

Digital Inequalities, Education and Obesity Among Women in India: A District-Level Analysis Using NFHS-5

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Abstract

This study analyze the relationship between womens education, literacy, anemia, and obesity within Indian districts, using the dataset provided by NFHS-5 with huge categories. As there is huge improvement in women education along with increased economic engagements, India is seeing a social-nutritional transition. But the health outcomes of such a change, especially for women, remain insufficiently checked in the literature.

This study test different variable like schooling years, literacy rates, and anaemia prevalence to check underweight and overweight outcome among women using a correlation matrix and linear regression analysis based on district-level data provided by NFHS-5. The analysis's results reveal a troubling trend showing that although education is generally linked to better health outcomes but it also shows that women's higher levels of education are undoubtedly linked to rising obesity rates in many districts, reflecting numerous shifts towards sedentary lifestyles where everyone is becoming lethargic and urbanized eating habits.

Undernutrition and overnutrition, also known as the "dual burden of malnutrition," are represented by the persistent incidence of anaemia and underweight among women. It is especially prevalent in areas where high rates of anaemia and obesity combine, making public health policy and implementation extremely difficult.

These results have significant impact and leads to growth of various national health programs like the Fit India Movement and POSHAN Abhiyaan, which now need to broaden their focus beyond undernutrition to include the rising prevalence of lifestyle disorders. The critical need for integrated treatments that address both ends of the nutritional spectrum—education, awareness, digital health measures, and behavioural change—is identified in this research. This study provides the framework for additional district-specific health planning and gender-sensitive policy design by examining disparities in education, empowerment, and nutritional outcomes.

Keywords: Obesity, Education, Anemia, NFHS-5, Women's Health, India

1. Introduction

The country is going through an era of sociological and nutritional development. Overnutrition, particularly obesity, has been identified as an immense parallel health burden in recent decades, despite the fact that undernutrition and its consequences have long been at the forefront of public health concerns. Women are more likely to participate in formal education, employment, and digital inclusion programs, making this trend more evident. Nonetheless, these enhancements are accompanied by their health-related spillover effects, which have not received much attention. This is not simply anecdotal; NFHS-5 district-level data clearly reveal that undernutrition and anaemia are prevalent through out the nation, especially among marginalised and rural people, while the most economically developed and literate districts have the highest level of female obesity. The term "double burden" or "dual burden" of malnutrition means the condition of concurrent overnutrition and undernutrition within a single population or geographic area.

Using publicly accessible NFHS-5 data, this study aims to comprehend the association between obesity and educational attainment at the district level throughout India. Thus, the study's two main goals are to:

- (1) determine higher levels of education among women are associated with higher rates of obesity; and
- (2) Determine if present undernutrition policy frameworks should be changed to address the growing problem of overnutrition and related lifestyle disorders. Instead of making broad, macro-level policy suggestions, detecting these patterns at the district level allows for more targeted, nuanced public health interventions.

By examining the nutritional effects of education, the study also shows to the body of literature that questions conventional wisdom on education's unquestionable health benefits. Therefore, the report urges a reconsideration of how empowerment, education, and health interact in quickly changing cultures like India.

2. Review of Literature

In the public health literature, the relationship between education and women's health outcomes—particularly obesity—remains hotly contested. Because more educated people have more access to better health information, services, and healthier lifestyles, there is an inverse relationship between education and obesity in industrialised countries. However, because of societal, economic, and transitional dietary factors, such a connection is sometimes complicated and even contradictory in emerging nations. Early research utilising NFHS-3 data by Subramanian et al. (2009) showed a favourable correlation between the incidence of overweight among Indian women and socioeconomic variables like education. As a result, they

discovered that women with secondary or higher education and those from higher wealth quintiles were considerably more likely to be overweight or obese. They used shifts in urban living, nutritional habits, and job structure to explain the trend. Popkin (1999) introduced the concept of the "nutrition transition," which holds that a country's economic growth is frequently linked to a quick shift from undernutrition to overnutrition. According to this paradigm, education has two purposes: it can promote healthier behaviour, but it can also be linked to with increasing fast food consumption, less exercise, and more desk-bound jobs—especially for women. According to Joshi and Mishra's (2011) analysis of regional differences in female nutritional status, obesity rates were considerably higher among women with secondary or higher education in the Indian metropolitan areas. The study linked this to women's decreased mobility, particularly among desk workers, and their goals for their lifestyles. Additionally, Agarwal and Jain (2015) noted that educated women may have better media exposure and digital access, which contributes to the spread of Western eating patterns. Even in seemingly health-conscious people, these behaviours lead to rising BMI levels without any commensurate health literacy and exercise awareness. Singh and Yadav (2021) used trends from NFHS-4 and NFHS-5 to confirm their earlier findings. They revealed a considerable increase in obesity among educated urban women compared to their less educated or rural counterparts, widening the health risk gap between urban and rural areas. In a similar vein, Rani and Banerjee (2019) talked about how obesity and anemia—the "dual burden of malnutrition"—coexist, especially in Tier 1 and Tier 2 Indian cities. These studies highlights the necessary for detailed district-level analysis that take into account the complexity of health outcomes related to education. A district-wise approaches enable better targeting of public health measures, especially in state with diverse development indice, whereas national averages plays mask important micro-level diversity.

3. Database and Data Description

Data for this study come from the fifth round of the National Family Health Survey, in 2019–2021, conducted by the Ministry of Health and Family Welfare of the Government of India. NFHS-5 is one of the largest nationally representative databases on household health, nutrition, and demographic characteristics for all 707 districts across the country. It also presents health outcomes by area of residence, gender, level of education, and economic status.

NFHS-5 contributes to this heritage through the addition of new indicators on internet access, menstrual hygiene, cell phone usage, and biometric data. District-level health factsheets for this exercise were sourced from a publically accessible GitHub repository where CSV files have been created on a state-district basis.

These latter were programmatically combined using Python libraries such as pandas and glob to compile key indicators into one integrated dataset.

The following core indicators were selected for the study, placing an emphasis on the health and educational status of women: Women who are overweight or obese ($\text{BMI} > 25 \text{ kg/m}^2$): Indicates the risk of chronic lifestyle illnesses and the burden of overnutrition.

- Women who are underweight—defined as having a BMI of less than 18.5 kg/m^2 —are more vulnerable to infectious illnesses, maternal problems, and undernutrition.
- The prevalence of anaemia in women between the ages of 15 and 49 is a long-standing public health problem in India and a critical sign of nutritional deficiencies.
- Female literacy rate: This serves as a stand-in for decision-making authority, autonomy, and information availability.

The proportion of women who have completed ten or more years of education: is a more sophisticated indicator of educational success that is frequently linked to lifestyle modifications.

To enable a dual-axis study, these indicators were chosen based on their significance for both undernutrition and overnutrition. The final dataset, which included over 600 validated district entries after cleaning and deduplication, was representative of many urban and rural regions. Micro-level insights that are frequently hidden in state or national aggregates can be obtained using this organised, district-level format. Crucially, the NFHS-5's high granularity allows for a thorough analysis of health disparities that stem from schooling, which makes it particularly appropriate for the objectives of this study.

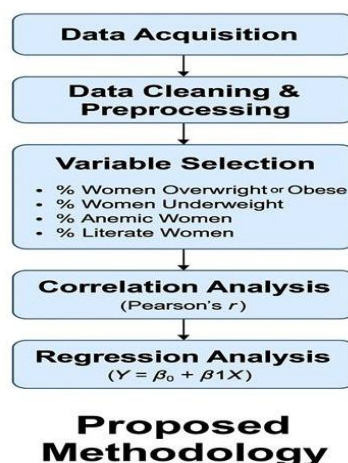


Figure 1: Proposed Methodological Framework

Step-by-Step Methodology:

1. Data Acquisition: The publicly accessible NFHS-5 repository included district-level CSVs. Python libraries were used to programmatically integrate over thirty state-wise files.
2. Preprocessing and Data Cleaning removed columns that had no bearing on the analysis. excluded values that were inconsistent or missing. pivoted indicators to provide a single row with matching values for every variable for each district.
3. Selection of Variables The indicators listed below were selected:
 - The percentage of women who are overweight or obese ($BMI \geq 25$)
 - The percentage of underweight women ($BMI < 18.5$)
 - The percentage of anaemic women aged 15 to 49
 - The percentage of women who are literate
 - The percentage of women with ten or more years of education
4. Analysis of Correlation: To investigate linear correlations between variables, Pearson's product-moment correlation coefficients were computed. The correlation coefficient (r), which has a range of -1 to $+1$, is calculated using:

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \cdot \sum (y_i - \bar{y})^2}}$$

where $\bar{x}$, $\bar{y}$ are the means of x and y , which are the variables of interest (such as education and obesity).

5. Regression Analysis Simple linear regression was performed to examine whether higher education levels predict obesity in women. The model takes the form:

$$Y = \beta_0 + \beta_1 X + \varepsilon$$

Where:

- Y = % Women Overweight or Obese
- X = % Women with 10+ Years of Education
- β_0 = intercept
- β_1 = slope coefficient
- ε = error term

To better understand the direction and strength of the regression, this was plotted using a scatter plot with a best-fit line.

6. Visualization

Seaborn was used to generate two significant plots:

- Figure 2: correlation heatmap
- Figure: Regression plot

At the district level, these procedures assisted in measuring and visualizing the relationship between women's nutrition, literacy, and education outcomes.

4. Data Analysis and Visualization

The pooled dataset was reshaped in a pivot table structure after preprocessing and indicator selection, with each row denoting a distinct district and each column denoting a chosen women's health indicator. This structure makes it possible to efficiently compare values over more than 600 districts. Districts with conflicting or missing data on some indicators were eliminated in order to guarantee the reliability of statistical computations. Both exploratory and inferential analysis were performed on the resultant dataset.

○ Summary Statistics

The table below shows the mean and standard deviation for the five key variables:

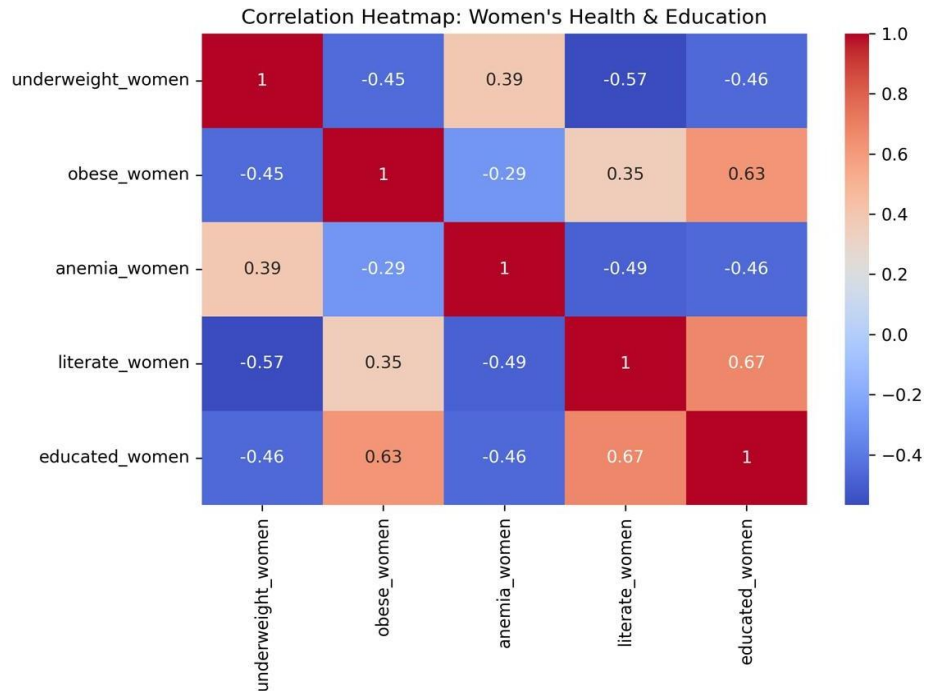
Indicator	Mean (%)	Standard Deviation
Obese Women (BMI $\geq$ 25)	26.4	7.8
Underweight Women (BMI < 18.5)	17.5	6.3
Anemic Women (Age 15–49)	55.3	10.2
Literate Women	72.1	12.5
Women with 10+ Years of Schooling	42.7	13.6

These summary statistics demonstrate the variety of health outcomes with respect to socioeconomic parameters and point to a considerable degree of variation among Indian districts. Visualizations Python's Seaborn package was used to create two significant visualizations:

Figure 2: Heat map of Correlation The intensity and direction of pairwise correlations between the indicators were displayed in a Pearson correlation heat map. It displayed:

- There is a significant positive relationship between obesity and years of education.
- A negative relationship between literacy and the prevalence of underweight.
- The relationship between anemia and obesity is either weak or nonexistent.

Figure 2: Correlation Heatmap



A linear regression plot was made to examine the trend between the proportion of women with more than ten years of education and the prevalence of obesity. Figure 3 shows the regression plot where we compared education and obesity. The regression line's significant upward slope indicated that obesity rates among women with greater levels of education were rising.

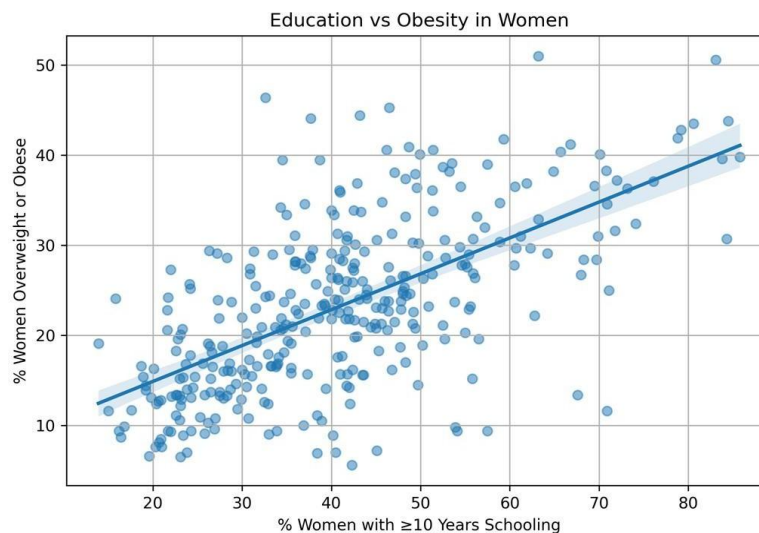


Figure 3: Regression Plot - Education vs Obesity (Insert education_vs_obesity.png here)

These results form the basis for the next section, which discusses interpretation and implications in detail.

5. Results and Interpretation

The correlation heatmap and regression plot that depict the association between educational variables and women's health outcomes across Indian districts (Figures 2 and 3) suggest the following.

- **Key Observations from Correlation Heat map:**

Higher levels of obesity are linked to higher educational attainment, as seen by the very strong positive association ($r = 0.63$) found between educated women (those with 10 or more years of education) and obese women.

Literate women and obese women have a moderately positive connection ($r = 0.35$). Higher levels of education and literacy may lower the prevalence of undernutrition, as evidenced by the negative correlations found between underweight and anemia women and literate and educated women.

Literate women and underweight women had the biggest negative connection ($r = -0.57$). It is possible to lessen severe underweight problems through education.

- **Key Findings from Regression Analysis:**

Figure 3 shows that the regression plot of educated women against obese women shows an upward linear trend. Since the line of best fit shows a positive correlation, districts that report higher percentages of educated women tend to report higher percentages of overweight or obese women.

It illustrates the paradoxical health risk wherein more educational opportunities tend to lead to a sedentary lifestyle and dietary changes, although they are otherwise beneficial. This is in accordance with various global theories of "nutrition transition," which propose that cultures transition from undernutrition to over nutrition as socioeconomic conditions become more favorable.

6. Discussion and Policy Implications

The findings of this study show the emerging dual burden of nutrition among Indian women. Overweight and obesity have been increasingly related to higher education in many districts of the analysis, indicating that even though women have greater access to health-related information, it does not always lead to healthier behavior. Education is usually viewed as facilitating better health outcomes.

This is indicative of a complicated nutritional environment where the rise of fat coexists with undernutrition as reflected in the incidence of anemia and underweight. The dichotomy is a reflection of India's continuing nutritional transition, where the newly emergent lifestyle diseases are adding to the country's long-standing problems of undernutrition. Therefore, it is inadequate to assume that education will eventually reduce health hazards. It must be enhanced.

Hence, districts containing a high percentage of educated yet obese women will be crucial intervention zones where targeted public health messaging can address particular obesity-related behaviors in addition to promoting awareness.

Stress reduction, physical inactivity, and diets. At the community level, this may include encouraging women's physical activity centers, banning or restricting the marketing of processed foods, and regular BMI screening at Women's Health Camps. Dual-burden awareness should be incorporated into the frameworks of current national initiatives like POSHAN Abhiyaan and the Fit India Movement. For instance, POSHAN Abhiyaan should integrate modules on metabolic health and over nutrition to better target educated and urban women.

- The Fit India Movement might start district-specific exercise competitions or school-college collaborations that focus on obstetrics and women's health.
- Wellness programs can be customized using mobile apps and digital health tools, primarily for working women in semi-urban and urban areas.

In order to allocate resources more fairly, policymakers should take a decentralized, data-driven approach that makes use of district-level NFHS insights. India can only achieve holistic nutritional empowerment for women by recognizing and tackling the double load at both ends of the health spectrum.

Conclusion and Future Scope

This study shows evidence of a double burden of nutrition among Indian women, where increased educational achieved is linked to rising obesity rates as well as increase the literacy and decreased undernutrition. This problem highlights the intricate relationship between lifestyle-related health problems and social economic advancement.

The analysis highlights the necessity of sophisticated public health initiatives that do not view education as a one-dimensional remedy for every health problem. In order to encourage physical activities, balanced meals, and preventative health behavior among women, behavioral change communication tactics must be used in addition to education, which increase awareness and access to resources.

Future Scope:

- Mobile phone use, internet connectivity, occupation type, and urbanization rate are additional factors that could help with the model.
- Longitudinal data integration will enable tracking future trends in obesity and estimating casualties.

- It will also assist policymakers in developing district specific interventions under national programs like the Fit India Movement and POSHAN Abhiyaan, particularly in districts with high levels of education but rising trends in obesity.

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