

Determinants of Female Literacy in India: the Role of School Education Quality, Health Outcomes and Poverty

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Abstract

Education has become a powerful tool for achieving gender equality and promoting inclusive development. Higher female literacy has been a game changer in providing employment opportunities for women, better health, higher family income and greater participation in decision-making. Although India has made significant progress in improving female literacy over the past decades yet large differences exist across various states. Some states have achieved universal or near-universal female literacy, while others continue to struggle because of poor educational facilities, weak health care systems and large poverty.

This study examines the factors influencing female literacy across Indian states using secondary data. Female literacy is taken as the dependent variable while the School Education Quality Index, Health Index and Poverty Headcount Ratio are considered as Independent variables. Multiple regression analysis is used to examine the relationship between these variables.

It indicates that States with better quality schools and stronger health care systems generally report higher female literacy rates whereas states with higher poverty levels tend to perform poorly. These results suggest that improving female literacy is not determined by a single factor instead it requires a combined effort to strengthen education, healthcare and poverty reduction programmes rather than focusing on one sector alone.

The study thus highlights the importance of integrated public policies for achieving gender equality and sustainable development. The findings may assist policymakers in designing targeted interventions to reduce regional disparities in female literacy across India.

Keywords: Female Literacy, School Education Quality, Health Index, Poverty, Human Development, India.

Introduction

Education is a fundamental driver of economic growth, social progress and human development. Among various educational indicators available, female literacy occupies a central position because of its potential to increase ensure ensuring consistency After excluding observationslabour participation, improves household decision-making and contributes to better health as well as educational outcomes for future generations (Becker, 1964; Sen, 1999). Countries with higher female literacy generally saw lower fertility rates, improved maternal and child health. Every day girls face barriers to education due to poverty, cultural norms and, poor infrastructure. Girl's education is a strategic development priority for the World Bank. (UNESCO, 2023; World Bank, 2023).

Samagra Shiksha, Beti Bachao Beti Padhao and the Right to Education Act have helped India in reaching its target yet educational, healthcare and socio-economic disparities continue to exist across states. (Ministry of Statistics and Programme Implementation [MoSPI], 2024; NITI Aayog, 2023). States such as Kerala and Mizoram have achieved very high female literacy while others continue to face serious educational challenges.

Among all the Education Indicators, female literacy holds a special position because its positive impact in the society. An educated woman is keen to participate in the workforce, make informed health decisions, educate her children and also contribute to the overall development of her community. Therefore, female literacy is found to be the strongest indicator of human development. Health is another important factor. Healthy children are more regular to schools and are better at learning. Good healthcare services, proper nutrition and maternal health

contribute directly to better educational outcomes. In contrast, poor health conditions reduce school attendance and negatively affect learning.

Even Poverty plays a crucial role in determining educational opportunities. Families with limited financial resources often struggle to bear the costs of education. In many poor households, girls are expected to help their mothers with household chores or care for younger siblings thereby increasing the chances of dropout. Hence, Poverty continues to be one of the biggest barriers to female education in many parts of India.

Better schools improve learning outcome, healthier children are more likely to remain in school and lower poverty enables families to invest more in education. Thereby, creating a close link between education quality, health and poverty.

Many previous studies have worked on female literacy in India mostly focusing on household characteristics, income or government expenditure separately. Very few studies have examined how school education quality, health outcomes and poverty together influence female literacy across Indian states. This study attempts to fill this gap by analysing these factors using recent state-level data.

Research Gap.

The existing literature also shows that education, health and poverty are closely interconnected. Improvements in one area often reinforce progress in the others. States with better educational systems have stronger health outcomes and lower poverty levels. Altogether it creates a more supportive environment for female education.

Also, many previous studies focused on finding the relationship between female literacy and educational expenditure, household income or socio-economic factors but very few have analysed the combined influence of school education quality, health outcomes and poverty using recent state-level data for India. The present study throws light on this gap by examining how these factors jointly influence female literacy across Indian states through multiple regression analysis and provides a broader understanding of the determinants of female literacy.

Literature Review

Education has historically been recognised as a key driver of human development. Among different dimensions female literacy has always received special attention. It impacts women's social status, economic independence, family welfare and overall quality of life directly. Educated women are more likely to participate in the workforce, make informed decisions regarding healthcare and family planning and invest in the children's education. As a result, improving female literacy has become a major objective for both developed and developing countries.

Education levels differ dramatically between developing and developed countries. Building upon several decades of thought about human capital and centuries of general attention to education in the more advanced countries It is natural to believe that a productive development strategy would be to raise the schooling levels of the population. Indeed, this is exactly the approach of the Education for All initiative and a central element of the Millennium Development Goals (Hanushek and Woessmann,2015)

Health is another important indicator affecting literacy levels. Children with proper nutrition and good health are more regular to school. The Health Index aims to accelerate the pace of achieving health outcomes and encourages cross learning among states/UTs. The Health Index is conceptualised as a game changer, as it helps to shift the focus of the states and UTs from inputs, outputs and budget spends to health outcomes. (Niti Aayog,2021). According to the World Bank (2023), investments in healthcare contribute not only to improved health outcomes but also to higher levels of educational achievement.

Another persistent barrier is poverty. Financial pressure often lead to limited access to educational resources. It increases the chances of school dropout among girls. In many low-income households girls are expected to help their mother with household responsibilities or contribute to family income. Further reducing their chances of completing school. (UNDP, 2023).

Objectives Of the Study

The study has the following objectives:

1. To examine the level of female literacy across Indian states.
2. To analyse the relationship between school education quality and female literacy.
3. To examine the effect of health outcomes on female literacy.
4. To assess the influence of poverty on female literacy.
5. To identify the most important determinants of female literacy using multiple regression analysis.

Research Hypotheses

Based on the review of literature and theoretical arguments, the following hypotheses are proposed:

H₀₁: School Education Quality Index has no significant effect on female literacy.

H₁₁: School Education Quality Index has a significant positive effect on female literacy.

H₀₂: Health Index has no significant effect on female literacy.

H₁₂: Health Index has a significant positive effect on female literacy.

H₀₃: Poverty Headcount Ratio has no significant effect on female literacy.

H₁₃: Poverty Headcount Ratio has a significant negative effect on female literacy.

H₀₄: School Education Quality Index, Health Index, and Poverty Headcount Ratio do not jointly explain variations in female literacy.

H₁₄: School Education Quality Index, Health Index, and Poverty Headcount Ratio jointly explain variations in female literacy.

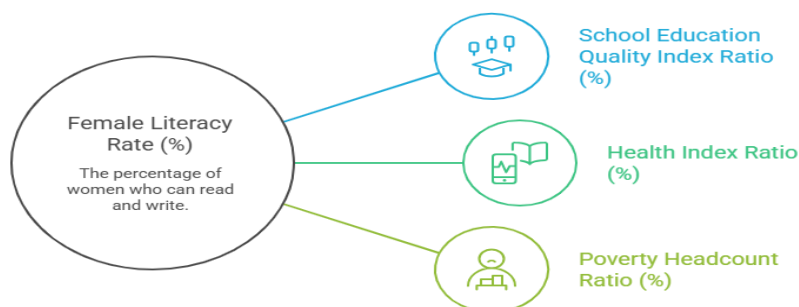
Theoretical Framework

The study is based on Human Capital Theory (Becker, 1964) and the Capability Approach (Sen, 1999). Together, these theories provide a comprehensive framework for understanding female literacy as both an economic and social development outcome. Human Capital Theory argues that education enhances individual productivity and contributes to economic growth and development while, the Capability Approach works on how education expands human freedom and social participation. Together, these theories provide a large framework for understanding female literacy as both an economic and social development outcome.

In Human Capital Theory, education is considered as an investment rather than a cost. When individuals receive quality education, they not only acquire knowledge but also skills that increase their productivity and earning potential in future. Also, Educated women are more likely to participate in economic activities, make informed decisions and contribute to national progress. Therefore, factors that provide educational opportunities are expected to increase female literacy.

According to Amartya Sen, Capability Approach provides a broader view development should not be measured only by income but by people's ability to live the lives they value. Education enables women with greater freedom to participate in social and economic life and making independent decisions regarding health, employment and family welfare. Female literacy, Therefore, Female literacy is not only an educational indicator but a strong measure of empowerment and human development.

Unveiling the Multifaceted Influence on Female Literacy



Made with Napkin

The present study assumes that female literacy is influenced by three major dimensions of human development:

- **School Education Quality** represents the effectiveness of the education system.
- **Health Outcomes** determine children's ability to attend and benefit from schooling.
- **Poverty** affects a family's capacity to invest in education.

Research Methodology

Nature of the Study

The present study is quantitative, analytical and cross-sectional in nature. It examines interstate variations in female literacy using secondary data collected from official government sources. The study aims to identify the factors that significantly influence female literacy across Indian states.

Data Source

The study is entirely based on secondary data obtained from reliable government publications. The data on Female Literacy have been taken from the Periodic Labour Force Survey (PLFS), 2023–24. The School Education Quality Index has been obtained from NITI Aayog's School Education Quality Index Report ,2016–17. Health Index data have been collected from NITI Aayog's Healthy States, Progressive India Report (2019–20). Poverty Headcount Ratio data have been taken from NITI Aayog's National Multidimensional Poverty Index Report (2023). These sources are widely used in academic research ensuring the reliability of the data.

Sl. No.	State	Female Literacy (%)	School Education Quality Index (2016–17)	Health Index (2019–20)	Poverty Headcount Ratio (%) (2022–23)
1	Andhra Pradesh	66.0	56.1	69.95	4.2
2	Arunachal Pradesh	77.5	NA	NA	NA
3	Assam	81.2	56.1	47.74	14.5
4	Bihar	68.0	37.3	31.00	26.6
5	Chhattisgarh	71.0	54.9	50.70	11.7
6	Goa	89.5	NA	NA	NA
7	Gujarat	77.2	63.0	63.59	9.0
8	Haryana	76.5	69.5	49.26	5.3

9	Himachal Pradesh	83.1	62.8	63.17	3.9
10	Jharkhand	69.2	30.6	47.55	23.3
11	Karnataka	76.1	52.9	57.93	5.7
12	Kerala	94.0	82.2	82.20	0.5
13	Madhya Pradesh	67.8	47.2	36.72	15.0
14	Maharashtra	81.5	62.5	69.14	5.5
15	Manipur	87.3	NA	NA	NA
16	Meghalaya	92.4	NA	NA	NA
17	Mizoram	97.5	NA	NA	NA
18	Nagaland	93.8	NA	NA	NA
19	Odisha	72.3	60.2	44.31	11.1
20	Punjab	78.8	59.1	58.08	4.4
21	Rajasthan	64.5	59.4	41.33	10.8
22	Sikkim	80.1	NA	NA	NA
23	Tamil Nadu	80.2	73.4	72.42	1.4
24	Telangana	69.8	NA	NA	NA
25	Tripura	91.6	NA	NA	NA
26	Uttar Pradesh	69.4	46.5	30.57	17.4
27	Uttarakhand	76.4	48.1	44.21	6.9
28	West Bengal	77.0	NA	NA	8.6
29	Jammu & Kashmir	NA	47.1	46.99	2.8

Table 1. Source: Compiled by the author using data from PLFS 2023–24 (MoSPI), School Education Quality Index, NITI Aayog (2016–17), Healthy States, Progressive India Report, NITI Aayog (2019–20), and National Multidimensional Poverty Index Report, NITI Aayog (2023).

Coverage of the Study

The dataset included **29 Indian States and Union Territories**. However, several states had missing values for the School Education Quality Index and Health Index. Therefore, the regression analysis was carried out using observations with complete information to ensure consistency. After excluding observations with missing values, the final regression analysis was conducted using 19 states with complete information.

Statistical Techniques

The study employs four statistical techniques.

1) Descriptive Statistics

Descriptive statistics are used to understand the basic characteristics of the variables. Measures such as the mean, standard deviation, minimum, and maximum values provide an overview of interstate differences in female literacy, school education quality, health outcomes and poverty.

2)Correlation Analysis

Pearson's correlation analysis is used to examine the strength and direction of the relationship between female literacy and each explanatory variable.

3)Multiple Linear Regression

Multiple regression analysis is employed to identify the combined influence of school education quality, health outcomes, and poverty on female literacy.

The regression model is specified as:

$$FL_i = \beta_0 + \beta_1 SEQI_i + \beta_2 HI_i + \beta_3 PHR_i + \varepsilon_i$$

where:

- FL = Female Literacy
- $SEQI$ = School Education Quality Index
- HI = Health Index
- PHR = Poverty Headcount Ratio
- β_0 = Intercept
- $\beta_1, \beta_2, \beta_3$ = Regression coefficients
- ε = Error term

4)Diagnostic Tests

To ensure the reliability of the regression model, diagnostic tests such as multicollinearity (Variance Inflation Factor), normality of residuals, and residual plots are examined.

Results And Interpretation**1)Descriptive Analysis**

	Female Literacy (%)	School Education Quality Index (2016–17)
Valid	28	19
Missing	2	11
Mean (arithmetic)	78.92	56.26
Std. Deviation	9.374	12.16
Minimum	64.50	30.60
Maximum	97.50	82.20

Table 2. Descriptive Statistics

The study examines interstate variations in female literacy and its major determinants across India. Data examination reveals that there is considerable differences in Female Literacy among Indian states.

States such as Mizoram (97.5%), Kerala (94.0%), Nagaland (93.8%), Meghalaya (92.4%) and Tripura (91.6%) have achieved higher levels of female literacy whereas states including Rajasthan (64.5%), Andhra Pradesh (66.0%), Madhya Pradesh (67.8%), Bihar (68.0%) and Uttar Pradesh (69.4%) continue to report relatively lower literacy rates among women.

Socio-economic indicators in Kerala shows better performance in school education quality (82.2) and health outcomes (82.20) whereas states such as Bihar and Jharkhand are still backward in these areas. Bihar (26.6%), Jharkhand (23.3%) and Uttar Pradesh (17.4%) reported higher multidimensional poverty levels in comparison to

Kerala (0.5%) and Tamil Nadu (1.4%) that record much lower levels. The above differences suggests that States with stronger educational systems, better health facilities and lower poverty levels tend to achieve better outcomes in female literacy.

2)Correlation Analysis

			Pearson's r	p
Female Literacy (%)	-	Poverty Headcount Ratio (%) (2022-23)	-0.603	.006
Female Literacy (%)	-	Health Index (2019-20)	0.686	.002
Female Literacy (%)	-	School Education Quality Index (2016-17)	0.687	.002
Poverty Headcount Ratio (%) (2022-23)	-	Health Index (2019-20)	-0.740	< .001
Poverty Headcount Ratio (%) (2022-23)	-	School Education Quality Index (2016-17)	-0.764	< .001
Health Index (2019-20)	-	School Education Quality Index (2016-17)	0.720	< .001

Table 3. Pearson Correlation Matrix

Pearson's correlation analysis shows positive association of female literacy with the School Education Quality Index and Health Index. It suggests that states with better educational systems and health conditions tend to achieve higher female literacy levels. In contrast poverty shows a negative relationship with female literacy indicating that states with higher poverty levels generally experience lower female literacy outcomes.

3)Multiple Regression Analysis

Model Summary - Female Literacy (%)

Model	R	R ²	Adjusted R ²	RMSE	R ² Change	df1	df2	p
M ₀	0.000	0.000	0.000	7.431	0.000	0	17	
M ₁	0.748	0.559	0.465	5.438	0.559	3	14	.008

Note. M₁ includes Poverty Headcount Ratio (%) (2022-23), School Education Quality Index (2016-17), Health Index (2019-20)

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M ₁	Regression	524.9	3	175.0	5.918	.008
	Residual	413.9	14	29.57		
	Total	938.9	17			

Note. M₁ includes Poverty Headcount Ratio (%) (2022-23), School Education Quality Index (2016-17), Health Index (2019-20)

Note. The intercept model is omitted, as no meaningful information can be shown.

Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p	Collinearity Statistics	
							Tolerance	VIF
M ₀	(Intercept)	75.18	1.752		42.92	< .001		
M ₁	(Intercept)	42.09	16.17		2.603	.021		
	Poverty Headcount Ratio (%) (2022-23)	0.220	0.384	0.215	0.574	.575	0.224	4.456
	School Education Quality Index (2016-17)	0.317	0.200	0.525	1.582	.136	0.286	3.493
	Health Index (2019-20)	0.242	0.148	0.479	1.641	.123	0.370	2.700

Table 4. Multiple Regression Results

Multiple linear regression analysis was performed to examine the combined effect of the School Education Quality Index, Health Index and Poverty Headcount Ratio on female literacy.

The value of correlation coefficient $R = 0.748$ reflects a strong relationship between the observed and predicted values of female literacy. The coefficient of determination i.e $R^2 = 0.559$ shows approximately 55.9% of the variation in female literacy across states is explained jointly by the three explanatory variables also the Adjusted R^2 is 0.465 explains that there is 46.5% of the variation in female literacy. The remaining 44.1% variation in

female literacy may be explained by factors not included in the present model. The model has a Root Mean Square Error (RMSE) of 5.438 suggesting it to be a good fit.

According to ANOVA results the regression model is statistically significant with $F = 5.918$ and $p = 0.008$. It shows that when 3 explanatory variables are considered together they explain variations in female literacy across Indian states.

The regression coefficients also provide insights about the individual contribution of each explanatory variable. First is the School Education Quality Index where β coefficient is 0.317, p is 0.136, Health Index β coefficient is 0.242, and p is 0.123 exhibit positive associations with female literacy. Poverty Headcount Ratio's β coefficient is 0.220 and p is 0.575 making it statistically insignificant. The overall model shows that these socio-economic factors collectively contribute to explaining interstate variations in female literacy even none of the individual predictors are significant at the 5% level.

Partial Regression Plot

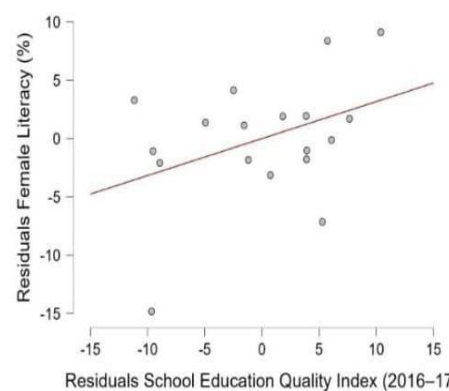


Figure 1. Partial Regression Plot for School Education Quality Index

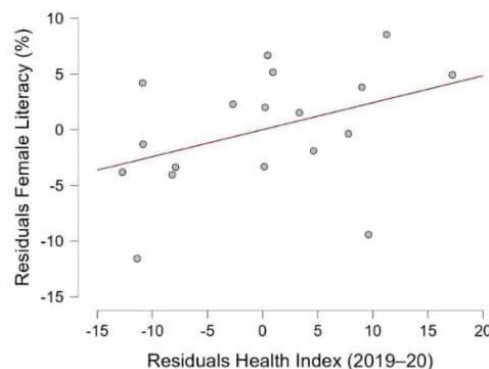


Figure 2. Partial Regression Plot for Health Index

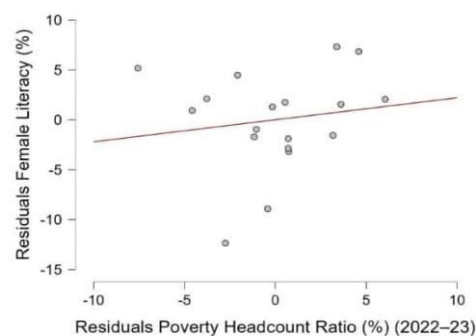


Figure 3. Partial Regression Plot for Poverty Headcount Ratio

Figure 1 shows positive linear association of the School Education Quality Index shows a and female literacy indicating improvements in school education are linked with higher female literacy. Figure 2 demonstrates another positive association between the Health Index and female literacy, suggesting that better health outcomes contribute positively to literacy levels. Figure 3 shows a weak and statistically insignificant relationship between Poverty Headcount Ratio and female literacy. Overall, the plots exhibit approximately linear trends with no evident non-linear patterns thereby supporting linearity and inclusion of these predictors in the multiple regression model.

4)Regression Diagnostic Tests

Before interpreting the regression results, diagnostic tests were conducted to verify whether the assumptions of multiple linear regression were satisfied.

- Multicollinearity**

Collinearity Diagnostics

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Intercept)	Poverty Headcount Ratio (%) (2022–23)	School Education Quality Index (2016–17)	Health Index (2019–20)
M ₁	1	3.567	1.000	0	0.004	0.001	0.002
	2	0.412	2.942	0	0.139	0.003	0.009
	3	0.017	14.69	0.017	0.041	0.276	0.854
	4	0.004	28.75	0.983	0.816	0.72	0.135

Note. The intercept model is omitted, as no meaningful information can be shown.

Table 5. Regression Diagnostic Tests

Variance Inflation Factor (VIF) values were calculated to assess multicollinearity among the explanatory variables. The values were **3.493,2.700,4.456** for the School Education Quality Index, Health Index ,Poverty Headcount Ratio respectively.Since all VIF values are below the threshold level of **5** so multicollinearity is not considered a serious concern in the model.

- Residual versus Predicted Plot**

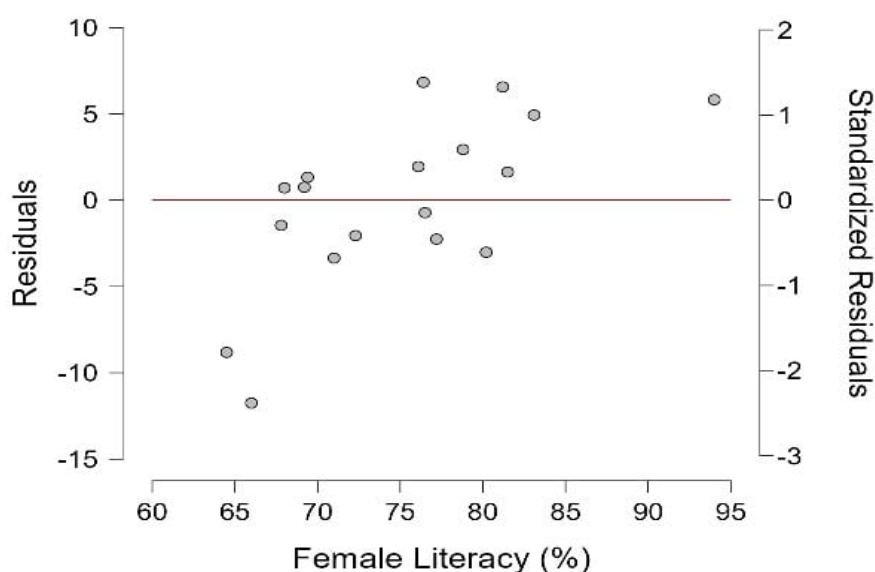


Figure 4. Residual versus Predicted Plot

The Residual versus Predicted plot was examined to check for linearity and homoscedasticity. The residuals appeared to be randomly distributed around the zero reference line without any systematic pattern or funnel-shaped distribution so it satisfies the above mentioned assumption.

- **Normal Q-Q Plot**

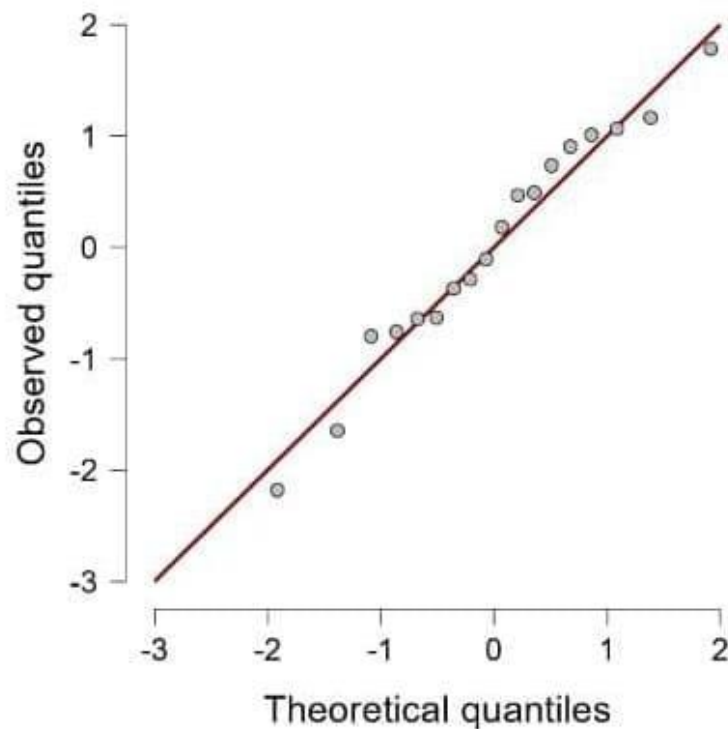


Figure 5. Normal Q-Q Plot

The Normal Q-Q Plot checks whether the residuals are normally distributed or not. From the Figure 5 it was found to lie close to the diagonal reference line with only minor deviations at the extreme ends. Such deviations are common in cross-sectional data and do not indicate any serious problem in the normality assumption.

Also, the diagnostic tests confirm that the model satisfies the assumptions of multiple linear regression indicating that the estimated coefficients are reliable and appropriate for interpretation.

Hypothesis Testing

The hypotheses proposed in the study were tested using the results of the multiple regression analysis.

Hypothesis	Predictor	Test Statistic	p-value	Decision	Conclusion
H ₀₁ : School Education Quality Index has no significant effect on female literacy.	School Education Quality Index	$\beta = 0.317$	0.136	Fail to Reject H ₀	No statistically significant independent effect on female literacy.
H ₀₂ : Health Index has no significant effect on female literacy.	Health Index	$\beta = 0.242$	0.123	Fail to Reject H ₀	No statistically significant independent effect on female literacy.

H ₀₃ : Poverty Headcount Ratio has no significant effect on female literacy.	Poverty Headcount Ratio	$\beta = 0.220$	0.575	Fail to Reject H ₀	No statistically significant independent effect on female literacy.
H ₀₄ : School Education Quality Index, Health Index, and Poverty Headcount Ratio jointly do not explain female literacy.	Overall Regression Model	F= 5.918	0.008	Reject H ₀	The explanatory variables jointly have a statistically significant effect on female literacy.

Discussion

The findings suggest that female literacy in India is shaped by a combination of educational, health and socio-economic influences instead of any single factor. The regression model was statistically significant indicating that the School Education Quality Index, Health Index and Poverty Headcount Ratio together explain a significant portion of the variation in female literacy among Indian states.

While the School Education Quality Index and Health Index showed positive relationships with female literacy. Though none of them were statistically significant when considered individually. Similarly, the Poverty Headcount Ratio was also statistically insignificant and showed unexpected positive coefficient.

The lack of statistical significance may be attributed to the limited sample size and the interrelationship among explanatory variables. Also education quality, health and poverty are closely knitted making it difficult to separate their independent influence. Various factors such as parental education, urbanisation, cultural norms and public investment in education also affect female literacy which are not included in the model.

However, correlation analysis supports the anticipated relationships showing positive associations of female literacy with school education quality and health along with the negative association with poverty. Thus, the result suggest that improving female literacy requires an integrated policy approach that boosts education, improves health outcomes and reduces poverty in states with low literacy rates.

Policy Implication

The following policy measures could help lessen regional disparities in female literacy:

- **Strengthen the quality of school education:** Increasing enrolment and retention of girls in school can be achieved by the school infrastructure, lowering student-teacher ratio, increase learning outcome and appointment of trained teacher.
- **Improve healthcare access:** Girls attendance and academic score as be increased by providing easy adolescent health and nutrition program, routine health examination and improvement maternity healthcare in rural and economically weaker areas
- **Reduce obstacle to education caused by poverty:** Scholarships, free textbooks, uniforms, bicycles and conditional cash transfer programmes are the example of financial aid given to families to retain girls in school.
- **Focus on educationally disadvantaged states:** States with low female literacy should receive interventions based on the challenges they are facing. Also, instead of adopting a uniform approach, customized state-specific policies should be designed to address local problems. This will ensure more effective implementation and equitable improvements in the literacy rates.

- **Promote community awareness and gender-sensitive initiatives:** These programmes should address social and cultural mindset that discourage girl's education. Gender-sensitive campaigns can promote equal opportunities, challenge stereotypes behavior, and encourage support from family.
- **Adopt an integrated policy framework:** Since education, health, and poverty are closely related so coordinated efforts will sustainably improve female literacy.

Conclusion

Female literacy is an important indicator of women's empowerment and human development. The present study examined the influence of the School Education Quality Index, Health Index and Poverty Headcount Ratio on female literacy across Indian states using multiple regression analysis. The results revealed that the explanatory variables jointly have a statistically significant effect on female literacy and explain a substantial proportion of interstate variation. Although the individual predictors were not statistically significant at the 5 per cent level, their positive associations with female literacy highlight the importance of educational quality and health outcomes in improving literacy levels among women.

The findings suggest that female literacy is influenced by a combination of educational, health and socio-economic factors rather than by any single determinant. Therefore, policies aimed at improving female literacy should adopt an integrated approach that simultaneously strengthens school education, improves health outcomes and reduces poverty. Such coordinated efforts can help reduce regional disparities and promote inclusive and sustainable development across India.

Future research may include additional determinants such as female labour force participation, urbanisation, educational expenditure and digital connectivity to gain a more holistic and comprehensive understanding of the factors influencing female literacy disparities across Indian states.

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