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Original Article

Female Education and Risk Factors of Noncommunicable Diseases across India: An Exploration

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ABSTRACT

Introduction: Non-communicable diseases are rapidly rising worldwide, causing serious public health concerns that must be addressed. Past studies exhibit the relation between education and the prevalence of non-communicable diseases and the associated risk factors. Therefore, this study aimed to investigate the influence of female education on risk factors such as overweight/obesity, increased blood sugar, elevated blood pressure, tobacco and alcohol use linked to the incidence of non-communicable diseases across 28 states of India by using the data from National Family Health Survey 5. **Materials and Methods:** The present study uses National Family Health Survey 5 (2019-21) data. Different groups of female education and various risk factors resulting in non-communicable diseases have been considered to analyse their association. **Results:** Linear regression analysis revealed a statistically significant association between female education and the risk factors for non-communicable diseases except for alcohol consumption. **Conclusion:** Education is linked to overweight/obesity, increased blood sugar and elevated blood pressure among females. Therefore, effective awareness programs and promotional activities along with improvement in female education need to be undertaken to help women self-manage risk factors causing non-communicable diseases.

Keywords: Female, Education, Risk Factors, Non-communicable Diseases, India.

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INTRODUCTION

The Sustainable Development Goal (SDG) 4 that aims to "guarantee inclusive and equitable quality education as a key factor for positive change, highlighting the transformative power of education in nurturing a sustainable and equitable world" (UNESCO, n.d.). SDG 3, which intends to ensure healthy lives and promote the well-being for all at all ages is essential for sustainable development (UN, 2023). Non-Communicable Diseases (NCDs) are chronic, non-transmissible and often of long duration (UNICEF, 2021). NCDs are caused by a combination of genetic, physiological, environmental, and behavioural factors that account for almost 74% of all deaths worldwide every year. NCDs kill around 17 million people every year before the age of 70 years. Maximum deaths caused by NCDs are found in low- and middle-income countries. The crucial risk factors associated with the occurrence of NCDs include unhealthy diets, insufficient physical activity, tobacco use, alcohol consumption, and air pollution. Worldwide, annually, tobacco, excess salt/sodium intake, and alcohol use lead to over 8 million, 1.8 million, and 3 million deaths, respectively. In addition, the major metabolic risk factors, such as elevated Blood Pressure (BP), raised blood glucose, and overweight/obesity, tend to increase the risk of NCDs (WHO, 2023).

Cigarette smoking is a major cause of NCDs among Koreans (Kim and Oh, 2013). Obesity and hypertension are significantly associated with tobacco use (Vijayakarthikeyan *et al.*, 2017). A study conducted in Bhutan has also shown that tobacco users had a higher risk of developing diabetes mellitus (Sithey *et al.*, 2021). A cross-sectional descriptive study undertaken in Kancheepuram, Tamil Nadu has highlighted a strong and significant association between obesity, diabetes, and intake of alcohol (Vijayakarthikeyan *et al.*, 2017). A positive and significant association was also found between hypertension and alcohol consumption (Vijayakarthikeyan *et al.*, 2017; Sithey *et al.*, 2021; Ejigu and Tiruneh, 2023). In Ethiopia, Ejigu *et al.*, revealed that hypertension was positively associated with overweight/obesity (Ejigu and Tiruneh, 2023). Previous studies conducted in developing countries have shown that the incidence of NCDs was much higher among low educated people than people with higher education (Ajaero *et al.*, 2021; Al-Hanawi, 2021). Studies examining the impact of education on overweight/obesity

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have revealed an inverse relationship between education and overweight using data from three national surveys conducted over a 10-year period in Vietnam. Multiple logistic regression analysis revealed a negative association between higher educational attainment and overweight (Nguyen *et al*., 2007). A study related to Japanese women aged 25-50 years pointed out that unmarried women with university or higher education have a lower risk of being overweight/obese as compared to those with high school or lower education (Murakami *et al*., 2017). The correlation between the risk factors linked to NCDs and education analysed in Brazil revealed that obesity was more prevalent among women with less than a college or university education than highly educated women (Mpofu *et al*., 2016). Another study confirmed that the Body Mass Index was higher among people who belonged to low educational groups, and were found to be overweight and obese (Steele *et al*., 2017; Petrelli *et al*., 2022). While a study conducted in the Puducherry district of South India indicated that overweight/obesity had increased with an improvement in education levels (Sivanantham *et al*., 2021).

Studies indicating the influence of education on diabetes found that people with lower or no education had a higher risk of developing Type 2 Diabetes Mellitus (T2DM) than highly educated people (Choi and Shi, 2001; Williams *et al*., 2010; Hwang and Shon, 2014; Kim *et al*., 2017; Siddiqui *et al*., 2017; Petrelli *et al*., 2022). Studies conducted in China and in Kerala, India revealed that women with low education had higher chances of developing diabetes (Wu *et al*., 2019; Negi *et al*., 2020). Research findings in Germany conveyed that individuals with higher education had a lower risk of developing the T2DM than individuals belonging to lower education groups. Thus, it was shown that improvement in educational level significantly reduces the risk of T2DM (Steele *et al*., 2017). However, some studies have found that individuals with education had a higher risk of developing diabetes than those without education (Corsi and Subramanian, 2019; Lamb *et al*., 2021). In India, an increase in educational level resulted in a higher prevalence of self-reported diabetes (Corsi and Subramanian, 2012). A significant and direct correlation was observed between education and the prevalence of diabetes mellitus (Corsi and Subramanian, 2012; Kusumaningrum and Ricardo, 2022). It was made known that people with a university degree had 2.86% higher chances of developing diabetes mellitus than those with primary education. This indicated that people with higher education have a higher risk of developing diabetes mellitus contradicting some other studies (Kusumaningrum and Ricardo, 2022).

Examination of the association between educational level and hypertension revealed that in Brazil, the chances of having self-reported hypertension was higher among less than a college or university educated women (Mpofu *et al*., 2016). Studies conducted in India show that people with secondary or higher education had a lower prevalence of hypertension than those without education (Ghosh and Kumar, 2019; Lalu *et al*., 2021). A cross-sectional study conducted in Kerala found that illiterate people had a greater risk of developing uncontrolled hypertension than those with education (Lalu *et al*., 2021). Thus, less educated individuals are more likely to experience hypertension (Steele *et al*., 2017; Petrelli *et al*., 2022). However, another study in Kerala using the Relative Concentration Index has highlighted that women with more education had a higher prevalence of high blood pressure (Negi *et al*., 2020). Studies examining the interconnection between education and alcohol consumption have highlighted that people from higher education groups had a higher alcohol consumption (Grittner *et al*., 2013; Steele *et al*., 2017) and highly educated women were more likely to drink heavily than those with lower levels of education (Bloomfield *et al*., 2006; Grittner *et al*., 2013). However, research carried out in the Puducherry district indicated that the chances of alcohol use had reduced with a rise in educational levels (Sivanantham *et al*., 2021). India has witnessed a continuous rise in alcohol use thereby affecting not only individuals, family, and society but also the entire country (Marara *et al*., 2016).

Regarding the impact of education on tobacco use, research in Brazil using chi-square tests and multivariable logistic regression models revealed that undergraduate women had a higher probability of current smoking than women with a college graduation or higher (Mpofu *et al*., 2016). Another research in Pakistan depicted a significant association between smoking and education among both men and women. People with secondary or higher education had a lower probability of smoking than those without education, indicating that smoking reduces with an improvement in education (Zubair *et al*., 2022). Similarly, in Puducherry, India, there was a reduction in tobacco use due to a rise in educational levels (Sivanantham *et al*., 2021).

The foregoing literature review shows contradictory association between women's education and risk of being overweight/obese, getting diabetes, risk of hypertension, high blood pressure, and alcohol consumption. Tobacco use or smoking was found to have reduced at higher levels of education. In this background, this study aims to investigate the association between female education and the risk factors linked to the incidence of NCDs among Indian states.

MATERIALS AND METHODS

Data Sources

The present study utilizes secondary sources of data from National Family Health Survey 5 (NFHS-5), 2019-21. NFHS provides a nationally representative information about population, health, and nutrition of India, its states and union territories.

Overweight or obesity among women has been defined as having Body Mass Index ≥ 25.0 kg/m^2. High or very high blood sugar level indicates having a blood sugar level greater than 140 mg/dL

or taking medicine to control blood sugar level. Elevated blood pressure shows having Systolic ≥140 mm of Hg and/or Diastolic ≥90 mm of Hg or taking medicine to control blood pressure. The data pertaining to the tobacco uses or alcohol intake includes females aged 15 years and above.

Statistical Analysis

For analysis, female education was categorised into three levels: (i) no schooling to less than 5 years of schooling, (ii) 5 to 9 years of schooling and (iii) 10 or more years of schooling. An interconnection between female education and the risk factors responsible for the incidence of NCDs across states of India was evaluated using linear regression analysis.

RESULTS

Status of Education

Table 1 depicts that on average, the proportion of women among 28 states of the country belonging to 10 or more years of schooling (44%) was maximum followed by women with 5-9 years of schooling (32.62%) and the minimum proportion of women having no schooling to below five years of schooling was 23.38%. Among all the states, Kerala had the lowest proportion (2.6%) of women with less than 5 years of schooling while Bihar had the highest percentage (43.5%). The proportion of women with 5-9 years of schooling was lowest in Telangana (18.7%) while Tripura had the highest (55%). The proportion of women having 10 or more years of education was the lowest in Tripura (23.2%) whereas Kerala had the maximum (77%).

Risk Factors of NCDs

The mean proportion of overweight or obese women among different Indian states was 25.32%, with Meghalaya having the lowest (11.5%) and Punjab having the highest (40.8%) percentage. The average of women with high or very high blood sugar level was 13.63% with Rajasthan having the lowest proportion (7.2%) while Kerala having the highest (24.8%). The mean proportion of women having elevated blood pressure was 22.73% with Rajasthan having lowest proportion (15.4%) and Sikkim with the highest (34.5%). The average proportion of women using tobacco was 14.25%, with Punjab (0.4%) having the lowest proportion and Mizoram (61.6%) having the highest proportion. The mean proportion of women consuming alcohol was 3.33% with Kerala having lowest (0.2%) and Arunachal Pradesh with the highest proportion (24.2%).

Female Education and Risk Factors Causing NCDs

The association between the different levels of female education and the risk factors linked to the incidence of NCDs across India was analysed using regression analysis (Table 2). The correlation between the level of education and overweight/obesity was significant (multiple R=0.74). Nearly 50% of the variation in overweight or obesity among women can be illustrated by their education levels indicated by $R^{2=}$0.548 and Adjusted R^2=0.492 with a statistically significant result (p=0.000 <0.01). This implies that the level of education is positively associated with overweight or obesity among women. Most of the North and South states of India have almost 50% of women with 10 or more years of education while these states also have a higher proportion of women who are overweight or obese above national average (25.32%)

Table 1: Descriptive Statistics Pertaining to Female Education Levels and NCD Risk Factors.

Summary Statistics	Women with no schooling and <5 years of schooling	Women with 5-9 years of schooling	Women with 10 or >years of schooling	Overweight or obese	High or very high blood sugar level	Elevated blood pressure	Use of tobacco	Alcohol intake
Mean	23.38	32.62	44	25.32	13.63	22.73	14.25	3.33
Standard Error	1.857	1.494	2.497	1.736	0.797	0.854	2.876	1.025
Median	24.95	31.6	42	23.65	13.2	22.4	8.6	0.9
Mode	43.5	38.2	50.4	30.1	14.7	22.4	8.4	0.3
Standard Deviation	9.83	7.91	13.21	9.19	4.22	4.52	15.22	5.43
Sample Variance	96.65	62.55	174.63	84.39	17.82	20.44	231.72	29.44
Range	40.9	36.3	53.8	29.3	17.6	19.1	61.2	24
Minimum	2.6	18.7	23.2	11.5	7.2	15.4	0.4	0.2
Maximum	43.5	55	77	40.8	24.8	34.5	61.6	24.2
Confidence Level (95%)	3.812	3.067	5.124	3.562	1.637	1.753	5.902	2.104

Source: Author's calculations based on NFHS-5 data.

indicating highly educated women being overweight or obese (Figure 1). A moderate positive correlation (multiple R=0.58) was also found between female education and high or very high blood sugar levels. However, the effect of female education on the high or very high blood sugar level is low as evident from the low R^2=0.336 and this outcome is found to be statistically significant (p=0.018 <0.05). It can be seen in Figure 2 that majority of West and South states of India have a higher percentage of women with high or very high blood sugar level (national average=13.63%) while these states have a larger proportion of women with above five years of education. A moderate positive correlation between education and elevated blood pressure was also observed (multiple R=0.62). Furthermore, 38.80% of the variation shown in elevated blood pressure among females may be explained by their education level (R^2=0.388 and adjusted R^2=0.311) with a statistically significant result (p=0.007<0.01). It can be observed that Southern Indian states have a higher percentage of women with elevated blood pressure (national average=22.73%) despite of having a higher percentage of women with above primary level of education (Figure 3). Dependence of alcohol consumption on the educational level is found to have a negligible correlation indicated by multiple R=0.13 (R^2=0.018 and adjusted R^2=-0.103) and the result is found to be statistically insignificant (p=0.926>0.05). Tobacco use is seen being associated with the level of female education as the multiple R =0.744; R^2=0.552, and adjusted R^2=0.496. This indicates that around 50% of tobacco use can be explained by women's education and the result is statistically significant at 1% level (p=0.000<0.01). This result can be analysed based on the pattern of consumption of tobacco by region. Figure 4 shows that most of the Northeast Indian states

Table 2: Estimated Results of Linear Regression Analysis Related to Female Education and NCD Risk Factors.

Key Regression Output Indicators	Female education and overweight or obesity	Female education and high or very high blood sugar level	Female education and elevated blood pressure	Female education and alcohol consumption	Female education and tobacco use
Multiple R	0.740	0.579	0.623	0.137	0.743
R^2	0.5482	0.3360	0.3882	0.0187	0.5527
Adjusted R^2	0.4918	0.2531	0.3117	-0.1038	0.4968
Standard Error	6.5484	3.6484	3.7507	5.7011	10.7975
p-value	0.0002***	0.0183**	0.0072***	0.9267	0.0001***

Source: Author's calculations based on NFHS-5 data.N.B.: Female education: No schooling to < 5 years of schooling, 5 to 9 years of schooling and 10 or more years of schooling.
*** and ** denotes significant at 1% and 5% level respectively.

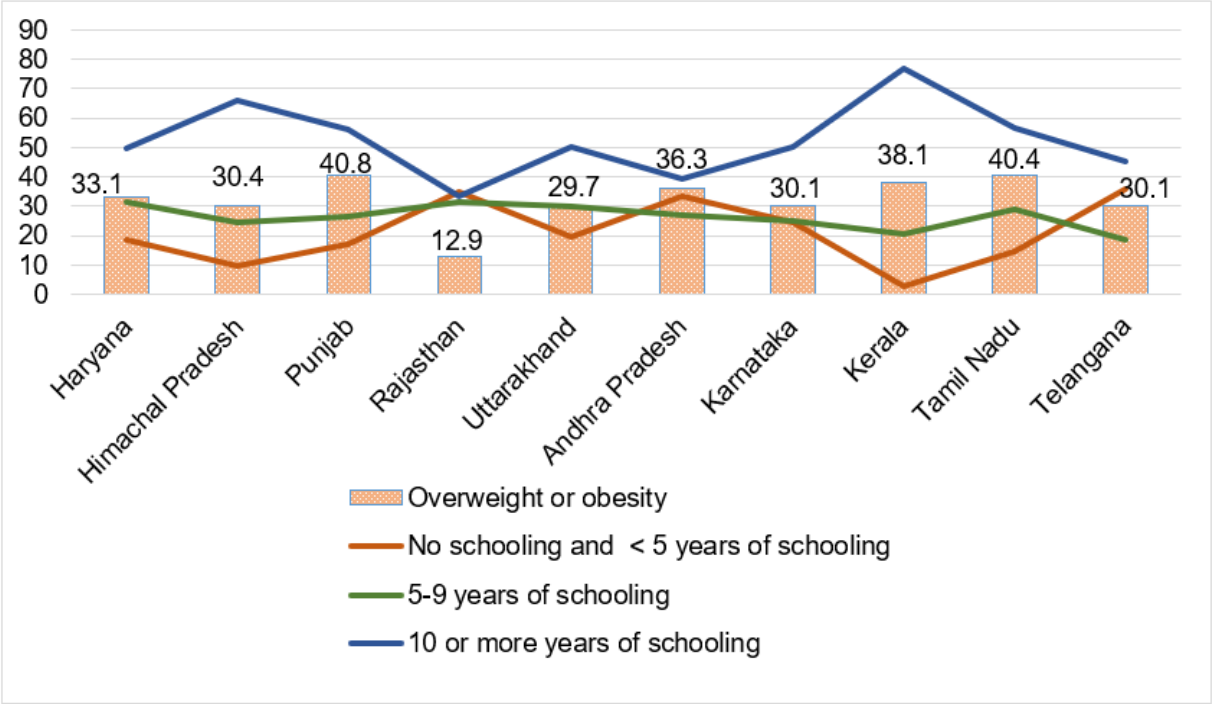

Figure 1: Levels of Education and Overweight or Obesity among Women in North and South India (in percentages). Source: NFHS-5, 2019-21.

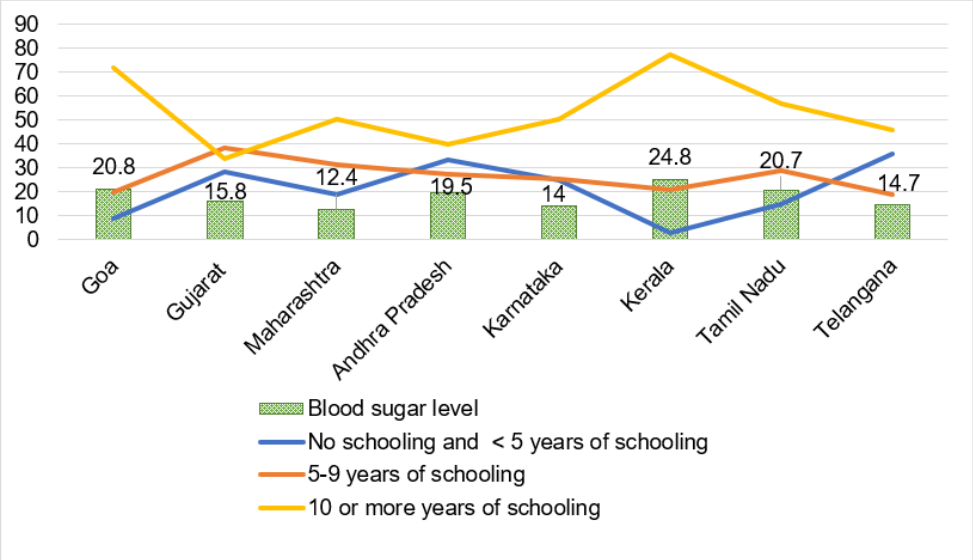

Figure 2: Educational Level and Blood Sugar Level among Women in West and South India (in percentages). Source: NFHS-5, 2019-21.

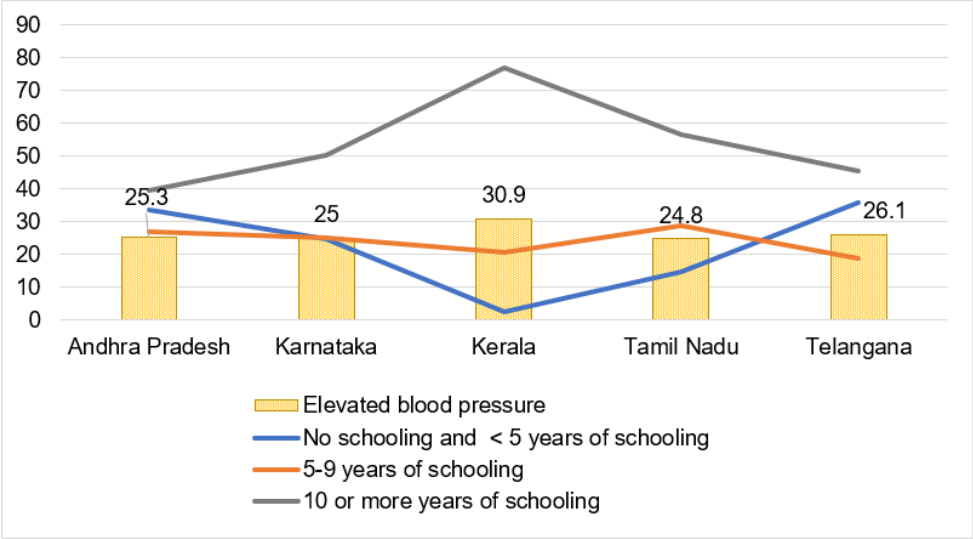

Figure 3: Levels of Education and Elevated Blood Pressure among Women in Southern India (in percentages). Source: NFHS-5, 2019-21.

have a higher percentage of women above five years of schooling while tobacco use found to be very high and above the national average (14.25%). This shows that tobacco use in this region could be based on climatic condition.

DISCUSSION

The impact of education on NCD prevalence and its risk factors has been demonstrated in many developed and developing countries, including India. Our study found a positive and significant association of education with overweight or obesity among women supporting the literature that revealed a rise in education levels leading to an increase in overweight/obesity (Sivanantham *et al.*, 2021). However, this finding contradicts a few previous studies, wherein a higher education was negatively associated with overweight (Nguyen *et al.*, 2007; Mpofu *et al.*, 2016; Murakami *et al.*, 2017; Steele *et al.*, 2017; Petrelli *et al.*, 2022). In our study, a positive correlation was also found between female education and high or very high blood sugar levels which is akin to a few earlier studies (Corsi and Subramanian, 2012; Corsi and Subramanian, 2019; Lamb *et al.*, 2021; Kusumaningrum and Ricardo, 2022) while deviates from Several other studies (Choi and Shi, 2001; Williams *et al.*, 2010; Hwang and Shon, 2014; Kim *et al.*, 2017; Siddiqui *et al.*, 2017; Steele *et al.*, 2017; Wu *et al.*, 2019; Negi *et al.*, 2020; Petrelli *et al.*, 2022). The study found a positive correlation between education and elevated BP that supports the study by Negi *et al.*, 2020, while is inconsistent with the previous studies (Mpofu *et al.*, 2016; Steele *et al.*, 2017; Ghosh and Kumar, 2019; Lalu *et al.*, 2021; Petrelli *et al.*, 2022). A negligible correlation between educational level and alcohol consumption was found in our study. Some studies have shown

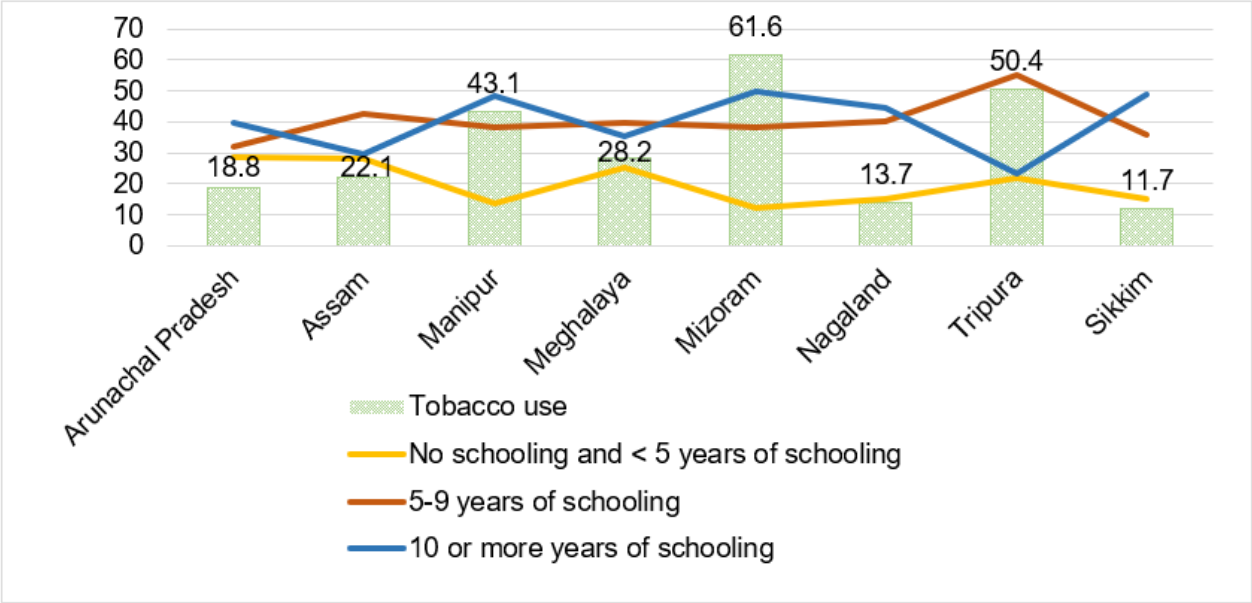

Figure 4: Education Levels and Use of Tobacco among Women above 15 years in Northeast India (in percentages). Source: NFHS-5, 2019-21.

that people with higher education had a higher alcohol intake (Bloomfield *et al*., 2006; Grittner *et al*., 2013; Steele *et al*., 2017), while another study indicated a reduction in alcohol use with a rise in the educational levels (Sivanantham *et al*., 2021). Notably, tobacco use was found to have a direct association with the level of women's education, which fails to support the previous studies (Mpofu *et al*., 2016; Sivanantham *et al*., 2021; Zubair *et al*., 2022).

CONCLUSION

Globally, the prime reason for death and disability among people is NCDs causing millions of deaths and most of these deaths happen in low- and middle-income countries. NCDs are chronic in nature, and affect the productive capacity of the individuals and the society. Education can play a vital role in controlling the prevalence and risk factors causing NCDs. This study intended to find out the link between female education and NCD risk factors across India. The analysis indicated some association between female education and NCD risk factors. The level of female education was found to have positive association with overweight/obesity, raised blood sugar level, elevated blood pressure, and tobacco use, except for alcohol intake. This might be due to lifestyle and increased stress level of women with increased level of education in some states.

The study suggests that, in addition to education, other factors are also responsible for NCDs. Therefore, a thorough study of NCD risk factors allied with each level of schooling/education and other relevant factors can enable to understand the impact of female education on NCD risk factors more accurately. This would help to frame relevant policy framework to face the challenges of NCDs and march towards sustainable development. The study suggests to focus on quality education, especially female education, along with the effective awareness programs and promotional activities that will help in self-management of the risk factors associated with the incidence of non-communicable diseases. Women's education can contribute not only to manage her own health but also the health of her family.

LIMITATIONS

The present analysis is based on the data with overall figures of schooling of women and the risk factors of NCDs among the states of India. A proper study based on individuals' level of education and NCD risk factors may provide a better understanding between female education and NCD risk factors.

ABBREVIATIONS

NFHS: National Family Health Survey; **NCDs:** Noncommunicable diseases; **SDG:** Sustainable Development Goal; **BP:** Blood Pressure; **T2DM:** Type 2 Diabetes Mellitus.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

SUMMARY

The present study is based on the National Family Health Survey 5 (2019-21) data aimed to examine the association between female education and NCD risk factors such as overweight/obesity, increased blood sugar, elevated blood pressure, tobacco, and alcohol use across 28 states of India. Data were analyzed based on mean values, standard deviation, percentages, and *p*-values using MS Excel software. The results of linear regression analysis showed that female education had a statistically significant and positive association with the risk factors for non-communicable

diseases, except for alcohol consumption. It can be concluded that education plays an important role in managing NCD risk factors to some extent, while effective awareness programs and promotional activities are needed in addition to improvement in female education.

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