

Regional variation of overweight women in India



Introduction

Overweight and obesity among women have become major public health concerns in India, reflecting the country's rapid socioeconomic transition, urbanisation, and lifestyle changes. Rising body mass index (BMI) levels are associated with increased risks of hypertension, diabetes, and other non-communicable diseases. Using the NFHS-5 (2019–21) dataset, this study examines the regional variation in women's BMI and explores how various factors such as wealth index, marital status, age group, fried food consumption also consumption of meat or chicken, milk and eggs, current pregnancy status, and number of children influence overweight and obesity patterns. The analysis aims to identify the key determinants of BMI differences among women and provide insights into the broader socio-demographic and nutritional landscape of India.

Study Objectives:

- To analyse the state-wise distribution of women's BMI in India using NFHS-5 data to identify regional patterns of overweight and obesity.
- To examine the association between BMI and key socio-economic and demographic factors such as wealth index, marital status, age group, and dietary habits.
- To explore the influence of reproductive and lifestyle factors including current pregnancy status and number of children on women's BMI.
- To identify the major causal or contributing variables affecting overweight and obesity among Indian women.
- How overweight is associated with increased risks of hypertension, diabetes, and other non-communicable diseases.
- To establish statistical relationships between BMI and the selected variables using Chi-square test.



Methodology:

The present study is based on secondary data obtained from the National Family Health Survey (NFHS-5, 2019–21), from the Individual dataset (IAIR7ADT). The analysis focuses on assessing the regional and socio-demographic variation of Body Mass Index (BMI) among women aged 15–49 years in India , also showing how overweight and obesity is associated with increased risks of hypertension, diabetes, and other non-communicable diseases

1. Data and Variables:

The dependent variable is BMI(v445), analysed both as a continuous measure and as categorical types - Underweight, Normal, Overweight, and Obese. The independent variables include State/Region, Age Group (v013), Marital Status, Wealth Index, Fried Food Consumption (s731h), Current Pregnancy Status with no. of living children (v219),alcohol consumption, frequency takes milk or curd (s731a) , frequency of eats eggs (s731e), Frequency of eats fish (s731f), frequency of eats chicken (s731g). Also consider bmi as independent variable and take some disease as dependent variable such as currently has hypertension (s728b), currently has chronic respiratory disease including asthama (s728c), currently has heart disease (s728e).

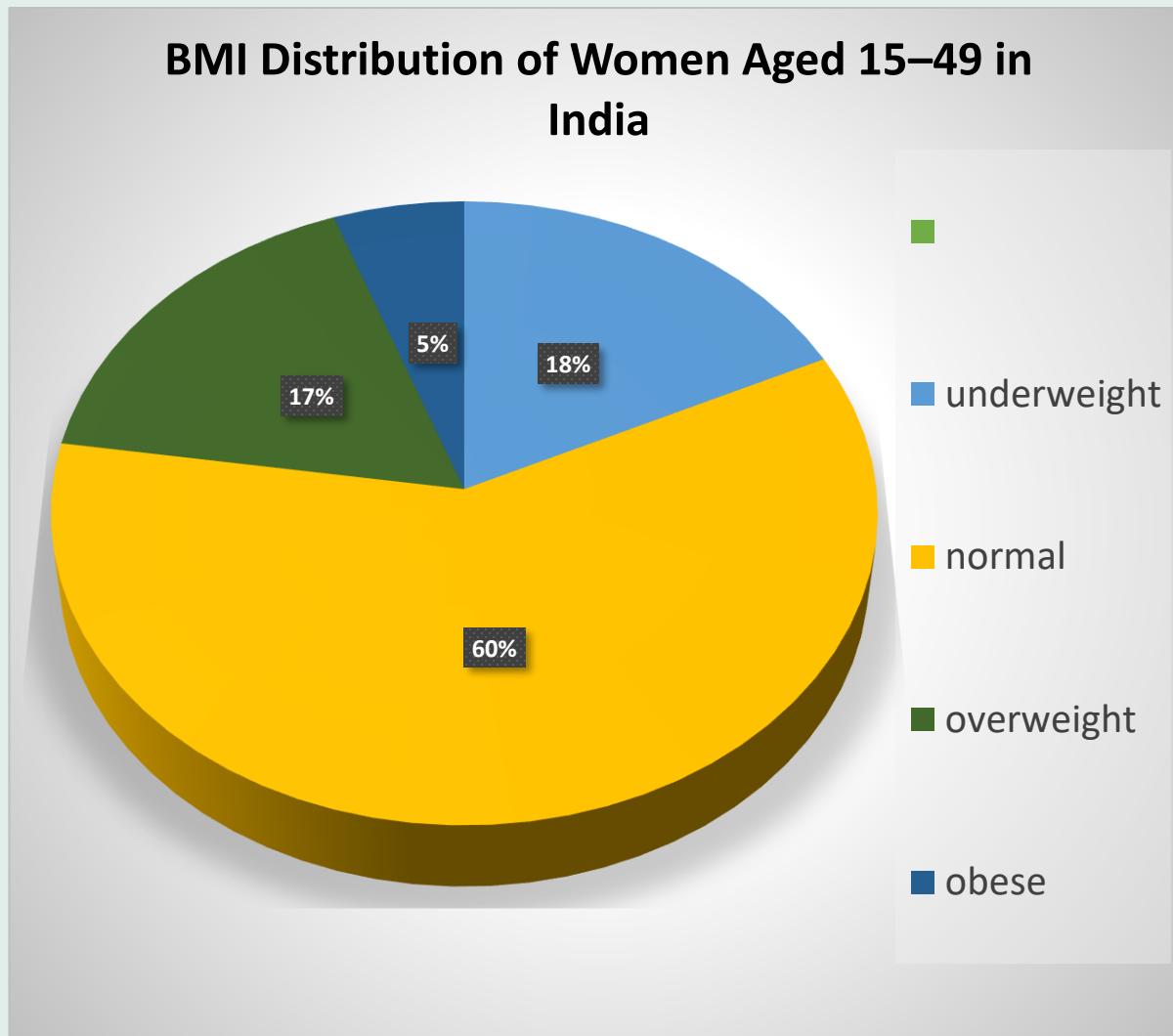
	v013	v024	v025	v106	v198a	v213	v219	v437	v438	v501	s722d	s722e	s722x	s728b	s728c	s728e	s731a	s731e	s731f	
1	35-39	maharas..	rural	primary	poorest	no or u..	8	244	1562	never i..	no	no	no	no	no	no	no	weekly	daily	weekly
2	25-29	odisha	rural	seconda..	poorer	no or u..	2	396	1988	married	no	no	no	no	no	no	no	daily	weekly	weekly
3	20-24	bihar	rural	no educ..	poorest	no or u..	8	235	1531	never i..	no	no	no	no	no	no	no	never	occasio..	weekly
4	15-19	gujarat	rural	seconda..	middle	no or u..	8	385	1959	married	no	no	no	no	no	no	no	weekly	never	never
5	20-24	uttar p..	rural	seconda..	richest	no or u..	8	393	1979	never i..	no	no	no	no	no	no	no	weekly	weekly	never
6	15-19	chhatti..	rural	primary	poorest	no or u..	8	333	1828	never i..	no	no	no	no	no	no	no	occasio..	weekly	occasio..
7	35-39	bihar	rural	no educ..	poorer	no or u..	4	385	1956	married	no	no	no	no	no	no	no	weekly	occasio..	occasio..
8	25-29	jharkha..	urban	seconda..	poorest	no or u..	2	390	1988	married	no	no	no	no	no	no	no	weekly	occasio..	occasio..
9	35-39	bihar	rural	no educ..	poorest	no or u..	5	391	1970	married	no	no	no	yes	no	yes	yes	weekly	weekly	weekly
10	25-29	jharkha..	rural	seconda..	poorer	no or u..	2	372	1921	widowed	no	no	no	no	no	no	no	occasio..	occasio..	weekly
11	15-19	madhya ..	rural	seconda..	poorest	no or u..	8	427	2058	never i..	no	no	no	don't k..	no	no	no	never	occasio..	occasio..
12	40-44	west be..	rural	no educ..	poorest	no or u..	5	281	1411	married	no	no	no	no	no	no	no	never	weekly	occasio..
13	20-24	karnata..	rural	no educ..	poorer	yes	2	404	2080	married	no	no	no	no	no	no	no	daily	weekly	occasio..
14	35-39	manipur	rural	primary	poorest	no or u..	4	238	1335	married	no	no	no	no	no	no	no	occasio..	weekly	weekly
15	45-49	assam	rural	no educ..	poorest	no or u..	4	376	1929	married	no	no	no	no	no	no	no	occasio..	occasio..	occasio..
16	20-24	punjab	urban	seconda..	middle	no or u..	1	481	1992	married	no	no	no	no	no	no	no	occasio..	occasio..	occasio..
17	30-34	chhatti..	rural	seconda..	poorest	no or u..	4	304	1949	married	no	no	no	no	no	no	no	weekly	daily	daily
18	15-19	karnata..	urban	higher	poorer	no or u..	8	392	1969	never i..	no	no	no	no	no	no	no	daily	weekly	occasio..
19	25-29	chhatti..	rural	seconda..	middle	yes	2	389	1959	married	no	no	no	no	no	no	no	never	occasio..	occasio..
20	45-49	odisha	rural	no educ..	poorest	no or u..	3	398	1935	married	no	no	no	no	no	no	no	never	weekly	weekly
21	30-34	tripura	rural	seconda..	poorer	no or u..	1	399	1981	married	no	no	no	no	no	no	no	daily	weekly	weekly
22	45-49	west be..	urban	no educ..	poorest	no or u..	2	227	1494	widowed	no	no	no	no	no	no	no	daily	weekly	weekly
23	20-24	rajasth..	rural	higher	richest	no or u..	8	328	1773	never i..	no	no	no	no	no	no	no	daily	never	never
24	40-44	maharas..	rural	no educ..	middle	no or u..	2	408	1982	married	no	no	no	no	no	no	no	never	weekly	never
25	30-34	madhya ..	rural	seconda..	poorer	no or u..	5	396	1972	married	no	no	no	no	no	no	no	daily	weekly	never
26	20-24	bihar	rural	seconda..	middle	no or u..	8	401	1984	never i..	no	no	no	yes	no	yes	no	weekly	weekly	weekly

2. Analytical Methods:

- Cross-tabulation was performed to examine the state-wise distribution of BMI and its relationship with selected socio-demographic and lifestyle factors. Chi-square tests were used to determine the association between categorical variables, such as BMI type with Wealth Index, Age Group, Fried Food Consumption , Residence type, Frequency of meat or chicken consumption, Frequency of milk or curd consumption, Frequency of fish consumption , alcohol consumption , currently has hypertension , currently has chronic respiratory disease including asthma, currently has heart disease .
- For my work I have first generate a new variance bmi by doing $v445/100$, then I drop all missing and non response values as well as those values which are < 10 or > 60 now I categorized bmi values into 4 groups such as <18.5 "underweight",, 18.5 to 24.9 is "normal",, 24.9 to 29.9 is "overweight",, and lastly 29.9 to max as "obese", and generate new variable such as bmi_n.
- I also created a new variable name as alcohol_consume for which if women consume ever consume wine , hard liquor or others then it's consider as alcohol consume if never consume any one of them then it's consider as alcohol_consumed.
- Also for further analysis i created two groups for bmi such as "not overweight" where i consider underweight and normal category and "overweight" for overweight and obese category. As our work is on overweight i did each & every analysis and diagram on overweight.
- For all association tests were conducted using Stata software, and results were interpreted at a 5% level of significance ($p < 0.05$) and all the diagrams are generated using Microsoft Excel .

Explatory Data Analysis

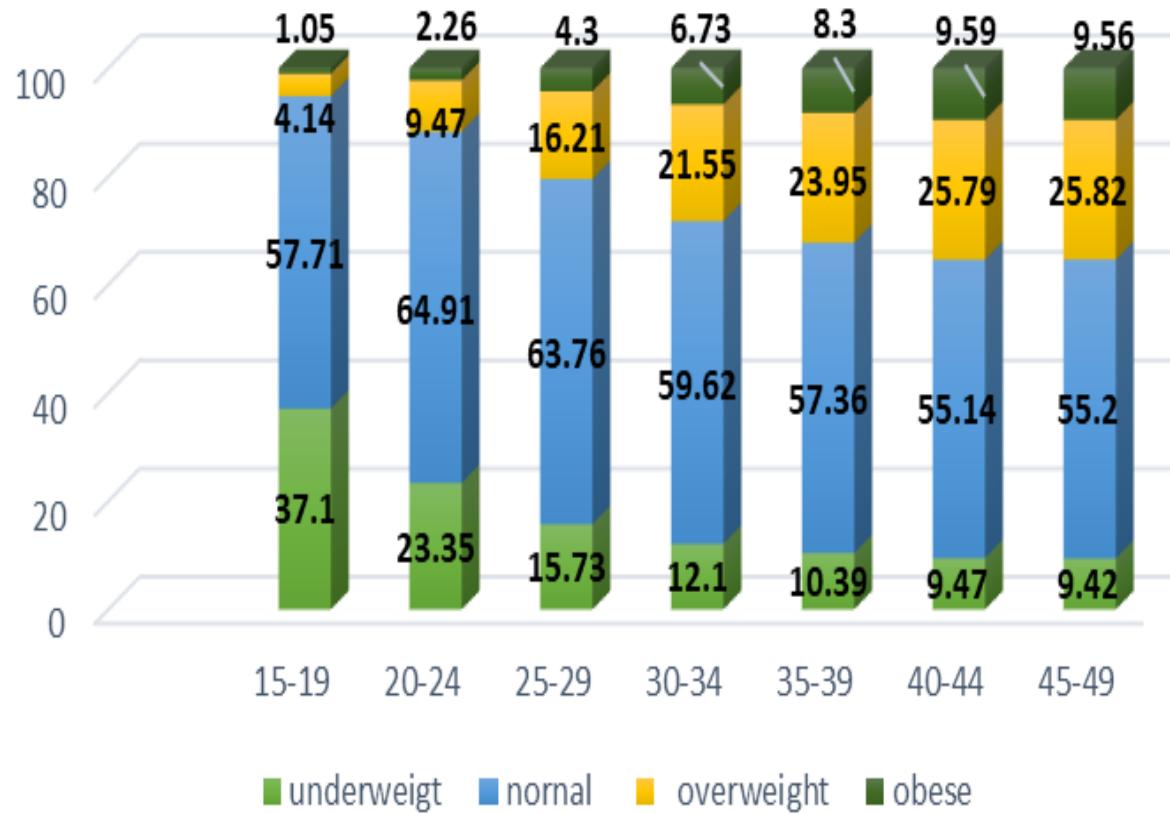
BMI distribution of women aged 15-49 in India



- ❑ Nearly 60% of Indian women (ages 15–49) fall within the normal BMI range (18.5–24.9).
- ❑ About 18% of women are underweight.
- ❑ Around 17% fall into the overweight category, and 5% are obese.
- ❑ The chart highlights the double burden of malnutrition, where both underweight and overweight coexist in the population.
- ❑ Overweight & obese (23%) now exceeds the proportion of underweight women (17%), indicating a shift toward rising overnutrition.

BMI distribution of women across age group 15-49 in India

Distribution of BMI of women across the age group in India

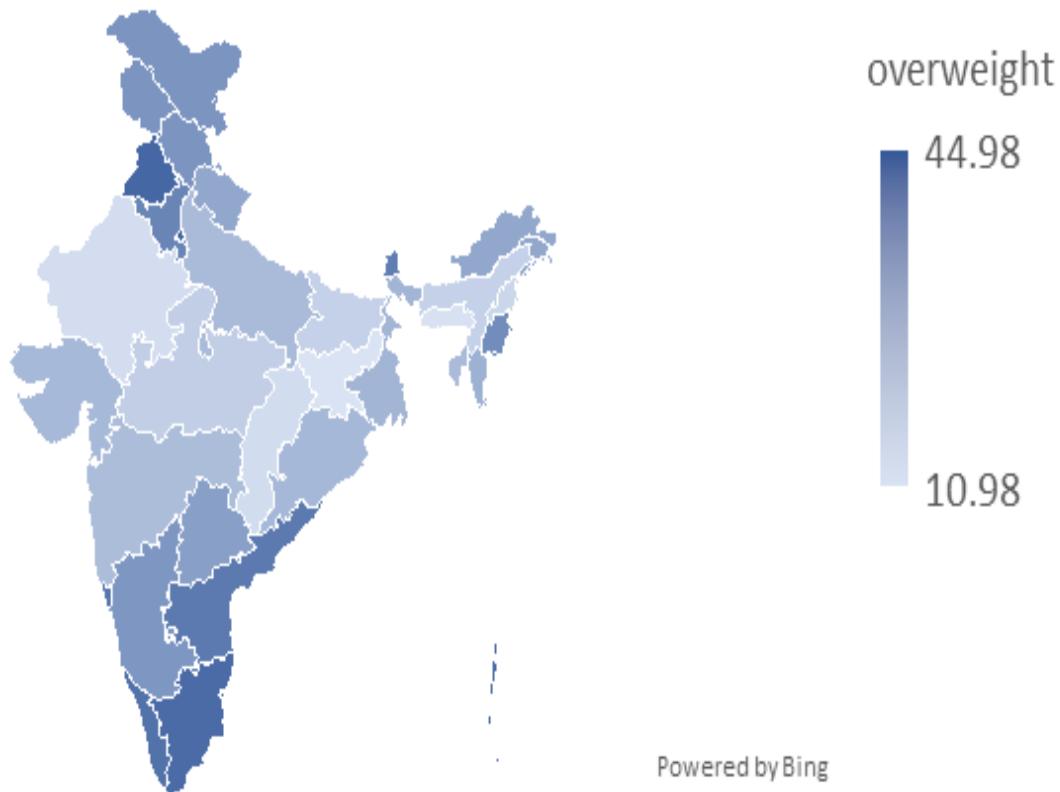


- This 100% stacked bar chart shows BMI distribution (underweight, normal, overweight, obese) among Indian women aged 15–49.
- A clear age-dependent shift is visible:
- Underweight prevalence decreases sharply with increasing age.
- Overweight and obesity steadily increase as age rises.
- In the 40–44 and 45–49 age groups, levels of overweight and obesity are almost the same, indicating a stabilization at older ages.
- The chart highlights India's double burden of malnutrition, showing that underweight is concentrated among younger women, while overweight and obesity dominate in older age groups.

- **Younger Women (15-19):** This group's primary nutritional challenge is undernutrition (37.1% underweight).
- **Older Women (40-49):** This group's primary challenge is overnutrition and also some other factors like marriage , child bearing , consumtion of alcohol for the 45-49 age group, the combined percentage of overweight and obese (25.82% + 9.56%) is 35.38%, which is significantly higher than the 9.42% who are underweight.
- **Transitional Period:** The 20s and early 30s represent a nutritional transition period where the prevalence of underweight declines rapidly while the prevalence of overweight and obese begins to accelerate.
- This is an overview of bmi structure among Indian women from age 15-49 . But my work is only based on overweight women (overweight and obese) in India , for further analysis we are only interested in overweight women as the prevelance of normal weight in every group is much higher than other categories.
- For further analysis we are going to see how bmi of women depends on other socio-economic and demographic factors.

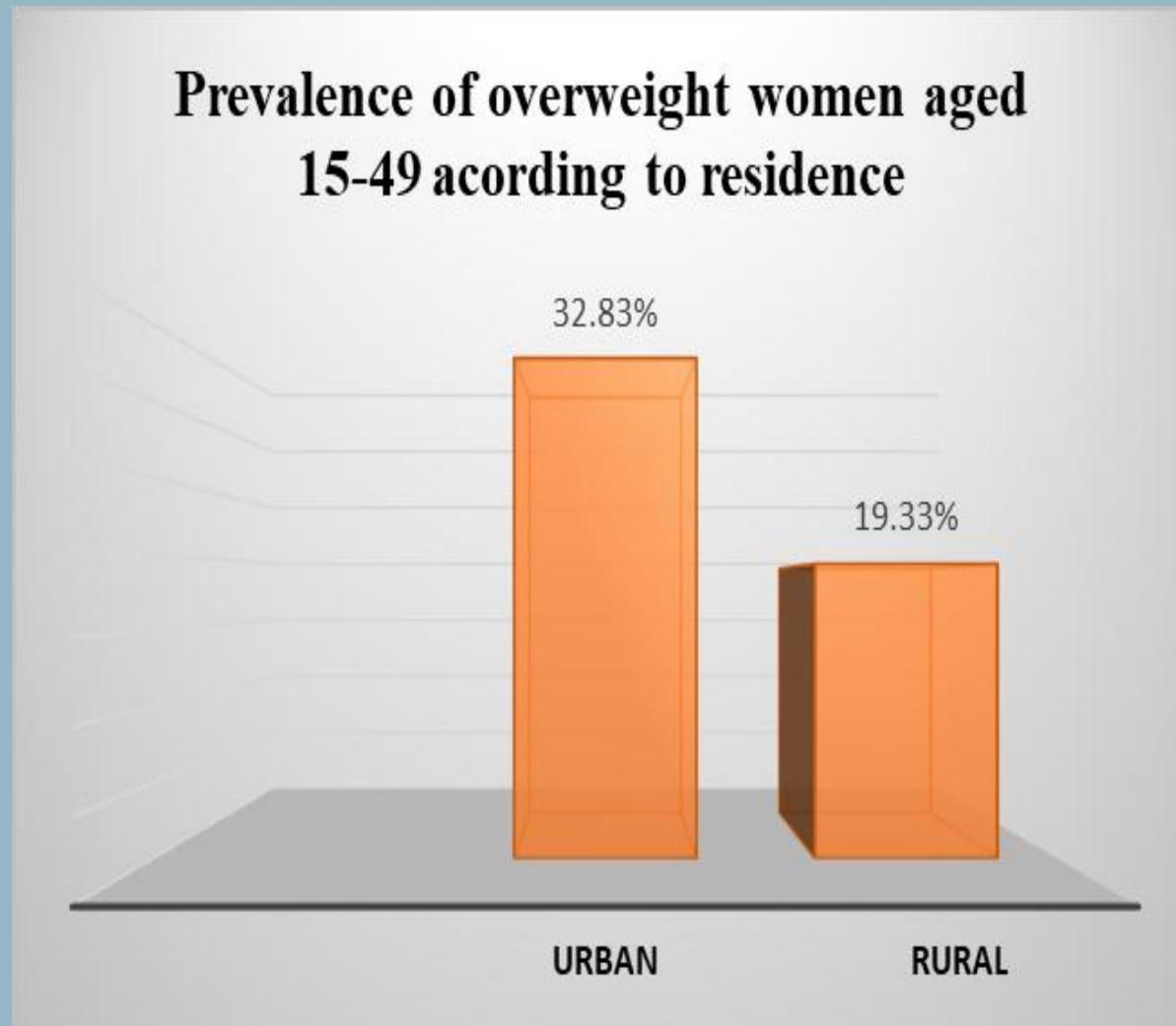
BMI distribution of women aged 15-49 across the states in India

Distribution of overweight women aged 15-49 across states in India



- The choropleth map shows the geographical distribution of overweight women (15 - 49 years) across Indian states.
- A clear spatial disparity is visible, indicating regional clustering rather than random variation.
- Southern states (Kerala, Tamil Nadu, Karnataka): Higher prevalence of overweight women.
- Northwestern & Northern states (Punjab, Haryana): Very high prevalence.
- Eastern & Central states (Bihar, Jharkhand, Chhattisgarh): Lower prevalence.
- Northeastern region: Mostly lower to moderate prevalence.

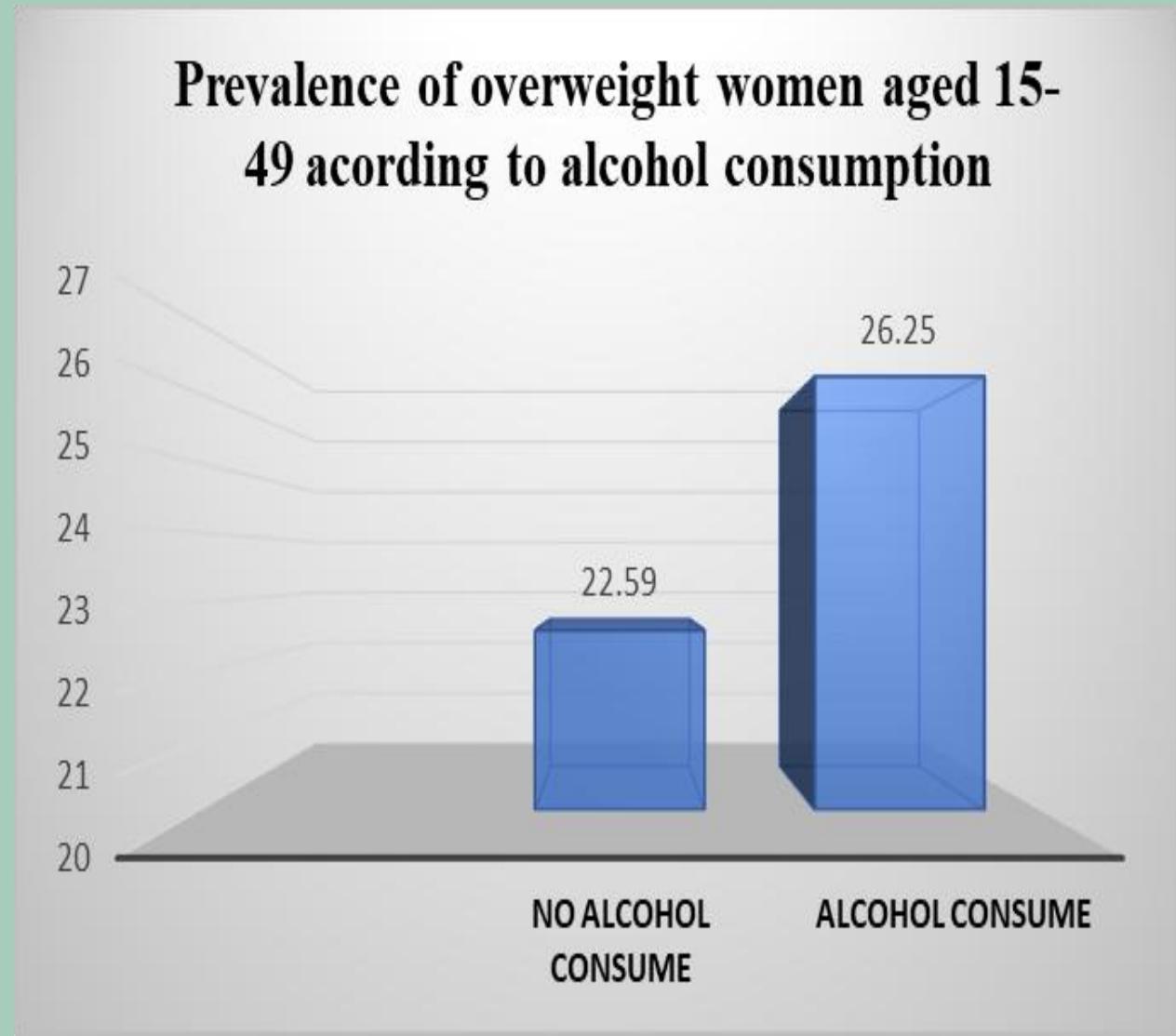
Prevalence of overweight women aged 15-49 according to residence



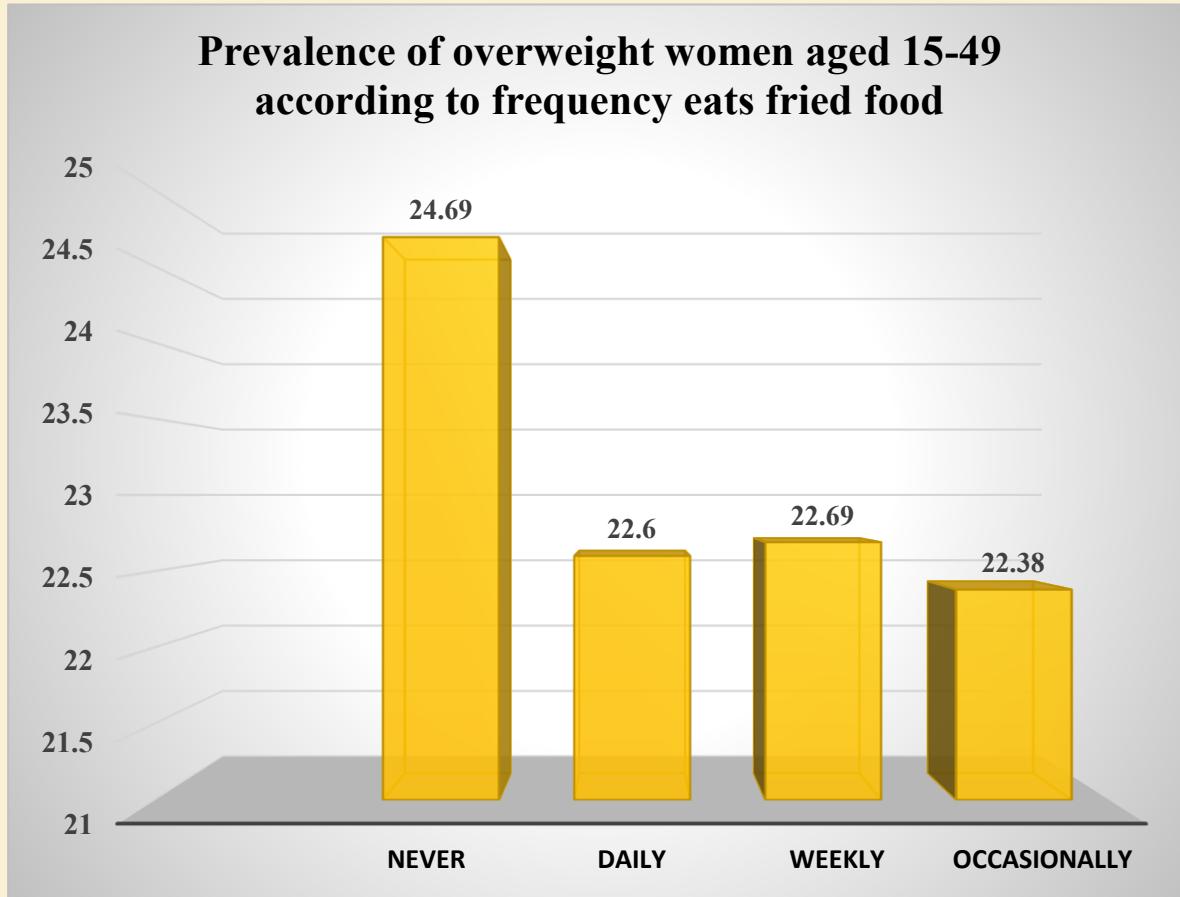
- The chart highlights a significant urban–rural gap in overweight prevalence among women aged 15 - 49.
- Urban women: 32.83% are overweight.
- Rural women: 19.33% are overweight.
- Higher overweight prevalence in urban areas is linked to more sedentary, office-based jobs and reduced physical activity.
- Higher incomes in urban households increase access to calorie-dense, processed foods.
- Urban environments often have limited safe and accessible spaces for physical activity.
- Multiple socioeconomic and lifestyle factors contribute to higher overweight rates among urban women compared to rural women.

Prevalence of overweight women aged 15-49 according to alcohol consumption

- The bar chart shows that women who consume alcohol - regularly, weekly, or occasionally - have a higher prevalence of being overweight compared to non-alcohol consumers.
- Although the percentage difference is not very large, the trend still indicates a positive association between alcohol consumption and overweight.
- Medical explanation: Alcoholic drinks (especially those mixed with sugary beverages) add extra calories and can disrupt metabolism, contributing to weight gain.
- Socio-economic factors: Alcohol consumption often occurs during social events where high-calorie foods are consumed, increasing total calorie intake.

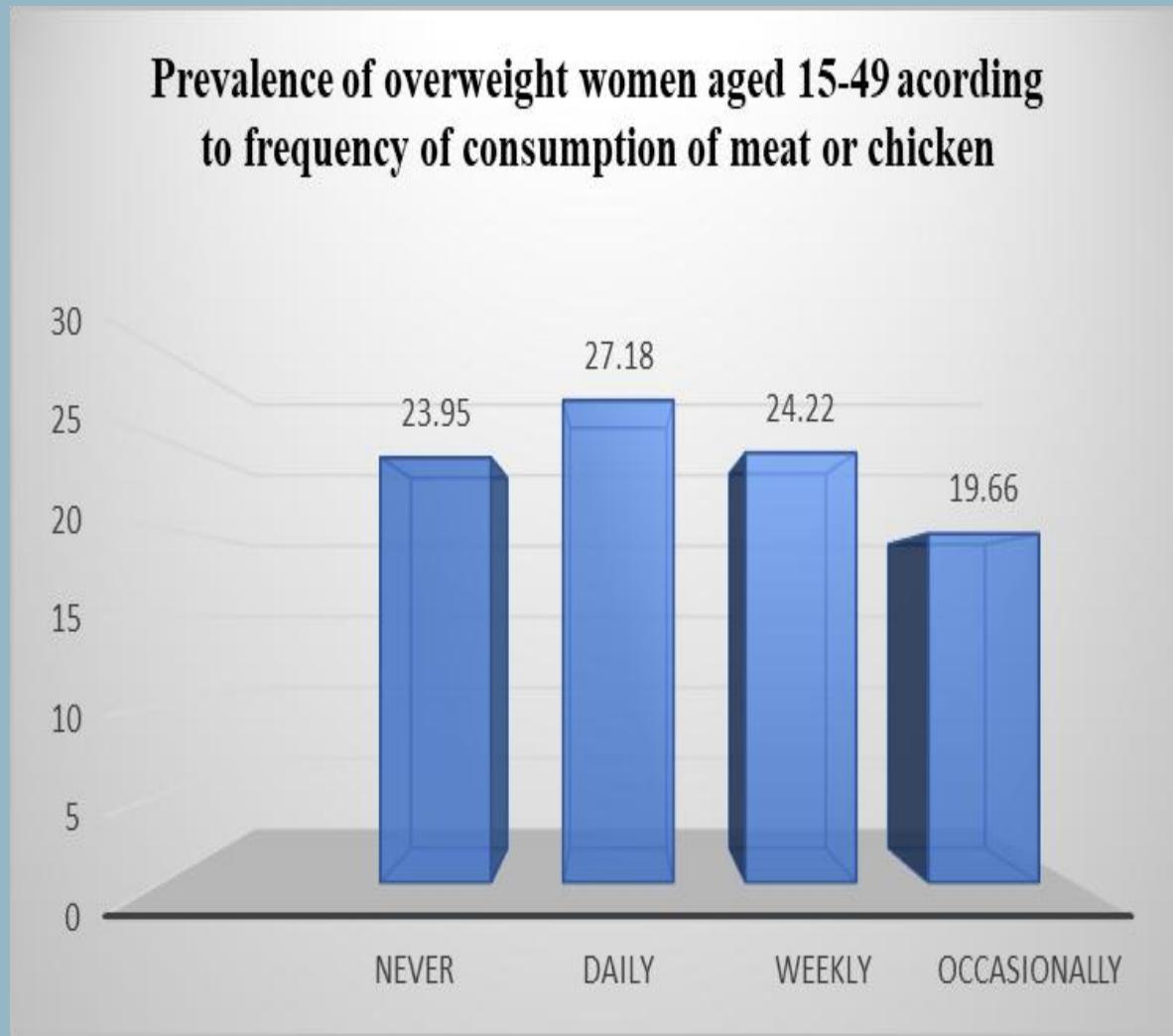


Prevalence of overweight women aged 15-49 according to fried food consumption



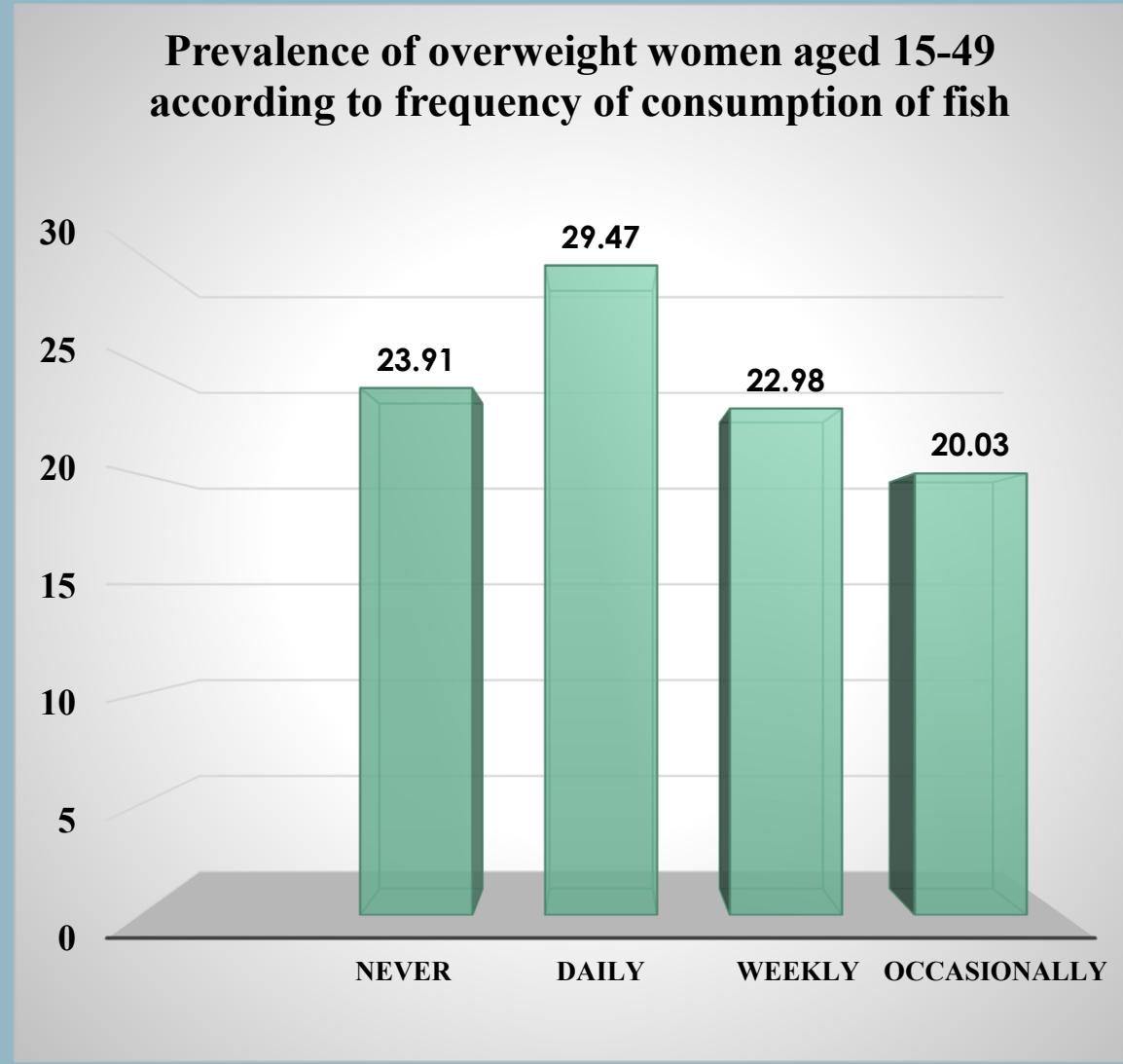
- Here for never consuming fried foods has highest prevalence rate 24.69%. Overweight prevalence can remain high even among women who never eat fried food due to other calorie-dense dietary habits, low physical activity, or pre-existing weight-control diets.
- Self-reported food frequency may involve under-reporting, especially of foods perceived as unhealthy, which can distort associations.
- Frequent fried-food consumers may be younger or more physically active, which offsets the impact of high-calorie foods.
- Socio-economic factors -such as access to healthy foods, type of occupation, and education -shape dietary behavior and weight outcomes.
- The small range of differences suggests fried-food frequency is not a dominant predictor of overweight on its own; overweight is multi-factorial.

Prevalence of overweight women aged 15-49 according to chicken/meat consumption



- The graph compares overweight prevalence among women (15-49 years) by frequency of meat/chicken consumption.
- Daily consumers show the highest overweight prevalence (27.18%).
- Weekly consumers follow with 24.22%.
- Never consumers have a slightly lower prevalence (23.95%).
- Occasional consumers have the lowest prevalence (19.66%).
- Daily meat intake may lead to higher calorie and fat consumption, increasing the risk of weight gain.
- Frequent meat eaters may consume more energy-dense, processed, or fried meat dishes due to convenience or cultural habits.
- Occasional or non-consumers may rely more on plant-based, fiber-rich diets, supporting healthier body weight.

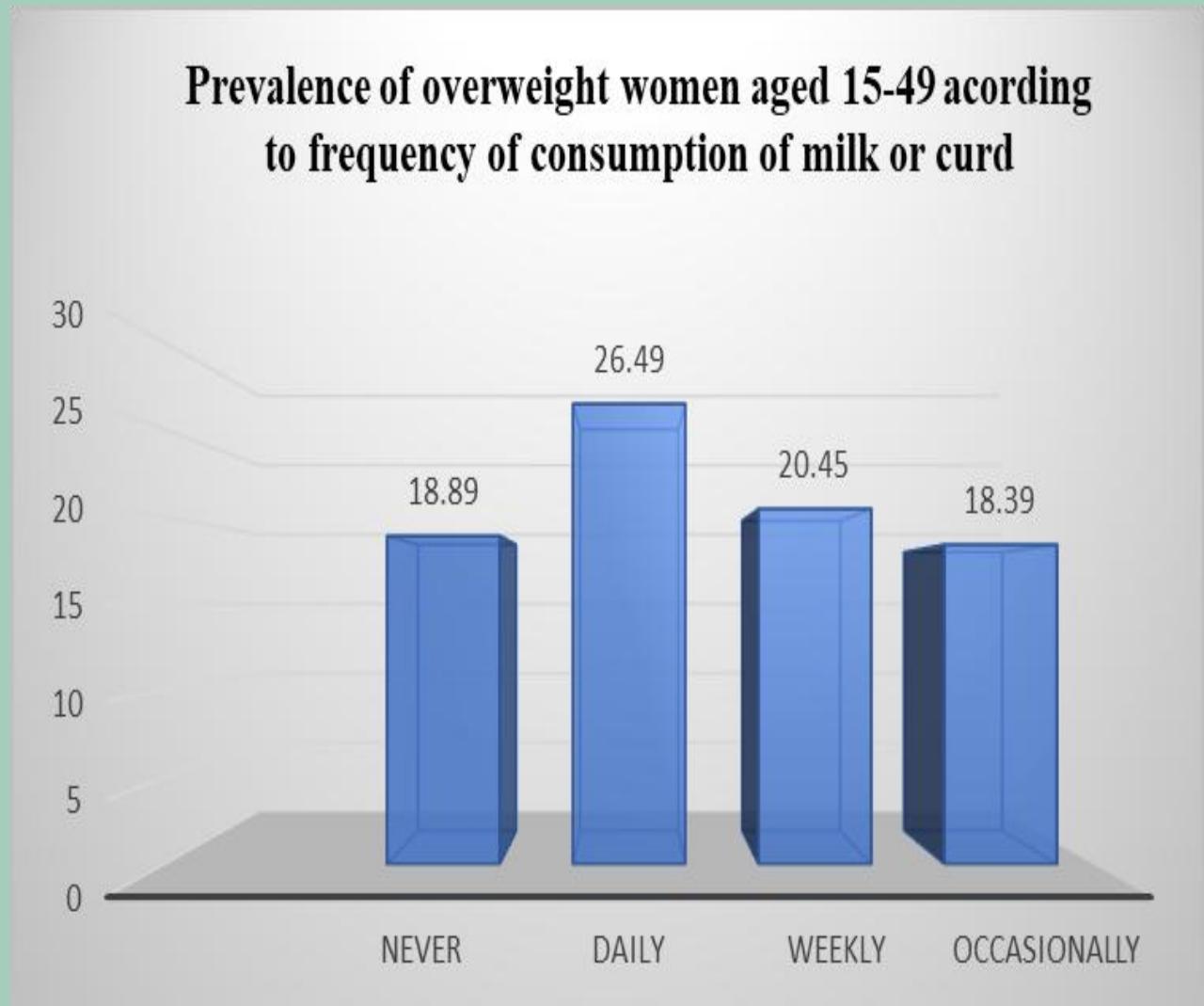
Prevalence of overweight women aged 15-49 according to fish consumption



- ❑ The pattern is not linear; overweight prevalence varies by frequency of fish consumption.
- ❑ Daily fish eaters show the highest overweight prevalence (29.47%).
- ❑ Weekly consumers have a lower prevalence (22.98%).
- ❑ Occasional consumers show even lower rates (20.03%).
- ❑ Daily fish consumption may indicate higher overall food intake, richer diets, or fish prepared using high-calorie cooking methods.
- ❑ Weekly or occasional fish eaters may have more balanced diets, combining proteins with vegetables and carbohydrates, supporting healthier weight.

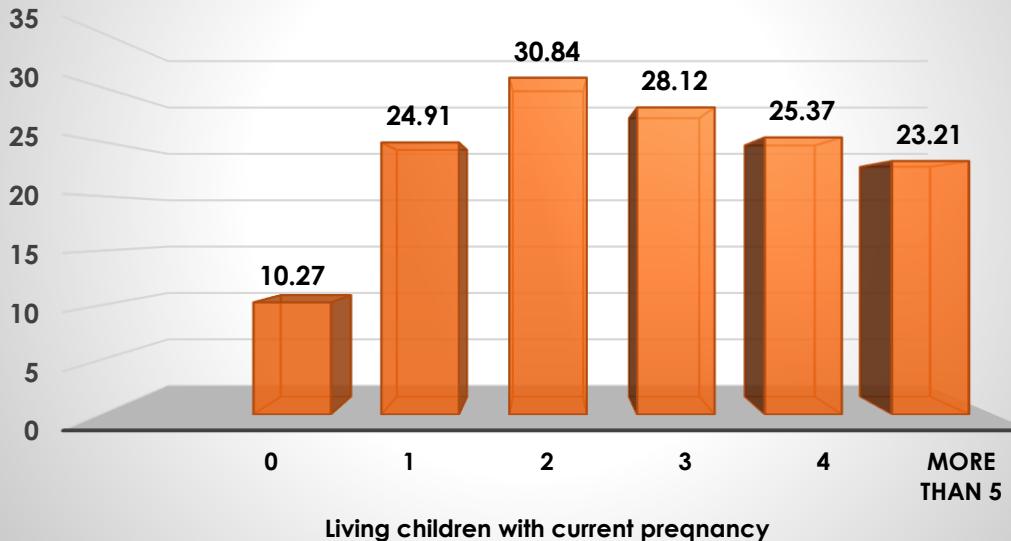
Prevalence of overweight women aged 15-49 according to milk/curd consumption

- Overweight prevalence varies by milk/curd consumption frequency.
- **Daily consumers:** highest overweight rate (26.49%).
- **Weekly consumers:** moderate rate (20.45%).
- **Never consumers:** lower rate (18.89%).
- **Occasional consumers:** lowest rate (18.39%).
- Full-fat dairy increases calorie intake, contributing to overweight.
- Daily consumption often reflects higher income and more sedentary lifestyles.



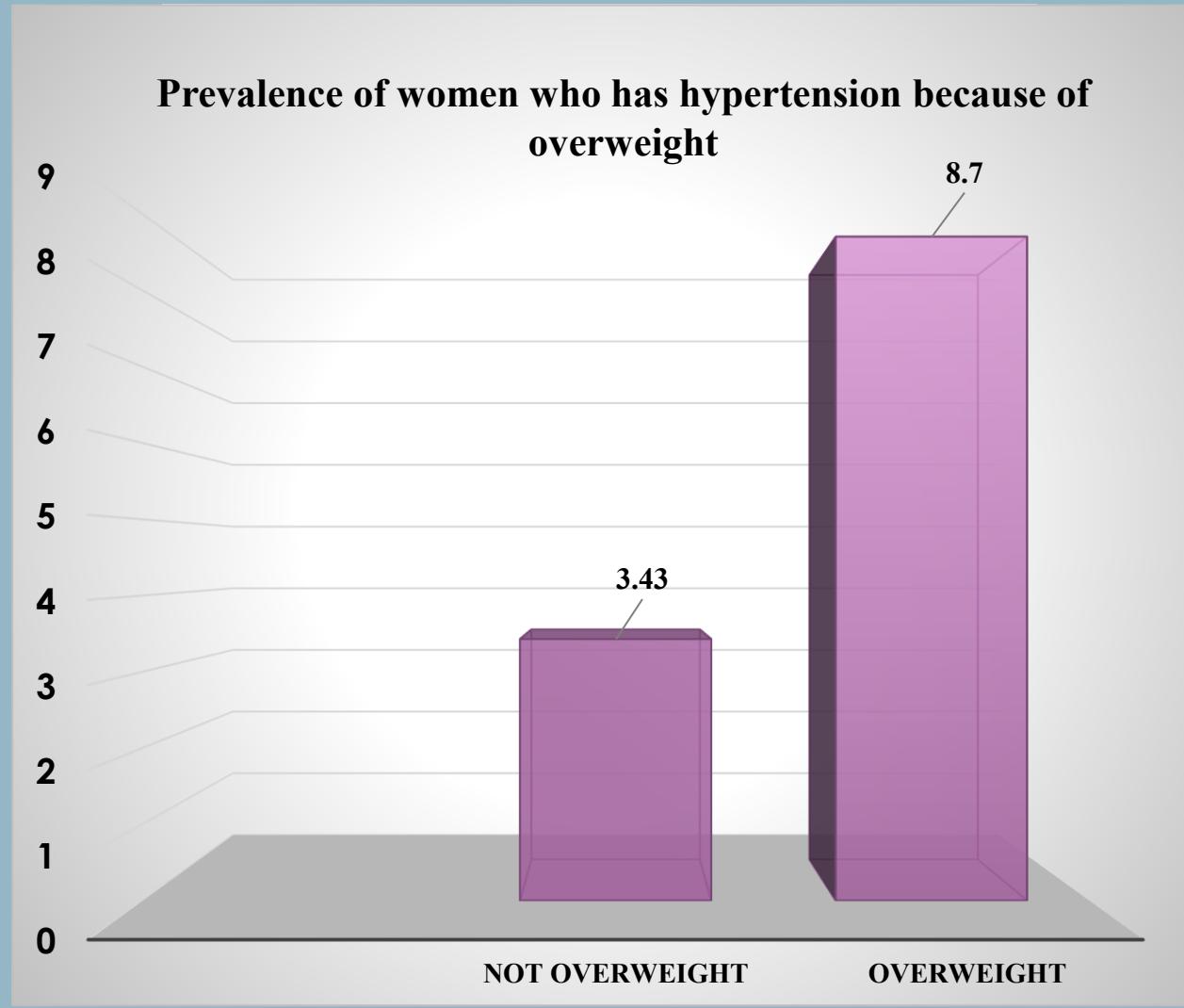
Prevalence of overweight women aged 15-49 according to living children with current pregnancy

Prevalence of overweight women aged 15-49 according to living children with current pregnancy



- Overweight prevalence rises sharply after childbirth due to post-partum weight retention and metabolic changes.
- Women with no children tend to be younger and more active, which explains their much lower overweight prevalence.
- Women with 1 - 2 children often face reduced physical activity and higher caregiving demands, contributing to weight gain.
- Increasing number of children is linked with greater household stress and irregular eating patterns, affecting weight.
- Slight decline after 3 - 4+ children may reflect higher physical activity in larger households or different socio-economic conditions.
- Overall, the pattern reflects a mix of biological, lifestyle, and socio-economic factors associated with childbearing.

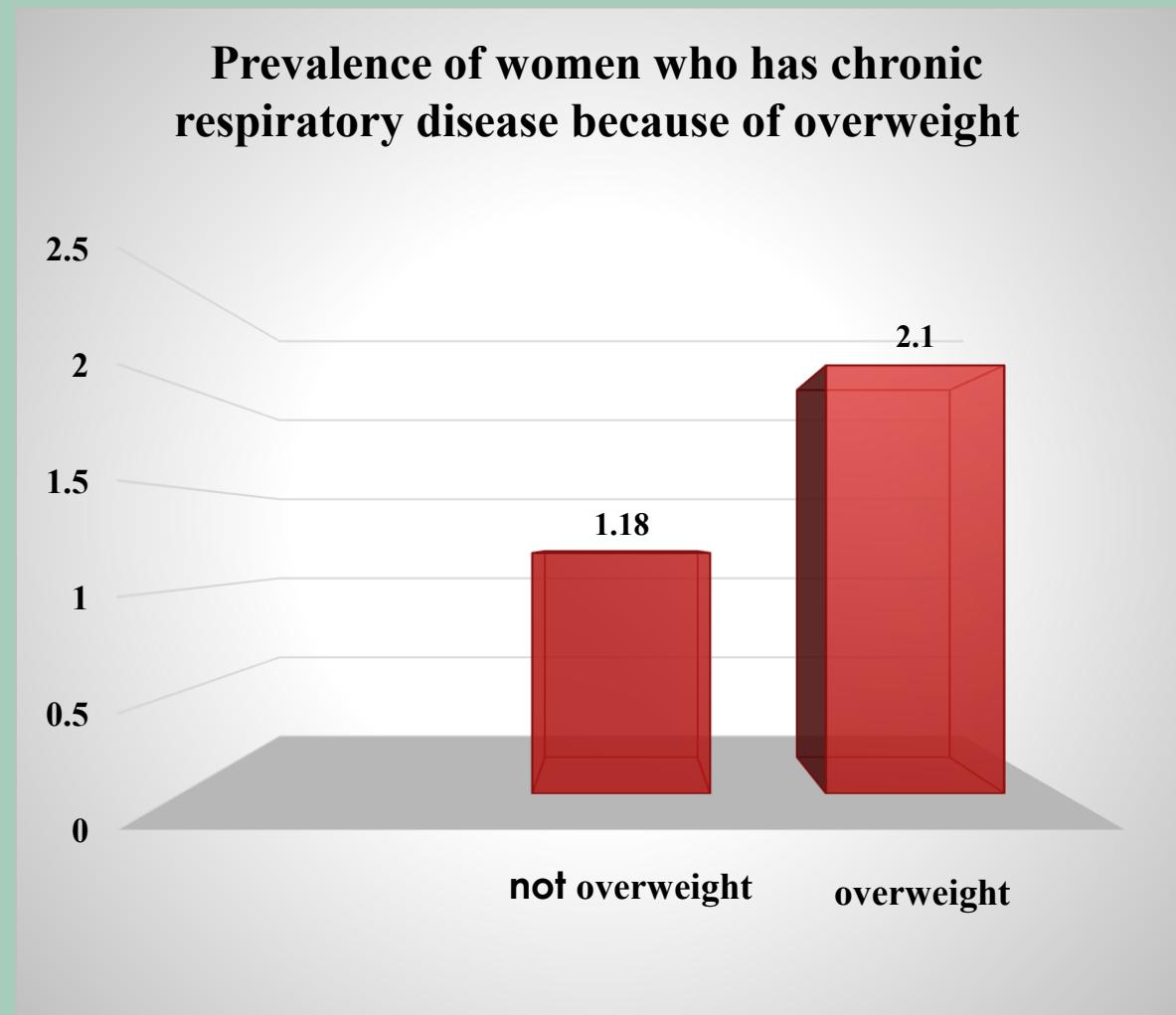
Prevalence of women aged 15-49 who has hypertension because of overweight



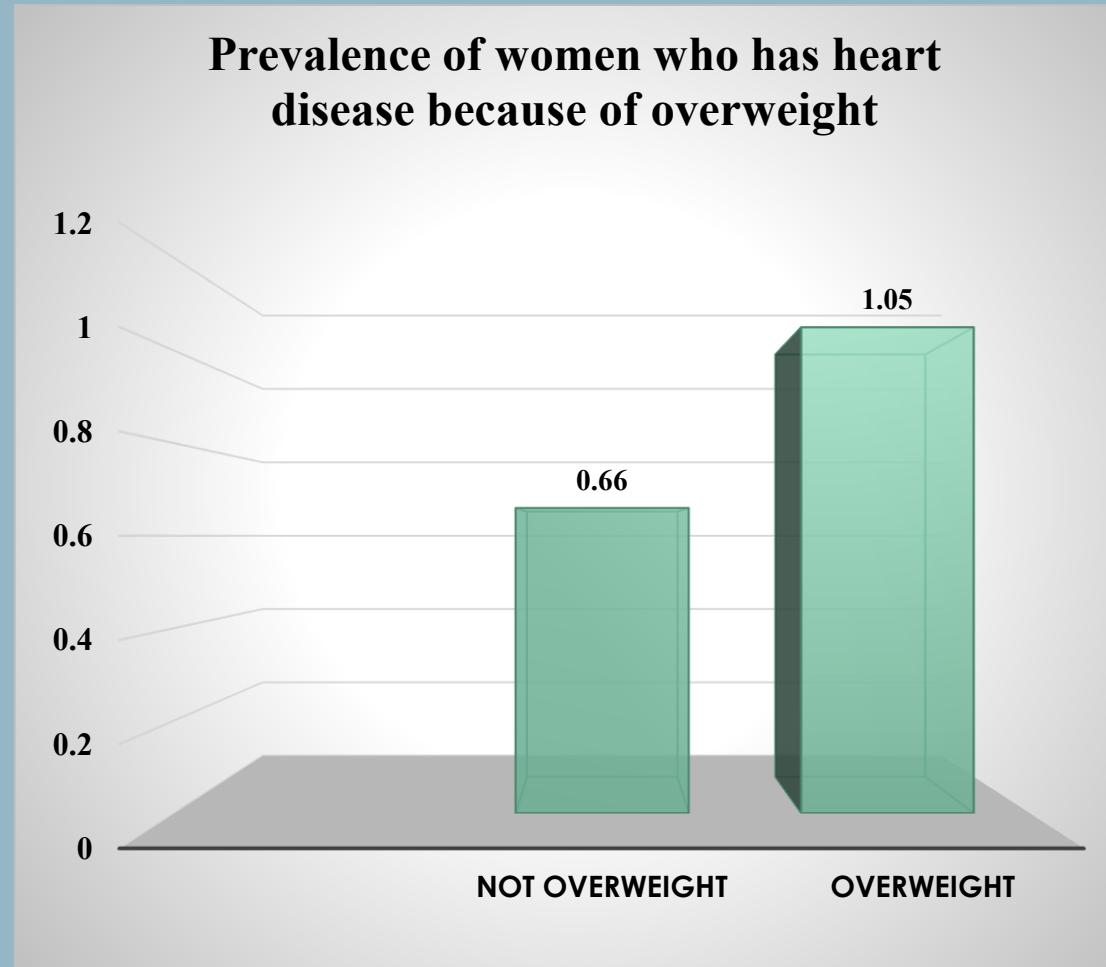
- Data shows hypertension is more than twice as common in overweight women (8.7%) compared to non-overweight women (3.43%).
- Highlights a strong association between excess body weight and elevated blood pressure.
- Supports established evidence that overweight increases cardiovascular strain, raising hypertension risk.
- Emphasizes the importance of weight management in preventing hypertension among women.

Prevalence of women aged 15-49 who has chronic respiratory disease because of overweight

- ❑ Chronic respiratory disease is almost twice as common in overweight women (2.1%) compared to non-overweight women (1.18%).
- ❑ Indicates a strong association between excess body weight and impaired respiratory function.
- ❑ Excess fat around the chest and abdomen reduces lung expansion, leading to restricted breathing.
- ❑ Overweight increases airway inflammation, contributing to chronic respiratory conditions.
- ❑ Higher body weight strains respiratory muscles, making breathing less efficient.
- ❑ Overweight is linked to reduced lung volume and airflow, increasing the risk of chronic respiratory disease.



Prevalence of women aged 15-49 who has heart disease because of overweight



- The graph shows that overweight women have a higher prevalence of heart disease (1.05) compared to non-overweight women (0.66).
- This indicates a clear association between excess body weight and increased heart disease risk in women.
- Extra body weight contributes to higher blood pressure and elevated LDL cholesterol, both major drivers of heart disease.
- Being overweight also increases the chance of insulin resistance and Type 2 diabetes, which further damages blood vessels.
- Chronic inflammation caused by excess fat tissue accelerates arterial damage and heart disease progression.
- Overall, the data suggests that maintaining a healthy weight significantly lowers cardiovascular risk in women.

Testing of Hypothesis :

For this project I have done chi square test to see association between bmi and other variables . As both bmi and other independent or dependent variables are categorical as well as independent statistically I use chi-square test.

- BMI type showed a significant relationship with all the variables that I have taken.
- For all association tests we have considered a 5% level of significance. For all the association test our p-value < 0.05 i.e our null hypothesis : There is no association between the two categorical variables is rejected , so we can conclude that all study variables are associated with bmi.
- State, Age Group ,living children with pregnancy,Wealth Index,Fried Food Consumption, alcohol consumption, frequency takes milk or curd , frequency of eats eggs, Frequency of eats fish,frequency of eats chicken , currently has hypertension , currently has chronic respiratory disease including asthma, currently has heart disease all variables are associated with our study variable bmi.



Key Findings

- ❖ Overweight & obese women = 23%, higher than underweight (17%).
- ❖ **Strong age pattern:** overweight rises sharply after age 30; highest in 40–49 years.
- ❖ **Clear regional differences:** South, Punjab & Haryana = highest & East/Central = lowest.
- ❖ Urban women have much higher overweight (32.8%) than rural women (19.3%).
- ❖ Daily consumption of meat or chicken, fish, milk or curd, and alcohol use linked with higher overweight.
- ❖ Fried-food frequency is not a dominant predictor of overweight on its own; overweight is multi-factorial.
- ❖ Overweight women show higher prevalence of hypertension, respiratory disease, and heart disease.
- ❖ Chi-square tests show BMI is significantly associated ($p < 0.05$) with all study variables.

CONCLUSION

- Overweight among Indian women is rising and linked to lifestyle, socioeconomic, and regional factors.
- India faces a double burden of malnutrition - undernutrition in younger women and overnutrition in older women.
- Urbanisation and changing food habits are major drivers of overweight.
- High-calorie diets and sedentary routines increase overweight risk.
- Overweight significantly elevates risks of major NCDs like hypertension and heart disease.
- Multidimensional findings indicate need for targeted nutrition and lifestyle interventions.
- Public health strategies should be region-specific and focus on awareness, healthy diets, and physical activity.