# Analysis of Nutritional Status among Scheduled Tribe Women in India
## A Study from NFHS-4

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***Abstract***

**Background: The nutritional status of a population has well-established, profound health effects across the lifecycle and is closely connected with cognitive and social development. Tackling malnutrition is a global concern as it is the single largest risk factor affecting the burden of disease estimates worldwide. The tribal population in India is more vulnerable to malnutrition and related health problems under severe socio-economic stress.**

**Objective: This study determines the prevalence of nutritional status among Schedule Tribe Indian women by states and several background characteristics. It also tries to examine the socio-economic differentials in nutritional status among those women.**

**Methods: The data is taken from the 4th round of National Family Health Survey (NFHS 4) conducted by the International Institute for Population Sciences, Mumbai (2015-2016). Body Mass Index (BMI) was computed and recoded according to the specification of the World Health Organization (WHO). Bivariate analysis and multinomial logistic regression were used to assess the effects of socio-economic characteristics.**

**Results: The overall prevalence of underweight among schedule tribe females is 31.7% and the prevalence of overweight/obese is 10.1%. From the west region most of the tribal women are found to be underweight. Scheduled Tribe women belonging to the urban area are found more prone to be overweight. The factors that are protective against being underweight are them being in older ages, having higher years of education, being married and being from households of higher wealth index.**

**Conclusion: Although the prevalence of underweight is higher among tribal women than the women from the general population, the majority of the study population are found to be of normal BMI. In some of the states like Nagaland, Mizoram and Manipur, the prevalence of overweight tribal women exceeds the number of underweight which slightly indicates towards the dual burden of malnutrition.**

***Index Terms:*** **Body mass index, Multinomial logistic regression, Underweight, Overweight, Socio-economic factors, India**

## I. INTRODUCTION

Malnutrition in all its forms is a critical challenge for any population. Tackling malnutrition is a global concern as it is the single largest risk factor affecting the burden of disease estimates worldwide. Almost one in every third person suffers from one form of malnutrition or another (WHO and the UN report, 2016). Although adult nutritional status can be examined in many ways, the body mass index (BMI) is widely used because it is inexpensive, non-invasive anthropometric measure and is suitable for large scale surveys (Bhattacharya et al., 2019). Malnutrition suggests not only undernutrition but also over weight and obesity. Underweight (including stunting and wasting), as well as obesity and overweight are various types of unhealthy weight that result in malnutrition. Each type of undesirable weight has distinctive clinical measurement as well as numerous causes and wellbeing results. The situation of malnutrition in India is a matter of concern as India has the highest number of undernourished people in the world (194.6 million during 2014-16, Food and Agricultural Organization). Tribes of India are endogamous population, isolated from general people with physical, cultural and socio-economic characteristics, constituting about 8.6 % of the total population in India (Census of India, 2011). The vast majority of them dwell in rustic zones, for the most part in far off underserved timberland locales with almost no essential community luxuries like vehicle, streets, markets, social insurance, safe drinking water or sanitation. Hence, tribal population in India is more vulnerable to malnutrition and related health problems under severe socio-economic stress. (Ghosh, 2016). The present study is undertaken to assess the nutritional status of Indian tribal women from several socioeconomic and demographic background where malnutrition remains a common health problem.

## II. MATERIALS AND METHODS

The data for this study have been drawn from fourth round of National Family Health Survey (NFHS). NFHS 4 was carried out from 20th January, 2015 to 4th December, 2016, in all 29 states and seven Union Territories of India. A two-stage sampling strategy was undertaken. The first stage consisted of selecting 28,586 primary sampling units using Probability Proportional to Size (PPS); the population sizes being determined using the 2011 Census count data. Primary sampling units were mapped completely for all the households located in each of them. After mapping, those which contained less than 40 households were merged with the nearest primary sampling unit and every unit containing more than 300 households were split into two separate units. In the second stage,

22 households were selected in each primary sampling unit using systematic random sampling. Women aged 15–49 years in the selected households were invited to participate in the survey. Height and Weight of those women were measured using the Seca 213 stadiometer and the Seca 874 digital scale respectively. Data on various socio-economic and demographic characteristics like place of residence, caste, religion, education level, wealth index of the respondents were collected in this survey.

For this study, the variables under consideration were height of respondent in cm and weight of respondent in Kg. Body Mass Index was computed with it recoded in underweight (BMI < 18.5), normal weight (BMI between 18.5-24.9) and overweight/obese (BMI≥ 25) according to the specification of the World Health Organization (WHO). With enough backing from literatures, the socio-demographic and economic variables across which levels of BMI was studied were region in which the respondent resides, age of respondent, place of residence, religion, educational attainment, status in wealth quintile, marital status of the respondent, children ever born and whether the respondent drinks alcohol or not. The study excluded pregnant women and women with a birth in the preceding 2 months.

Descriptive statistics were used to understand the characteristics of the sample population. Analysis was done by using appropriate sample weights. Chi square test was performed to identify the variables that had association with BMI levels in ST females. Cross tabulation table is performed for all the independent variables with the dependent variable where the row percentages are obtained to reflect the prevalence in each group. Then to find the determinants of BMI levels, multivariate analysis was performed. Predictive models on the dependent variable was developed using multivariate logistic regression to evaluate the effects of all the independent variables together. The odds ratio and 95% confidence intervals of the odds ratios are also computed to assess the degree of association between the risk factors and the dependent variable.

Multinomial Logistic Regression is the predictive analysis used to conduct a categorical dependent variable with more than two unordered and nominal levels. It is an extension of the binary logistic regression model where the value of dependent variable consists of more than two categories. The logit multinomial model can be written as:

$$\log\left\{\frac{\text{Prob}(\text{Category}_j)}{\text{Prob}(\text{Category}_q)}\right\} = b_0^j + \sum_{i=1}^{k} b_i^j x_i \quad ; j = 1,2, \dots \dots, (q-1) \tag{1}$$

Where, $b_0^j$ =intercept for the j-th logit, $b_i^j$=regression coefficient for i-th predictor $x_i$ in the j-th logit, k=number of predictors in the model. In the above expression, one of the categories is used as reference and is called the baseline category. In our study, the different categories are underweight and overweight/ obesity and the reference category is normal weight.

## III. RESULTS

**Table 1: Percentage of ST women aged 15-49 with BMI by states, India, NFHS 4**

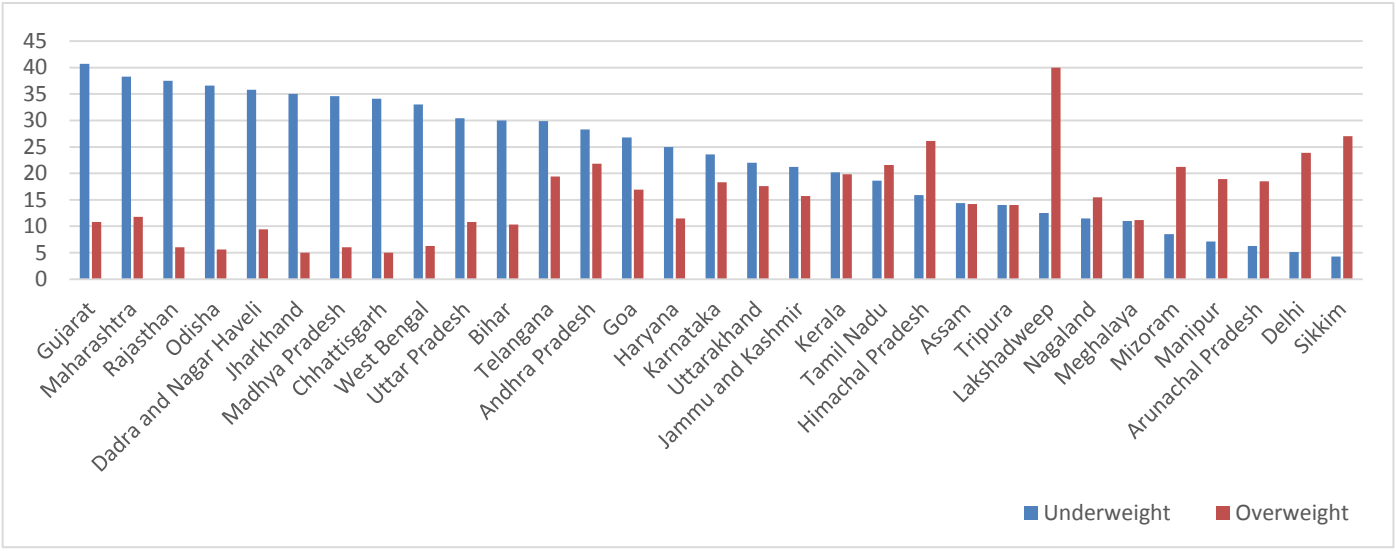
| State | Underweight | Normal Weight | Overweight | N |
|---|---|---|---|---|
| Andaman and Nicobar Islands | | 76.9 | 23.1 | 13 |
| Andhra Pradesh | 28.3 | 49.9 | 21.8 | 1541 |
| Arunachal Pradesh | 6.3 | 75.1 | 18.5 | 394 |
| Assam | 14.4 | 71.4 | 14.2 | 2087 |
| Bihar | 30.0 | 59.7 | 10.3 | 1694 |
| Chandigarh | 100.0 | 0.0 | 0.0 | 1 |
| Chhattisgarh | 34.1 | 60.9 | 5.0 | 4533 |
| Dadra and Nagar Haveli | 35.8 | 54.7 | 9.4 | 106 |
| Daman and Diu | 14.3 | 57.1 | 28.6 | 7 |
| Goa | 26.8 | 56.3 | 16.9 | 71 |
| Gujarat | 40.7 | 48.4 | 10.8 | 4473 |
| Haryana | 25.0 | 63.5 | 11.5 | 52 |
| Himachal Pradesh | 15.9 | 58.0 | 26.1 | 157 |
| Jammu and Kashmir | 21.2 | 63.1 | 15.7 | 567 |
| Jharkhand | 35.0 | 60.0 | 5.0 | 4201 |
| Karnataka | 23.6 | 58.1 | 18.3 | 3244 |
| Kerala | 20.2 | 60.1 | 19.8 | 243 |
| Lakshadweep | 12.5 | 47.5 | 40.0 | 40 |
| Madhya Pradesh | 34.6 | 59.4 | 6.0 | 7836 |
| Maharashtra | 38.3 | 49.9 | 11.8 | 7137 |
| Manipur | 7.1 | 73.9 | 18.9 | 322 |
| Meghalaya | 11.0 | 77.8 | 11.2 | 1255 |
| Mizoram | 8.5 | 70.3 | 21.2 | 519 |
| Nagaland | 11.5 | 73.0 | 15.5 | 651 |

| | | | | |
|---|---|---|---|---|
| Delhi | 5.1 | 70.9 | 23.9 | 117 |
| Odisha | 36.6 | 57.9 | 5.6 | 5427 |
| Puducherry | 0.0 | 60.0 | 40.0 | 5 |
| Punjab | 11.1 | 70.4 | 18.5 | 27 |
| Rajasthan | 37.5 | 56.5 | 6.0 | 4444 |
| Sikkim | 4.3 | 68.7 | 27.0 | 115 |
| Tamil Nadu | 18.6 | 59.9 | 21.6 | 867 |
| Tripura | 14.0 | 71.9 | 14.0 | 641 |
| Uttar Pradesh | 30.4 | 58.8 | 10.8 | 1125 |
| Uttarakhand | 22.0 | 60.4 | 17.6 | 245 |
| West Bengal | 33.0 | 60.6 | 6.3 | 3179 |
| Telangana | 29.9 | 50.8 | 19.4 | 1591 |
| Total | 31.7 | 58.2 | 10.1 | 58927 |

**Note**: The body mass index (BMI) is expressed as the ratio of weight in kilograms to the square of height in meters (kg/m2). Excludes pregnant women and women with a birth in the preceding 2 months.
**Source**: Computed from NFHS 4 individual data file.

The states having sample size less than 40 are not interpreted. It has been observed that 31.7% of Indian ST women are underweight and 10.1% of them are overweight. The prevalence of underweight among ST women is highest in Gujarat (40.7%) followed by Maharashtra, Rajasthan and Odisha having 38.3%, 37.5% and 36.6% respectively. In Sikkim, the prevalence of underweight is the lowest (4.3%) and prevalence of overweight is found to be second highest (27%) followed by Himachal Pradesh, Delhi and Andhra Pradesh having 26.1%, 23.9% and 21.8% of overweight tribal women respectively. Along with having large prevalence of overweight, Andhra Pradesh (28.3%) and Himachal Pradesh (15.9%) have a large prevalence of underweight also. While most of the states have large proportion of underweight tribal women, the states like Tamil Nadu, Himachal Pradesh, Nagaland, Mizoram, Manipur, Arunachal Pradesh, Delhi and Sikkim have more percentage of overweight than underweight among tribal women.

**Figure 1: Prevalence of underweight and overweight among Schedule Tribe women aged 15-49 in the States/UT of India**




**Map 1: Prevalence of underweight tribal women aged 15-49 in the States/UT, India**

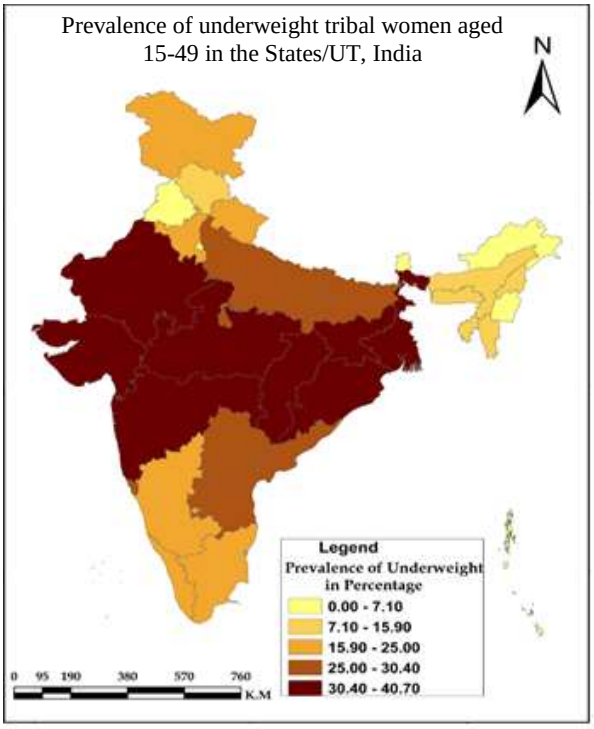



**Table 2: Percentage of ST women aged 15-49 with BMI by Background Characteristics, India, NFHS 4**

| Background Characteristics | Underweight | Normal | Overweight | N |
|---|---|---|---|---|
| **Age** | | | | |
| 15-24 | 40.0 | 56.4 | 3.6 | 20419 |
| 25-34 | 30.0 | 59.4 | 10.6 | 17934 |
| 35+ | 25.1 | 58.9 | 16.0 | 20574 |
| **Type of place of residence** | | | | |
| Urban | 21.6 | 56.2 | 22.1 | 9234 |
| Rural | 33.6 | 58.6 | 7.8 | 49693 |
| **Marital Status** | | | | |
| Never Married | 39.4 | 56.9 | 3.7 | 13746 |
| Married | 29.6 | 58.6 | 11.9 | 41986 |
| Widowed/Divorced/Separated | 27.5 | 58.9 | 13.6 | 3194 |
| **Children Ever Born** | | | | |
| 0 | 38.0 | 57.3 | 4.7 | 17641 |
| 1-2 | 28.4 | 58.2 | 13.4 | 19860 |
| 3+ | 29.7 | 59.0 | 11.4 | 21425 |
| **Highest educational level** | | | | |
| No education | 33.3 | 58.1 | 8.7 | 24939 |
| Primary | 31.8 | 58.4 | 9.8 | 7999 |
| Secondary | 31.3 | 58.2 | 10.5 | 22839 |
| Higher | 23.0 | 58.3 | 18.7 | 3151 |
| **Religion** | | | | |
| Hindu | 33.4 | 57.0 | 9.6 | 50662 |
| Others | 21.3 | 65.7 | 13.0 | 8265 |
| **Wealth Index** | | | | |
| Poorest | 39.2 | 57.4 | 3.4 | 23943 |
| Poorer | 32.9 | 59.4 | 7.7 | 15501 |
| Middle | 25.5 | 60.7 | 13.9 | 9492 |
| Richer | 19.7 | 57.5 | 22.8 | 6241 |
| Richest | 15.2 | 53.4 | 31.4 | 3750 |

| Drinks Alcohol | | | | |
|---|---|---|---|---|
| No | 32.0 | 57.9 | 10.2 | 55052 |
| Yes | 28.6 | 62.5 | 8.9 | 3876 |
| **Total** | 31.7 | 58.2 | 10.1 | 58927 |

**Note:** The body mass index (BMI) is expressed as the ratio of weight in kilograms to the square of height in meters (kg/m2). Excludes pregnant women and women with a birth in the preceding 2 months.
**Source:** Computed from NFHS 4 individual data file

It is observed from that the prevalence of underweight in ST women is more in lower age groups (40% in 15-24 to 25.1% in 35+), and prevalence of overweight is more in higher age groups (3.6% in 15-24 to 16% in 35+). More urban ST women are found to be overweight (22.1%) than underweight (21.6%) and more rural women are found to be underweight (22.1%) than overweight (7.8%). Prevalence of underweight was more in never married women (39.4%) than married (29.6%) and widowed/ divorced/ separated women (27.5%). Prevalence of underweight is more in women without any child (38%). As educational level increases from no education to higher the percentage of underweight decreases (33.3% to 23%) and percentage of overweight in tribal women increases (8.7% to 18.7%). Similar pattern is observed in the wealth index also. Prevalence of underweight in Hindu women (33.4%) is more than of it in the other religions (21.3%). Women who do not drink alcohol are have more percentage of underweight (32%) and overweight (10.2%) people than in the group of women who drink alcohol (28.6% and 10.9% respectively).

**Figure 2: Prevalence of underweight and overweight among ST women aged 15-49 in several background characteristics**

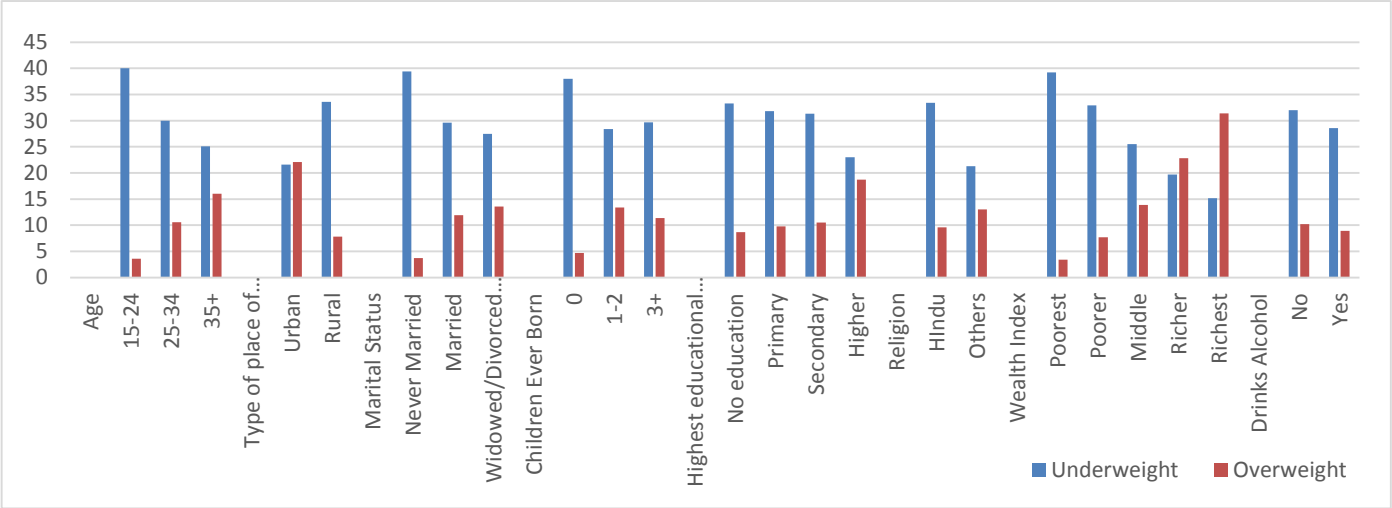



Table 3 contains the output of multinomial logistic regression of BMI levels on several socio-economic characteristics from NHHS-4 individual dataset. The background characteristics do not always have significant association with the BMI levels. To check whether the association is significant or not, the significance is given in the table. The relative risk ratios and their upper and lower bounds of 95% confidence intervals are also shown. Results show that ST women from West and North region are more likely to be underweight and ST women from North east are least likely to be underweight. The relative risk ratio of underweight among '15-24' and '25-34' year age group is 1.752 and 1.277 times significantly higher relatively compared to 35+ years aged women. The relative risk of overweight in urban area is 1.287 times significantly higher than it in rural areas (95% CI =1.190-1.391). The relative risk of underweight is significantly higher in never married women than widowed/ divorced/ separated women (RRR=1.235, 95% CI=1.104-1.382). The relative risk of underweight is significantly lower women with no child or women with 1-2 children compared to the women with 3 children or more. The relative risk ratio of being underweight in people with no education, primary and secondary education is 1.252, 1.149 and 1.093 times significantly higher than people with higher secondary education. Hindu women found to be more likely to be underweight (RRR=1.181) significantly All categories of wealth index are found to be significantly associated with underweight and overweight. The relative risk of underweight is 2.234, 1.892, 1.434 and 1.156 times significantly higher in poorest, poorer, middle and richer group respectively as compared to the richest group.

**Table 3: Relative Risk showing the effect of background variables on BMI among ST women in India: Results from Multinomial logistic regression Analysis**

| Background Characteristics | Underweight vs normal weight | | | Overweight vs normal weight | | |
|---|---|---|---|---|---|---|
| | Exp(B) | 95% CI Lower Bound | 95% CI Upper Bound | Exp(B) | 95% CI Lower Bound | 95% CI Upper Bound |
| **Region** | | | | | | |
| North | 1.081* | 0.996 | 1.173 | 0.578*** | 0.513 | 0.652 |
| Central | 0.959 | 0.895 | 1.028 | 0.523*** | 0.472 | 0.578 |
| East | 1.001 | 0.934 | 1.073 | 0.592*** | 0.534 | 0.655 |
| North East | 0.357*** | 0.322 | 0.396 | 0.676*** | 0.603 | 0.759 |
| West | 1.64*** | 1.532 | 1.756 | 0.728*** | 0.666 | 0.796 |
| South® | | | | | | |
| **Age** | | | | | | |
| 15-24 | 1.754*** | 1.644 | 1.871 | 0.291*** | 0.260 | 0.326 |
| 25-34 | 1.277*** | 1.215 | 1.343 | 0.619*** | 0.577 | 0.664 |
| 35+® | | | | | | |
| **Place of residence** | | | | | | |
| Urban | 0.949 | 0.889 | 1.013 | 1.287*** | 1.190 | 1.391 |
| Rural® | | | | | | |
| **Marital Status** | | | | | | |
| Never Married | 1.235*** | 1.104 | 1.382 | 0.552*** | 0.458 | 0.665 |
| Married | 0.959 | 0.880 | 1.046 | 1.134** | 1.009 | 1.274 |
| Widowed/Divorced/ Separated® | | | | | | |
| **Children ever born** | | | | | | |
| 0 | 0.907** | 0.835 | 0.986 | 1.052 | 0.918 | 1.207 |
| 1-2 | 0.933*** | 0.888 | 0.981 | 1.056 | 0.984 | 1.133 |
| 3+® | | | | | | |
| **Education Level** | | | | | | |
| No education | 1.252*** | 1.127 | 1.392 | 0.820*** | 0.718 | 0.936 |
| Primary | 1.149** | 1.030 | 1.282 | 0.860** | 0.746 | 0.990 |
| Secondary | 1.093* | 0.992 | 1.205 | 0.899* | 0.800 | 1.010 |
| Higher® | | | | | | |
| **Religion** | | | | | | |
| Hindu | 1.181*** | 1.107 | 1.260 | 0.962 | 0.877 | 1.055 |
| Others® | | | | | | |
| **Wealth index** | | | | | | |
| Poorest | 2.234*** | 1.990 | 2.509 | 0.136*** | 0.119 | 0.156 |
| Poorer | 1.892*** | 1.689 | 2.120 | 0.270*** | 0.239 | 0.304 |
| Middle | 1.434*** | 1.279 | 1.608 | 0.433*** | 0.387 | 0.484 |
| Richer | 1.156** | 1.028 | 1.301 | 0.698*** | 0.630 | 0.775 |
| Richest® | | | | | | |
| **Drinks alcohol** | | | | | | |
| No | 0.948 | 0.876 | 1.025 | 1.010 | 0.890 | 1.146 |
| Yes® | | | | | | |

**Note**: ***, ** and *: <1%, <5% and <10% level of significance respectively
**Source:** Computed from NFHS 4 individual datafile.

## IV. DISCUSSION

Prevalence of underweight is more in tribal women than overweight. According to NFHS 4 Report, 22.9 percent of Indian women are underweight and the overall prevalence of underweight among schedule tribe female is found to be 31.7 in this study, which is much higher than the national estimates. From west region most of the tribal women are found to be underweight and the prevalence of underweight is lowest in the North-East region. The factors that are protective against being underweight for ST women are them being in older ages, having higher years of education, being from households of higher wealth index. But females who follow Hinduism, who are never married or have 3 or more children are more prone to be underweight. The overall prevalence of overweight/obesity among them is 10.1. Although place of residence does not have any significant association of being underweight, urban women have significantly higher relative risk of being overweight. Being in older ages and residing in urban area, marriage, having higher education and higher wealth index are generally the factors responsible for being overweight. Children ever born, religion or drinking alcohol did not have significant impact on them being overweight/obese.

## V. CONCLUSION

Although the prevalence of underweight is higher among tribal women, the majority of them are found to be of normal BMI. In some of the states the prevalence of overweight tribal women exceeds the number of underweight which slightly indicates towards dual burden of malnutrition. This study population is mostly under-nourished than general population and it is important to come up with interventions and programs that could address the under nutrition among them. Efforts must be made to educate them and enhance their level of economic status so that the prevalence of underweight can be reduced substantially. In future studies, more aspects and variables like physical activity, intake of micronutrients etc. can also be included to assess the effect of those variables on Nutritional Status among this population.

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