5p57

Farooq, M. S. (2018). Millennium Development Goals (MDGS) and Quality Education Situation in Pakistan at Primary Level. *International Online Journal of Primary Education*, *7*(1), 1–23.

Ferrant, G., & Kolev, A. (2016). Does Gender Discrimination in Social Institutions Matter for Long-term Growth? Cross-country Evidence. *OECD Working Paper No. 330*, *330*. www.oecd.org/dev/wp.

Fort, M., Schneeweis, N. E., & Winter-Ebmer, R. (2021). More Schooling, More Children? Compulsory Schooling and Fertility in Europe. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2532863

Fort, M., Schneeweis, N., & Winter-Ebmer, R. (2016). Is Education Always Reducing Fertility? Evidence from Compulsory Schooling Reforms. *Economic Journal*, *126*(595), 1823–1855. https://doi.org/10.1111/ecoj.12394

Gabrielson, L. (2010). *Maternal Schooling in Pakistan : The Girl Effect in Action*. *1*(2), 60–73.

Government of Pakistan. (1987). Pakistan Contraceptive Prevalence Survey. *Population Welfare Division, Ministry of Planning and Development, Islamabad, Pakistan.*

Grépin, K. A., & Bharadwaj, P. (2015). Maternal education and child mortality in Zimbabwe. *Journal of Health Economics*, *44*, 97–117. https://doi.org/10.1016/j.jhealeco.2015.08.003

Grossman, M. (2006). Education and Nonmarket Outcomes. *Handbook of the Economics of Education*, *1*(06), 577–633. https://doi.org/10.1016/S1574-0692(06)01010-5

Haque, M. S. (2018). *The cause of low enrolment of females secondary education: A comparative study between Bangladesh and Pakistan.* http://www.journalijdr.com

Hennink, M., Rana, I., & Iqbal, R. (2005). Knowledge of personal and sexual development amongst young people in Pakistan. *Culture, Health and Sexuality*, *7*(4), 319–332. https://doi.org/10.1080/13691050500035367

Idrees, A. S., & Sarwar, S. (2023). *Factors Associated With School Dropout in Pakistan: an Assessment Using Survival Analysis*. *September*.

Imbens and Rubin. (2015). “Causal Inference in Statistics, Social, and Biomedical Sciences.” In Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction. In *Cambridge University Press*. https://doi.org/10.4324/9781003319061-6

Kattan, Bentaouet;, R., & Burnett, N. (2004). Education For All Working Paper No. 30108, Education Sector, Human Development Network. *World Bank,Washington, DC.*

Keats, A. (2018a). Women's schooling, fertility, and child health outcomes: Evidence from Uganda's free primary education program. *Journal of Development Economics*, *135*, 142–159. https://doi.org/10.1016/j.jdeveco.2018.07.002

Keats, A. (2018b). Women's schooling, fertility, and child health outcomes: Evidence from Uganda's free primary education program. *Journal of Development Economics*, *135*(June), 142–159. https://doi.org/10.1016/j.jdeveco.2018.07.002

Lam, D., & Duryea, S. (1999). Effects of schooling on fertility, labor supply, and investments in children, with evidence from Brazil. *Journal of Human Resources*, *34*(1), 160–192. https://doi.org/10.2307/146306

Lavy, V., & Zablotsky, A. (2015). Women's schooling and fertility under low female labor force participation: Evidence from mobility restrictions in Israel. *Journal of Public Economics*, *124*, 105–121. https://doi.org/10.1016/j.jpubeco.2015.02.009

Mccrary, B. J., & Royer, H. (2011). The Effect of Female Education on Fertility and Infant Health : Evidence from School Entry Policies Using Exact Date of Birth Author. *American Economic Association*, *101*(1), 158–195. https://doi.org/doi:10.1257/aer.101.1.158

Monstad, K., Propper, C., & Salvanes, K. G. (2008). Education and fertility: Evidence from a natural experiment. *Scandinavian Journal of Economics*, *110*(4), 827–852. https://doi.org/10.1111/j.1467-9442.2008.00563.x

Musaddiq, T., & Said, F. (2023). Educate the girls: Long run effects of secondary schooling for girls in Pakistan. *World Development*, *161*, 106115. https://doi.org/10.1016/j.worlddev.2022.106115

Nawaz, A. R., Anwar, U., & Aquil, F. (2021). An economic impact of political instability: An evidence from Pakistan. *Journal of Economic Impact*, *3*(1), 47–54. https://doi.org/10.52223/jei3012106

Osili, U. O., & Long, B. T. (2008). Does female schooling reduce fertility? Evidence from Nigeria. *Journal of Development Economics*, *87*(1), 57–75. https://doi.org/10.1016/j.jdeveco.2007.10.003

Pakistan Lawyer. (2024). *Article 25A of the constitution of Pakistan: Empowering education for all*. Pakistan Lawyer, Easy Access to Justice.

Sathar, Z., Crook, N., Callum, C., & Kazi, S. (1988). Women's status and fertility change in Pakistan. *Population & Development Review*, *14*(3), 415–432. https://doi.org/10.2307/1972196

Shaikh, B. T., & Rahim, S. T. (2006). Assessing knowledge, exploring needs: A reproductive health survey of adolescents and young adults in Pakistan. *European Journal of Contraception and Reproductive Health Care*, *11*(2), 132–137. https://doi.org/10.1080/13625180500389463

Snilstveit, B., Stevenson, J., Phillips, D., Vojtkova, M., Gallagher, E., Schmidt, T., Jobs, H., Geelen, M., Pastorello, M. G., & et al. (2016). The Impact of Education Programmes on Learning and School Participation in Low- and Middle-Income Countries. 3ie Systematic Review Summary 7. In *International Initiative for Impact Evaluation, ashington, DC*. https://www.3ieimpact.org/sites/default/files/2019-05/SR24-education-review_2.pdf

Strauss, J., & Thomas, D. (1995). Human resources: Empirical modeling of household and family decisions. *Handbook of Development Economics*, *3*(PART A), 1883–2023. https://doi.org/10.1016/S1573-4471(05)80006-3

UNFPA, P. (2019). *Estimating the Health Impacts and Economic Returns of Increased Family Planning Provision in Sindh*.

World Bank. (2009). *Abolishing School Fees in Africa: Lessons from Ethiopia, Ghana, Kenya, Malawi, and Mozambique. Washington, DC.*

Zuehlke, E. (2009). *Changes in fertility rates among muslims in India, Pakistan, and Bangladesh*. Population Reference Bureau. https://www.prb.org/resources/changes-in-fertility-rates-among-muslims-in-india-pakistan-and-bangladesh/

Chapter 3

Does Intimate Partner Violence Increase the Risk of High Fertility Behavior in Pakistan?

Abstract

Intimate partner violence (IPV), a devastating consequence of gender inequality in society, is the most common type of IPV, with intimate partners perpetrating the majority of abuse and causing serious health repercussions for women. Women who have experienced abuse are also at a greater risk of reproductive health effects, inconsistent and poor levels of contraceptive usage, unwanted pregnancies, and unfavorable pregnancy outcomes. Pakistan remains with a high fertility rate, despite several programs and policies aimed at attaining significant fertility reductions in the region. This research examines whether women's exposure to domestic violence is a contributing factor to increased fertility in Pakistan. We used data from the Pakistan Demographic Health Survey (PDHS) 2017-2018. A weighted sample of 3,416 currently married women in Pakistan was analyzed. Our dependent variable is the total number of children ever born, which is the proxy of fertility, and the main explanatory variable is intimate partner violence (physical, emotional, and sexual). An instrumental variable Poisson generalized method of moments estimator was used in estimating the model. This helped us deal with the significant endogeneity among our primary variables of interest. Our findings support the hypothesis that women who have experienced domestic violence have greater fertility rates compared to those who have not. The IV Poisson generalized method of moments analysis revealed a causal link between increased fertility and violence in Pakistan after controlling for background characteristics. The study suggests that policies and programs aimed at reducing Pakistan's high birth rate should prioritize addressing systemic gender inequity, which contributes to violence against women in Pakistan.

Keywords: Intimate Partner Violence, Fertility, Instrumental Variable, Poisson Generalized Method of Moments, Demographic Health Survey, Pakistan.

3.1 Introduction

Domestic violence against women is a major public health problem and an infringement of women's human rights. According to World Health Organization estimations, one in every three women (30%) has suffered abuse from an intimate partner in their lifetime. Domestic violence is typically defined as a partner's behavior that causes physical, sexual, or psychological harm, including physical aggressiveness, sexual assault, psychological assault, and controlling behaviors (World Health Organization, 2013). According to the World Health Organization (2005), domestic violence is "the range of sexually, psychologically, and physically coercive acts used against adult and adolescent women by current or former male intimate partners." Although physical intimate partner abuse has been more commonly studied, findings indicate that psychological intimate partner violence (IPV) may be utilized to retain dominance and control over women, potentially contributing to or accompanying physical assault (Follingstad, 2011; Lee Ann Hoff, 2009).

Pakistan has been considered one of the countries with the biggest gendered power imbalance, which benefits males due to its classical patriarchal society (Hadi, 2017). Women are traditionally viewed as men's dependents in society, and women have limited decision-making power and minimal freedom in shaping their socioeconomic identities (Mumtaz et al., 2011). These obstacles make women more vulnerable to violence. They experience various deviant, dangerous, or violent activities, including sexual assault, rape, forced marriage, and intimate partner violence (Hadi, 2017). Girls and women receive inadequate education, with lower literacy rates compared to males contributing to the unequal power dynamic within the household (Saqib and Ahmad, 2014). Pakistan has a population of 220 million, with women representing 49% of its population. However, the Global Gender Gap Index 2024 places Pakistan 145 out of 146 countries worldwide concerning gender equality (World Economic Forum, 2024). Gender-based violence may limit women's control over their fertility (Hindin et al., 2008; Miller et al., 2010). Domestic violence and fertility are a complex phenomenon, and being pregnant or giving birth may be related to a reduction in violence, as women acquire prestige in their family by demonstrating their fertility. On the other hand, being pregnant and giving birth may be related to an increase in aggressive behavior, owing to the added interpersonal and household stress generated by pregnancy (Raifman et al., 2021). In addition, Pritadrajati (2023) has demonstrated that bigger family sizes cause domestic violence, implying that fertility increases IPV. Intimate partner violence is a serious public health issue that affects

physical, mental, and reproductive health during the entire life course. Infertility is not merely a reproductive health problem; it is also a social problem that may have an impact on family, marital, and other interpersonal connections, especially in cultures where childbirth is precious and fundamental to women's identities. In societies where childbearing is highly regarded, women who are either unable to bear offspring or possess a small family may experience social judgment (Yang et al., 2014). Conversely, some of the studies have shown a link between intimate partner violence and fertility (Frade and Odimegwu, 2018; Odimegwu et al., 2015; Stieglitz et al., 2018). Therefore, experiences of violence can influence fertility, and infertility can impart risk for IPV (Bourey and Murray, 2022). Furthermore, fertility also affects IPV (Pritadrajati 2023). These findings indicate a complex, bidirectional link between gender-based violence and reproductive challenges, emphasizing the importance of integrated methods to deal with both issues concurrently. However, the bidirectional link suggests a presence of endogeneity to support a causal relationship between IPV and fertility. Despite this, there is still a lack of studies examining the causal factors that domestic violence is a contributing factor to increased fertility.

Pakistan is divided into four provinces: Sindh, Punjab, Khyber Pakhtunkhwa, and Balochistan, as well as the territories of Islamabad, each with its own population, employment, education, and other socioeconomic, demographic, and geographic characteristics (PDHS, 2012–2013). Some provinces and regions (for example, Punjab, Islamabad, and Sindh) are more modernized than other regions because they have greater rates of schooling, higher-quality electronic media and educational facilities, and better access to healthcare (PDHS, 2006–2007). Khyber Pakhtunkhwa and Balochistan are more traditional, heavily affected by patriarchal values, and have a greater incidence of IPV. According to the PDHS (2017-2018), Khyber Pakhtunkhwa (52%) and Balochistan (49%) have the largest number of women who have suffered physical, sexual, or emotional violence from their spouses. In Islamabad and Punjab, 32 percent of women face marital violence, and the lowest proportion is observed in Sindh (18%).

The rapid population growth rate in Pakistan has created major challenges in achieving the targets of the Sustainable Development Goals (SDGs). Pakistan is one of the nations that has experienced rapid population expansion since its founding because of a high fertility rate that continued into the middle of the 1980s at more than 6 births per woman. In 1984–85, the average number of children per woman fell to fewer than 6, the first trend of declining fertility (Government of Pakistan, 1987) announcing the onset of fertility transition that took place in

the 1990s (Sathar and Casterline, 1998). In 1985–90, the total fertility rate was 5.4 births per woman. During 2006–07, the total fertility rate dropped to 4.1 births per woman and to 3.8 births per woman by 2013 (PDHS, 2012–13). According to PDHS (2017–18), the fertility rate was found to be 3.6 births per woman. Alternative indirect methods of calculation Naz et al. (2023) suggest that these figures could be underestimated, with fertility still above 4 children per woman on average. Although the government of Pakistan has taken some initiatives to overcome the problem of higher fertility rates, fertility remains relatively high and is decreasing at a slow pace. To lower Pakistan's future population growth rate and benefit from a demographic dividend, there is a need to reduce fertility. To achieve this, it is important to understand the indicators that are contributing to the rise or fall of fertility as well as devise strategies to deal with them.

Intimate partner violence (IPV), a serious sign of gender inequality, is the most common kind of violence, with intimate partners accounting for the vast majority of abuse, resulting in considerable negative health effects for women. Women who have been subjected to IPV are more likely to have reproductive health problems, irregular contraceptive use, unexpected pregnancies, and poor pregnancy outcomes. Despite several policies and programs aimed at reducing fertility, Pakistan's fertility rate remains high, indicating a variety of underlying issues. This study investigates whether female exposure to domestic violence may contribute to Pakistan's high fertility rates.

Therefore, the purpose of this research is to propose a causal link between women's IPV and fertility and to determine whether this relationship explains part of the persistently high fertility levels in Pakistan. While there is substantial research on the association between intimate partner violence and fertility, there is no study that has examined the causal relationship between IPV and fertility. Furthermore, researchers have yet to investigate this issue in Pakistan. Our research addresses this gap by investigating the complex and bidirectional link between intimate partner violence and fertility in Pakistan. The paper is organized as follows: Section 3.2 sets the theoretical background, Section 3.3 presents our empirical evidence, Section 3.4 discusses methodology, data source, and study variables and presents our analytical technique, Section 3.5 presents and analyzes the results, Section 3.6 discusses the findings, and Section 3.7 adds a conclusion.

3.2 Theoretical Background

Scholars have mostly used two theoretical frameworks to determine the correlates of intimate partner violence (IPV). According to the resource theory (Blood and Wolfe, 1960), spouses with fewer resources, such as education and income, are more prone to experience intimate partner violence (Goode, 1971; Vyas and Watts, 2009). Gender performance theory (West and Zimmerman, 1987) is a feminist epistemology that considers gender power dynamics and structural imbalances (Anderson, 1997). According to this point of view, IPV is culturally rooted and reinforces patriarchal norms (Chung et al., 2008; Weitzman, 2014). Both perspectives have offered ways of comprehending the intricacies of IPV in Western countries (Anderson, 1997; Goode, 1971). There is also a series of competing and/or complementary theoretical propositions attached to these two frameworks. For instance, gender inequality theory/gender performance theory and cultural and social norm theory both discuss power dynamics and the pressure on women to bear children. These norms are influencing resource distribution, while the resource theory posits that the unequal distribution of resources between partners is a primary cause and will influence power dynamics (reinforcing norms and gender inequality) (Shepherd, 2016; Törnblom and Kazemi, 2012).

Numerous theoretical points of view contribute to our knowledge of IPV against women. Resource theory, which developed from previous theories of marital power (Blood and Wolfe, 1960), contends that resource inequities in marital relationships are the primary reason for IPV (Goode, 1971; Vyas and Watts, 2009). Women's bargaining power depends on their economic and non-economic resources (Blood and Wolfe, 1960). This authority not only represents the ability to affect family interactions, such as involvement in chores and household decision-making (Bargain et al., 2019; Hu, 2019), but it might also protect from violence (Bowlus and Seitz, 2006). Therefore, supporters of this point of view consider spousal resources as the key organizing force in marital relationships, with resource imbalances motivating the use of IPV. In addition, intimate partner violence is a multifaceted, complex phenomenon, as evidenced by theory and research.

Relational reliance both reflects and determines marital power (Goode, 1971; Kalmuss and Straus, 1982). The availability of assets can boost women's autonomy and protect them from intimate partner violence (Goode, 1971). Women's education has a crucial role in challenging established gender stereotypes (Flake, 2005; Jewkes, 2002), particularly those related to female domesticity and social expectations. Education can increase women's access to support

networks, reducing the likelihood of rationalizing their spouses' utilization of IPV (Jewkes, 2002; Yount & Li, 2009) and preparing them to leave violent partnerships (Vyas and Watts, 2009).

IPV can negatively impact women's health by exacerbating menopausal symptoms, increasing the risk of diabetes and sexually transmitted infections, and contributing to high-risk behaviors like substance and alcohol abuse. It can also lead to persistent diseases and pain (Stubbs and Szoeke, 2022). Moreover, marital violence raises concerns about reproductive rights, which are evaluated internationally by utilizing indicators related to reproductive health as the key measurement for success in fulfilling these rights (World Health Organization, 2006b). These include the right to control fertility, the ability to choose to have children or not, and their quantity and timing of childbearing (United Nations, 2014). According to Principle 4 of the International Conference on Population and Development (ICPD) Program of Action, "Advancing gender equality and equity and the empowerment of women, and the elimination of all kinds of violence against women, and ensuring women's ability to control their own fertility, are cornerstones of population and development-related programs." The Sustainable Development Goals (SDGs) emphasize women's sexual and reproductive health issues (SDG 3.7) and gender inequality issues (SDG 5) in their global agenda. However, objectives for both SDGs have been established, individual nations must still identify strategies to fulfill those targets and examine the links between these developmental aspects, considering the interconnected nature of vital development and health challenges (UNFPA, 1995).

IPV correlates include low educational attainment, low socioeconomic status, alcohol use by male partners, physical strength dissimilarities, women's acceptance of violence in intimate relationships, and rural status of residency. All of these factors, along with strongly ingrained patriarchal societies, traditional family values promoting harmony, and ideological demands to sustain marriages, drive women to become trapped in violent relationships (Adu, 2023; Aslam et al., 2015; Nabaggala et al., 2021; Navarro-Mantas et al., 2022; Ranganathan et al., 2021; Sardinha et al., 2022; Shubina et al., 2023). Furthermore, use of alcohol by the husband is highly linked with intimate partner violence (World Health Organization, 2006a). More specifically, men who abuse alcohol or other substances are more prone to harm their spouses (Nabaggala et al., 2021). In summary, the use of alcohol by the husband is a very good instrumental variable for intimate partner violence.

Multiple theoretical frameworks propose that IPV might have life-course and intergenerational repercussions (Collins, 2000; Ford-Gilboe et al., 2005; Riddell et al., 2009; Straus et al., 2006; Uslucan and Fuhrer, 2008). The intergenerational transmission of violence theory contends that experiencing domestic violence (direct victimization) or watching it (indirect/vicarious victimization) can result in subsequent cycles of IPV, either perpetration or victimization (Black et al., 2010; Kalmuss, 1984; Straus et al., 1980; Uslucan and Fuhrer, 2008). In summary, parental IPV is linked to a greater probability of experiencing or committing IPV in adulthood, which is a good instrumental variable for IPV. It depends on the social environment, life experience, and context. It has also been proved statistically that parental IPV and the husband's use of alcohol are good instrumental variables for IPV (see appendix A).

A bigger family is thought to be more prone to turn to violence because of the additional strain of caring for several children, which can generate enormous frustration and anxiety (Hoffman et al., 1994). As a member of a large family, the experience of violence may become not just an option but also an expected response to these circumstances.

3.3 Empirical Evidence

The impact of IPV on reproduction varies, especially in developing nations with high fertility rates, although empirical evidence supports a relationship between violence and fertility (Frade and Odimegwu, 2018; Odimegwu et al., 2015; Stieglitz et al., 2018). Studies have shown that under certain situations, there is a link between violence and fertility. One example of this research is the World Health Organization's multi-country examination of women's violence and health, which was conducted in 15 locations across 10 nations (World Health Organization, 2005). Excluding Thailand and Japanese cities, this study shows that women who had experienced violence were more likely to have children than women who had not. Furthermore, there are different recent studies, Shams Ghahfarokhi (2024) found that women who have experienced IPV may have slightly higher fertility rates than women who have not experienced IPV. Research from India and sub-Saharan Africa revealed that women who have experienced sexual IPV are more likely to engage in multiple high-risk reproductive attitudes (Aboagye et al., 2024; Das et al., 2022). Notably, women who have experienced IPV have shorter intervals between pregnancies and are more at risk of an unwanted pregnancy (Maxwell et al., 2018). Pritadrajati (2023) found evidence of a direct causal link between family size and an increased prevalence of intimate partner violence, with bigger families being more likely to tolerate violent behavior. In contrast, other studies have shown that there is no relationship between

violence and fertility or have suggested that it is only associated with specific conditions (Landeis et al., 2021). These results indicate that the link between violence and fertility may be complicated and specific to the context and that further study is needed to acquire a thorough knowledge of this relationship and its implications for reproductive health. Notably, there are no studies on the relationship between domestic violence and fertility in developed countries. There is no study either particularly focusing on gender-based violence and fertility in Pakistan.

3.4 Methodology

The aim of the paper is to analyze the complex and bidirectional phenomena of gender-based violence and fertility, taking into consideration socioeconomic and demographic factors. Hence, this research examines whether women's exposure to domestic violence is a contributing factor to increased fertility in Pakistan. The hypothesis under consideration regarding this study is to analyze the causal relationship between gender-based violence and fertility, which is as follows:

H_0 Women who experience IPV have increased their fertility.

H_1 Women who experience IPV do not increase their fertility.

3.4.1 Data Source

The study analyzed the 2017-2018 Pakistan Demographic Health Survey (PDHS) dataset; it is an accessible source created by ICF in Rockville, Maryland, USA. ICF conducted the fourth survey in Pakistan as part of the DHS international series (PDHS 2017-2018) in collaboration with the National Institute of Population Studies (NIPS). PDHS is a nationally representative two-stage stratified cluster sample and cross-sectional data of ever-married women and men aged between 15 and 49. Pakistan is divided officially into four provinces: Sindh, Punjab, Balochistan, and Khyber Pakhtunkhwa (KPK), with other regions like Federally Administrated Tribal Areas (FATA) and the capital of the country, Islamabad Capital Territory (ICT). The PDHS is intended to provide a reliable estimate for numerous variables for a range of health and demographic analyses across several areas of interest. DHS interviews solely one eligible woman from each household selected for an IPV interview, yielding a weighted sample of 3,416 currently married women in Pakistan.

3.4.2 Study Variables

This section describes how the research variables were operationalized and the scales used to measure them. The dependent variable, total number of children ever born, is a measure of women's lifetime fertility at the time of the survey, and it is a count variable. To measure this variable in the DHS, each woman was given a series of questions on the number of sons and daughters now living with her, those living elsewhere, and those born alive but who subsequently died. The main explanatory variable is intimate partner violence. Intimate partner violence (IPV) is defined as a woman experiencing any form of either physical, emotional, and sexual violence from her current or past husband. It was coded as a dichotomous variable.

Based on the literature, the study included predictor factors as well as control variables chosen for their statistical significance to fertility (Das et al., 2022; Frade and Odimegwu, 2018). These variables included the age of the women (15–49 years); women's educational attainment (no education, primary, secondary, and higher); age at first marriage; place of residence (urban, rural); and household wealth quantile (poorest, poorer, middle, richer, and richest). Furthermore, resource theory proposes a framework for understanding how decision-making authority, behavioral control, and violence are interconnected (Blood and Wolfe, 1960). For the decision-making variable, the responder makes decisions about her healthcare, large home purchases, and family/relative visits, either individually or with her spouse, and responses were either yes if she participated in decision-making or no. For the controlling behavior or marital control variable, the responder has experienced instances of controlling conduct from her spouse, such as jealousy if she talks to other men, allegations of being unfaithful, refusal to allow her to meet her female friends, attempts to limit communication with her family, or insistence on knowing wherever she is, and responses were either yes if she has experienced controlling behavior or no. The study includes an instrument variable based on the theoretical background; parental IPV is related to an increased chance of experiencing or committing IPV as an adult, according to the intergenerational transmission of violence theory (Black et al., 2010; Kalmuss, 1984; Straus et al., 1980; Uslucan and Fuhrer, 2008). This variable included knowledge of parental IPV, such that the respondent answered affirmatively to the question of whether she had ever seen her father hit her mother, and the responses were either yes if she had knowledge of parental IPV or no. Additionally, use of alcohol by a husband is highly linked with IPV (World Health Organization, 2006a; Adu, 2023; Aslam et al., 2015; Nabaggala et al., 2021; Navarro-Mantas et al., 2022; Ranganathan et al., 2021; Sardinha et al., 2022; Shubina et

al., 2023). In particular, husbands who abuse alcohol or other drugs are more likely to hurt their wives (Nabaggala et al., 2021). Alcohol consumption is informed by respondents being asked if their husband or partner drank alcohol, and the responses were either yes or no.

3.4.3 Analytical Technique

The relationship between IPV and fertility is complex, interactive, and bidirectional. Previous research has revealed that IPV affects women's fertility (Frade and Odimegwu, 2018; Odimegwu et al., 2015; Stieglitz et al., 2018). Conversely, women who have no children may experience violence or coercion because of their reproductive circumstances (Akpinar et al., 2019; Stellar et al., 2016). These studies suggest that violence can affect fertility outcomes, while fertility status (especially infertility) can also increase the probability of dealing with violence. On the other hand, recent research by Pritadrajati (2023) and Raifman et al. (2021) has shown that larger family size and childbirth increase intimate partner violence, meaning that fertility also affects IPV. Thus, there is evidence of a bidirectional link, suggesting the presence of endogeneity. Furthermore, our data is cross-sectional and survey-based, making it difficult to account for unobserved factors such as cultural norms and social attitudes. This creates a possibility of omitted variable bias and simultaneity bias. Therefore, there is a problem of endogeneity in our model, which is very critical and strong. In this study, the outcome variable is the total number of children ever born, which is a count variable; therefore, we use the Generalized Method of Moments (GMM) estimator for IV Poisson regression to address endogeneity and estimate the causal effect of Intimate Partner Violence (IPV) on fertility. Considering the possibility for heteroscedasticity and intra-cluster correlation in cross-sectional data, we used the GMM estimator, which is robust against heteroscedasticity, while cluster-robust standard errors produce asymptotically valid inferences for clustered data. Therefore, we use a marginal effect with cluster-robust standard errors and survey weights to obtain an accurate estimate under survey designs (e.g., sample weights and clustering) (Cameron and Miller, 2015; Greene, 2018; Wooldridge, 2010; Mullahy, 1997). This method allows for the specification of additional exogenous variables that have no direct influence on the dependent variable and the instrumentation of endogenous variables using omitted instruments. The instrumental variable Poisson generalized method of moments can be specified as

$$E\left[f_i \mid IPV_i, W_i\right] = exp\left(\beta_0 + \beta_1 IPV_i + \beta_2' W_i\right.$$

where f_i is the fertility of the i th woman measured by the number of children ever born to a woman, IPV is the measure of intimate partner violence, and W is a measure of control variables including age cohort, women's education, husband's education, wealth index, place of residence, decision-making, and marital control. We instrument for intimate partner violence using alcohol use and parental experience of IPV. The GMM estimation is based on the moment conditions;

$$E\left[Z_i\left(f_i - exp(\beta_0+\beta_1 IPV_i+\beta 2' W_i)\right)\right] = 0$$

where Zi represents our instruments variables.

3.5 Results

3.5.1 Descriptive Statistics of Key Variables

Table 3.1 shows the summary statistics of the variables used in the model. The statistics indicate that 33.56 percent of women have experienced intimate partner violence (physical, emotional, and sexual), and 66.44 percent have not experienced IPV. The husband's alcohol consumption was 3.60%. 63.08 percent of women took major decisions either alone or jointly with their spouses. 20.49 percent of the respondents said that they know that they have seen their father beating their mother, and 27.65 percent of women experienced marital control by their husband. 50.35 percent of women had no formal education, and those with primary, secondary, and higher education were 15.5, 19.88, and 14.27 percent, respectively. It makes the proportion of no formal education for women slightly higher than primary, secondary, and higher education together. Although men have higher educational attainment on average, their distribution follows a similar pattern. 30.65 percent of partners had no formal education, and primary, secondary, and higher education were 16.22, 32.26, and 20.86 percent, respectively. Most of the women live in rural areas, with a rate of 62.24%, and 37.76% live in urban areas. The highest proportion of women in the age group of 18-25 years at first marriage is 56.91 percent, and the age groups of 14, 15-17, and 26 and above years are 8.08, 27.31, and 7.70 percent, respectively. The statistics also show that 19, 20.79, 19.51, 20.26, and 20.44 percent of the women fall under the wealth status of poorest, poorer, middle, richer, and richest, respectively.

Table 3.2 represents the prevalence of intimate partner violence according to the characteristics of the study population (n = 3,416). We observed that women aged 30-49 experienced more IPV than women aged 15-29. A smaller percentage of women who had ever experienced IPV

reported completing higher levels of education (79.74% vs. 20.26%). It is observed that women with no formal education, primary education, or secondary education experience higher levels of IPV than women with higher education. Women who experienced IPV were less likely to report that their partners had completed higher education (76.48% vs. 23.52%); similar patterns are shown in partner IPV and education. Additionally, IPV is more prevalent among women living in rural regions. Furthermore, 49.91, 34.67, 31.22, and 29.79 percent of women aged 14, 15-17, 18-25, and 26 and older experienced IPV at first marriage. This means that women who were younger at first marriage experience more IPV than older women. The statistics also show that 35.93, 41.98, 37.45, 29.96, and 22.65 percent of women experienced IPV under the wealth status of poorer, poorest, middle, richer, and richest, respectively. It means that women who are poor experience more IPV than rich women. Approximately 30 percent of women who experienced IPV took the major decision alone or with their spouse, and about 40 percent of women who did not take a decision had experienced IPV, meaning that women who took major decisions either alone or jointly experienced lower IPV. Most of the women experienced IPV (79.58%) when their husbands drank alcohol, compared to those whose husbands did not drink alcohol (31.84%). Similarly, most of the women who had experienced IPV (57.36%) knew that they had parental knowledge of IPV compared to those who did not have parental knowledge of IPV (27.31%).

3.5.2 Empirical Results

The results show that gender-based violence (physical, emotional, and sexual) has a significant causal effect on fertility rates in Pakistan in Table 3.3. A higher rate of IPV increases the fertility rate with an effect size of 0.85, meaning that a woman who has suffered gender-based violence is expected to have a 0.85 higher fertility rate than someone who has not.

The results show that women’s education, husband’s education, wealth status, and women’s age at first marriage are significant fertility predictors. In accordance with the literature, the results further show that fertility decreases with respondent secondary and higher education, husband secondary education, wealth status, and women’s age at first marriage. Fertility decrease with women's and their partners’ education is expected because education is inclined towards fewer children. The results also show that fertility declines with household wealth status. Furthermore, age at first marriage suggests that later marriages tend to have lower fertility rates due to factors such as increased education.

3.6 Discussion

The aim of this paper was to estimate the causal effect of gender-based violence experienced by women, especially IPV, on their fertility in Pakistan. The findings show that gender-based violence is positively linked to fertility, which is consistent with previous research. The findings suggest that women who have suffered gender-based violence have significantly more children on average than their peers who have not. The introduction of instrument variables, like partner alcohol consumption and knowledge of parental IPV, both increasing the risk of IPV but not fertility, allows us to confirm the influence of IPV on fertility. The findings of the study demonstrate that IPV contributes to higher fertility among Pakistani women, other factors being equal. These results are consistent with previous research. For instance, they are consistent with findings of gender-based violence as one of the causes contributing to chronically high fertility rates in Uganda, as reported by Frade and Odimegwu (2018). In line, Stieglitz et al. (2018) found that intimate partner violence predicts increased marital fertility among Bolivian Tsimané forager-horticulturists, whereas Odimegwu et al. (2015) reported that women who suffered domestic violence had higher fertility rates in Sub-Saharan Africa. Our result shows a positive causal relationship between intimate partner violence (IPV) and fertility in Pakistan. The result aligns with previous studies that have reported a positive association between intimate partner violence and fertility (Frade and Odimegwu (2018); Odimegwu et al., (2015); Stieglitz et al., (2018)). Previous studies showed associations without showing causality. Our research contributes to the literature by using an instrumental variable approach to address endogeneity and develop robust causal estimation. This finding suggests that the positive associations shown in prior research may indeed represent underlying causal mechanisms relating to IPV and fertility.

According to our findings, respondents' wealth quintile, age at first marriage, education level (secondary and higher), and partner’s secondary education level are inversely related to high fertility behaviors. Previous literature has shown that enhancing women's status via education and increasing household income not only decreases physical and sexual violence against women but also has a trickle-down effect on reproductive practices, ultimately reducing fertility (Das et al., 2022). Furthermore, age at first marriage suggests that later marriages tend to have lower fertility rates due to factors such as increased education (Frade and Odimegwu, 2018).

3.7 Conclusion

Our results suggest that intimate partner violence is linked to fertility behavior among women in Pakistan. In Pakistan, intimate partner violence (physical, mental, and sexual) and its different expressions should be taken into account while developing and implementing policies to improve women's reproductive health. It is widely accepted that women's empowerment and autonomy can reevaluate physical, emotional, and sexual rights, as well as raise awareness of reproductive health behaviors, implying that improving women's socioeconomic status through education and employment opportunities should be key policy goals. There is a requirement for a better understanding of intimate partner violence and high reproductive behavior, and women's empowerment through education, employment, and secure access to contraception may help reduce fertility and particularly unwanted births directly as well as indirectly through reducing IPV.

It is necessary to address the possible effect of domestic violence on women's reproductive decisions, their access to reproductive healthcare, and autonomy. Addressing domestic violence and supporting reproductive health and rights are essential to ensure that women can make informed reproductive decisions and maintain control over their bodies and fertility. Intimate partner violence not only harms the victims immediately, but it also has long-term effects on the family structure and society. These repercussions are interwoven like chain links and can cause significant damage. Considering this, the research study emphasizes the importance of policies and programs targeted at managing fertility and reproductive rights in Pakistan that take into account the societal values and norms that promote gender inequality and violence against women. Addressing these underlying factors via policies and programs can prevent intimate partner violence and enhance reproductive rights and health for women in Pakistan. The study suggests that policies and programs aimed at reducing Pakistan's high birth rate should prioritize addressing systemic gender inequity, which contributes to violence against women in Pakistan.

Table 3.1 Summary statistics of the variables in the model.

Variable	Frequency	Percent	Variable	Frequency	Percent
Experienced violence			Decision making		
No	2,269	66.44	Does not participated	1,261	36.92
Yes	1,147	33.56	Participated	2,155	63.08
Husband/partner drinks alcohol			Marital control		
No	3,293	96.40	No	2,471	72.35
Yes	123	3.60	Yes	945	27.65
Parental knowledge of IPV			Place of residence		
No	2,711	79.51	Urban	1,290	37.76
Yes	699	20.49	Rural	2,126	62.24
Women education			Husband education		
No education	1,729	50.35	No education	1,015	30.65
Primary	529	15.50	Primary	537	16.22
Secondary	679	19.88	Secondary	1,068	32.26
Higher	488	14.27	Higher	691	20.86
Age of women			Age at first marriage		
15-19	115	3.36	Up to 14	276	8.08
20-24	495	14.51	15-17	933	27.31
25-29	655	19.19	18-25	1,943	56.91
30-34	721	21.11	26+	263	7.70
35-39	628	18.38			
40-44	401	11.75			
45-49	400	11.70			
Wealth status					
Poorest	649	19.00			
Poorer	710	20.79			
Middle	666	19.51			
Richer	692	20.26			
Richest	698	20.44			

Source: Author's computation from PDHS (2017-18).

Table 3.2 Prevalence of intimate partner violence according to the characteristics of the study population (n=3,416).

Variables	n	Intimate partner violence		χ^2 (*p*-value)
		No	Yes	
Women age cohorts				
15-19	114.6	70.47	29.53	17.1 (0.008)
20-24	495.5	71.73	28.27	
25-29	655.5	68.28	31.72	
30-34	721	62.80	37.20	
35-39	628	64.86	35.14	
40-44	401	65.46	34.54	
45-49	400	65.73	34.27	
Women education				
No education	1,719.6	62.86	37.14	92.02 (0.000)
Primary	529.4	61.33	38.67	
Secondary	679	69.94	30.06	
Higher	487.4	79.74	20.26	
Husband education				
No education	1,015	62.75	37.25	49.68 (0.000)
Primary	537	61.18	38.82	
Secondary	1,068.3	66.92	33.08	
Higher	691	76.48	23.52	
Place of residence				
Urban	1,290	71.19	28.81	21.99 (0.000)
Rural	2,125.7	63.56	36.44	
Age at first marriage				
Up to 14	276.1	50.09	49.91	39.3424 (0.000)
15-17	932.8	65.33	34.67	
18-25	1,943.8	68.78	31.22	
26+	263	70.21	29.79	
Wealth status				
Poorest	649.1	64.07	35.93	105.04 (0.000)
Poorer	710	58.02	41.98	
Middle	666.3	62.55	37.45	
Richer	692	70.04	29.96	
Richest	698.1	77.35	22.65	
Decision making				
Does not participated	1,261	60.16	39.84	50.28 (0.000)
Participated	2,154.7	70.12	29.88	
Marital control				
No	2,471.3	78.18	21.82	631.37 (0.000)
Yes	944.3	35.70	64.30	
Husband/partner drinks alcohol				
No	3,292.5	68.16	31.84	109.48 (0.000)
Yes	123.1	20.42	79.58	
Parental knowledge of IPV				
No	2,712	72.69	27.31	329.10 (0.000)
Yes	699	42.64	57.36	

Source: Author's computation from PDHS (2017-18).

Table 3.3 Average Marginal Effect with Cluster-Robust Standard Errors of IV Poisson Estimate.

Variables	Marginal effects	Robust St. Err	z	P>|z|	[95% conf. interval]	
Any violence (No violence)	0.855**	0.353	2.420	0.016	0.162	1.547
Age cohort (15-19)						
20-24	0.897***	0.081	11.070	0.000	0.738	1.056
25-29	2.176***	0.099	22.060	0.000	1.983	2.370
30-34	3.362***	0.114	29.380	0.000	3.138	3.587
35-39	3.981***	0.124	32.130	0.000	3.738	4.224
40-44	4.936***	0.154	32.060	0.000	4.635	5.238
45-49	5.155***	0.187	27.570	0.000	4.789	5.522
Women education (No education)						
Primary	-0.143	0.137	-1.050	0.296	-0.411	0.125
Secondary	-0.229*	0.134	-1.710	0.087	-0.490	0.033
Higher	-0.477***	0.158	-3.010	0.003	-0.788	-0.166
Husband education (No education)						
Primary	0.236*	0.133	1.780	0.075	-0.023	0.496
Secondary	-0.219*	0.114	-1.920	0.055	-0.444	0.005
Higher	-0.067	0.152	-0.440	0.658	-0.365	0.230
Wealth status (Poorest)						
Poorer	-0.239	0.150	-1.590	0.111	-0.533	0.055
Middle	-0.287*	0.162	-1.760	0.078	-0.605	0.032
Richer	-0.497***	0.171	-2.910	0.004	-0.832	-0.162
Richest	-0.831***	0.193	-4.300	0.000	-1.209	-0.452
Place of residence (Urban)						
Rural	-0.016	0.117	-0.130	0.894	-0.244	0.213
Age at first marriage (Up to 14)						
15-17	-0.489***	0.184	-2.660	0.008	-0.850	-0.129
18-25	-1.402***	0.178	-7.880	0.000	-1.751	-1.053
26+	-2.748***	0.204	-13.490	0.000	-3.148	-2.349
Decision making (No)	-0.161	0.099	-1.630	0.104	-0.355	0.033
Marital Control (No)	-0.097	0.177	-0.550	0.585	-0.443	0.250

**** p<.01, ** p<.05, * p<.1. Reference categories in parenthesis for categorical variable*

3.8 Bibliography

Aboagye, R. G., Donkoh, I. E., Okyere, J., Seidu, A. A., Ahinkorah, B. O., & Yaya, S. (2024). Association between sexual violence and multiple high-risk fertility behaviours among women of reproductive age in sub-Saharan Africa. *BMC Public Health*, *24*(1), 1–12. https://doi.org/10.1186/s12889-023-17444-3

Adu, C. (2023). Socio-economic inequalities in intimate partner violence justification among women in Ghana: analysis of the 2014 Ghana Demographic and Health Survey data. *International Health*, *15*(2), 182–188. https://doi.org/10.1093/inthealth/ihac032

Akpinar, F., Yilmaz, S., Karahanoglu, E., Ozelci, R., Coskun, B., Dilbaz, B., & Tekin, Ö. M. (2019). Intimate partner violence in Turkey among women with female infertility. *Sexual and Relationship Therapy*, *34*(1), 3–9. https://doi.org/10.1080/14681994.2017.1327711

Anderson, K. L. (1997). Gender, status, and domestic violence: An integration of feminist and family violence approaches. *Journal of Marriage and the Family*, *59*(3), 655–669.

Aslam, S. K., Zaheer, S., & Shafique, K. (2015). Is spousal violence being "vertically transmitted" through victims? Findings from the Pakistan Demographic and Health Survey 2012-13. *PLoS ONE*, *10*(6), 1–11. https://doi.org/10.1371/journal.pone.0129790

Audra J. Bowlus, & Seitz, S. (2006). Domestic violence, employment, and divorce. *International Economic Review*, *47*(4), 1113–1149.

Bargain, O., Boutin, D., & Champeaux, H. (2019). Women's political participation and intrahousehold empowerment: Evidence from the Egyptian Arab Spring. *Journal of Development Economics*, *141*(May 2018), 102379. https://doi.org/10.1016/j.jdeveco.2019.102379

Black, D. S., Sussman, S., & Unger, J. B. (2010). A further look at the intergenerational transmission of violence: Witnessing interparental violence in emerging adulthood. *Journal of Interpersonal Violence*, *25*(6), 1022–1042. https://doi.org/10.1177/0886260509340539

Blood, R. O., & Wolfe, D. M. (1960). *Husbands and Wives, the Dynamics of Married Living. Free Press Glencoe.*

Bourey, C., & Murray, S. (2022). Intimate partner violence among women with infertility. *The Lancet Global Health*, *10*(6), e778–e779. https://doi.org/10.1016/S2214-109X(22)00205-

Cameron, A. C., & Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, 50(2), 317–372.

Chung, G. H., Tucker, M. B., & Takeuchi, D. (2008). Wives' relative income production and household male dominance: Examining violence among Asian American enduring couples. *Family Relations*, *57*(2), 227–238. https://doi.org/10.1111/j.1741-3729.2008.00496.x

Das, M., Tóth, C. G., Shri, N., Singh, M., & Hossain, B. (2022). Does sexual Intimate Partner Violence (IPV) increase risk of multiple high-risk fertility behaviours in India: evidence from National Family Health Survey 2015–16. *BMC Public Health*, *22*(1), 1–10. https://doi.org/10.1186/s12889-022-14289-0

Flake, D. F. (2005). Individual, family, and community risk markers for domestic violence in Peru. *Violence Against Women*, *11*(3), 353–373. https://doi.org/10.1177/1077801204272129

Follingstad, D. R. (2011). A measure of severe psychological abuse normed on a nationally representative sample of adults. *Journal of Interpersonal Violence*, *26*(6), 1194–1214. https://doi.org/10.1177/0886260510368157

Ford-Gilboe, M., Wuest, J., & Merritt-Gray, M. (2005). Strengthening capacity to limit intrusion: Theorizing family health promotion in the aftermath of woman abuse. *Qualitative Health Research*, *15*(4), 477–501. https://doi.org/10.1177/1049732305274590

Frade, S., & Odimegwu, C. (2018). What is the association between IPV and Fertility in Uganda? *Population Horizons*, *15*(2), 41–54. https://doi.org/10.1515/pophzn-2018-0001

Goode, W. J. (1971). Force and Violence in the Family. *Journal of Marriage and the Family*, *33*(4), 624–636. https://doi.org/10.2307/349435

Government of Pakistan. (1987). Pakistan Contraceptive Prevalence Survey. *Population Welfare Division, Ministry of Planning and Development, Islamabad, Pakistan.*

Greene, W. H. (2018). *Econometric Analysis* (8th ed.). Pearson

Hadi, A. (2017). Patriarchy and Gender-Based Violence in Pakistan. *European Journal of Social Sciences Education and Research*, *10*(2), 297. https://doi.org/10.26417/ejser.v10i2.p297-304

Hindin, M. J., Kishor, S., & Ansara, D. L. (2008). IntImate partner vIolence among couples in 10 DHS countries: Predictors and health outcomes. In *Calverton, Maryland, USA: Macro International Inc.* (Issue December).

Hoffman, K. L., Demo, D. H., & Edwards, J. N. (1994). Physical Wife Abuse in a Non-Western Society: An Integrated Theoretical Approach. *Journal of Marriage and the Family*, *56*(1), 131. https://doi.org/10.2307/352709

Hu, Y. (2019). What About Money? Earnings, Household Financial Organization, and Housework. *Journal of Marriage and Family*, *81*(5), 1091–1109. https://doi.org/10.1111/jomf.12590

Jewkes, R. (2002). Intimate partner violence: Causes and prevention. *Lancet*, *359*, 1423–1429. https://doi.org/10.1016/s0140-6736(02)08357-5

Kalmuss, D. S. (1984). LThe Intergenerational Transmission of Marital Aggression. *Journal of Marriage and Family*, *46*, 11–19. https://doi.org/10.1002/ab.22007

Kalmuss, D. S., & Straus, M. A. (1982). Wife's marital dependency and wife abuse. *Journal of Marriage and the Family, 44*, 277–286. https://doi.org/10.2307/351538

Landeis, M., Guzzo, K. B., Manning, W. D., Longmore, M. A., & Giordano, P. C. (2021). *A research note on intimate partner violence experiences and early and unintended childbearing*. *419*.

Lee Ann Hoff. (2009). *Violence and abuse issues: Cross-Cultural Perspectives for Health and Social Services*. https://doi.org/10.4324/9780203875629

Maxwell, L., Nandi, A., Benedetti, A., Devries, K., Wagman, J., & García-Moreno, C. (2018). Intimate partner violence and pregnancy spacing: Results from a meta-analysis of individual participant time-to-event data from 29 low-and-middle-income countries. *BMJ Global Health*, *3*(1). https://doi.org/10.1136/bmjgh-2017-000304

Miller, E., Jordan, B., Levenson, R., & Silverman, J. (2010). Reproductive coercion: connecting the dots Between Partner Violence and unintended pregnancy. *Contraception*, *81*(6), 457–459. https://doi.org/10.1016/j.contraception.2010.02.023.Reproductive

Mullahy, J. (1997). Instrumental-variable estimation of count data models: Applications to models of cigarette smoking behavior. *Review of Economics and Statistics*, *79*(4), 586–593. https://doi.org/10.1162/003465397557169

Mumtaz, Z., Salway, S., Shanner, L., Bhatti, A., & Laing, L. (2011). Maternal deaths in Pakistan: Intersection of gender, caste, and social exclusion. *BMC International Health and Human Rights*, *11*(SUPPL. 2), 2–7. https://doi.org/10.1186/1472-698X-11-S2-S4

Nabaggala, M. S., Reddy, T., & Manda, S. (2021). Effects of rural–urban residence and education on intimate partner violence among women in Sub-Saharan Africa: a meta-analysis of health survey data. *BMC Women's Health*, *21*(1), 1–23. https://doi.org/10.1186/s12905-021-01286-5

Navarro-Mantas, L., de Lemus, S., García-Sánchez, E., McGill, L., Hansen, N., & Megías, J. L. (2022). Defining power and agency in gender relations in El Salvador: Consequences for intimate partner violence and omen's mental health. *Frontiers in Psychology*, *13*(April), 1–14. https://doi.org/10.3389/fpsyg.2022.867945

Naz, L., Kamal, A., Kamran, A., & Trueha, K. (2023). Pattern and trends of the total and age-specific fertility rates during 1990–2018 in Pakistan. *BMC Women's Health*, *23*(1). https://doi.org/10.1186/s12905-023-02435-8

Odimegwu, C., Bamiwuye, O. S., & SA, and A. (2015). Gender-based violence as a new proximate determinant of fertility in sub-Saharan Africa. *Southern African Journal of Demography*, *16*(1), 87–121.

Patricia Hill Collins. (2000). Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment (2nd ed.). In *Routledge*.

Pritadrajati, D. (2023). *Family size and domestic violence in a high-fertility society*. https://ssrn.com/abstract=4470337

Raifman, S., Puri, M., Arcara, J., & Diamond-Smith, N. (2021). Is there an association between fertility and domestic violence in Nepal? *AJOG Global Reports*, *1*(2). https://doi.org/10.1016/j.xagr.2021.100011

Ranganathan, M., Knight, L., Abramsky, T., Muvhango, L., Polzer Ngwato, T., Mbobelatsi, M., Ferrari, G., Watts, C., & Stöckl, H. (2021). Associations Between Women's Economic and Social Empowerment and Intimate Partner Violence: Findings From a Microfinance

Plus Program in Rural North West Province, South Africa. *Journal of Interpersonal Violence*, *36*(15–16), 7747–7775. https://doi.org/10.1177/0886260519836952

Riddell, T., Ford-Gilboe, M., & Leipert, B. (2009). Strategies used by rural women to stop, avoid, or escape from intimate partner violence. *Health Care for Women International*, *30*(1–2), 134–159. https://doi.org/10.1080/07399330802523774

Saqib, M., & Ahmad, S. M. (2014). Root causes of low female literacy in FATA Pakistan: (A case study of Jalozai Camp). *International Journal of Academic Research in Business and Social Sciences*, *4*(3). https://doi.org/10.6007/ijarbss/v4-i3/728

Sardinha, L., Maheu-Giroux, M., Stöckl, H., Meyer, S. R., & García-Moreno, C. (2022). Global, regional, and national prevalence estimates of physical or sexual, or both, intimate partner violence against women in 2018. *The Lancet*, *399*(10327), 803–813. https://doi.org/10.1016/S0140-6736(21)02664-7

Sathar, Z. A., & Casterline, J. B. (1998). The Onset of Fertility Transition in Pakistan. *Population and Development Review*, *24*(4), 773. https://doi.org/10.2307/2808024

Seema Vyas and Charlotte Watts. (2009). How does economic empowerment affect women's risk of intimate partner violence in low and middle income countries? A systematic review of published evidence. Journal of International Development. *IJournal of International Development*, *21*(5), 577–602.

Shams Ghahfarokhi, M. (2024). Investigating the relationship between spousal violence against women and total fertility rate in Afghanistan. *BMC Public Health*, *24*(1), 1–9. https://doi.org/10.1186/s12889-024-18944-6

Shepherd, S. (2016). *The Cambridge introduction to performance theory*. Cambridge University Press. https://doi.org/10.1017/CBO9781139600194

Shubina, O., Mshana, G., Sichalwe, S., Malibwa, D., Mosha, N., Hashim, R., Nahay, F., Ayieko, P., Kapiga, S., & Stöckl, H. (2023). The association between alcohol consumption and intimate partner violence in young male perpetrators in Mwanza, Tanzania: a cross-sectional study. *Global Health Action*, *16*(1). https://doi.org/10.1080/16549716.2023.2185967

Stellar, C., Garcia-Moreno, C., Temmerman, M., & Van Der Poel, S. (2016). A systematic review and narrative report of the relationship between infertility, subfertility, and

intimate partner violence. *International Journal of Gynecology and Obstetrics*, *133*(1), 3–8. https://doi.org/10.1016/j.ijgo.2015.08.012

Stieglitz J, Trumble BC, Kaplan H, G. M. (2018). Marital violence and fertility in a relatively egalitarian highfertility population. *Nature Human Behaviour*, *2*(8), 565–572. doi:10.1038/s41562-018-0391-7

Straus, M. A., Gelles, R. J., & Steinmetz, S. K. (1980). *Behind Closed Doors: Violence in the American Family*. https://doi.org/10.4324/9781351298681

Stubbs, A., & Szoeke, C. (2022). The effect of intimate partner violence on the physical health and health-related behaviors of women: A systematic review of the literature. *Trauma, Violence, and Abuse*, *23*(4), 1157–1172. https://doi.org/10.1177/1524838020985541

Törnblom, K., & Kazemi, A. (Eds.). (2012). *Handbook of Social Resource Theory*. Springer New York. https://doi.org/10.1007/978-1-4614-4175-5

UNFPA. (1995). Programme of Action of the International Conference on Population and Development. Paper presented at the International Conference on Population and Development, Cairo, Egypt. In *Newsletter (Inter-African Committee on Traditional Practices Affecting the Health of Women and Children)* (Issue 17).

United Nations. (2014). *UNFPA O, Reproductive Rights are Human Rights: A Handbook for National Human Rights Institutions, The Danish Institute for Human Rights Copenhagen.* (Vol. 42). https://www.unfpa.org/sites/default/files/pub-pdf/NHRIHandbook.pdf

Uslucan, H., & Fuhrer, U. (2008). Intergenerational Transmission of Violence. In U. Sch¨onpflug (Ed.), Cultural transmission: Psychological, developmental, social, and methodological aspects,. *Cambridge University Press*, 391–418. https://doi.org/%0A10.1017/CBO9780511804670.018

Weitzman, A. (2014). Women's and men's relative status and intimate partner violence in India. *Population and Development Review*, *40*(1), 55–75. https://doi.org/10.1111/j.1728-4457.2014.00650.x

West, C., & Zimmerman, D. H. (1987). Doing gender. *Gender & Society*, *1*(2), 125–151. https://doi.org/10.1177/0891243287001002002

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel*

data (2nd ed.). MIT Press

World Economic Forum. (2024). *Global Gender Gap Report 2024* (Issue June). https://www.weforum.org/publications/global-gender-gap-report-2024/

World Health Organization. (2005a). *WHO Multi-country Study on Women's Health and Domestic Violence against Women: : initial results on prevalence, health outcomes, and women's responses*. https://apps.who.int/iris/handle/10665/43309

World Health Organization. (2005b). *WHO Multi-country Study on Women ' s Health and Domestic Initial results on prevalence*. https://www.who.int/publications/i/item/9241593512

World Health Organization. (2006a). Intimate partner violence and alcohol. In *World health Organization*. https://www.canada.ca/content/dam/phac-aspc/migration/phac-aspc/sfv-avf/sources/fem/fem-intin-alco/pdf/fem-whoms-alco-eng.pdf

World Health Organization. (2006b). Reproductive health indicators: Guidelines for their generation, interpretation, and analysis for global monitoring. In *World health Organization*. https://iris.who.int/bitstream/handle/10665/43185/924156315X_eng.pdf?sequence=1

World Health Organization. (2013). *Global and regional estimates of violence against women: prevalence and health effects of intimate partner violence and non-partner sexual violence. World Health Organization.* https://iris.who.int/handle/10665/85239

Yang, L. H., Chen, F. pei, Sia, K. J., Lam, J., Lam, K., Ngo, H., Lee, S., Kleinman, A., & Good, B. (2014). "What matters most:" A cultural mechanism moderating structural vulnerability and moral experience of mental illness stigma. *Social Science and Medicine*, *103*, 84–93. https://doi.org/10.1016/j.socscimed.2013.09.009

Yount, K. M., & Li, L. (2009). Women's "justification" of domestic violence in Egypt. *Journal of Marriage and Family*, *71*(5), 1125–1140. https://doi.org/10.1111/j.1741-3737.2009.00659.x

APPENDIX A

Appendix A.3.1 Linear Regression with Only Instrument Variables (Cluster-Robust Standard Errors)

Any form violence	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Husband/partner drinks alcohol							
Yes	.401	.056	7.16	0	.291	.511	***
Parental knowledge of IPV							
Yes	.279	.027	10.44	0	.226	.331	***
Constant	.263	.014	18.90	0	.236	.291	***

Mean dependent var	0.380	SD dependent var	0.485
R-squared	0.090	Number of obs	3301
F-test	81.157	Prob > F	0.000
Akaike crit. (AIC)	4102.791	Bayesian crit. (BIC)	4121.097

*** *p<0.01, ** p<0.05, * p<0.1*

Appendix A.3.2 Linear Regression with Control Variables (Cluster-Robust Standard Errors)

Any form of violence	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Husband/partner drinks alcohol							
Yes	.304	.054	5.59	0	.197	.411	***
Parental knowledge of IPV							
Yes	.22	.025	8.95	0	.171	.268	***
Women age cohort							
20-24	-.032	.046	-0.69	.488	-.123	.059	
25-29	.022	.048	0.44	.657	-.074	.117	
30-34	.089	.049	1.83	.067	-.006	.185	*
35-39	.052	.049	1.06	.292	-.045	.149	
40-44	.086	.052	1.64	.102	-.017	.189	
45-49	.089	.055	1.61	.108	-.019	.197	
Age at first marriage							
15-17	-.108	.041	-2.61	.009	-.189	-.026	***
18-25	-.102	.044	-2.32	.021	-.188	-.016	**
26-38	-.112	.055	-2.05	.041	-.22	-.004	**
Education level							
Primary	.005	.031	0.15	.882	-.055	.065	
Secondary	.027	.034	0.79	.432	-.04	.093	
Higher	-.02	.033	-0.60	.548	-.086	.046	
Husband's education							
Primary	.067	.034	1.98	.049	0	.134	**
Secondary	.05	.03	1.64	.101	-.01	.109	
Higher	.008	.034	0.24	.813	-.058	.074	
Wealth index							
Poorer	.023	.032	0.70	.483	-.041	.086	
Middle	.004	.04	0.11	.916	-.074	.083	
Richer	-.024	.042	-0.57	.566	-.107	.059	
Richest	-.065	.049	-1.33	.184	-.16	.031	
Place of residence							
Rural	-.004	.026	-0.16	.875	-.055	.047	
Decision making							
Participated	-.03	.025	-1.17	.243	-.08	.02	
Marital control							
Yes	.355	.025	14.08	0	.306	.405	***
Constant	.231	.066	3.50	.001	.101	.36	***

Mean dependent var	0.377	SD dependent var	0.485
R-squared	0.227	Number of obs	3203
F-test	27.308	Prob > F	0.000
Akaike crit. (AIC)	3490.830	Bayesian crit. (BIC)	3642.627

*** *p<0.01*, ** *p<0.05*, * *p<0.1*

We conducted two regression analyses to validate our instrumental variables: parental knowledge of IPV and the husband's use of alcohol. Initially, we regressed any form of violence with our instruments alone to determine its direct relevance. Second, we incorporated control variables to address potential confounding factors. The p-value of parental knowledge of IPV

and the use of alcohol by the husband are statistically significant in both cases. This indicates that they have a strong relationship with any form of violence. Our instruments are very strong because F-statistic is quite high.

Conclusion

The dissertation focuses its attention on three subjects that are of considerable importance: The first chapter investigates the relationship between fertility and education in Pakistan, and the second chapter examines the causal effect of education on fertility in Pakistan by using changes in secondary and primary schooling law as a source of exogenous variation, and in the third chapter, it focuses on intimate partner violence increasing the risk of high fertility behavior in Pakistan. The results are based on empirical analyses using Poisson regression, a local randomization regression discontinuity design, and an instrumental variable Poisson generalized method of moments estimator, respectively.

Education has been considered for many centuries to be the most important influence in shaping the attitudes and behaviors of women. It has been recognized as an important factor influencing the behavior and outcomes of fertility. Female education significantly affects their reproductive health behaviors. Educated women exhibit unconventional reproductive behaviors, for example, delayed age at first marriage and first birth, and are likely to have fewer children than those without formal education. One of the key factors affecting fertility is regarded as education. Therefore, in the first chapter, examine the relationship of education with fertility for women. The results propose strong evidence that fertility is significant and inversely affected by women's education. Women with secondary and higher education have fewer children compared to women with no education, while female education at the primary level did not significantly affect fertility in the research. Furthermore, the age of first cohabitation, age at first birth, and wealth index were revealed to be significant determinants of fertility. It implies that higher schooling leads to greater opportunities and encourages women's engagement in other economic activities.

Therefore, education is an important factor in reducing fertility and encouraging women's participation in other economic activities. Universal primary and secondary education is one of the key objectives of the Sustainable Development Goals and has become an integral part of global development initiatives. The simplest government instrument to encourage enrollment is the abolition of school fees. Abolition of school fees, demonstrating strong adherence to this policy by international development agencies as an essential tool for achieving the goal of universal primary education. The government of Pakistan is designing policies to reduce fertility; the point is how effectively these

policies or reforms are being implemented, which supports better education and helps stabilize the fertility rate. For that reason, in the second chapter, we use Pakistan's Article 25(A) implementation of reform about free and compulsory education for primary and secondary levels as a source of exogenous variation across different regions in varied periods to estimate the causal effect of education on fertility. As a result of national reform, increases in education do not reduce the number of children born per woman in Punjab and Balochistan, and the implementation of compulsory primary and secondary schools does not improve educational attainment in Sindh and Islamabad, while fertility falls due to family planning practices. Several factors may hamper the predicted effects of low fertility rates and an older age at first birth. For example, frequent government changes and political instability have had a substantial impact on the consistency and effectiveness of educational policy, high dropout rates among girls, quality of education, early marriages, gender discrimination, religious factors, and male-dominated society, resulting in inconsistent utilization of Article 25(A) across provinces. Although education reforms increase education, and increased education leads to delayed births, delayed maternal age results in decreased fertility. The compulsory schooling law would have important implications for the economic welfare of women in Pakistan. In terms of distributive implications, compulsory schooling has the potential to improve the well-being of the poor, which is the after-effect of reduced fertility rates. Government and policymakers should take action to overcome these issues and continue to invest in education reforms while constantly monitoring their broader socio-economic implications.

The fertility rate in Pakistan is very high due to several contributing factors. In the final chapter, we have illustrated whether women's exposure to domestic violence is a contributing factor to increased fertility in Pakistan. The results show that women who have experienced gender-based violence have, on average, significantly more children than their peers who have not. Intimate partner violence (physical, emotional, and sexual) and its various manifestations should be taken into account while formulating and implementing policies to improve women's reproductive health in Pakistan. The study suggests that policies and programs to reduce Pakistan's high birth rate should prioritize addressing systemic gender inequality, which contributes to violence against women in Pakistan.