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

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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, education 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

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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 (Van 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 in 0.3 births per woman between 2013 and 2018. Figure 1 provides a quick overview of the trend in fertility rate in Pakistan.

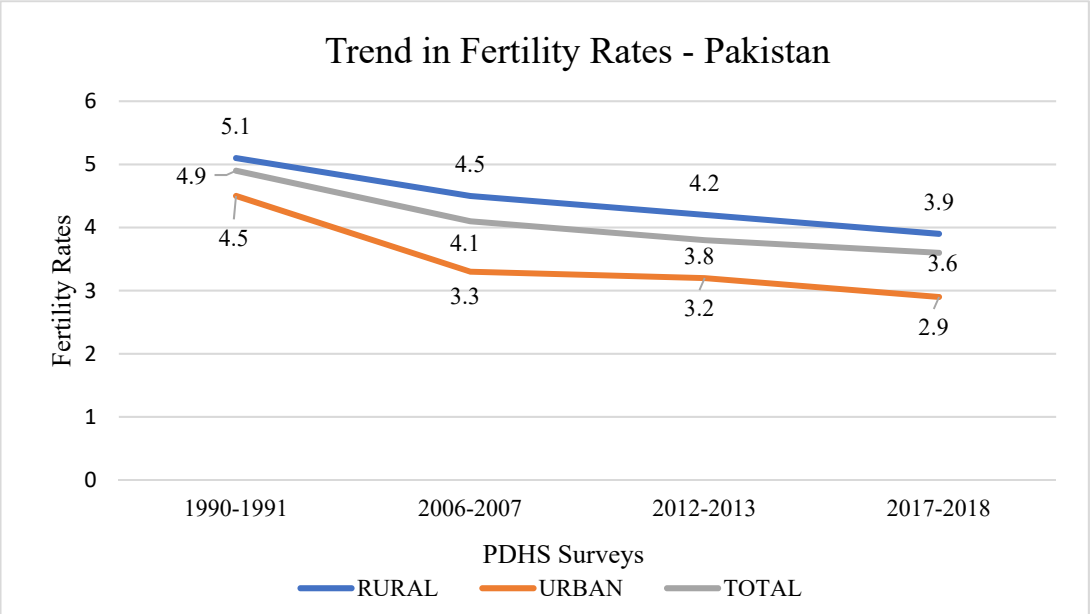


Figure 1. Trend in fertility rates by residence. Source: Pakistan Demographic Health Survey (PDHS) 2017–2018.

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 enrolment 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%.

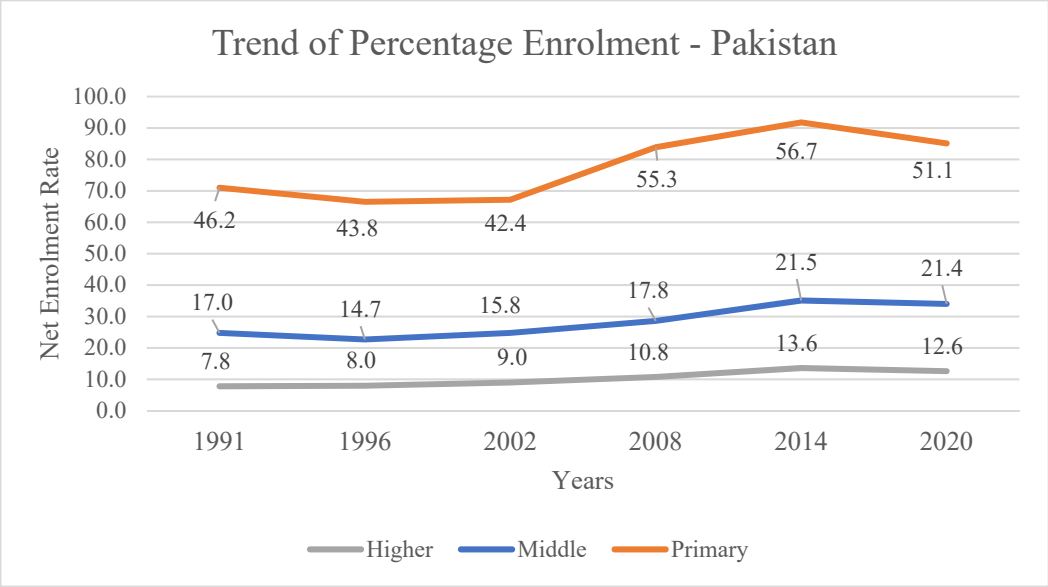


Figure 2. Trend of Percentage Enrolment—Pakistan. Source: Pakistan Social and Living Standards Measurement Survey (PSLMS).

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.

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 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 the research on demographic factors, one of the important components is education that affects the success of a nation. Backing with this reason, we build the pillars of our research to concrete the 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, by 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, which were randomly selected from Pakistan's all 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 2 contains a review of the literature, Section 3 discusses methodology and data description, Section 4 presents our econometric strategy, Section 5 discusses the results, Section 6 presents discussion and conclusion, and Section 7 presents recommendation and policy implication.

2. Review of the Literature

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

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 low educated quantity 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 semi century around in the whole of Europe and non-European English speaking countries. The research conveyed that the desire for one or two children decreased and 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 framework

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).

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 deducted fertility, while a high fertility rate was observed by 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 over 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 relatively high focus on Pakistan, there is no study that is specifically focused on the association between education and fertility.

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. Education 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.*

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 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 education 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.

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 square model and other linear models for the distribution of count variables, like total children ever born (CEBR), which is highly skewed with a long right tail.

4.1. Poisson Model

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

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

where

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

Settings can introduce observed heterogeneity as follows:

$$\lambda_i = exp(x_i\beta)\ i = 1, \ldots, n, \tag{3}$$

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).

$$E(Y_i/x_i) = exp(x_i\beta) \tag{4}$$

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 it is the case of 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:

$$ln(\lambda(X) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n \tag{5}$$

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

$$\lambda = e(\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X) \tag{6}$$

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

4.2. Research Model

In this study, a model from Kebede et al. (2022); 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:

$$CEB_i = \alpha + \beta_1 WE_1 + \beta_2 Age_2 + \beta_3 RE_3 + \beta_4 WI_4 + \beta_5 PR_5 + \beta_6 HE_6 + \beta_7 AFB_7 + \beta_8 AFC_8 + \mu_i \quad (7)$$

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.

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.

5.1. Descriptive Analysis

Table 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 between age group 20–49 is higher than that of the 15–19 age group. The percentage 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, less women had their first birth at age 21 or older compared to those who had their first birth at age 20 or younger. As the percentage distribution of respondents in 15–20 years of age is less than the percentage distribution of 21–49 years of age. 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.

Table 1. Percentage distribution of women aged 15–49 by selected characteristics from 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		

Table 1. *Cont.*

Variables	Frequency	Percent
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

5.2. Estimates from Econometric Analysis

Table 2 shows unadjusted Poisson regression coefficients of women's education 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.

Table 2. Unadjusted Poisson regression estimates (with 95% CI) of the effects of women's education on children ever born (CEB).

CEBR	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	***

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

5.3. Results for Econometric Analysis

Table 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 education attainment and children ever born (CEB) shows that women's education 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.

Table 3. Adjusted Poisson regression coefficients 95% CI) of the association between women's education and total children ever born by selected characteristics of women aged 15–49 from Pakistan 2017–2018 PDHS.

CEBR	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	0.995	**
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	*
Husband/partner's							
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	***

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

Also, the confounding factors considered, age in the 5-year group ($p < 0.01$) reported a positive association in Balochistan, while negative in Sindh and ICT 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 education 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 ($p < 0.01$).

6. Discussion and Conclusions

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. The fact also confirms the result that education is inclined towards fewer children. According to the study finding, secondary or higher education has a most substantial negative impact on fertility compared to primary 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 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 lesser 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.

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.

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