



# Female Educational Attainment in Shaping Marriage Pattern: A Spatial Analysis on Siliguri Municipal Corporation, West Bengal, India

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**Abstract :** Education is crucial elements of society for societal progress as well as growth. It is empowering individuals with knowledge, skills, and responsibility to drive positive change. The study examines the spatial distribution of female literacy, gender disparities in education, and the impact of literacy on marriage age within the Siliguri Municipal Corporation (SMC) area. Utilizing primary data from 100 household surveys and secondary data from the District Statistical Handbook 2013 and District Census Handbook 2011, various statistical methods such as Location Quotient, Sopher's Gender Disparity Index, Mann-Whitney U Test, and Chi-Square Test were employed. The findings reveal significant gender disparities in literacy rates across different wards, with central areas of SMC showing higher female literacy compared to peripheral regions. The analysis highlights a positive correlation between literacy and delayed marriage age, indicating that literate women tend to marry later compared to their illiterate counterparts. Additionally, the study finds a significant association between educational levels and area of residence, with women in non-slum areas exhibiting higher literacy rates than those in slum areas. These results underscore the importance of targeted educational policies and interventions to bridge gender gaps, improve educational access and quality, and promote socio-economic development. Addressing socio-cultural barriers and enhancing support systems for women's education are crucial for achieving gender equality and empowering women in the SMC area. The study's insights contribute to the broader discourse on gender disparities in education and provide a foundation for future research and policy formulation aimed at fostering inclusive growth and development.

**Keywords -** Female literacy, Gender disparity, Education, Marriage age, Socio-economic development.

## INTRODUCTION

Education is essential for societal progress and growth, empowering individuals to make positive changes and gain knowledge, skills, and responsibility (Kiba, 2021). It significantly shapes personal and community success and development (Siddiqui & Khan, 2022a). In many impoverished countries, the educational disadvantage for women is linked to high fertility rates (Van Bavel, 2013). Indian society shows apparent inequality, with education being a crucial factor in individual and regional development (Ching, 2016; Saha & Roy, 2020). Education is vital in assessing a society's civilization and shaping individuals both personally and socially (Hoque & Hashmi, 2020). UNESCO defines literacy as the ability to read, understand, and use written materials to reach goals and actively participate in society (Saha & Roy, 2020). Gender equality in education has been a focus in India, aiming to empower women economically (Kiba, 2021). Despite progress, India still faces a gender gap in education, particularly in rural areas (Ghosh & Sarkar, 2015; Saha & Roy, 2020). Increasing female literacy positively impacts women's societal participation and knowledge (Majumder & Roy Chowdhury, 2020). Educational inequality persists due to economic disadvantages and entrenched biases (Chandra, 2019). Illiteracy leads to major societal issues like a weakened economy, poor health, and uncontrolled population growth (Singh, 2015). High literacy rates correlate with better socio-economic development and longer life expectancy (Khan, 2004). Despite initiatives, women's literacy in India remains below the national average (Sen & Roy, 2022), and expanding higher education for women has delayed parenthood age.

Biswas (2017) analysed census data from 1951-2011 to examine the literacy status of women in West Bengal, revealing a high female literacy rate compared to the national average, though growth has slowed. The study also explored the urban-rural divide and literacy rates among SCs, providing insights for future research on women's education in the state. Sen and Roy (2022) investigated female literacy and marriage age among a scheduled caste community in Siliguri, India, finding a positive correlation between literacy and later marriage. This primary research underscores literacy's significance for women's socio-economic progress

and suggests further research into the cultural implications of literacy in different ethnic contexts. Marak and Sutradhar (2021) studied gender equality in West Bengal's secondary schools, highlighting challenges despite policies promoting education access. They noted improvements in girls' enrolment but persistent disparities in retention and participation, especially among vulnerable groups. Their research emphasizes the need to look beyond enrolment numbers to assess true gender equality in education. Gohain and Das (2020) examined the educational experiences of Mishing women in Ahomoni Miri Village, Assam. They found low literacy rates and identified challenges such as gender bias, domestic responsibilities, lack of family support, limited mobility, and negative social attitudes towards female education. Their findings highlight the barriers Mishing women face and the need for targeted interventions to improve their educational opportunities.

### NEED OF THE STUDY

Probably, the unequal availability of education for girls within SMC is an issue of concern. The percentage of literate women could vary notably amongst different regions. One possible worry is that there appears to be a sizable gender disparity regarding educational attainment at SMC. This disparity suggests that, in conjunction with men, women in SMC may have lower literacy rates. It's unclear how a woman's education and when she marries in SMC interact with each other. If women marry later in life due to higher levels of literacy, is there a positive correlation between the two? Within SMC, there is concern about possible educational disparities between different areas. Some regions may have a lower percentage of educational attainment than others.

### STUDY AREA

Siliguri, a key urban center in Northern West Bengal, serves as the gateway to North East India and the primary commercial hub in North Bengal due to its strategic location near international and state borders (Rukhsana et al., 2022). Situated in the Terai region at the Himalayan foothills along the Mahananda River, Siliguri is the third-largest city in West Bengal by area, with a flourishing tourism industry. The city's coordinates are 26°72' N latitude and 88°41' E longitude, covering 41.9 sq. km (Rukhsana et al., 2022). It connects to hill towns like Gangtok and Darjeeling and to Kolkata via NH-31, New Jalpaiguri Station, and Bagdogra Airport (Ministry of Urban Development, 2015). Siliguri Municipal Corporation (SMC) was established in 1949, spans 47 wards across Darjeeling and Jalpaiguri districts (Fig. 1). The SMC area covers 41.9 sq. km and is divided into Core, Intermediary, and Periphery zones, with significant slum growth accompanying urban expansion. Sraban Nagar and Matangini Colony II are the largest slums in wards 18 and 28, respectively. From 2011 to 2018, recognized slums increased from 154 to 187, with 154 officially recognized (Roy Sarkar, 2018). Siliguri is the largest and fastest-growing city in Northern West Bengal, after Kolkata and Asansol (Rukhsana et al., 2022).

### OBJECTIVES

The objectives of the present study are following

1. Inquire about the spatial distribution of female literacy rate among SMC.
2. Investigate the gender differentiability of literacy rate in SMC.
3. Discover the impact of literacy on female age of marriage.
4. Evaluate the association between educational level and area of resident.

### DATABASE AND METHODOLOGY

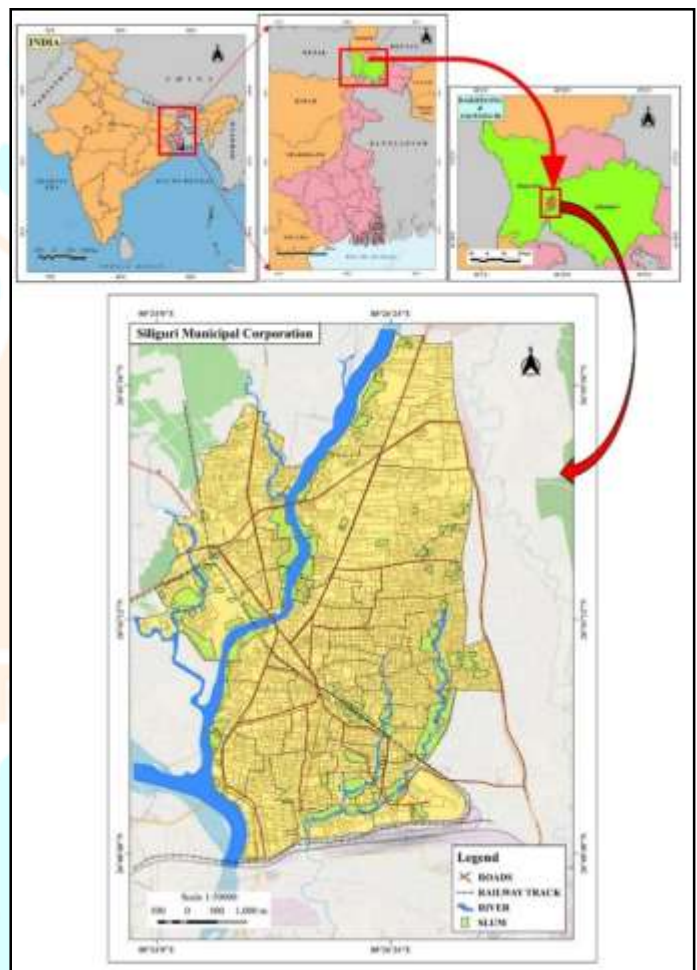
All the work has been completed using primary data and secondary data gathered from multiple sources, i.e. District Statistical Handbook 2013 and District Census Handbook 2011. Primary Survey has been done by 100 household survey (50 houses in slum and 50 houses in non-slum) through interview method across the SMC. IBM SPSS V.27 and MS Excel was utilized to perform statistical calculations, while QGIS environment was employed for cartographic map presentations. In order to complete this task, various methods have been employed, which are described below.

#### Location Quotient

Location Quotient used to analyse the the spatial distribution of female literacy rate among SMC. The formula for calculating the Location Quotient is as follows:

$$L. Q. = \frac{(e_i / e)}{(E_i / E)} \dots\dots\dots(1)$$

Where,  $e_i$  = No. of literate female population per ward,  $e$  = Total literate female population of SMC,  $E_i$  = No. of female population per ward,  $E$  = Total female population of SMC.



**Gender Disparity Index**

Here, we have used Sopher's disparity index (1974) to analyse the disparity in literacy rates between males and females (Kayal & Roy Chowdhury, 2023). The formula for Sopher's disparity index (1974) is as follows:

$$DI = \log\left(\frac{X_2}{X_1}\right) + \log\left(\frac{100-X_1}{100-X_2}\right) \dots \dots \dots (2)$$

Where, DI is the Gender disparity index by D. E. Sopher; X1 is value of deprived group that is female; X2 is the value of dominant group that is male (Sopher, 1974).

The purpose of using logarithms is to mitigate the impact of the levelling-off effect. This effect occurs when regions with higher literacy rates may appear to have lower levels of disparity compared to regions with lower literacy rates, despite having the same gender gap.

Seventeen variables across three broad categories have been used to measure regional disparities in educational development.

**Mann-Whitney U Test**

To show the impact of literacy on female age of marriage of Siliguri Municipal Corporation area the Mann-Whitney U Test (1947) has been applied at 5 percent significance level. The mathematical expression of this Index is:

$$U_1 = n_1 n_2 \frac{n_1 + 1}{2} - R_1 \dots \dots \dots (3)$$

$$U_2 = n_1 n_2 \frac{n_2 + 1}{2} - R_2 \dots \dots \dots (4)$$

Where  $n_1$  and  $n_2$  are the sample sizes of group 1 and group 2, respectively.  $R_1$  be the sum of the ranks for group 1 and  $R_2$  be the sum of the ranks for group 2.

Determine the U Value:

$$U = \min(U_1, U_2) \dots \dots \dots (5)$$

The smaller of  $U_1$  and  $U_2$  is used as the test statistic U.

**Chi-Square Test**

The Chi-Square Test has been used to evaluate the association between educational level and area of resident in Siliguri Municipal Corporation. The Pearson's Chi square formula is

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \dots \dots \dots (6)$$

Where,  $O_{ij}$  is the observe frequency, and  $E_{ij}$  is the expected frequency And the formula for Yate's Corrected Chi-Square Statistic is

$$\chi_{yates}^2 = \sum (|O_i - E_i| - 0.5)^2 / E_i \dots \dots \dots (7)$$

Where,  $O_i$  is the observe frequency and  $E_i$  is the expected frequency.

**RESULT AND DISCUSSION**

**Gender Disparity in Literacy**

Gender disparity refers to unequal treatment and opportunities based on gender, favoring men and disadvantaging women (Wang & Degol, 2017). The 2011 Indian census showed a 16% gap between male and female literacy rates (Katiyar, 2016), with disparity starting from infancy due to parental biases, especially in hilly rural areas with lower incomes. In SMC, the 2011 census data revealed significant gender disparities in literacy rates across various wards. The highest disparities were in wards 16 (0.1532), 1 (0.1491), 5 (0.1422), and 18 (0.1418), while the lowest were in wards 11 (0.0674), 19 (0.0902), 35 (0.0916), and 13 (0.0967). The map (Fig. 3) classifies these disparities into five zones: very high, high, medium, low, and very low.

The analysis underscores the need for targeted educational policies to reduce gender disparity, particularly in rural and disadvantaged areas. Enhancing educational access and quality for women can significantly improve their socio-economic status and well-being. Addressing socio-cultural barriers and promoting the benefits of female education are also crucial. A multi-faceted approach, including equal access to education, healthcare, economic opportunities, and challenging gender

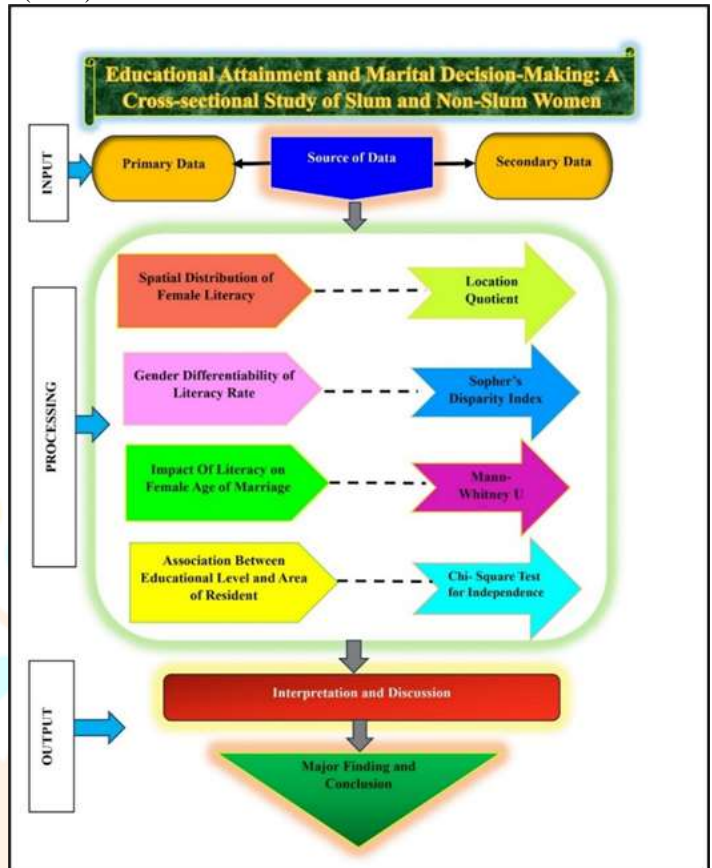


Figure 2: Methodological Flowchart

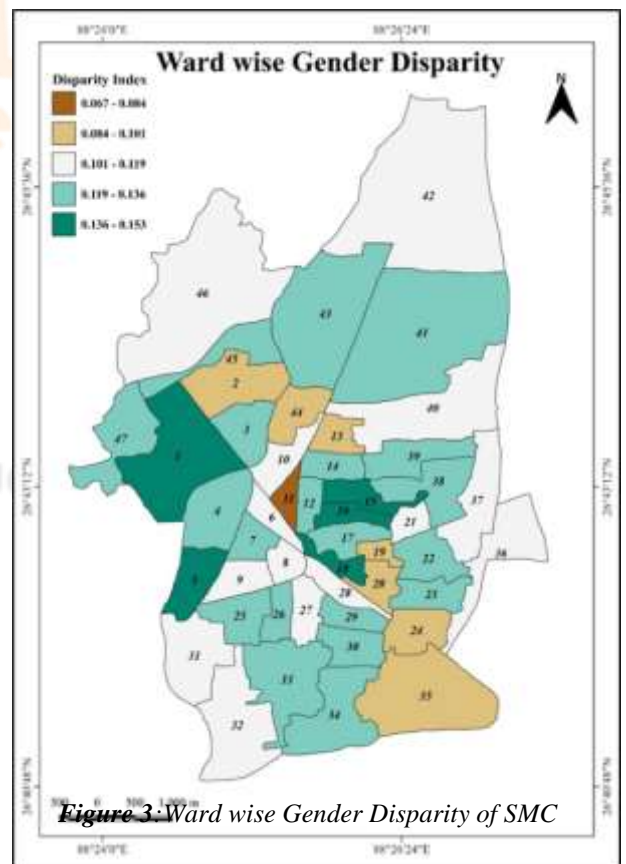


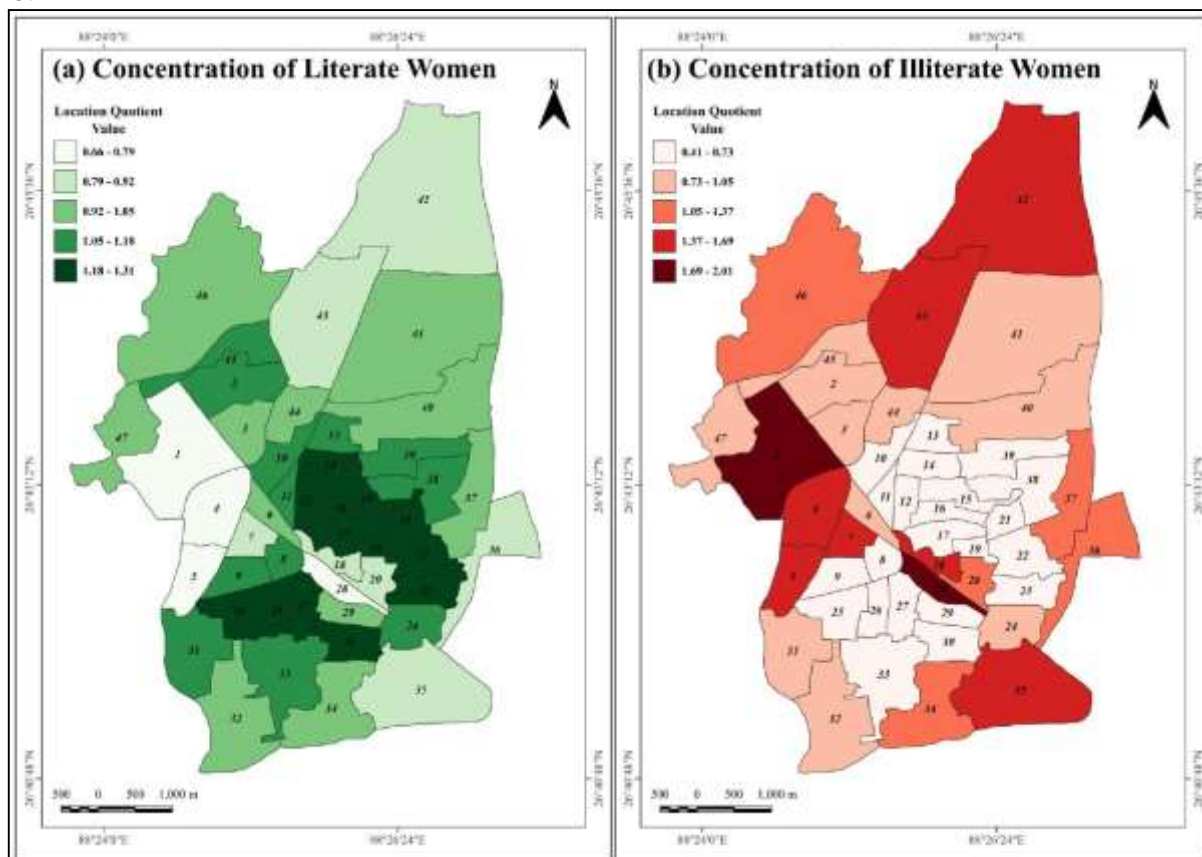
Figure 3: Ward wise Gender Disparity of SMC

stereotypes, is essential for gender equality and women's empowerment. Collaboration between governments, civil society, and local communities is vital to develop solutions for the unique challenges faced by women in these areas.

### Concentration of Literate and Illiterate Women

The Location Quotient (LQ) is a valuable tool for measuring industry concentration in a region, aiding policymakers and researchers in planning and assessing regional economic growth (Chiang, 2009). For the 47 wards of SMC, LQ was used to map (Fig. 4) the distribution of literate and illiterate females in 2011. The highest concentration ( $LQ > 1$ ) of literate females is found in wards 2, 8-17, 19, 21-27, 30, 31, 33, and 38. Balanced distribution ( $LQ = 1$ ) appears in wards 3, 6, 29, 32, 34, 37, 40, 41, 44, 46, and 47. The lowest concentration ( $LQ < 1$ ) is in wards 1, 4, 5, 18, 20, 28, 35, 36, 42, and 13.

Conversely, the highest concentration ( $LQ > 1$ ) of illiterate females is in wards 1, 4, 5, 7, 18, 28, 35, 42, and 43. Balanced distribution ( $LQ = 1$ ) is in wards 20, 34, 36, 37, and 46, while the lowest concentration ( $LQ < 1$ ) is in wards 2, 3, 8-17, 19, 21-27, 29-33, 38-41, 44, and 45.



**Figure 4(a):** Concentration map of literate women of SMC; **Figure 4(b):** Concentration map of illiterate women of SMC

The high concentration of literate women in Siliguri Municipal Corporation (SMC) can be attributed to family support, financial stability, and better educational facilities. Central parts of SMC show higher literacy among women, while frontier wards have lower literacy rates. This central concentration indicates good accessibility, educational environments, and parental awareness, leading to positive outcomes. The high number of literate women in SMC signifies a community that values education and promotes gender equality. This leads to improved health, increased economic productivity, and enhanced social cohesion. The supportive environment for educational initiatives and empowerment programs creates opportunities for women's leadership, entrepreneurship, and advocacy for women's rights. SMC can leverage this demographic advantage to implement policies and projects that drive sustainable development and foster inclusive growth.

### Impact of literacy on female age of marriage

The Mann-Whitney U test, proposed by Mann and Whitney (1947), compares each observation  $x_i$  in one sample with each observation  $y_j$  in another sample by combining and ranking the data from both samples. The ranks are then separated, and the sums of the ranks are calculated for each sample (Oti et al., 2021). This non-parametric test is useful for comparing two separate groups, especially when parametric test assumptions are unmet, making it widely used across disciplines. The age at which females marry is a critical societal indicator. In India, the minimum legal age for female marriage is 21 years, and marrying below this age is considered child marriage, which negatively impacts health, education, and emotional development. Despite being illegal, female child marriage remains a significant issue (Sen & Roy, 2022). The Indian Prime Minister announced the formation of a committee under the Ministry for Women and Child Development to address maternal mortality and women's nutrition and to consider raising the minimum marriage age for females (Vishwanath & Roy, 2020).

To test the research hypothesis, a Mann-Whitney U Test was conducted at a 5% significance level ( $\alpha = 0.05$ ). The analysis, using a sample size of 79 literate women and 21 illiterate women, revealed that the sum rank of literate women ( $R1 = 4805.50$ ) was greater than that of illiterate women ( $R2 = 244.50$ ). The mean age of marriage for literate women (24.899) was significantly higher than

that for illiterate women (14.524), with the difference being statistically significant at the 5% level ( $p < 0.05$ ). The U value calculated was smaller than the critical value, leading to the acceptance of the alternative hypothesis, which states that literacy impacts the age of marriage for females in this study area. The average age of marriage for literate women is 25, compared to 15 for illiterate women. The survey data indicates that literacy plays a significant role in delaying the age of marriage, as educational engagement and support schemes discourage child marriages.

**Table 1:** Relationship between Literacy and Female Age of Marriage

Literacy Status	Age of Marriage		Average Age of Marriage
	Less than 21 Years	21 Years and Above	
Illiterate	100% (21)	0% (0)	15
Literate	20.25% (16)	79.74% (63)	25

*Source: Field Survey, 2024 and computed by the author using SPSS v. 27 based on primary data*

**Table 2:** The Ranks Assigned to the Data Point for Performing Mann-Whitney U Test

Ranks				
Literacy Status		N	Mean Rank	Sum of Ranks
Age of Marriage	Illiterate	21	12	244.50
	Literate	79	61	4805.50
	Total	100		

*Source: Computed by the author using SPSS v. 27 based on primary data*

**Table 3:** The Result of Mann-Whitney U Test

Test Statistics	
Mann-Whitney U	13.500
Asymp. Sig. (2-tailed)	0.0000000000046337
a. Grouping Variable: Literacy Status	

*Source: Computed by the author using SPSS v. 27 based on primary data*

The study underscores the crucial role of women's literacy in influencing the age of marriage. Higher literacy levels empower women to make informed decisions about their lives, delaying marriage and leading to better education, employment opportunities, health outcomes, and greater autonomy. Promoting female literacy is essential for individual empowerment and broader societal progress, challenging traditional norms and fostering gender equality. Educated women are more likely to participate in decision-making processes, such as partner selection, family planning, and household finances, promoting egalitarian marital dynamics. However, disparities exist between women in slum and non-slum areas, with those in slums facing more barriers to education and limited control over marital choices. This highlights the need for targeted interventions to improve educational opportunities and empower women in slum communities.

**Association between Educational level and Area of Resident**

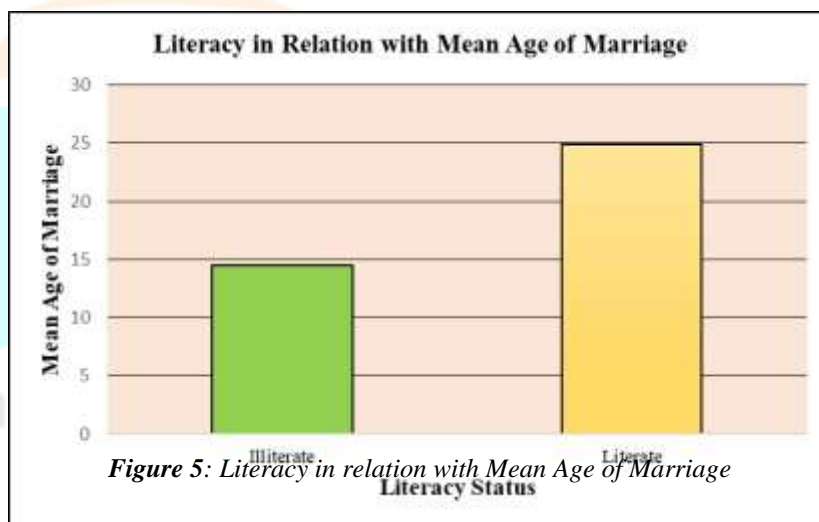
The Chi-square test is used to determine associations between categorical variables in statistical research. According to Kothari (2007), the test checks how well the observed data distribution aligns with the expected distribution (Nihan, 2020).

**Pearson's Chi-Square**

The Pearson's Chi-square test value, degrees of freedom, and P value are provided in the table. For this case, the test statistic was  $X^2 = 4.882$ , which is highly significant ( $p < 0.001$ ), indicating a significant association between area of residence and literacy (Field, 2024).

**Yate's Correction**

The Yate's Chi-square test value, degrees of freedom, and P value are also given in the table. The test statistic was  $X^2 = 4.943$ , also highly significant ( $p < 0.001$ ), indicating an association between area of residence and literacy (Field, 2024).



**Figure 5:** Literacy in relation with Mean Age of Marriage

**Table 4:** Number of literate and illiterate in slum and non- slum area

	Illiterate	Literate	Total
<b>Slum</b>	15	35	50
<b>Non-slum</b>	6	44	50
<b>Total</b>	21	79	100

Source: Field Survey, 2024

**Table 5:** Results of Chi-square test

Test Method	P Value	Degree of freedom	Test Statistic
Pearson's Chi-square	0.027	1	4.88
Yate's correction	0.026	1	4.94

Source: Calculated by author

The hypothesis to be tested is that there is no association between area of residence and literacy. The alternate hypothesis suggests that literacy is not independent of the area of residence. The p-value of 0.0262, being less than 0.05, leads to rejecting the null hypothesis, indicating a significant association between living in slum or non-slum areas and literacy. This suggests that residence impacts women's literacy.

The study highlights the significant impact of improving living conditions on women's literacy levels. Better infrastructure like schools and libraries in residential areas enhances educational opportunities, empowering women to achieve literacy. Addressing poverty, infrastructure deficits, and social barriers can create an environment conducive to women's education. Community-based initiatives promoting literacy and providing support services further amplify these positive effects. Recognizing the role of residential environments in educational outcomes allows societies to promote gender equality, empower women, and foster inclusive development.

## MAJOR FINDINGS

- ✦ In the central part of the Siliguri Municipal Corporation area, the author observed a significant gender disparity.
- ✦ By coincidence, the central part of the Siliguri Municipal Corporation area witnessed a notable concentration of educated women.
- ✦ The frontier part of the SMC shows a lower concentration of educated women, indicating a higher prevalence of illiterate women in this frontier zone.
- ✦ The high concentration of literate women in the central parts of the SMC area can be attributed to the presence of various educational facilities and easy accessibility to them.
- ✦ The mean age of marriage for illiterate individuals in the SMC area is 15, which is below the legal age of marriage in India, set at 21 years.
- ✦ On the other hand, literate individuals in the SMC area have an average marriage age of 25, which aligns with the legal age of marriage in India. Moreover, educated women in particular are more aware of their rights and are committed to pursuing their education and empowerment before getting married.
- ✦ Literate females in the SMC area have a higher likelihood of getting married at a later age due to the positive influence of literacy.
- ✦ Women living in slum areas should prioritize enhancing their literacy levels and actively engage in educational programs.
- ✦ In slum areas of SMC, it is worth noting that there is a higher proportion of literate women compared to illiterate women.
- ✦ The area in which women reside in SMC has a significant influence on their literacy rates.

## RECOMMENDATIONS

- ✦ *Gender Disparity Intervention:* To promote gender equality in Siliguri Municipal Corporation (SMC), it is crucial to adopt targeted programs and policies that specifically tackle gender disparities, particularly in remote and underdeveloped areas. These interventions should be designed to ensure that women have equal access to education and opportunities, creating a more inclusive and fair society.
- ✦ *Gender Equality Initiative in Frontier Areas:* Dedicate funding towards enhancing education facilities and promoting easy access to education in the frontier areas of SMC. This initiative aims to elevate female literacy rates, thereby mitigating the prevalence of illiteracy in these regions.
- ✦ *Integrating Literacy into Health and Economic Programs:* Ensure that existing health and economic development programs targeting women in SMC include literacy components. This approach will promote the overall well-being of women by providing them with the necessary literacy skills to effectively navigate health-related information and economic opportunities.
- ✦ *Promote Knowledge on Legal Age of Marriage:* Implement awareness campaigns specifically targeting slum areas to educate communities about the legal age of marriage in India. Emphasize the significance of adhering to this age restriction in order to prevent early marriages and empower women.

- ✦ *Residential Location-Focused Initiatives:* Develop initiatives that take into account the influence of residential location on women's literacy, like mobile literacy units or literacy centres established in local neighbourhoods, aiming to reach women in areas characterized by lower literacy rates.
- ✦ *Host Community Workshops and Discussions:* Arrange workshops and discussions within slum areas to foster dialogues regarding the significance of education, women's empowerment, and appropriate marriage ages.
- ✦ *Encourage Male Involvement:* Encourage men to play an active role in promoting women's education and empowerment by emphasizing the positive impact of gender equality on the entire community. Seek their support for initiatives that enhance women's educational opportunities, emphasizing the collective benefits of such endeavours.

## CONCLUSION

Education is a valuable asset, particularly for addressing social issues, as it enhances individuals' ability to respond effectively. Higher educational levels correlate with better problem-solving skills, making literate individuals more adept at tackling social challenges than illiterate ones. Significant gender disparities necessitate targeted interventions to address systemic inequalities and promote gender equity. Identifying areas with the largest gender gaps provides insights into the causes, often rooted in social norms, discriminatory practices, and unequal access to resources. The presence of educated women in Siliguri Municipal Corporation signifies a commitment to education and presents an opportunity for positive change and a more equitable future. Recognizing the influence of residential environments on educational outcomes enables societies to implement measures promoting gender equality, empowering women, and fostering inclusive development.

The study highlights how education and socio-economic status influence women's decision-making in marital partner selection, emphasizing the importance of education in empowering women and revealing disparities between women from slum and non-slum areas. To promote gender equality and women's empowerment, policymakers should remove educational barriers and foster women's agency, creating an inclusive society where everyone can reach their full potential regardless of socio-economic background or gender. The study's findings underscore the need for investing in education for marginalized women and challenging traditional gender norms through gender-sensitive education. These efforts are crucial for breaking the cycle of poverty and fostering a culture of equality and respect within families and communities.

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