

Impact of schooling on teenage pregnancy: a multilevel analysis by province in Ecuador for the year 2019

Impacto de la escolaridad en el embarazo adolescente: un análisis multinivel por provincias de Ecuador para el año 2019

Wilson Israel Pangay Vallejo

Independent Researcher, Ecuador

isra211julio@gmail.com

 <https://orcid.org/0009-0007-8303-7042>

Received: November 23, 2025

Accepted: March 26, 2026

Published: July 23, 2026

 *Spanish version here*

DOI: <https://doi.org/10.25097/rep.n44.2026.03>

Cómo citar / How to cite: Pangay Vallejo, W. I. (2026). Impact of schooling on teenage pregnancy: a multilevel analysis by province in Ecuador for the year 2019. *Revista Economía y Política*, (44), 41-58. <https://doi.org/10.25097/rep.n44.2026.03>

ABSTRACT

This study examines the impact that educational attainment has on adolescent pregnancy in Ecuador during 2019, using descriptive statistical analysis, probabilistic discrete choice models, and a multilevel analysis at two levels: individual and provincial. The data come from INEC sources: ENSANUT and ENEMDU. The results reveal that 15.8% of young women became pregnant that year, with an educational gap of 1.2 years between those who experienced this situation and those who did not. Completing one additional year of schooling reduces the likelihood of adolescent motherhood by 3.4%, showing greater effectiveness at earlier stages of education. At the territorial level, provinces with higher population density and greater economic development show a 59.2% higher probability of adolescent pregnancy. This issue primarily affects rural communities and vulnerable ethnic groups, highlighting the need to design geographically contextualized government strategies that promote access to education and sexual and reproductive education initiatives.

KEYWORDS: territorial inequality, early pregnancy, human capital, multilevel analysis



RESUMEN

Este estudio examina cual es el impacto que la formación académica tiene en el embarazo adolescente en Ecuador durante el año 2019, empleando análisis estadísticos descriptivos, modelos probabilísticos de elección discreta y un análisis multinivel en dos escalas: individual y provincial. Los datos provienen de fuentes del INEC: ENSANUT y ENEMDU. Los resultados revelan que el 15,8% de las jóvenes quedaron embarazadas ese año, con una brecha educativa de 1,2 años entre quienes vivieron esta situación y quienes no. Cursar un año escolar adicional disminuye 3,4% las posibilidades de maternidad adolescente, mostrando mayor efectividad en etapas tempranas. A nivel territorial, las provincias con mayor densidad poblacional y desarrollo económico presentan 59,2% más probabilidad de gestación juvenil. Esta problemática afecta principalmente a comunidades rurales y grupos étnicos vulnerables, poniendo en manifiesto la necesidad de diseñar estrategias gubernamentales contextualizadas geográficamente que promuevan el acceso educativo e iniciativas de educación sexual y reproductiva.

PALABRAS CLAVE: desigualdad territorial, gestación temprana, capital humano, análisis multinivel

1. INTRODUCTION

Adolescent pregnancy is a global problem with significant consequences for the health, social, and economic development of those affected. Each year, approximately 21 million adolescents in low- and middle-income countries become pregnant, largely due to a lack of quality sex education, limited access to contraceptives, and challenging social or economic circumstances (World Health Organization [WHO], 2024; Miquilena & Lara, 2021). Given this, it can be said that this problem directly affects people in vulnerable positions, resulting in school dropout, the intergenerational transmission of poverty, and pregnancy-related risks, thereby placing increased pressure on the public health system and social programs.

Consequently, the theoretical foundation of this study draws on the contributions of Grossman (1972), who expanded the concept of human capital proposed by Becker (1964) by incorporating health as a key element, since for the author, health not only functions as an immediate consumer good, but also represents an investment that influences productive capacities and income throughout life, becoming one of the pillars of economic development and social well-being. This conceptual framework allows us to understand education and reproductive health as interconnected dimensions of human capital in the adolescent population.

Although the evidence in the literature is limited, various studies indicate the existence of a negative relationship between years of schooling and the probability of adolescent pregnancy. In this regard, studies by Martinez et al. (2020), Mohr et al. (2019), Mendoza & Fernández (2018), and Rodríguez & Fernández (2018) agree that as educational attainment increases, the incidence of teenage pregnancies tends to decrease. In addition, the environment in which adolescents grow up—such as the level of urbanization and the economic conditions of their community—also influences this phenomenon; therefore, improving access to education is not enough; the context in which they live must also be taken into account.

In light of this issue, the study analyzes how, in Ecuador, the educational level of young women and provincial characteristics influence the probability of teenage pregnancy in 2019. Although the national literature has addressed the topic through descriptive, qualitative, or single-level models (Mendoza & Fernández, 2018; Rodríguez & Fernández, 2018), the use of multilevel models has been limited. Therefore, a hierarchical discrete choice model is applied that integrates individual and territorial factors, constituting its main methodological contribution and providing evidence for public policies with a regional focus.

2. LITERATURE REVIEW

Theoretical and Conceptual Foundations

Adolescence, defined by the WHO and the Pan American Health Organization [PAHO] (2006) as the period between the ages of 10 and 19, constitutes a critical stage characterized by rapid transformations in the physical, emotional, and social dimensions. During this phase, individuals develop new ways of perceiving and thinking associated with their biopsychosocial maturation, making them a group particularly vulnerable to early reproductive decisions with lasting consequences.

Looking back, the relationship between education and adolescent motherhood began to attract academic interest in the 1960s, just as Becker (1964) proposed the theory of human capital. For him, studying was a smart move because it could open more doors and improve future earnings. Later, Grossman (1972) took the idea a step further, placing health at the center of human capital, arguing that health is not merely something to be enjoyed but a resource that has real weight in productivity, and that those who accumulate more years of schooling tend to make better decisions. From this perspective, it becomes clear why educational attainment and regional differences can influence the risk of teenage pregnancy. There is a direct link between schooling, health, and what is known as human capital.

On the other hand, Elder (1974) developed the life-course perspective to understand how experiences in early life shape people's social and psychological development. From this perspective, what happens during childhood or adolescence does not fade over time but continues to influence decisions and life trajectories, which is key to understanding why teenage pregnancy is such a complex phenomenon. Along similar lines, Easterlin (1975) linked decisions about having children to economic and social factors, arguing that the fertility of young couples is shaped by how they perceive their own situation compared to that of their family of origin and by the size of their cohort.

As early as the 1980s, Moore et al. (1986) analyzed the social and economic consequences of teenage pregnancy, highlighting both immediate and long-term effects, particularly in education and employment. At the same time, Krugman's (1991) core-periphery model demonstrated that the initial advantages of certain areas tend to widen inequality gaps due to the concentration of resources. Later, Duranton & Puga (2004) and Combes (2008) noted that these territorial advantages extend beyond the economic sphere. More recently, Roca & Puga (2017) demonstrated that urban density facilitates the transmission of information and access to sex education and health services, creating clear differences in opportunities for young people depending on the province in which they live.

Expanding on this perspective, Michael Marmot and Richard Wilkinson (2005), with support from the World Health Organization, argued that social, environmental, and economic factors are fundamental determinants of a population's health. Their theory holds that access to education, income, employment, and basic services shapes social structures, which clearly impacts issues such as teenage pregnancy. Furthermore, these factors contribute to the perpetuation of cycles of poverty and inequality from one generation to the next.

International Empirical Evidence

Building on these basic theoretical ideas, empirical studies show quite clearly that there is an inverse relationship between educational attainment and teenage pregnancy in various settings. Kiernan & Smith (2003), for example, analyzed various European countries and found that as women's years of education increased, early pregnancy rates declined, particularly when this was accompanied by high-quality education and participation in after-school activities.

From a territorial perspective, Henderson (2003) conducted an interesting analysis of urbanization and economic growth using a multilevel approach, finding that urbanization processes vary across local economic and social dynamics. In turn, the concentration of the urban population depends heavily on each country's policies and institutions, which affect social phenomena such as teenage pregnancy. In urban areas, there is typically much better access to sex education, reproductive health services, and more educational and employment opportunities.

Along the same lines, Pebley & Sastry (2003) studied how neighborhood characteristics influence adolescent reproductive health, showing that densely populated areas with high levels of poverty tend to have more teenage pregnancies, partly because there is less social cohesion, limited resources, and greater exposure to social risks. Furthermore, Bruce & Clark (2004) added to this, showing that urban contexts with unequal services, limited parental supervision, and ambiguous social norms widen gaps in sexual health.

Looking at the issue from a prevention perspective, Kirby (2007) found in his analyses that the most effective programs combine comprehensive sex education with information on abstinence, contraceptive use, and the development of communication skills. In developing countries, Were (2007) documented in Kenya that teenage pregnancy is linked to a combination of poverty, low educational levels, cultural traditions, and difficulties in accessing reproductive health services.

Expanding the perspective to sub-Saharan Africa, Biddlecom et al. (2007) showed that those with more years of education use more contraceptive methods and have fewer unplanned pregnancies. Similarly, García et al. (2012) and Azevedo et al. (2012) confirmed in Latin America that higher levels of education reduce the likelihood of teenage pregnancy. Piawpongpakawat (2013) observed a similar pattern in Thailand, where 16% of pregnancies were among adolescents, most of whom had not completed secondary school. Although 75% were aware of contraceptive methods, only 67% used them correctly, revealing a significant gap between knowledge and actual practice. Meanwhile, from the perspective of social capital, Sampson (2012) found that neighborhoods with high population density and low social capital have higher rates of teenage pregnancy, as support networks and social supervision are weaker.

Finally, Kane et al. (2013) in the United States and Contreras and González (2015) in Chile found that the higher the educational level, the lower the probability of teenage pregnancy. However, Blunch (2017) showed that this relationship can disappear when variables such as language proficiency are included, suggesting that human capital is even more complex than it appears. Internationally, Singh et al. (2017) concluded that providing universal access to contraceptives and comprehensive sex education through public policies leads to a clear reduction in pregnancy rates.

Latin American and Ecuadorian Perspectives

Focusing on Latin America, Cáceres et al. (2010) and Blanc et al. (2016) confirmed that investing in education and completing high school reduces teenage pregnancies and opens up better job opportunities for the future. On the other hand, Donkor & Lariba (2017) argue that formal sex education can increase young people's curiosity, so they advocate that information should be conveyed directly only by parents, schools, and religious leaders to avoid confusion.

In Ecuador, which is the central focus of this study, Mendoza & Fernández (2018) found that adolescent girls who completed high school are much less likely to become pregnant. For this reason, they recommend policies that support lifelong education and comprehensive sex education programs. Examining regional differences within the country, Rodríguez & Fernández (2018) analyzed the situation in rural areas using a qualitative approach. They found that adolescents there face barriers, including a lack of infrastructure, a shortage of trained personnel, and cultural obstacles, which result in higher pregnancy rates.

In Ecuador, various studies have analyzed the personal and socioeconomic factors of adolescent pregnancy using logit or probit models with data from ENSANUT. Research such as that by Pérez Arrobo (2016) and Cadena Mosquera (2019) identifies risks associated with age, educational level, and contraceptive use, as well as urban-rural differences. López et al. (2023) and Andrade Tafur & Benavides Pozo (2024) examine socioeconomic and access barriers, while Ortiz & Carrillo (2021) highlight the role of education, contingent on overcoming economic, cultural, and geographic obstacles. However, most of these studies focus on individual analyses and do not incorporate a multilevel approach that integrates personal and provincial factors, revealing a methodological gap in the national literature.

Multilevel analysis and contextual factors

To support the methodological approach of this study, Frick & Rodríguez-Pose (2018) examined the relationship between urban concentration and economic growth. They found that the impact of these factors varies across contexts: in developed countries, urban concentration drives growth, but in developing countries, the benefits are less clear. This difference demonstrates why it is necessary to analyze specific factors in the Ecuadorian case, where urban concentration carries significant weight because it determines access to key resources for human development. This justifies a multilevel analysis by province to examine how each province's specific characteristics affect the probability of teenage pregnancy.

Implications and consequences

It is worth reviewing the consequences associated with teenage pregnancy, as reported in the literature. Venegas & Valles (2019) note that pregnant adolescents often give up their freedom, take on responsibilities prematurely, and distance themselves from their friends, which limits their personal and professional development. Similarly, Mohr et al. (2019) concluded that pregnancy hinders academic and career growth and reduces the potential for building human capital, especially in low- and middle-income countries.

At the regional level, Martinez et al. (2020) reviewed studies in Latin America and noted that high rates of teenage pregnancy are often linked to a lack of early sex education. For their part, Celhay et al. (2020) provided direct evidence by demonstrating that sudden school closures in Chile increased teenage pregnancies by between 1.5% and 5%. This shows that schools not only fulfill an educational function but also serve as spaces for social support and human capital formation.

Looking at the broader consequences, Morgan et al. (2022) showed that becoming a mother during adolescence hinders the development of human capital, noting that 79% of girls who drop out of school after a pregnancy do so because of the stigma and because motherhood changes their priorities. Taking a more global approach, Boutayeb (2023) went on to study adolescents from 10 countries. She found that those from marginalized or disadvantaged groups are more likely to become pregnant. At the same time, Moshi & Tilisho (2023) added a couple of other factors to the analysis, such as sexual abuse and peer pressure, which also play a role.

3. MATERIALS AND METHODS

Data sources and variables

The data used come from the National Health and Nutrition Survey (ENSANUT, 2019) and the National Survey on Employment, Unemployment, and Underemployment (ENEMDU, 2019), and the study considered adolescent pregnancy as a dichotomous dependent variable among women aged 10 to 20, following the precedent set by Moore et al. (1986) and Mendoza & Fernández (2018). The main independent variable was the level of schooling in years completed, selected because empirical

evidence indicates that education significantly reduces the probability of adolescent pregnancy (Biddlecom et al., 2007).

Regarding Level 1 variables, corresponding to individual characteristics, the study included area of residence to capture differences in access to health services (Bruce & Clark, 2004), age to adjust the probability within the studied range, access to information on sexuality and contraceptive methods due to their documented effect on reducing teenage pregnancies (Donkor & Lariba, 2017), and ethnicity to account for cultural and social inequalities.

Level 2 variables, corresponding to the provincial context, included the unemployment rate as an indicator of local economic opportunities, the GINI index to capture income inequality, market potential, and the Herfindahl-Hirschman index as a measure of population concentration, all selected for their relevance in the literature on territorial socioeconomic conditions (Kearney & Levine, 2012), as detailed in Table 1.

Table 1

Description of the variables

Level 1 variables				
Variable type	Variable	Notation	Unit of measurement	Description
Dependent	Teenage pregnancy	And	0-1	1 = pregnancy between ages 10–20; 0 = no pregnancy.
Independent	Level of education	ES	Years	Years of formal education completed.
Control	Area of residence	AR	0-1	0 = rural; 1 = urban.
Control	Age	ED	Years	Range: 10–20 years.
Control	Information on sexuality	SX	0-1	1 = received information; 0 = did not receive.
Control	Information on contraceptive methods	AN	0-1	1=received information; 0=did not receive.
Control	Ethnicity	ET	0-1	0=white/mixed race; 1=indigenous/Afro-Ecuadorian/Montubio
Level 2 variables				
Variable		Notation	Unit of measurement	Description
Unemployment Rate		TDESM	Rate	Percentage of the economically active population that is unemployed.
GINI Index		GINI	0-1	Inequality in income distribution.
Market potential		LPDM	Logarithm	Potential demand for goods/services.
Herfindahl-Hirschman Index		HHI	0–1	Population concentration/urbanization

Note: Author based on ENSANUT (2019) and ENEMDU (2019)

Analytical strategy

Descriptive analysis

A descriptive statistical analysis was conducted using a combination of visual and statistical tools. Cross-tabulation charts facilitated the comparative visualization of pregnancy across different educational levels and its interrelation with relevant socioeconomic factors. Additionally,

nonparametric statistics and contingency tables were used to examine the degree of association between variables, given their qualitative nature.

To validate the association results, the chi-square test was applied, and Cramér's V coefficient was calculated to measure the strength of association between categorical variables. This specific analysis required recoding the level of education into ordinal categories (none/literacy, elementary, secondary, and higher) while maintaining the continuous variable for subsequent analyses. Cramér's V coefficient was calculated using the following formula.

$$V = \sqrt{\frac{X^2}{n * \min(k - 1, r - 1)}} \quad (1)$$

Where represents the chi-square statistic, n the sample size, r the number of categories of the dependent variable, and k the categories of the independent variable.

Discrete Choice Modeling

Given the dichotomous nature of the dependent variable, a probit model was implemented, known for its suitability for analyzing binary variables (Wooldridge, 2010). This model uses the standard normal cumulative distribution function, establishing probabilities between 0 and 1 and capturing nonlinear relationships between predictors and the event of interest, whose general specification is:

$$\Pr(Y=1|X) = \Phi(X\beta) \quad (2)$$

Where Φ denotes the cumulative distribution function of the standard normal distribution, Y is the variable for adolescent pregnancy, X is the vector of explanatory variables, and β are the estimated coefficients.

Since the coefficients of the probit model only indicate the direction of the relationships, marginal effects were calculated to quantify the impact of each variable on the probability of pregnancy. The marginal effects are derived as:

$$\frac{\partial P(Y_i = 1 | X_i)}{\partial X_{ij}} = \phi(X_i\beta) \beta_j \quad (3)$$

In this case, ϕ represents the standard normal density function, indicating how unit changes in alter the probability of $Y=1$, holding all other variables constant. The full model specification incorporated the aforementioned control variables:

$$\Pr(Y=1|X) = \Phi(\alpha + X\beta_i + \varepsilon_i) \quad (4)$$

Where α is the intercept, ε_i is the error term, and the subscript i denotes individual observations.

Multilevel hierarchical model

The recognition that adolescent pregnancy is influenced by both individual characteristics and provincial contextual factors led to the implementation of a two-level hierarchical probit model. This methodological approach explicitly acknowledges the nested structure of the data, where individual observations are grouped within provinces, and allows for the simultaneous estimation of individual and territorial effects (Fory & Olivera, 2020). The first level of the model specifies the individual probability:

$$\Pr(Y_{ij}=1|X) = \beta_0 + \beta_1 X_{ij} + \mu_j + \varepsilon_{ij} \quad (5)$$

Such that Y_{ij} represents teenage pregnancy for individual i in province j , X_{ij} are the individual characteristics, μ_j captures the variability across provinces, and ε_{ij} is the individual error. The second level models interprovincial variability:

$$\mu_j = \gamma_0 + \delta Z_j + v_j \quad (6)$$

Where Z_j represents provincial socioeconomic characteristics, γ_0 is the second-level intercept, and v_j is the provincial random error. Integrating both levels yields the complete model:

$$\Pr(Y_{ij}=1|X) = (\beta_0 + \gamma_0) + \beta_1 X_{ij} + \delta Z_j + \varepsilon_{ij} + v_j \quad (7)$$

This multilevel model allows the total variance to be decomposed into individual and provincial components, identifying how contextual factors such as urbanization and inequality moderate the influence of individual characteristics such as educational attainment. The marginal effects calculated from this model quantify the differentiated impact of educational attainment according to the provincial context, providing evidence for territorially differentiated policies.

All models were estimated using maximum likelihood, and marginal effects were calculated at the mean values of the explanatory variables. The results are presented through graphical representations that facilitate the interpretation of causal relationships and allow us to visualize how unit increases in educational attainment modify the probability of adolescent pregnancy in different territorial contexts.

4. RESULTS AND DISCUSSION

Table 2 presents the descriptive analysis based on 16,029 cases, the results of which indicate that nearly 15.8% of Ecuadorian adolescents experienced a pregnancy in 2019. This figure is very similar to that reported by Piawpongpakawat (2013) in Thailand, at 16%. All of this suggests that the problem transcends geographical and cultural boundaries and, far from being merely a local issue, presents itself as a global concern that requires constant attention.

Table 2

Descriptive statistics

Variable	Observations	Mean	Standard deviation	Min	Max
Level 1 variables					
Teenage pregnancy	16,029	0.1579637	0.3647183	0	1
Level of education	16,029	12.49342	2.998154	0	21
Area	16,029	0.572712	0.4947002	0	1
Age	16,029	14.95096	3.111755	10	20
Sexuality Information	16,029	0.635598	0.4812771	0	1
Contraceptive Information	16,029	0.7265581	0.4457396	0	1
Ethnicity	16,029	0.2476761	0.4316761	0	1
Level 2 variables					
Unemployment rate	16,029	3.387596	2.116554	1.21596	10.1861
Gini Index	16,029	0.4263426	0.0505233	0.3237998	0.503509

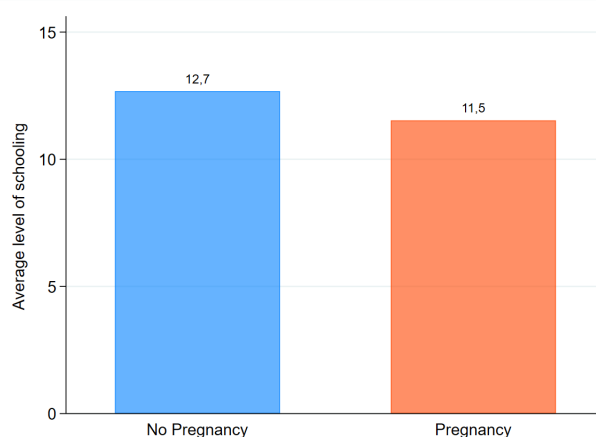
Market potential	16,029	12.38974	1.377254	8.766218	15.2067
HHI Index	16,029	0.0362936	0.0189716	0.0043245	0.059605

Note. Authors (2026)

Figure 1 illustrates the relationship between schooling and adolescent pregnancy, revealing significant differences: non-pregnant adolescents have an average of 12.7 years of schooling, while pregnant adolescents have 11.5 years, indicating a gap of 1.2 years. This negative association corroborates the conclusions of Kiernan & Smith (2003) and García et al. (2012) regarding the protective role of remaining in the education system. It aligns with Kane et al.'s (2013) findings on how educational limitations perpetuate cycles of socioeconomic vulnerability.

Figure 1

Average years of schooling by presence of teenage pregnancy



Note. Authors (2026)

The chi-square test confirmed the statistically significant association between educational attainment and pregnancy. Table 3 presents the contingency between adolescent pregnancy and educational attainment. However, the Cramer's V coefficient of 0.227 indicates a moderate relationship, suggesting that, although education acts as a protective factor, other relevant contextual determinants coexist. As Blunch (2017) points out, insufficient schooling not only reflects economic constraints but also reflects broader structural inequalities that perpetuate social exclusion.

Table 3

Association between Adolescent Pregnancy and Educational Attainment

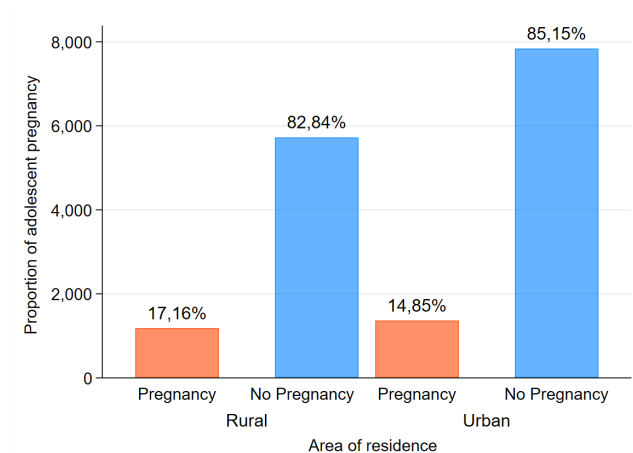
Pregnancy	Educational Level				Total
	None/Literate	Basic	Upper Secondary	Higher	
No	21	8,941	4,093	442	13,497
Yes	16	930	1,495	91	2,532
Total	37	9,871	5,588	533	16,029

Pearson $\chi^2=832.66$; $p<0.001$.

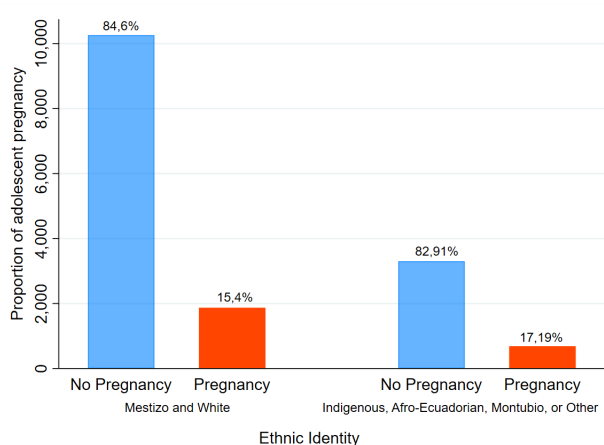
Note. Authors (2026)

Regional and Ethnic Disparities

Regarding Figure 2, the territorial analysis reveals significantly higher pregnancy rates in rural areas (17.16%) compared to urban areas (14.85%), highlighting deep structural inequalities. These results support the research by Rodríguez & Fernández (2018) and Singh et al. (2017), who document how infrastructure limitations, combined with cultural barriers in rural communities, restrict access to sexual health services and reproductive education.

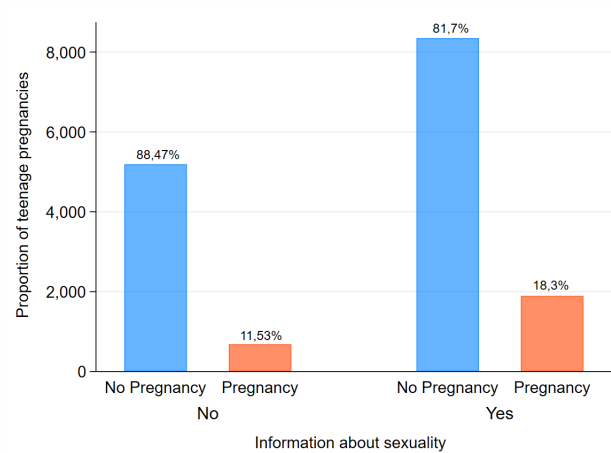
Figure 2*Proportion of Adolescent Pregnancies by Area of Residence**Note.* Authors (2026)

In Figure 3, differences by ethnic group are also striking: the rate reaches 17.2% among Indigenous, Afro-Ecuadorian, and Montubia adolescents, compared to 15.4% among Mestizo and White adolescents. In this regard, Ortiz & Carrillo (2021) note that these young women often face common barriers, ranging from institutional discrimination to a lack of programs that truly take their cultural contexts into account, highlighting inequalities that remain unresolved.

Figure 3*Proportion of Teenage Pregnancy by Ethnic Identification**Note.* Authors (2026)

A surprising finding that defies expectations emerges when analyzing the link between access to information and teenage pregnancy. According to Figure 4, among those who did not receive information on sexuality, 88.47% did not experience pregnancy, while 11.53% did. Conversely, among those who received sexual information, 81.7% did not experience pregnancy, while 18.3% did, showing a difference of 6.8 percentage points that suggests a higher incidence of pregnancy among informed adolescents.

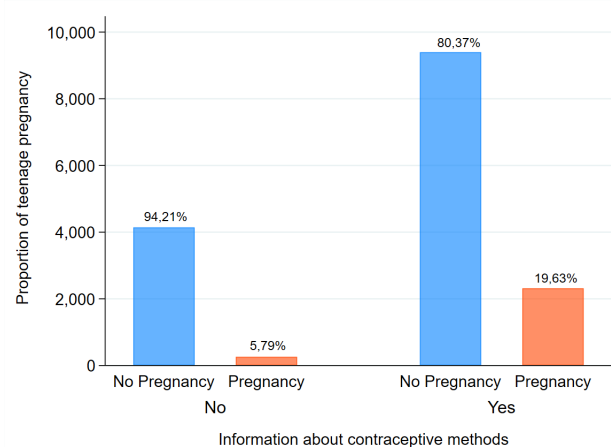
Figure 4
Proportion of adolescent pregnancies by sexual education



Note. Authors (2026)

This apparent paradox becomes more pronounced when examining data on contraceptive methods in Figure 5. Among adolescents without such information, 94.21% did not experience pregnancy, versus 5.79% who did. In contrast, among those who received contraceptive information, 80.37% did not experience pregnancy versus 19.63% who did, revealing a substantial difference of 13.8 percentage points.

Figure 5
Proportion of Teenage Pregnancies by Contraceptive Information



Note. Authors (2026)

These findings differ from those of Blanc et al. (2016), who argue that greater access to sexual information reduces teenage pregnancy. However, contextual factors may explain the discrepancy; according to Donkor & Lariba (2017), sex education without complementary measures does not necessarily reduce the incidence, as it is often implemented in high-prevalence areas as a reactive response. Likewise, unaccounted-for socioeconomic factors may skew the information toward already vulnerable populations, making it difficult to draw direct conclusions.

This pattern highlights something that Biddlecom et al. (2007) had already noted: knowing the facts is not enough to translate that knowledge into real actions for reproductive health protection. Social barriers, cultural stigma, or an incomplete education ultimately hinder that leap from knowing to doing.

At the provincial level, the moderate Gini index reflects structural inequalities that, according to Krugman (1991), tend to be perpetuated by agglomeration effects. The low HHI indicates that Ecuador has not developed patterns of intensive centralization such as those observed by Henderson (2003). The high average market potential (12.39), coupled with limited urban agglomeration, aligns with the findings of Frick & Rodríguez-Pose (2018) regarding the limited evidence of benefits from urban concentration in developing countries.

The probit model indicates that each additional year of schooling reduces the probability of teenage pregnancy by 3.61%, which reaffirms the protective effect of education put forward by Cáceres et al. (2010). Table 4 presents the estimated marginal effects from the probit model, which are consistent with these results. According to these authors, attending school not only delays the onset of sexual activity but also improves the ability to make informed decisions about reproductive health.

Nevertheless, the model shows a positive and statistically significant quadratic term of 0.166%, suggesting diminishing returns in which the protective benefit of schooling weakens at higher levels of education. Azevedo et al. (2012) emphasize that this phenomenon requires looking beyond years of schooling, as the quality of education and the sociocultural environment also play a role in understanding it.

Table 4

Marginal effects of the probit model

Variables	Model 7
Level of education	-0.0361*** (0.00712)
Education ^ 2	0.00166*** (0.000288)
Area	-0.0286*** (0.00501)
Age	0.0660*** (0.000957)
Sexuality information	-0.0387*** (0.00619)
Contraceptive information	0.0199** (0.00848)
Ethnicity	0.0140** (0.00570)
Observations	16,029

Note: Authors (2026)

Urban residence reduces the probability by 2.86%, as these environments offer greater access to health services and better educational and employment opportunities. In contrast, in rural areas, barriers persist that widen social gaps, according to Venegas & Valles (2019). These results are consistent with López et al. (2023) and Andrade Tafur & Benavides Pozo (2024), who note that educational level, area of residence, and access to reproductive health services significantly influence the risk; however, unlike those studies, this one incorporates a multilevel approach that allows for the simultaneous analysis of individual and provincial effects.

As age increases, the probability rises by 6.60% per year, although having information about sexuality reduces it by 3.87%, confirming the effectiveness of comprehensive sex education programs highlighted by Kirby (2007). Paradoxically, knowledge of contraceptive methods increases the probability by 2%, which Biddlecom et al. (2007) attribute to the gap between knowledge and actual use due to cultural and social barriers.

Belonging to an ethnic minority increases the probability by 1.40%, reflecting structural inequalities associated with restrictive cultural norms and limited opportunities, according to Boutayeb (2023). Finally, the hierarchical probit model shows that schooling reduces the risk by 3.4%, although its effect diminishes at higher educational levels, in line with human capital theory applied to reproductive health. Table 5 presents the marginal effects of the multilevel model.

Table 5

Marginal effects of the multilevel model

Variable	dy/dx	Est. Error	z	p-value
Individual level				
Level of education	-0.034	0.007	-4.8	<0.001
Education ^ 2	0.002	0	5.56	<0.001
Area	-0.037	0.006	-6.3	<0.001
Age	0.064	0.002	36.22	<0.001
Sexuality information	-0.036	0.007	-5.58	<0.001
Contraceptive information	0.016	0.009	1.8	0.072
Ethnicity	0.016	0.009	1.71	0.087
Provincial level				
Unemployment rate	0.005	0.003	1.6	0.111
Gini coefficient	-0.03	0.165	-0.18	0.856
Market potential	0.006	0.007	0.92	0.355
HHI Index	0.592	0.332	1.78	0.075

Note: Authors (2026)

Belonging to an ethnic minority maintains a marginally significant effect of 1.6%, consistent with Were (2007), who highlights the influence of cultural traditions and structural barriers. Likewise, the provincial HHI index shows an effect of 59.2%, consistent with Sampson (2012) and Krugman (1991), indicating that population and economic concentration affect reproductive health and that greater economic diversification could protect the most vulnerable adolescents.

In contrast, provincial macroeconomic variables did not show significant effects. Contrary to certain theories, in Ecuador, personal and local structural factors predominate over aggregate economic indicators, which partially supports Kearney & Levine's (2012) approach. However, unemployment does not play a central role.

Implications and Limitations

The results show that adolescent pregnancy in Ecuador is a phenomenon in which individual and territorial factors interact. Education acts as a protective factor, albeit with diminishing returns, suggesting that not only access but also quality matters. The gap between knowledge and contraceptive use points to the need for interventions that overcome practical and cultural barriers. Likewise, provincial and ethnic differences call for policies with a local and cultural focus.

As a limitation, the cross-sectional design prevents establishing full causality, although consistency with previous studies supports the findings. Furthermore, the absence of variables such as educational quality, social capital, and gender norms limits the understanding of underlying mechanisms. Future studies should adopt longitudinal approaches and incorporate a greater number of contextual variables to identify causal pathways and guide more precise policies.

5. CONCLUSIONS

The results reveal that 15.8% of adolescents experienced pregnancy, highlighting significant inequalities: an educational gap of 1.2 years between pregnant and non-pregnant adolescents, higher rates in rural areas (17.2%) versus urban areas (14.8%), and a higher incidence in Indigenous, Afro-Ecuadorian, and Montubio communities (17.2%) compared to Mestizo and white populations (15.4%).

The probit model confirms that each additional year of schooling reduces the probability of teenage pregnancy by 3.61%. The effect of education is strongest at the elementary and secondary levels. Living in an urban area reduces the probability by 2.86%, while belonging to an ethnic minority increases it by 1.40%. These results are consistent with human capital theory as it relates to reproductive health decisions.

A notable finding is that knowledge of contraceptive methods actually increases the probability of pregnancy by 1.99%, while information about sexuality decreases it by 3.87%. This highlights a significant gap between theoretical knowledge and its practical application, as having information alone, without comprehensive support, is insufficient. The multilevel model adds that high population and economic concentrations (measured by the HHI index) increase the probability by 59.2%. Centralization appears to further complicate access to services in outlying areas. Economic variables at the provincial level had no significant impact, suggesting that local and structural factors matter more. Among the limitations is that the study is cross-sectional, which does not allow for causal conclusions. Data on the quality of education and social capital were also lacking. Longitudinal studies are needed to capture causal effects more robustly.

Based on the evidence, we must consider policies tailored both to each individual's situation and to the broader context. Each additional year of schooling helps reduce the risk, so it is recommended to invest in school retention programs with scholarships and mentoring, especially in rural areas and for vulnerable ethnic groups, focusing particularly on primary and secondary education, where the protective impact is greatest.

The paradox regarding contraceptive knowledge suggests that providing information is not enough. Educational programs need to be redesigned to focus on the development of practical skills, such as negotiation, decision-making, and self-efficacy. Thus, it is important to involve families through training that improves dialogue on reproductive health and ensures free and confidential access to contraceptives.

It is worth emphasizing that urbanization concentrates risk in peripheral areas, which demands specific responses, such as deploying mobile sexual health units in less urbanized provinces and adapting communication to connect culturally and make it more natural to address the issue. Similarly, to close the ethnic gap, it is essential to develop programs in collaboration with Indigenous, Afro-Ecuadorian, and Montubio communities, using materials in ancestral languages and ensuring appropriate intercultural guidance.

Finally, it is key to implement long-term monitoring systems to evaluate the impact of these interventions, as well as to establish stable intersectoral commissions (Education, Health, Social Inclusion) with protected funding to support the continuity of the projects.

REFERENCES

- Andrade Tafur, E. E. & Benavides Pozo, L. d. R. (2024). *Determinantes de la salud y embarazo adolescente en el año 2018*.
- Azevedo, J., Favara, M., Haddock, S. E., Lopez, L. F., Müller, M. & Perova, E. (2012). *Teenage pregnancy and opportunities in Latin America and the Caribbean: On teenage fertility decisions, poverty and economic achievement*. World Bank. <https://doi.org/10.1596/16978>
- Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis with special reference to education*, First edition. NBER. <https://www.nber.org/books-and-chapters/human-capital-theoretical-and-empirical-analysis-special-reference-education-first-edition>
- Biddlecom, A. E., Munthali, A., Singh, S. & Woog, V. (2007). Adolescents' views of and preferences for sexual and reproductive health services in Burkina Faso, Ghana, Malawi and Uganda. *African Journal of Reproductive Health*. <https://pmc.ncbi.nlm.nih.gov/articles/PMC2367115/>
- Blanc, A., Way, A. & Sadruddin, S. (2016). Adolescent pregnancy and fertility in Latin America: What do we know and what are the policy options? *International Perspectives on Sexual and Reproductive Health*, 42(3), 155-164.
- Blunch, N. (2017). Una adolescente enamorada: capital humano multidimensional y embarazo adolescente en Ghana. *The Journal of Development Studies*, 54, 557-573.
- Boutayeb, A. (2023). Social determinants of health and adolescent childbearing in WHO Eastern Mediterranean countries. *International Journal For Equity In Health*, 22(1), 78. <https://doi.org/10.1186/s12939-023-01861-2>
- Bruce, J. & Clark, S. (2004). The implications of early marriage for HIV / AIDS policy. *Population Council*. https://knowledgecommons.popcouncil.org/departments_sbssr-pgy/1456/
- Cáceres, C. F., Cueto, S. & León, J. (2010). Adolescent pregnancy in latin america: The case of Peru. *International Family Planning Perspectives*, 36(1), 26–32.
- Cadena Mosquera, D. N. (2019). Valoración de la mortalidad materna en mujeres de la Sierra rural: una tragedia evitable [Master's thesis, Universidad San Francisco de Quito]. Repositorio USFQ. <http://repositorio.usfq.edu.ec/handle/23000/8381>
- Celhay, P., Depetris-Chauvín, E. & Riquelme, C. (2020). Cuando una huelga golpea dos veces: movilizaciones estudiantiles masivas y embarazo adolescente en Chile. *Economía del desarrollo: estudios regionales y nacionales eJournal*. <https://doi.org/10.24275/uam/izt/dcsh/polis/2019v15n2/Penaglia>
- Combes, P. P. (2008). *Economic geography: The integration of regions and nations*. Princeton University Press. <https://doi.org/10.2307/j.ctvc4h9k>
- Contreras, D. & González, M. (2015). Impact of education on adolescent health: Evidence from Chile. *Journal of Health Economics*, 40, 145-157. <https://www.iza.org/publications/dp/8072/the-impact-of-adolescent-motherhood-on-education-in-chile>
- Donkor, A. K. & Lariba, A. L. (2017). The impact of sex education on teenage pregnancy in basic schools of Bawku municipal district in Ghana. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 3(3), 214-221. <https://doi.org/10.22219/jpbi.v3i3.4915>
- Duranton, G. & Puga, D. (2004). Micro-foundations of urban agglomeration economies. En V. Henderson y J. F. Thisse (Eds.), *Handbook of regional and urban economics* (Vol. 4, pp. 2063–2117). Elsevier.
- Easterlin, R. A. (1975) An economic framework for fertility analysis. *Studies in family planning*, 6, 54-63. <https://doi.org/10.2307/1964934>
- Elder, G. H. (1974). *Children of the great depression*. University of Chicago Press. <https://doi.org/10.4324/9780429501739>
- Encuesta nacional de empleo, desempleo y subempleo (ENEMDU). (2019). *Instituto Nacional de Estadística y Censos INEC*. <https://www.ecuadorencifras.gob.ec/enemdu-diciembre-2019/m>

- Encuesta nacional de salud y nutrición (ENSANUT). (2019). *Instituto Nacional de Estadísticas y Censos INEC*. <https://www.ecuadorencifras.gob.ec/encuesta-nacional-de-salud-y-nutricion-ensanut-2019/>
- Fory, J. A. & Olivera, M. J. (2020). Caracterización de la población gestante adolescente atendida en el Hospital Militar Central de Bogotá D.C., Colombia. 2012-2015. <https://doi.org/10.15446/revfacmed.v68n2.70818>
- Frick, S. A. & Rodríguez-Pose, A. (2018). Change in urban concentration and economic growth. *World Development*, 105, 156–170. <https://doi.org/10.1016/j.worlddev.2017.12.034>
- García, D., Puschel, K. & Soto, G. (2012). Family intervention to control childhood asthma and obesity in three pediatric practices in Santiago, Chile: a randomized controlled trial. *Family Practice*. <https://doi.org/10.3399/bjgp12X630098>
- Grossman, M. (1972). *The demand for health: A theoretical and empirical investigation*. National Bureau of Economic Research. <https://dokumen.pub/the-demand-for-health-a-theoretical-and-empirical-investigation-9780231544528.html>
- Henderson, V. (2003). The urbanization process and economic growth: The So-What Question. *Journal Of Economic Growth*, 8(1), 47-71. <https://doi.org/10.1023/a:1022860800744>
- Kane, T. J., Rouse, C. E. & Staiger, D. (2013). Estimating returns to schooling when schooling is misreported. *National Bureau of Economic Research*. <https://ideas.repec.org/p/nbr/nberwo/7235.html>
- Kearney, M. & Levine, P. (2012). Why is the teen birth rate in the united states so high and why does It matter? *The Journal Of Economic Perspectives*, 26(2), 141-166. <https://doi.org/10.1257/jep.26.2.141>
- Kiernan, K. & Smith, K. (2003). Unmarried parenthood: new insights from the Millennium Cohort Study. *Population trends*, (114), 26–33. <https://pubmed.ncbi.nlm.nih.gov/14730813/>
- Kirby, D. (2007). Respuestas emergentes: Resultados de investigaciones sobre programas para reducir el embarazo adolescente y las enfermedades de transmisión sexual. *Campaña nacional para prevenir el embarazo adolescente y no planificado*. 40(3), 206-217.
- Krugman, P. (1991) Increasing returns and economic geography. *Journal of Political Economy*, 99, 483-499. <https://doi.org/10.1086/261763>
- López, M., Paucar, M. J., Vega, M., Izurieta, D., Acosta, H., Simancas-Racines, D. & Angamarca, J. (2023). Factores asociados al embarazo adolescente en Ecuador y el rol del primer nivel de atención en salud: Un análisis a partir del instrumento ENSANUT 2018. *Práctica Familiar Rural*, 8(3). <https://doi.org/10.16921/pfr.v8i3.295>
- Marmot, M. & Wilkinson, R. (2005). Determinantes sociales de la salud. *Oxford University Press*. <https://doi.org/10.1093/ije/dyl121>
- Martínez, E. A., Montero, G. I. & Zambrano, R. M. (2020). El embarazo adolescente como un problema de salud pública en Latinoamérica. *ESPACIOS*, 41(47), 1-10. <https://doi.org/10.48082/espacios-a20v41n47p01>
- Mendoza, J. & Fernández, V. (2018). Educational attainment and teenage pregnancy in Ecuador: A probit model approach. *Revista Ecuatoriana de Sociología*, 34(2), 212-230.
- Miquilena, M. & Lara, E. (2021). Deserción escolar a causa del embarazo adolescente. *CAF*. <https://www.caf.com/es/blog/desercion-escolar-a-causa-del-embarazo-adolescente/>
- Mohr, R., Carbajal, J. & Sharma, B. B. (2019). *The Influence of educational attainment on teenage pregnancy in low-income countries: A Systematic Literature Review*.
- Moore, K., Peterson, J. & Furstenberg, F. (1986). Actitudes de los padres y aparición de actividad sexual temprana. *Journal of Marriage and the Family*, 777-782.
- Morgan, A. K., Agyemang, S., Dogbey, E., Arimiyaw, A.W. & Owusu, A.F. (2022). “Éramos niñas, pero de repente nos convertimos en madres”: evaluación de los efectos de la maternidad adolescente en el rendimiento educativo de las niñas en la región del Volta. *Cogent Social Sciences*, 8. <https://doi.org/10.1186/s12978-024-01821-0>

- Moshi, F. V. & Tilisho, O. (2023). The magnitude of teenage pregnancy and its associated factors among teenagers in Dodoma Tanzania: a community-based analytical cross-sectional study. *Reproductive Health*, 20(1), 28. <https://doi.org/10.1186/s12978-022-01554-z>
- World Health Organization (WHO). (2024). Adolescent pregnancy. <https://www.who.int/news-room/fact-sheets/detail/adolescent-pregnancy>
- Organización panamericana de la salud (OPS). (2006). *Descubriendo las voces de las adolescentes: definición del empoderamiento desde la perspectiva de las adolescentes*. <https://iris.paho.org/handle/10665.2/49409>
- Ortiz, A. & Carrillo, F. (2021). Gendered perspectives on adolescent pregnancy in Ecuador: A cultural and policy framework. *Ecuadorian Journal of Social Sciences*, 11(1), 112-130.
- Pebley, A. R. & Sastry, N. (2003). *Neighborhoods, poverty and children's well-being: A review*. <https://escholarship.org/uc/item/9sx1430n>
- Pérez Arrobo, G. A. (2016). *Determinantes del embarazo adolescente en Ecuador en el periodo 2011-2013*. <https://repositorio.puce.edu.ec/items/15ac7395-00e7-4b21-8b6b-1d4a66a08dfb>
- Piawpongpakawat, A. (2013). *Factores influyentes en el embarazo adolescente y comparación entre el nivel educativo del embarazo adolescente y el embarazo normal en el hospital Pakham, provincia de Buriram*.
- Roca, J. D. L. & Puga, D. (2017). Learning by working in big cities. *ideas.repec.org*. <https://ideas.repec.org/a/oup/restud/v84y2017i1p106-142..html>
- Rodríguez, R. & Fernández, J. (2018). Desigualdades rurales en el acceso a servicios de salud sexual y reproductiva en Ecuador. *Revista de Salud Pública y Medicina Comunitaria*. 7(4), 90-102.
- Sampson, R. J. (2012). Great American city: Chicago and the enduring neighborhood effect. *University of Chicago Press*. <https://scispace.com/pdf/great-american-city-chicago-and-the-enduring-neighborhood-12am3i8lhl.pdf>
- Singh, S., Darroch, J. E. & Ashford, L. S. (2017). El impacto de las políticas de salud sexual y reproductiva sobre la fecundidad adolescente en los países en desarrollo. *Perspectivas internacionales sobre planificación familiar*. 33(4), 118-125.
- Venegas, M. & Valles, B. N. (2019). *Factores de riesgo que inciden en el embarazo adolescente desde la perspectiva de estudiantes embarazadas*. https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1139-76322019000300006
- Were, M. (2007). Determinants of teenage pregnancies: The case of busia district in Kenya. *Economics & Human Biology*, 5(2), 322-339. <https://doi.org/10.1016/j.ehb.2007.03.005>
- Wooldridge, J. M. (2010). *Introducción a la econometría: un enfoque moderno*. Cuarta edición, México: Cengage Learning Editores.

ADDITIONAL INFORMATION

JEL classification: I21, J13, E24, C25

