Double Burden of Malnutrition Among Adolescent Women in India

A Dissertation as a prerequisite for the award of PGDM [Hospital and Health Management]

By

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PG/21-23/137, 2021-2023

At
International Institute of Health Management Research [IIHMR], Delhi

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2023

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Deliverables: Literature Review, data management, and analysis of NFHS data for Study topic: Double Burden of Malnutrition among Adolescent Women, Met the above deliverables using STATA, Microsoft Word and Excel

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The Dissertation is in prerequisite for the award of PGDM (Postgraduate Diploma in Health & Hospital Management) I wish her all success in her future endeavors.

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Ms. Aradhana Singh
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Acknowledgment

I would like to take this opportunity to express my heartfelt gratitude to all those who have contributed to the completion of this dissertation. Without their unwavering support, guidance, and encouragement, this research project would not have been possible. I would like to express my deepest gratitude and appreciation to all those who have contributed to the successful completion of my dissertation on the topic "Double Burden of Malnutrition Among Adolescent Women in India." This research would not have been possible without the support and guidance of several individuals, and I would like to take this opportunity to acknowledge their invaluable contributions.

I would also like to acknowledge, **Dr. Sutapa Bandhopadhyay Neogi,** Director, IIHMR, Delhi for providing an environment conducive to academic excellence and research. Her vision and commitment to fostering a culture of learning have been crucial in shaping my academic journey.

I would like to extend my heartfelt gratitude to **Project Co-Principal Investigator & Mentor [Guide] Dr. Mukesh Ravi Raushan**, Assistant Professor, International Institute of Health Management Research [IIHMR], Delhi for his unwavering guidance and mentorship throughout this research journey. His expertise, valuable insights, and constructive feedback have been instrumental in shaping the direction and quality of this dissertation. I am truly grateful for his patience, encouragement, and dedication to my academic growth. I would also like to express my sincere appreciation to **International Institute of Health Management and Research, Delhi** for constant support and encouragement. I am also indebted to the faculty members at IIHMR Delhi for their valuable input and constructive criticisms during the various stages of my research. Their diverse perspectives and expertise have enriched my understanding of the subject and have significantly contributed to the depth and breadth of this study.

I extend special thanks to the IT department, IIHMR-Delhi for providing the necessary technical support and resources that facilitated the smooth execution of this dissertation. Their prompt assistance with any technical issues encountered during the research process was greatly appreciated.

I am grateful to the Mr. Jagdish Prasad, Librarian and library staff, IIHMR-Delhi for their assistance in accessing relevant research materials and resources. Their efforts ensured that I had access to the latest and most relevant literature to support my research.

I extend my gratitude to my seniors and colleagues, who shared their experiences and expertise, offering me valuable advice and feedback that significantly improved the quality of this dissertation.Their willingness to share knowledge and assist me in various aspects of this research has been invaluable.

I would like to thank my family and friends for their unwavering support and encouragement throughout this journey. Their love, understanding, and belief in me have been a constant source of strength.

Finally, I thank all those who are not mentioned here, yet contributed in one way or another in completion of this dissertation. I solemnly remember all of their effort, encouragement, and enthusiasm that are bestowed on me at different times.

Last but not the least, I thank the almighty for keeping me cheerful and rooted throughout the work.

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LIST OF ABBREVIATIONS

S. No.	Symbol	ABBREVIATIONS
1	NFHS	National Family and Health Survey
2	ICMR	Indian Council of Medical Research
3	PHFI	Public Health Foundation of India
4	LMIC	Low- and Middle-Income Countries
5	BMI	Body Mass Index
6	GBD	Global Burden of Disease
7	PSUs	Primary Sampling Units
8	NCD	Non-Communicable Disease

Chapter 1 Introduction

1.1 Background

In low- and middle-income nations, the prevalence of overweight and obesity has significantly increased over the past few decades. This is brought on by several factors, such as changing dietary habits, an increase in sedentary behaviour, and urbanization. According to the WHO, 20% of adolescents (10–19 years) experience mental health issues, underscoring the urgency of taking action. On the other hand, inadequate nutrition can postpone or prevent maturation, leading to linear growth that is stunted and perpetuating the cycle of undernutrition and poverty. Noncommunicable diseases (NCDs) are becoming more common. In addition to the already high proportion of undernutrition in some population groups, the nutritional transition taking place in some low-middle income countries is increasing the burden of overweight and obesity in some population groups.

Adolescents account for 21% of the total population in India. The majority of boys and girls in developing countries enter adolescence malnourished, making them more susceptible to a variety of diseases(1). Adolescence, a second phase of high development, may act as a compensatory chance for delayed early childhood growth. Adolescent girls are a vital part of our society because they are not only valuable members of this generation but will also eventually become mother. Many factors, including socioeconomic position, environment, attitude towards female children and adolescent girls, nutritional ignorance, hygiene, and disease, are to blame for adolescent girls' current suboptimal nutritional status(2). To effectively address the double burden of malnutrition, it is also important to recognize the intersectionality of this issue with other global health challenges, such as poverty, and inequities in access to health care, nutritious foods and several conditions that manifest in adolescence(3)

1.2 Review of Literature

1.2.1 Obesity: Global Scenario

Teenage obesity is a global public health issue that is getting worse. The World Health Organization (WHO) defines adolescents as people between the ages of 10 and 19. With many nations reporting rising rates of overweight and obesity in this age group, the global burden of adolescent obesity is significant.

The WHO estimates that there are over 340 million overweight or obese adolescents worldwide, with the prevalence of overweight and obesity increasing from 4% in 1975 to over

18% in 2016. The rise has occurred similarly among both boys and girls: 18% of girls and 19% of boys were overweight in 2016. While under 1% of children and adolescents aged 5-19 were obese in 1975, more than 124 million children and adolescents (6% of girls and 8% of boys) were obese in 2016(WHO).

In 2015-2016, the prevalence of obesity among adolescents aged 12-19 years in the United States was 20.6%, with higher rates among Hispanic and Black adolescents (4). Overweight and obesity among adolescents have increased rapidly in Asia in recent years, with rates reaching 45.6% in China's urban areas (5). According to reports, students who attend school or college are more likely to become obese, and students struggle during their secondary and higher secondary education years. Teenagers reported the highest levels of anxiety about their future and academic performance. More than half of adolescent males and females also reported moderate to extremely severe stress(6). Girls' eating and activity patterns change during their adolescent years. Reduced reliance on parental guidance and food preferences, along with a decline in participation in sports and physical activity, may lead to an energy imbalance that increases the risk of weight gain. The likelihood of becoming overweight and maintaining an unhealthy level of body fat throughout the childbearing years may rise as a result of physiological changes in body composition, decreased insulin sensitivity, and psychological changes(7). In addition to the physical health consequences, adolescent obesity can also have negative psychological and social effects, such as poor self-esteem, social isolation, and stigma.

1.2.2 Thinness: Global Scenario

Another factor contributing to the burden of disease around the world is undernutrition. It is a silent emergency that is still a serious problem for global public health, especially in South-East Asia and Sub-Saharan Africa. It is a sign that a population's social and economic development, as well as human health, will be negatively impacted by poor nutrition(8). It ranks among the world's top causes of morbidity and mortality in children and teenagers. 18% of the world's population, or 1.2 billion adolescents (10–19 years old), live on this planet. More than half of all teenagers live in Asia(9). Over ten million children worldwide pass away from diseases that are both treatable and preventable each year. At least half of these fatalities are brought on by malnutrition(10). Long-term malnutrition in children and adolescents has a number of negative effects on their health, including stunted physical development, impaired motor and cognitive function, poor cognitive performance, a lower IQ, poor social skills, an

increase in behavioural issues, and a higher risk of disease transmission. Malnutrition on a global scale is still unacceptable, and efforts to reduce it are making slow progress(11).

1.2.3 Country Scenario: Obesity

Obesity among adolescents in India was found to be around 19.3%, according to a 2019 study published in the Journal of Family Medicine and Primary Care(12). Obesity among children and adolescents in India has increased significantly in recent years, according to a recent report published by the Indian Council of Medical Research (ICMR) in collaboration with the Public Health Foundation of India (PHFI). According to the report, the prevalence of overweight and obesity in children and adolescents has risen from 9.3% in 2006 to 19.3% in 2016(13). Adolescent obesity in India is linked to a variety of health risks, including type 2 diabetes, cardiovascular disease, and other metabolic disorders. Obesity is also prevalent in this age group, which can lead to long-term health consequences in adulthood(14).

1.2.4 Country Scenario: Thinness

In India, adolescents account for more than 21.4% of the population(15). Prior nutrition research in India concentrated on the major issue of undernutrition caused by nutritional shortages and high infection rates. But according to the data from the National Family Health Survey 1998/99 (NFHS 2), a considerable share of Indian women are overweight, and malnutrition rates are also high(16). Malnutrition is a serious human development concern in India. Despite considerable economic growth over the last two to three decades, malnutrition among children and adolescents in both urban and rural India continues to cost many lives due to India's massive population size, illiteracy, insufficient access to health care, and socioeconomic inequality. As a result, nutritional evaluations among adolescents and children have the potential to play a role in developing developmental strategies and programmes in India. India is the largest country in terms of population to more teenagers (about 243 million) than any other country. It is followed by China, which has over 200 million teenagers. Any of these countries' teenage populations dwarfs that of any other country. Adolescent girls are a vulnerable population group that accounts for roughly one-tenth of the Indian population. Around 30% of India's population is between the ages of 10 and 19(17). In India, about half of teenage girls aged 15 to 19 are underweight (UNICEF, 2012). The adolescent period is a critical stage in an individual's life. It is defined as the period of transition from childhood to adulthood and is characterised by very rapid growth. Adolescents go through significant growth and developmental changes, including physical growth, enhanced gross and fine motor abilities, and biological maturity. In girls, adolescence is a period during which the body prepares for

the dietary demands of pregnancy, nursing, and heavy workloads that females will soon face. As a result, adolescent girls are especially sensitive to the effects of malnutrition(18). Due to poorer placental function and competition for nutrients between the growing adolescent and the growing foetus, underweight adolescent girls may not reach their full potential before their first pregnancy and are more likely to give birth to a smaller baby than their counterparts over the age of twenty(19). The nutritional status, which is generally low during childhood, deteriorates as adolescent growth spurts occur. Teen mothers from low socioeconomic backgrounds suffer the most because prolonged malnutrition stunts skeletal growth and maturation. Teenage girls who are 145 cm tall and weigh 38 kg are at risk of having low birth weight kids(20).

1.2.5 Trend of the burden

Increase in overweight and obesity:

Over the last few decades, the prevalence of overweight and obesity in low- and middle-income countries has increased significantly. This is due to a variety of factors, including changing dietary habits, more sedentary lifestyles, and urbanisation. The coexistence of undernutrition and overnutrition in the same population, household, or individual is referred to as the double burden of malnutrition. There have been several changes in the nature and scope of the double burden of malnutrition over time(21).

Previously, the coexistence of undernutrition and infectious diseases was thought to be the primary cause of the double burden of malnutrition. This was especially prevalent in low- and middle-income countries, where poverty, a lack of access to healthcare, and poor nutrition were the primary causes of malnutrition. However, the nature of the double burden of malnutrition has shifted in recent years. While malnutrition persists in many parts of the world, overnutrition is becoming more common, even in low- and middle-income countries. Several factors have contributed to this shift, including urbanisation, changes in food systems, and globalisation. People's dietary habits have changed because of urbanisation, with people consuming more processed and high-calorie foods and becoming more sedentary. Obesity and related noncommunicable diseases such as diabetes and cardiovascular disease have increased as a result, coexisting with undernutrition in many low- and middle-income countries(22). Importantly, changes in food systems, such as the increased availability of cheap, high-calorie foods and the decline of traditional diets, have also contributed to the double burden of malnutrition. Globalization has exacerbated these trends by marketing unhealthy foods and beverages to developing countries. Overall, the double burden of malnutrition has evolved from

a phenomenon primarily associated with undernutrition and infectious diseases to one that includes both undernutrition and overnutrition, with an increasing prevalence of noncommunicable diseases. As a result, addressing the double burden of malnutrition necessitates a multifaceted approach that addresses malnutrition's root causes, such as poverty, inadequate healthcare, and unhealthy food systems.

Chapter 2 Data and Methods

2.1 Introduction

Malnutrition is a complex and multi-dimensional problem that affects people of all ages, genders, and socioeconomic backgrounds. It refers to both undernutrition, which is the lack of sufficient nutrients, and overnutrition, which is the excessive and unbalanced intake of nutrients. Women of age 15-19 years are a particularly vulnerable group when it comes to malnutrition, as they are still in the stage of physical development and need proper nutrition to ensure good health and prevent chronic diseases in later life(23).

The double burden of malnutrition is a term used to describe the coexistence of both undernutrition and overnutrition in the same population or individual. This phenomenon is common in low- and middle-income countries (LMICs), where people are increasingly exposed to a changing food environment that is characterized by a shift from traditional diets to more processed and energy-dense foods. Women of age 15-19 years are at risk of experiencing the double burden of malnutrition due to their unique nutritional needs and social circumstances.

This thesis aims to investigate the factors that contribute to the double burden of malnutrition among women of age 15-19 years. Specifically, this paper will focus on the following factors affecting malnutrition: the place of residence, marital status, education status, wealth, total children, region, religion, ethnicity, food consumption, and sanitation facility.

2.2 Need for the study

Malnutrition and obesity are major public health concerns around the world. Obesity prevalence has tripled worldwide since 1975, with estimates of 216,000 deaths and $113.9 billion in direct healthcare costs associated with obesity (BMI). Obesity raises the risk of serious health problems like hypertension, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, respiratory problems, and certain cancers. Undernutrition is a major public health issue that results in negative health outcomes such as stunted growth, weakened immune systems, and an increased risk of infectious and chronic diseases.

Despite their importance, behavioural risk factors associated with obesity and malnutrition are frequently overlooked. Medical education tends to emphasize biological aspects of diseases rather than psychological, behavioural, and social determinants of health. Public and global health policymakers and decision-makers frequently allocate few financial resources to behavioural medicine, preferring to prioritize other clinical fields and disciplines. Over the last

few decades, the dramatic rise in childhood and adolescent overweight and obesity has become a major public health concern. The global age-standardized prevalence of obesity in children aged 5 to 19 years increased from 0.7% in 1975 to 5.6% in 2016, and from 0.9% in 1975 to 7.8% in 2016. Over the course of 40 years, the number of obese girls increased tenfold, while the number of obese boys increased twelvefold. Similarly, millions of people worldwide suffer from malnutrition, particularly those living in low-income communities. Understanding the causes and consequences of malnutrition can help us understand the disease's burden and the factors that contribute to its occurrence. This understanding can help to guide the development of effective interventions to prevent and treat malnutrition. Malnutrition and disease caused by malnutrition research are critical for understanding disease burden and developing interventions. In 2016, 155 million people were chronically malnourished, and nutrition-related causes, primarily undernutrition, account for approximately 45% of deaths in children under the age of five. India bears a double burden of malnutrition, with a significant proportion of the population underweight and an increasing prevalence of overweight and obesity. In India, adolescents are especially vulnerable to malnutrition, with the double burden of malnutrition being a major concern. Adolescents who have a double burden of malnutrition are more likely to develop chronic health conditions such as diabetes, cardiovascular disease, and other noncommunicable diseases, which can hurt their health in adulthood.

According to the National Family Health Survey-5 (NFHS-5), 5% of adolescents are overweight or obese, while 7% are moderately or severely thin, putting them at risk of disease. Obesity and malnutrition are serious public health problems that need to be addressed immediately. While biological aspects of diseases are frequently the focus of medical training, it is crucial to also pay attention to psychological, behavioural, and social determinants of health. The field of behavioural medicine requires more financial support from public and global health policymakers. Malnutrition and obesity must be prevented and treated effectively, especially in vulnerable populations like children and adolescents especially in India and similar settings.

2.3 Burden of thinness

Malnutrition in the form of thinness or underweight is common among teenagers in India. An attempt is being made to address the burden of thinness, which has recently emerged as a significant public health concern. The cost of being slim is complex and can be seen from a number of angles. This section will examine the various facets of the stigma associated with thinness among adolescents in India. The National Family Health Survey (NFHS) reported that among adolescents in India (aged 10 to 19 years), the prevalence of thinness is 22.7%. Compared to urban areas (18.7%), rural areas have a higher prevalence of thinness (24.4%). The state of Bihar has the highest incidence of thinness (32.5%), while Goa has the lowest prevalence (9.7%). This suggests that the burden of thinness is not equally distributed among the various Indian states(24).

2.4 Causes of thinness

The problem of teenage thinness in India is caused by a number of reasons. The inability to obtain wholesome meals is one of the main causes. Undernutrition occurs in India because a lot of families cannot afford a healthy, balanced diet. The main causes of food insecurity, which can lead to teenage thinness, are poverty and poor household income. The burden of thinness is also provoked by poor sanitation and hygiene standards, a lack of education, and a lack of knowledge about appropriate dietary patterns. Teenagers who are underweight or severely thin are more likely to develop a number of ailments and health issues(25). A weaker immune system is among the most important effects of being thin, making teenagers more prone to infections and diseases. Moreover, being thin might result in poor academic performance, delayed growth and development, and decreased physical activity. In addition, thinness can increase the risk of chronic diseases such as diabetes, hypertension, and cardiovascular disease in later life.

The burden of thinness among teenagers in India varies by gender. The prevalence of thinness is higher among girls (24.6%) than boys (20.8%), according to the NFHS-5 survey. This might be brought on by unfair access to resources, such as healthcare and education, and gender discrimination. Girls often receive less food and medical attention than males in their households, which may explain why they are more likely to be slim(26).

The prevalence of thinness among adolescents in India varies by region. As previously indicated, Northeast region like Bihar has the highest frequency of thinness (32.5%) and Goa has the lowest prevalence (9.7%). Other states like Jharkhand, Madhya Pradesh, and Chhattisgarh are also heavily burdened by thinness. The significant burden of thinness is made

worse in many states by a high prevalence of poverty, poor literacy rates, and limited access to healthcare.

There are several factors that contribute to the burden of thinness among teenagers in India. Particularly among girls and in rural regions, there is a high prevalence of thinness, which varies among states. Poverty, limited access to healthcare and education, as well as bad sanitation and hygiene habits, are some of the factors that contribute to thinness. The burden of thinness must be addressed by a multi-sectoral strategy that targets its root causes, such as poverty, inequality, and poor access to healthcare and education.

2.5 Burden of Obesity

Obesity is a serious public health issue that has a negative impact on India's health, economy, and social well-being. The complicated condition of obesity is influenced by environmental, genetic, and behavioural factors. Throughout the past few decades, obesity has become more common in India, especially among urban people. In this thesis, we'll talk about how obesity is hurting India on a national level. Obesity is a significant risk factor for many chronic illnesses, such as diabetes, cardiovascular conditions, and several malignancies. India has the second-highest percentage of obese people in the world, after China, according to the Global Burden of Disease report (GBD 2019 Obesity Collaborators, 2021). Over the past 20 years, India's adult obesity prevalence has more than quadrupled, rising from 9.3% in 1998 to 20.7% in 2018. (National Family Health Survey, 2019). Children and adolescents in India are likewise becoming more and more obese, with the prevalence of obesity rising from 9.8% in 2005 to 11.7% in 2015. (NCD Risk Factor Collaboration, 2017). Individuals' health is being negatively impacted by the obesity epidemic, which is also contributing to the healthcare system(27).

2.6 Economic Burden

Obesity is a significant contributor to the development of many chronic illnesses, such as diabetes, cardiovascular disease, and several types of cancer. India has the second-highest percentage of obese people in the world, behind China, according to the Global Burden of Disease research (GBD 2019). Further burdening India's economy is obesity. Compared to people who are within a healthy weight range, the cost of healthcare for obese people is much higher. A Delhi-based study found that obese people had annual healthcare costs that were 34% more than those of people who were within a healthy weight range. Obesity can also lead to lower productivity and more absenteeism, which can have a detrimental effect on economic growth. An investigation carried out in Tamil Nadu estimated that the economic cost of obesity was 9.13% of the state's GDP.

In India, obesity is a social burden as well. A person's self-esteem and mental health may suffer as a result of the societal stigma and prejudice associated with obesity. Those with obesity reported facing discrimination in the workplace and in education, according to a Delhi study(28). Obesity can also lead to a decline in social mobility and a decline in quality of life. Nutritional considerations have an impact on the burden of obesity as well. In India, obesity is a common problem with malnutrition and undernutrition. 17.3% of children under five were wasting, and 33.4% were stunted, according to the National Family Health Survey, 2019–20. Anaemia was 50.3% common among women who were fertile(16). The prevalence of obesity in India is mostly due to the intake of foods that are high in calories but low in nutrients. In India, consumption of processed foods and beverages, especially by urban people, has been rising(29). In addition, India has a low consumption of fruits and vegetables, which contributes to micronutrient deficiencies.

2.7 Hypothesis

H_{01}: The prevalence of malnutrition is equal to socioeconomic factor

H_{02}: The outcome variable-malnutrition is independent of other demographic and socio-economic factors.

2.8 Data Source and Method

2.8.1 Source of data: National Family and Household Survey 5 [NFHS-5]

The data from National Family Health Survey i.e., NFHS-5 was used according to the availability of required information from different backgrounds. This information is used to document the factors affecting malnutrition and obesity among adolescents (data on adolescent girls and data related to nutrition outcomes. Household-level variables are the place of residence, religion, caste, and wealth index. Maternal characteristics include marital status, total children, education, work status, region, anthropometric information, etc. Anthropometric information was used as an indicator of the nutritional status of adolescents. The 2019-21 NFHS collected anthropometric data on the height and weight of women age 15-49 years. These data were used to calculate several measures of nutritional status such as women's height and body mass index (BMI). The study utilized data a total number of 112223 female adolescent 15-19 years (μ = XX; SD = XX) from the selected households by National Family Health Survey, 2019-21. The body mass index is calculated by dividing weight in kilograms by height in metres squared (kg/m2). The National Family Health Survey 5 (NFHS-5) conducted in India was used as a data source to analyse the double burden of malnutrition in India. NFHS-5 is a nationally representative survey conducted by the Ministry of Health and

Family Welfare, Government of India, in collaboration with the International Institute for Population Sciences, Mumbai. The survey provides detailed information on various aspects of population and health, including anthropometric measures, dietary intake, and health-related behaviours. NFHS-5 data can be used to examine the prevalence and patterns of undernutrition, overweight, and obesity in India, and to identify the factors associated with these conditions. The survey employed intensive interviewer trainings and standardised measurement tools and techniques.

The NFHS adopted two-stage sample design in most rural areas and a three-stage sample design in most urban areas. In each state, the rural sample was typically selected in two stages: the first stage involved selection of Primary Sampling Units (PSUs) with probability proportional to population size. The second stage involved the systematic selection for household within each PSU.

2.9 Dependent variable

The nutritional health status among female adolescent was assessed food items consumed in last 24 hours. To accomplish the objective of the current level of malnutrition among adolescents in India, the study used data from the NFHS-5. The main advantage of using these projections is that the population figures are projected for India including the dimensions of state, place of residence, age, sex, ethnicity, religion, wealth, marital status, total children, sanitation facility, and categories of education. To measure the double burden of malnutrition.

This involves data recording and modification according to the objectives. The data recoding and all analyses were done in STATA 14.2 [Ref.]. The analysis may involve inferential statistics, such as chi-square tests and regression analysis.

Variables: The place of Residence, Religion, Ethnicity, and Wealth index, Marital Status, Total Children, Education, Work Status, and Region.

Table 2.1: Description and coding categories of variables used in the analysis

Description and coding categories of variables used in the analysis	
Variables	Description and Coding categories
Age	The age of women recorded into category 15-19
Body Mass Index [BMI] of women	If the Women's BMI is below 18.5 then recorded as too thin or underweight; if BMI lies between 18.5-24.9 then it is considered as Normal weight; If BMI is between 25.0-29.9= Overweight; If BMI is equal to or greater than 30= Obese

Adolescents' current age	The information available in the data was converted into binary. For Instance, if the respondent reported "obese/malnourished in any category" recorded as 1 otherwise 0. Similarly, other factors are recorded as well.
Women's educational status	The women's educational attainment was recorded into 4 categories such as 0= no education; 1= Primary; 2= Secondary; 3= higher and above
Marital Status	The women's marital status was recorded into 3 categories such as 0= Never married; 1= Married; 2= Widowed or other
Number of children	The criteria were recorded into 2 categories such as 0= Zero (children) and 1= 1+ children
Types of Residence	The woman's place of residence was recorded into 2 categories such as 1= Urban and 2= Rural
Wealth Index	The Women's wealth of Index was recorded into 5 categories such as 1= Poorest; 2= Poorer; 3= Middle; 4= Richer; 5= Richest
Sanitation facility	Sanitation was categorised into 3 categories such as 1= Improved Sanitation; 2= Unimproved Sanitation; 3= Open Defecation
Religion	The Women's Religion was recorded into 4 categories such as 1= Hindu; 2= Muslim; 3= Christian; and 4= Others
Ethnicity	The Caste was categorized as Scheduled Caste= 1; Scheduled Tribe= 2; Other Backward Category= 3; and None= 4
Region	States were categorized into 6 regions namely; North, North East, East, West, Central, and South which were coded as 1, 2, 3, 4, 5, 6
Food Consumption	Food consumption was categorized as: Takes milk or curd, Eats pulses or beans, Eats dark green leafy vegetables, Eats fried food, Takes aerated drink, Eats eggs, Eats fish, Eats chicken or meat, Food Score 6 or more which were coded as 1 = Yes and 0 = No

The analysis's categorization of the variables made it possible to gain a deeper understanding of the prevalence and variables affecting malnutrition among Indian women. Several factors were taken into consideration, including age, BMI, educational level, marital status, number of children, type of residence, wealth index, sanitation facility, religion, ethnicity, and region. These variables were chosen because it is well-known that they have a significant impact on women's malnutrition.

The following factors were considered in the multivariate analysis of the double burden of malnutrition in India using data from NFHS-5:

Age [Respondents' current age]: Age of women in the age group of 15-19. The age of the women was taken at each age [continuous variable].

BMI: Body Mass Index of women categorized as too thin or underweight, normal weight, overweight, or obese. Information available in the data converted into binary with the value of (1) indicating the woman is obese/malnourished in any category and (0) indicating otherwise.

Women's educational status: educational attainment of women is categorized as no education, primary, secondary, or higher and above.

Marital status: Marital status of women categorized as never married, married, widowed, or other.

Number of Children: The number of children a woman has is categorized as 0 (no children) or 1+ (1 or more children).

Types of residence: The place of residence of women are categorized as urban or rural.

Wealth index: The wealth index of women is categorized as poorest, poorer, middle, richer, or richest.

Improved sanitation: The type of sanitation facilities available to women are categorized as improved sanitation, unimproved sanitation, or open defecation.

Religion: Religion of women categorized as Hindu, Muslim, Christian, or others.

Ethnicity: Ethnicity of women categorized as Scheduled Caste, Scheduled Tribe, Other Backward Category, or None.

Region: The region where the women live is categorized as North, North-east, East, West, Central, or South.

Food Consumption: The data on food items consumed was on 4 scale [Never, daily, weekly, and occasionally]. The frequency of food items consumed daily or weekly was recoded as Yes = 1 otherwise No = 0.

Takes milk or curd: This category determines whether individuals consume milk or curd. A score of 1 suggests that the person consumes milk or curd, while a score of 0 indicates the absence of milk or curd consumption.

Eats pulses or beans: This category signifies whether individuals consume pulses or beans. A score of 1 indicates the consumption of pulses or beans, while a score of 0 suggests the absence of their consumption.

Eats dark green leafy vegetables: This category determines whether individuals include dark green leafy vegetables in their diet. A score of 1 suggests the consumption of such vegetables, while a score of 0 indicates the absence of their consumption.

Eats fried food: This category signifies whether individuals consume fried food items. A score of 1 suggests the consumption of fried food, while a score of 0 indicates the absence of their consumption.

Takes aerated drink: This category determines whether individuals consume aerated drinks (carbonated beverages). A score of 1 indicates the consumption of aerated drinks, while a score of 0 suggests the absence of their consumption.

Eats eggs: This category signifies whether individuals consume eggs. A score of 1 suggests the consumption of eggs, while a score of 0 indicates the absence of their consumption.

Eats fish: This category determines whether individuals consume fish. A score of 1 indicates the consumption of fish, while a score of 0 suggests the absence of their consumption.

Eats chicken or meat: This category signifies whether individuals consume chicken or meat. A score of 1 suggests the consumption of chicken or meat, while a score of 0 indicates the absence of their consumption.

Food Score 6 or more: This category represents an overall food score. If an individual's cumulative score from the previous eight categories is 6 or more, they are assigned a score of 1, indicating that they meet the defined criteria. Otherwise, a score of 0 is assigned.

The study aimed to explore the association between these factors and the double burden of malnutrition that affects women in India. To calculate the odds ratios and 95% confidence intervals, a logistic regression analysis was performed. The analysis was adjusted for confounding factors such as age, education, wealth, and place of residence. The multivariate analysis cleared that women's BMI, educational status, wealth index, and place of residence were all significantly associated with the prevalence of the double burden of malnutrition. Women who were overweight or obese were more likely than normal-weight women to face the double burden of malnutrition. Women with more education and wealth were less likely to bear the double burden of malnutrition. Women in India's North, North East, and Central regions were more likely to face the double burden of malnutrition than those in the South. Other factors such as marital status, number of children, sanitation type, religion, and ethnicity were not found to be significantly related to the double burden of malnutrition.

2.10 Statistical method

2.10.1 Univariate

A single variable is examined in isolation using a statistical technique called univariate analysis, which focuses on the distribution, central tendency, dispersion, and shape of the variable. Before conducting more regression, it helped with the initial exploration and comprehension of the data by offering insights into the traits and behaviour of the variable.

2.10.2 Bivariate

A statistical method called bivariate analysis looks at the correlation between two variables. It investigates the interactions between two variables, offering information about causation, dependence, or correlation. It is frequently used to find patterns, predict the future, and comprehend the relationships between various factors in a dataset. Therefore, Chi-square distribution was used to understand the association between the variables [outcome and indicators].

2.10.3 Multivariate (Logit regression)

A statistical method called multivariate analysis, and more specifically logit regression, looks at the correlation between many independent variables and a binary dependent variable. It aids in determining the variables that affect the likelihood of an event or result occurring.

Consumption of WHO recommended food items was converted into a binary variable, measured from questions about what the frequency of consuming the food items in last 24 hour (if yes=1; otherwise=0).

The model of malnutrition [obese or not in one or thin or not in other] follows as,

$P_i = Pr\ (Y = 1 | X = x_i)$ Where, Y is outcome of malnutrition and x is covariates

Therefore,

$$Y = \beta_0 + \beta_1 x_i$$

The odds of the malnutrition can be written as,

$$P_i / (1-P_i) = exp\ (\beta_0 + \beta_1 x_i)$$

Therefore, using these multivariate and interaction models the study try to seek the answer of below research questions:

2.11 Research question

1. What is the level of obesity and overweight among adolescent girls in India?
2. What is the level of thinness among adolescent girls in India?
3. What are the closely associated common factors of obesity and thinness among adolescent girls in India?

2.12 Objectives

Broadly the study trying to investigate the factors associated with the double burden of malnutrition among adolescents in India. The specific objective of the study are:

1. To study the current level of malnutrition among adolescents in India.
2. To study the underlying factors of obesity and overweight among adolescent women in India.
3. To study the underlying factors of thinness among adolescent women in India

Chapter 3: Thinness among adolescent women in India

3.1 Introduction

Thinness is often associated with a range of negative health outcomes and can have long-term implications for the well-being and development of adolescent girls. While the factors influencing thinness are complex and multifaceted, this study aims to investigate the role of various socio-cultural, economic, and demographic factors, including region, religion, marital status, ethnicity, wealth, education, sanitation facility, and food consumption. In India, with its vast diversity in terms of geography, culture, and socioeconomic conditions, provides a rich landscape to examine the interplay of these factors on thinness among adolescent women.

3.2 Regional Disparities and Thinness among Adolescent women

- Geographic Distribution of Thinness: Exploring regional variations in the prevalence of thinness among adolescent girls across different states and union territories of India.

Religious Factors and Thinness among Adolescent women

- Religious Practices and Dietary Restrictions: Analysing the association between religious practices, dietary restrictions, and the prevalence of thinness among girls from different religious communities.

Marital Status, Ethnicity, and Thinness among Adolescent women

- Caste-based Disparities: Exploring how caste-based discrimination and marginalization contribute to thinness among adolescent girls from lower caste communities.

3.3 Socioeconomic Factors and Thinness among Adolescent women

- Wealth Disparities and Nutritional Status: Investigating the association between household wealth and thinness among adolescent girls, highlighting the impact of poverty and income inequality.
- Education and Thinness: Analysing the role of education in shaping nutritional knowledge, dietary practices, and overall health status among adolescent women.
- Sanitation Facilities and Health Outcomes: Examining the influence of access to clean water, sanitation facilities, and hygiene practices on thinness among adolescent women.

3.4 Reproductive Factors and Thinness among Adolescent women

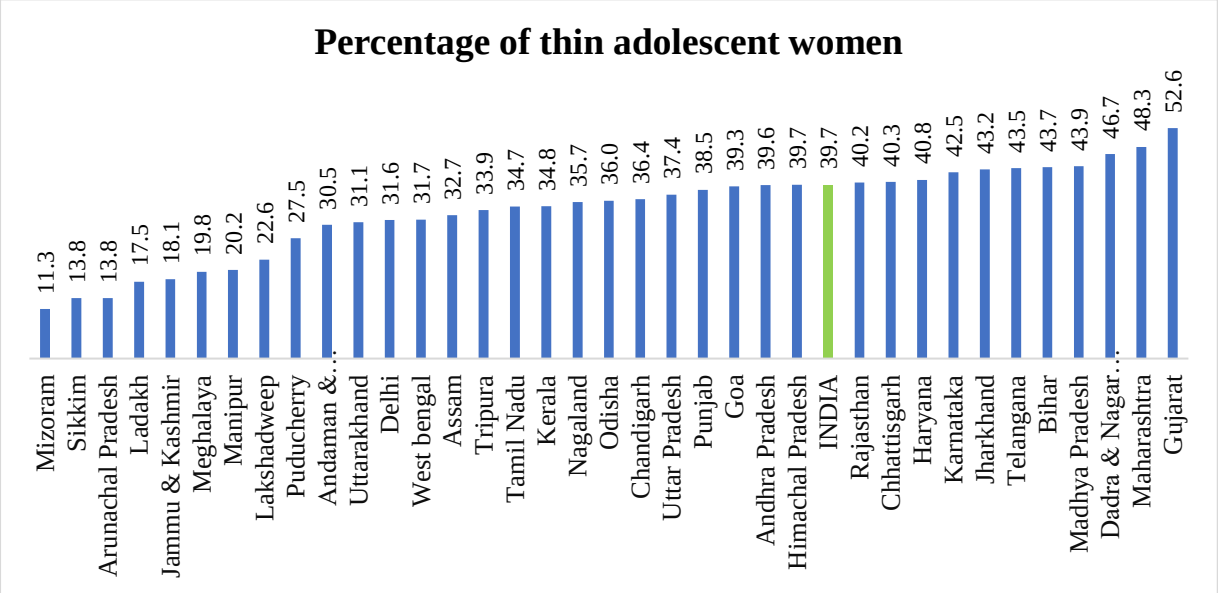
- Total Children: Exploring the total children, and thinness among adolescent girls, emphasizing the potential impact of early and frequent pregnancies on nutritional status.
- Maternal Health and Nutritional Status: Investigating the intergenerational consequences of maternal malnutrition on the Thinness of adolescent women.

Food Consumption Patterns and Thinness among Adolescent women

- Dietary Diversity and Nutritional Status: Analysing the relationship between food consumption patterns, dietary diversity, and the prevalence of thinness among adolescent women.

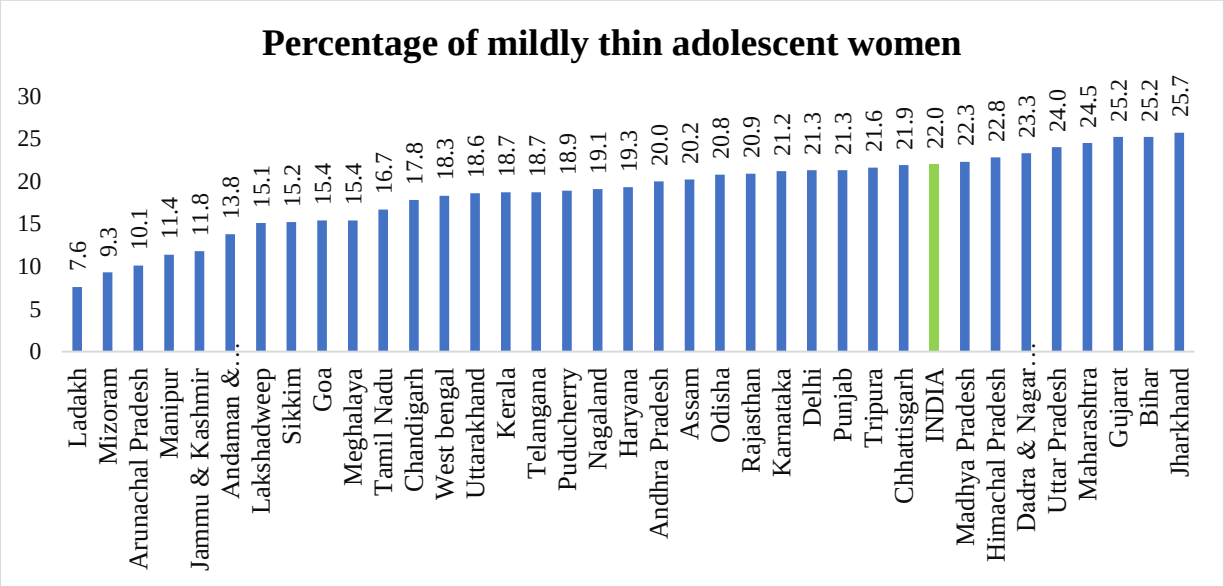
3.5 Results

Graph 3.1: Percentage of thin adolescent women by state, 2019-21, India



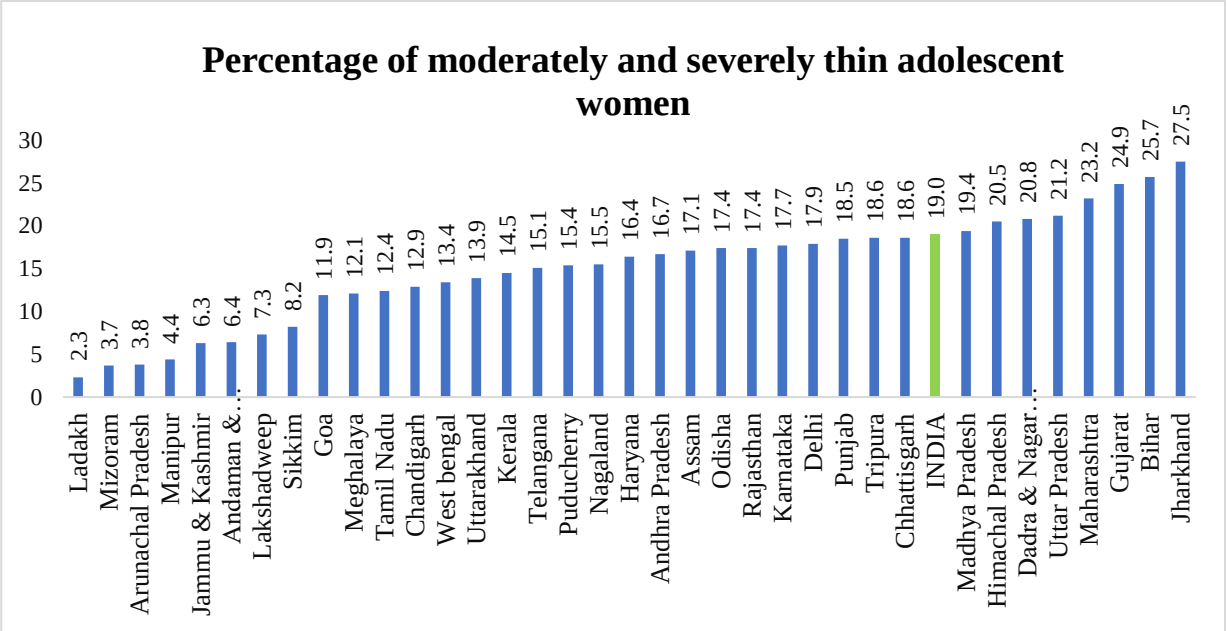
The graph 3.1 shows the graphical representation of thin adolescent women by different states in India. In India, on average at 39.7 per cent of adolescent women were reportedly thin. The majority of the states were found have lower percent of adolescent thin women. These states were West Bengal (31.7), Odisha (36.0), Uttar Pradesh (37.4), Andhra Pradesh (39.6) were among bigger states. Among union territory, Chandigarh (36.4). Among smaller states, Himachal Pradesh (39.7). Sikkim (13.8), Mizoram (11.3), Jammu & Kashmir (18.1). While on the other hand, some other states were found to have higher percentage of adolescent thin women than the national average. These states were Rajasthan (40.2), Chhattisgarh (40.3) and Maharashtra (48.3) and Gujarat (52.6).

Graph 3.2: Percentage of mildly thin adolescent women by state, 2019-21, India



The graph 3.2 shows the graphical representation of mildly thin adolescent women by different states in India. In India, on average at 22 per cent of adolescent women were reportedly thin. The majority of the states were found have lower percent of adolescent thin women. These states were West Bengal (18.3), Odisha (20.8), Andhra Pradesh (20) were among bigger states. Among union territory, Chandigarh (17.8) and Ladakh (7.6). Among smaller states, Manipur (11.4), Sikkim (15.2), Mizoram (9.3), While on the other hand, some other states were found to have higher percentage of adolescent thin women than the national average. These states were Jharkhand (25.7), Bihar (25.2) and Uttar Pradesh (24) and Himachal Pradesh (22.8).

Graph 3.3: Percentage of moderately and severely thin adolescent women by state, 2019-21, India



The graph 3.3 shows the graphical representation of moderately and severely thin adolescent women by different states in India. In India, on average at 19 per cent of adolescent women were reportedly moderately and severely thin. The majority of the states were found have lower percent of adolescent thin women. These states were Punjab (18.5), Telangana (15.1), Andhra Pradesh (16.7) were among bigger states. Among union territory, Puducherry (15.4) and Ladakh (2.3). Among smaller states, Tripura (18.6), Nagaland (15.5), Meghalaya (12.1), While on the other hand, some other states were found to have higher percentage of adolescent thin women than the national average. These states were Jharkhand (27.5), Bihar (25.7) and Gujarat (24.9) and Dadra & Nagar Haveli and Daman & Diu (20.8).

Table 3.1: Thinness among adolescent women by states, 2019-21, India

State	Thin BMI women	Mildly thin BMI women	Moderately and severely thin BMI women	*N*
	p< 0.001	p< 0.001	p< 0.001	
Jammu & Kashmir	18.1	11.8	6.3	924
Himachal Pradesh	39.7	21.2	18.5	502
Punjab	38.5	21.3	17.1	1905
Chandigarh	36.4	17.8	18.6	88
Uttarakhand	31.1	18.7	12.4	914
Haryana	40.8	21.9	19	2018
NCT of Delhi	31.6	18.7	12.9	1500
Rajasthan	40.2	22.8	17.4	7971
Uttar Pradesh	37.4	22.3	15.1	23500
Bihar	43.7	25.2	18.6	12810
Sikkim	13.8	11.4	2.3	40
Arunachal Pradesh	13.8	10.1	3.8	89
Nagaland	35.7	18.9	16.7	102
Manipur	20.2	13.8	6.4	171
Mizoram	11.3	7.6	3.7	72
Tripura	33.9	20	13.9	281
Meghalaya	19.8	15.4	4.4	310
Assam	32.7	20.8	11.9	2860
West Bengal	31.7	18.3	13.4	8781
Jharkhand	43.2	25.7	17.4	3171
Odisha	36	21.6	14.5	3193
Chhattisgarh	40.3	24	16.4	2844
Madhya Pradesh	43.9	24.5	19.4	6711
Gujarat	52.6	25.2	27.5	4900
Dadra & Nagar haveli and daman & Diu	46.7	20.9	25.7	39
Maharashtra	48.3	23.3	24.9	8444
Andhra Pradesh	39.6	19.1	20.5	3155
Karnataka	42.5	21.3	21.2	4962
Goa	39.3	18.6	20.8	146
Lakshadweep	22.6	15.2	7.3	7

Kerala	34.8	19.3	15.5	2311
Tamil Nadu	34.7	16.7	17.9	5339
Puducherry	27.5	15.4	12.1	93
Andaman & Nicobar Islands	30.5	15.1	15.4	23
Telangana	43.5	20.2	23.2	2033
Ladakh	17.5	9.3	8.2	17
N	**39.7**	**22**	**17.7**	**112223**

Note: p: Probability of chi-square

The table 3.1 shows the prevalence of different levels of thinness in women, categorized by state in India. The table includes the percentage of women who are "thin" (based on BMI) and the percentage who are "moderately/severely thin" for each state, as well as the total number of women included in the analysis. The statistical analysis of the data is presented in the form of p-values for the chi-square test, which is a measure of the association between the variables. The results show that the overall prevalence of moderately/severely thin among women in India is 17.7%. The rows correspond to different states in India, and the columns represent different levels of thinness. The three categories are "thin", "mildly thin", and "moderately/severely thin". The numbers in the table represent the percentage of women in each state who fall into each category. For example, in the state of Punjab, 38.5% of women are classified as "thin", 21.3% are "mildly thin", and 17.1% are "moderately/severely thin". The table also includes a total row, which shows the overall percentages for all of the states combined. According to this table, the prevalence of thinness in women in India is quite high, with almost 40% of women classified as "thin" and over 17% classified as "moderately/severely thin". The highest percentages of thinness are found in Gujarat (52.6% "thin"), Bihar (43.7% "thin"), and Madhya Pradesh (43.9% "thin"). The lowest percentages of thinness are found in Sikkim (13.8% "thin") and Mizoram (11.3% "thin").

Table 3.2: Thinness, mildly thin and moderately/severely thin adolescent women by background characteristics, 2019-21, India

	Thin BMI - women	Mildly thin BMI- women	Moderately and severely thin BMI - women	*N*
Age of Adolescent	p< 0.001	p< 0.001	p< 0.001	
15	46.6	24.3	22.4	23284
16	42.5	22.8	19.7	23100
17	39.0	21.7	17.3	22088
18	35.8	21.2	14.6	23904
19	33.7	19.6	14.1	19848
Highest educational level	p< 0.001	p< 0.001	p< 0.001	
No education	39.1	24.1	14.9	4566
Primary	40.5	24.2	16.3	5636
Secondary	40.2	22.1	18.1	93772
Higher or above	34.2	18.6	15.6	8249
Marital Status	p< 0.001	p< 0.001	p< 0.001	
Never Married	40.6	22.2	18.3	100999
Married	31.9	19.8	12.1	11068
Widowed	27.0	15.5	11.4	156
Number of children ever born	p< 0.001	p = 0.032	p< 0.001	
Zero	39.9	22.0	17.9	107981
1+	33.9	20.6	13.3	4242
Place of residence	p< 0.001	p< 0.001	p< 0.001	
Urban	37.0	19.9	17.1	31207
Rural	40.7	22.8	17.9	81016
Wealth Index	p< 0.001	p< 0.001	p< 0.001	
Poorest	42.2	24.5	17.7	25035
Poorer	41.8	23.2	18.5	25770
Middle	40.0	22.1	17.9	23752
Richer	38.2	20.0	18.2	21000
Richest	34.3	18.8	15.5	16667
Sanitation Facility	p< 0.001	p< 0.001	p< 0.001	
Improved sanitation	38.7	21.4	17.2	83949
Unimproved sanitation	42.3	22.8	19.5	2597

	Thin BMI - women	Mildly thin BMI- women	Moderately and severely thin BMI - women	*N*
Open defecation	43.5	24.0	19.4	23112
Religion	p< 0.001	p< 0.001	p< 0.001	
Hindu	40.7	22.5	18.2	90050
Muslim	36.0	20.4	15.6	17406
Christian	29.7	16.8	12.9	2245
Others	39.1	20.8	18.3	2522
Ethnicity	p< 0.001	p< 0.001	p< 0.001	
SC	40.8	22.9	17.9	25911
ST	41.6	23.4	18.2	10746
OBC	40.6	22.3	18.3	49352
None	36.7	19.9	16.7	21046
Region	p< 0.001	p< 0.001	p< 0.001	
North	37.4	21.1	16.2	15838
North-east	37.9	22.3	15.7	31881
East	52.6	25.2	27.5	4900
West	48.1	23.3	24.9	8629
Central	39.0	22.9	16.0	33055
South	38.7	19.1	19.5	17921
N	**39.7**	**22.0**	**17.7**	**112223**

The table 3.2 shows various demographic and socioeconomic factors that are potentially associated with thinness among adolescent women in India. The data is organized into several categories, including age of adolescent, highest educational level, marital status, number of children ever born, place of residence, wealth index, sanitation facility, religion, ethnicity, and region. For each category, the table presents the prevalence of thinness among women, by three categories of BMI: thin, mildly thin, and moderately and severely thin for each demographic factor.

The table 3.2 shows that the adolescent aged 15 years were thin compared to another age-group. The 47 percent, 43 percent and 34 percent of adolescent women were thin at age 15, 16 and 19 years of age [p<0.001]. The prevalence of thinness among women in these age groups ranges

from 33.7% to 46.6%, with the highest prevalence found among 15-year-olds and the lowest prevalence found among 19-year-olds. The prevalence of mildly thin and moderately and severely thin BMI categories also shows a similar pattern across the age groups, with the highest prevalence of both categories among 15-year-olds and the lower prevalence among 19-year-olds. The statistically significant chi-square test results indicate that there is a significant association between the age of adolescence and thinness among women ($p < 0.001$).

The educational level, which is divided into four categories: no education, primary, secondary, and higher and above, the prevalence of thinness among women ranges from 34.2% to 40.5%, with the highest prevalence found among women with no education, while it was lower among women with higher education. The prevalence of mildly thin and moderately and severely thin BMI categories also shows a similar pattern across the educational attainment, with the highest prevalence of both categories among women with no education and it was lower among women with higher education. The statistically significant chi-square test results indicate that there is a significant association between the highest educational level and thinness among women ($p<0.001$).

The marital status, which is divided into three categories: never married, married, and widowed. The prevalence of thinness among women in these category ranges from 27% to 40.6%, with the highest prevalence found among never-married women and the lowest prevalence found among widowed women. The prevalence of mildly thin and moderately and severely thin BMI categories also shows a similar pattern across the marital status categories, with the highest prevalence of both categories among never-married women and the lowest prevalence among widowed women. The statistically significant chi-square test results indicate that there is a significant association between marital status and thinness among women ($p < 0.001$).

The prevalence of thinness among women in these category ranges from 33.9% to 39.9%, with the highest prevalence found among women with zero children ever born and the lowest prevalence found among women with 1 or more children ever born. The prevalence of mildly thin and moderately and severely thin BMI categories also shows a similar pattern across the number of children ever born categories, with the highest prevalence of both categories among women with zero children ever born and the lowest prevalence among women with 1or more children ever born. The statistically significant chi-square test results indicate that there is a

significant association between the number of children ever born and thinness among women ($p < 0.001$).

The place of residence, which is divided into two categories: urban and rural. The prevalence of thinness among women in these category ranges from 37% to 40.7%, with the highest prevalence found among rural women and the lowest prevalence found among urban women.

Sanitation facility was found to have a significant impact on BMI status among women. Women with access to improved sanitation facilities were less likely to be thin, mildly thin, or moderately/severely thin compared to those with unimproved sanitation facilities or open defecation. This finding highlights the importance of access to improved sanitation facilities in improving the nutritional status of women.

The analysis also found that religion was associated with BMI status among women. Hindu women were more likely to be thin (40.7), mildly thin (22.5), or moderately/severely thin (18.2) compared to Muslim (36.0), Christian (29.7), or other (39.1) women. This may be related to cultural and dietary practices within the Hindu community and highlights the need for culturally sensitive interventions to address malnutrition in this population.

Similarly, ethnicity was also found to be associated with BMI status among women. Women from Scheduled Castes (SC) (40.8) were more likely to be thin, mildly thin, or moderately/severely thin compared to women from Scheduled Tribes (ST) (41.6), Other Backward Castes (OBC) (40.6), or none (36.7).

Lastly, the analysis found significant regional differences in BMI status among women in India. Women from the Eastern and Western regions of India were more likely to be thin, mildly thin, or moderately/severely thin compared to women from the Northern, Northeastern, Central, or Southern regions. This highlights the need for region-specific interventions to address malnutrition and improve the nutritional status of women in India.

Table 3.3: Percentage of moderately/severely thin women reporting consuming food items on daily or weekly by states in India, 2019-21

State	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Jammu & Kashmir	83.2	80.6	87.9	34.9	32.2	36.2	13.1	40.4	23.7
Himachal Pradesh	84.5	97.6	87.2	37.9	35.3	16.7	0.6	5.0	5.2
Punjab	78.6	87.8	92.4	32.5	15.6	12.7	3.0	6.8	5.8
Chandigarh	94.0	100	100	34.9	27.3	17.4	5.6	8.8	5.1
Uttarakhand	71.0	93.2	88.9	44.2	10.3	38.6	16.1	18.7	12.4
Haryana	80.6	91.5	89.6	40.5	18.9	13.6	4.0	6.7	5.3
NCT Of Delhi	73.6	94.5	88.8	55.5	25.3	48.5	18.7	34.2	24.4
Rajasthan	86.7	89.2	88.1	40.5	12.3	13.1	4.1	6.4	4.5
Uttar Pradesh	68.1	92.9	91.6	48.6	12.4	27.4	15.4	17.5	11.5
Bihar	66.7	95.1	89.8	45.3	19.5	36.3	36.4	31.8	19.3
Sikkim	86.9	99.6	96.5	41.9	18.3	70.4	37.9	63.3	36.4
Arunachal Pradesh	67.6	85.2	98.3	57.7	27.3	63.8	65.2	64.2	45.1
Nagaland	48.6	51.9	80.3	49.7	12.2	41.2	24.6	45.8	13.7
Manipur	49.7	80.1	97.5	62.8	20.7	55.2	61.5	48.1	26.8
Mizoram	27.8	54.4	90.0	97.9	15.2	56.1	16.3	48.1	6.6
Tripura	47.8	86.8	94.1	71.9	30.7	71.9	87.1	71.2	44.7
Meghalaya	59.3	82.6	84.7	66.7	20.4	66.6	55.5	45.7	35.8
Assam	55.5	90.7	84.2	73.3	28.6	66.7	79.4	53.8	37.8
West Bengal	50.6	90.7	95.3	67.5	14.7	82.1	85.3	60.7	37.7
Jharkhand	50.8	93.5	95.4	35.9	9.2	47.9	38.6	38.3	17.4
Odisha	27.2	93.1	96.5	57.2	12.8	63.5	62.9	43.4	16.5
Chhattisgarh	40.8	91.0	96.0	29.6	10.2	38.8	29.8	27.9	15.1
Madhya Pradesh	61.6	94.1	91.9	42.2	10.0	20.3	9.4	11.5	6.7
Gujarat	77.5	91.0	86.8	30.3	22.8	18.5	12.8	16.1	8.0
Dadra & Nagar Haveli and Daman & Diu	67.9	99.4	94.9	30.2	22.9	51.3	34.8	41.6	20
Maharashtra	70.5	87.5	88.5	30.7	16.7	46.1	28.4	41.3	17.9
Andhra Pradesh	87.4	93.1	79.9	42.6	31.9	82.5	53.6	79.2	39.4
Karnataka	91.1	97.1	96.8	46.1	27.4	66.6	34.1	52	36.6

State	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Goa	78.1	98.7	94.9	52.8	42.8	72.4	91	39.9	56.2
Lakshadweep	69.5	82.9	42.0	72.3	50.8	73.4	95.3	72.3	42.8
Kerala	77.2	86.3	52.2	66.1	22.5	63.2	82.8	50.7	38.9
Tamil Nadu	85.1	82.8	76.8	39.6	14.0	76.5	59.2	55.3	31.1
Puducherry	77.8	86.8	79.7	57.6	24.8	87.3	75.6	63.5	45.1
Andaman & Nicobar Islands	64.7	96.6	93.9	52.8	30.4	95.4	99.8	79.5	59.9
Telangana	80.3	91.2	74.9	29.3	13.9	75.5	14.1	70.0	19.9
Ladakh	94.2	74.6	92.7	48.6	35.6	55	9.3	40.6	27.6
N	**69.2**	**91.6**	**89.2**	**44.4**	**16.6**	**41.4**	**30.8**	**31.9**	**18.2**

The table 3.3 provides categorical information on various food consumption among women by states of India, 2019-21.

The percentage of women who consume milk or curd ranges from 27.2% in Odisha to 94.2% in Ladakh, with a national average of 69.2%.

The proportion of women who consume pulses or beans varies from 51.9% in Nagaland to 100% in Chandigarh, with an overall average of 91.6%.

The consumption of dark green leafy vegetables ranges from 42% in Lakshadweep to 100% in Chandigarh, with an average of 89.2% across the country.

The prevalence of fried food consumption varies from 29.3% in Telangana to 72.3% in Lakshadweep, with a national average of 44.4%.

The percentage of women who consume aerated drinks ranges from 9.2% in Jharkhand to 95.4% in Andaman & Nicobar Islands, with an overall average of 16.6%.

These categories indicate the consumption of eggs, fish, and chicken or meat, respectively. The data shows varying proportions of consumption across states, with Kerala, Andhra Pradesh, and Goa having higher percentages for these food items.

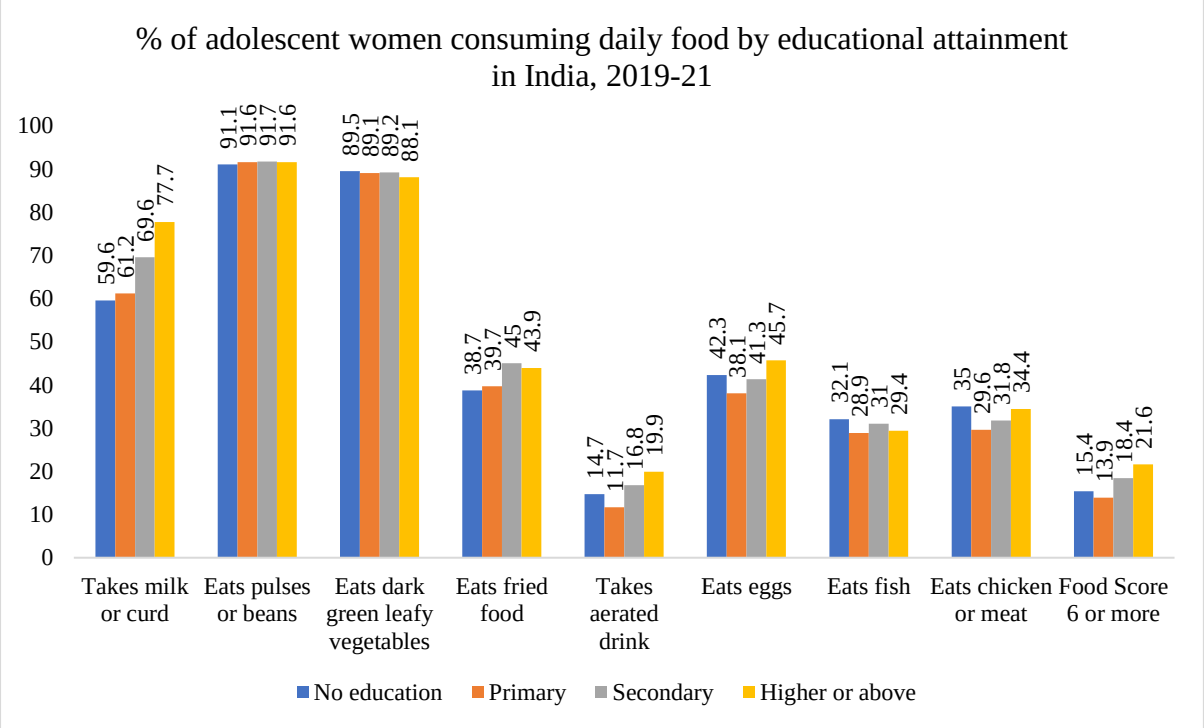
Food Score 6 or more: This category represents the percentage of women were found to have food score of 6 or more. The 38-39 percent moderately/severely thin women of Andhra Pradesh, Kerala and West Bengal were reportedly consuming 6 or more food items in India. On the other hand, the women of Punjab (5.8%), Haryana (5.3%), Himachal Pradesh (5.2%), Rajasthan (4.5%) were found to consume lesser than national average (18.2%).

Table 3.4: Percentage of moderately/severely thin women reporting consuming food items on daily or weekly by states in India, 2019-21

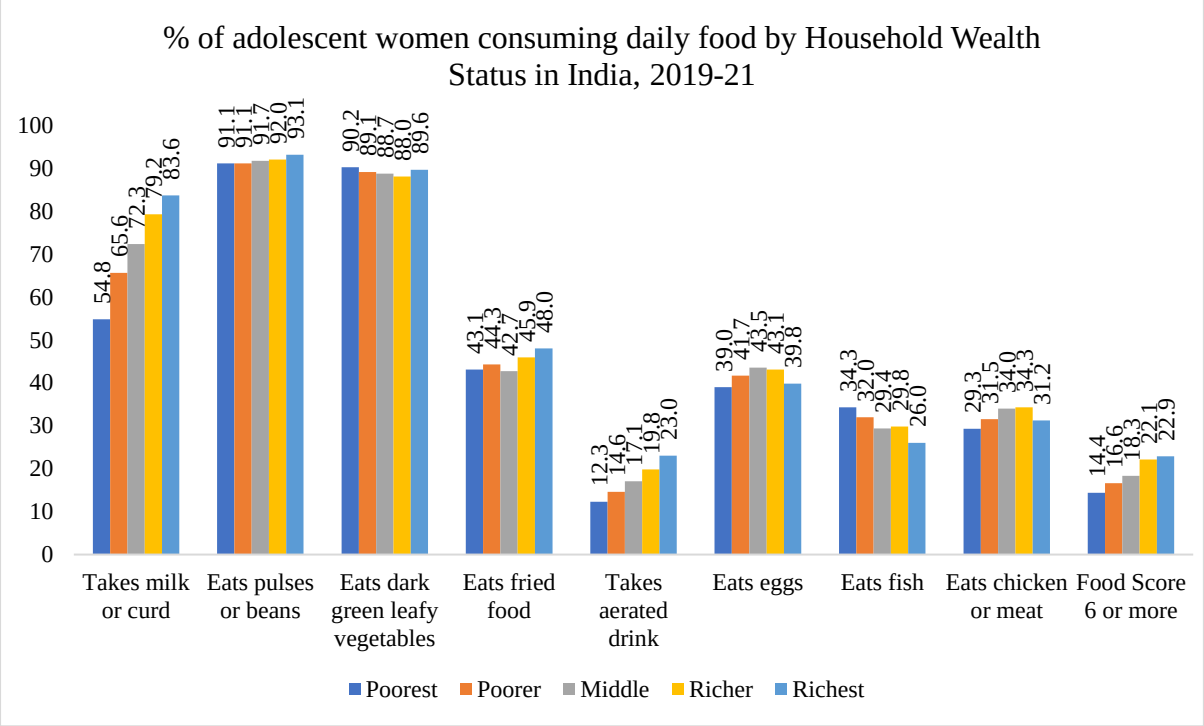
	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Adolescents current age									
15	70.4	92.2	89.1	44.7	16.5	40.9	30.5	31.2	17.8
16	68.9	90.8	88.4	44.1	16.7	41.7	31.4	32.0	18.2
17	68.9	91.6	88.8	45.4	16.7	41.3	30.1	31.3	18.1
18	69.1	92.3	89.8	43.5	16.2	41.3	30.6	31.7	18.6
19	68.4	91.2	89.9	44.2	17.0	42.3	31.7	34.2	18.9
Highest educational level									
No education	59.6	91.1	89.5	38.7	14.7	42.3	32.1	35.0	15.4
Primary	61.2	91.6	89.1	39.7	11.7	38.1	28.9	29.6	13.9
Secondary	69.6	91.7	89.2	45.0	16.8	41.3	31.0	31.8	18.4
Higher or above	77.7	91.6	88.1	43.9	19.9	45.7	29.4	34.4	21.6
Marital Status									
Never Married	69.8	91.7	89.0	44.2	16.6	40.8	29.9	31.2	17.9
Married	63.4	91.2	90.4	46.3	16.5	49.1	41.7	41.1	22.2
Widowed	48.0	100.0	97.2	49.1	20.2	42.7	39.4	38.2	16.8
Number of children ever born									
Zero	69.5	91.6	89.0	44.3	16.6	40.9	30.2	31.4	18.0
1+	62.8	91.9	92.5	48.8	15.4	56.8	50.7	48.9	25.3
Place of Residence									
Urban	75.4	92.7	88.1	47.3	21.3	49.3	33.5	39.1	24.9
Rural	67.1	91.3	89.5	43.4	15.0	38.7	29.9	29.4	15.9
Wealth index Combined									
Poorest	54.8	91.1	90.2	43.1	12.3	39.0	34.3	29.3	14.4
Poorer	65.6	91.1	89.1	44.3	14.6	41.7	32.0	31.5	16.6
Middle	72.3	91.7	88.7	42.7	17.1	43.5	29.4	34.0	18.3
Richer	79.2	92.0	88.0	45.9	19.8	43.1	29.8	34.3	22.1
Richest	83.6	93.1	89.6	48.0	23.0	39.8	26.0	31.2	22.9
Sanitation Facility									
Improved sanitation	71.6	91.9	89.1	45.2	17.6	42.4	31.4	32.6	19.4
Unimproved sanitation	65.8	94.7	90.0	46.3	18.2	49.9	38.5	41.2	23.0
Open defecation	62.2	90.6	89.5	41.5	13.3	37.6	28.3	28.7	14.0
Religion									
Hindu	70.1	91.8	89.4	43.3	16.0	37.5	27.3	27.9	16.1

	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Muslim	64.5	91.6	88.5	51.8	19.8	63.6	51.5	54.1	31.0
Christian	66.1	85.6	78.0	52.6	18.4	69.3	54.9	58.8	29.4
Others	68.3	88.9	91.3	33.2	15.9	27.2	15.4	21.8	9.8
Ethnicity									
SC	66.7	91.4	88.9	45.3	15.9	43.3	31.4	33.4	18.2
ST	54.8	89.3	89.1	36.3	12.5	41.9	30.2	32.0	13.6
OBC	73.2	92.0	88.8	43.6	16.4	38.9	27.6	29.4	17.6
None	71.4	92.3	90.1	46.5	18.0	40.2	31.5	32.3	18.9
Region									
North	82.9	90.0	88.9	40.6	16.0	18.0	5.9	10.2	7.3
North East	56.3	93.1	91.9	53.1	17.4	53.6	54.3	42.5	24.8
East	77.5	91.0	86.8	30.3	22.8	18.5	12.8	16.1	8.0
West	70.6	87.7	88.6	31.0	17.1	46.5	29.3	41.3	18.4
Central	64.2	93.0	92.0	45.5	11.7	26.8	15.3	17.1	10.7
South	85.7	90.5	80.4	43.9	22.4	73.0	47.6	60.0	33.8
N	**69.2**	**91.6**	**89.2**	**44.4**	**16.6**	**41.4**	**30.8**	**31.9**	**18.2**

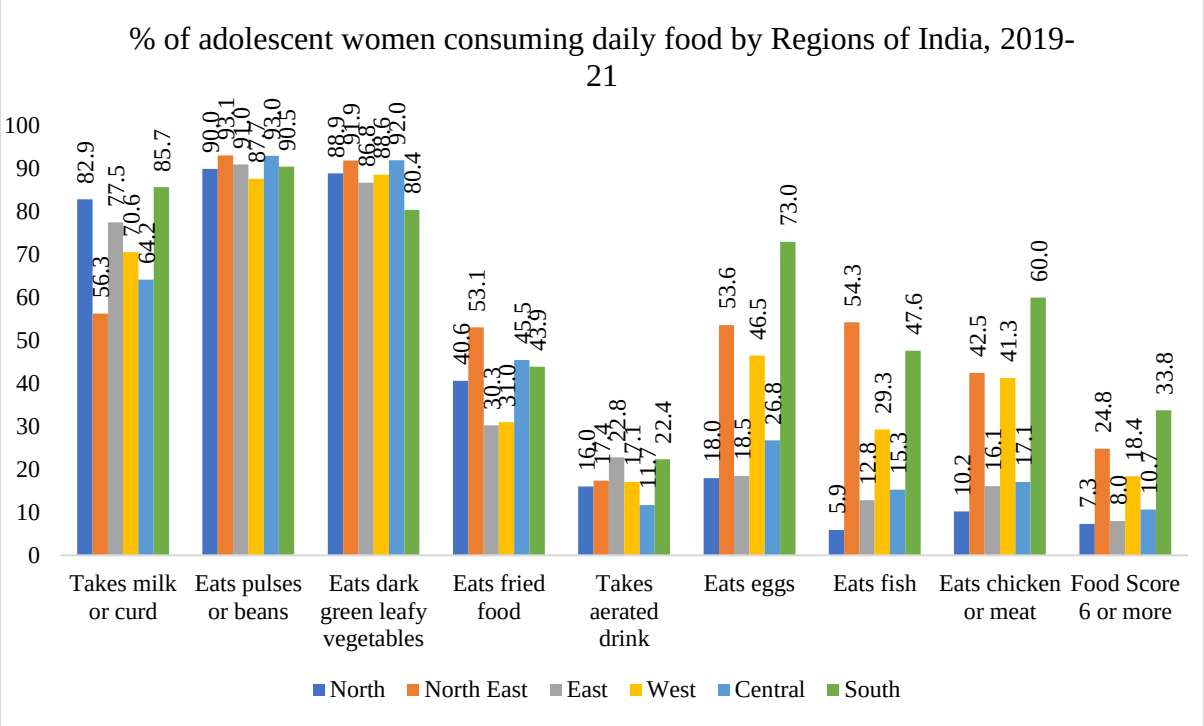
Graph: 3.4: Percentage of adolescent women consuming daily food by educational attainment in India, 2019-21



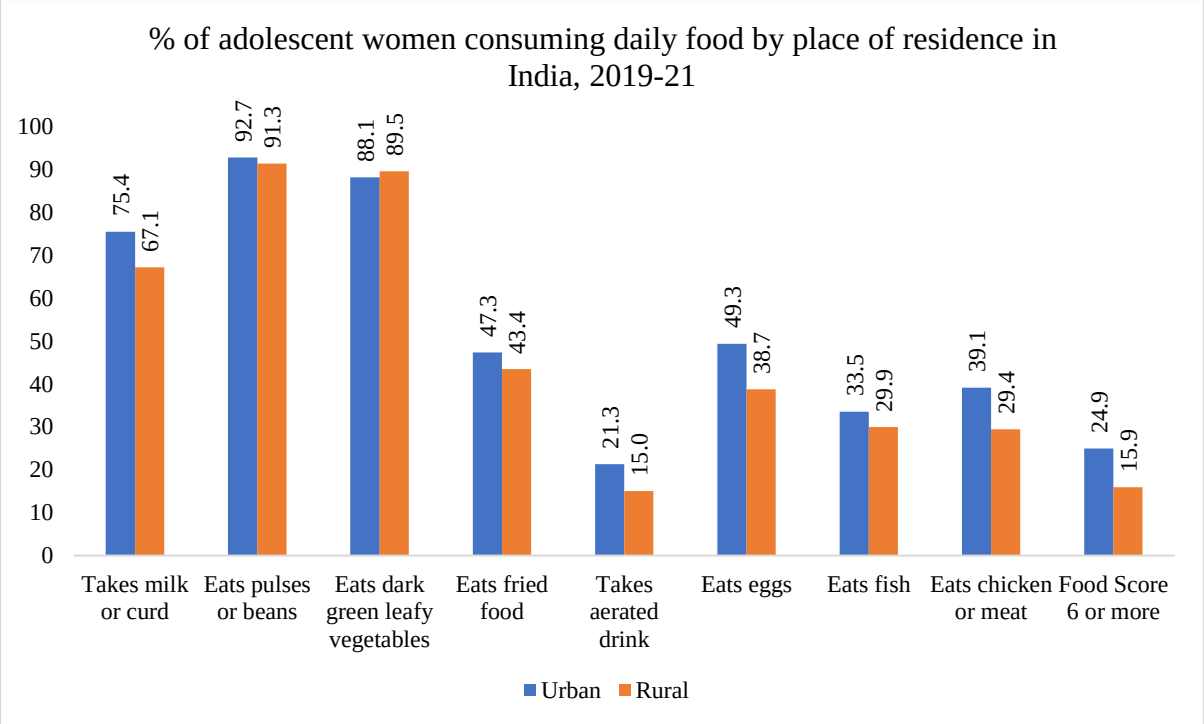
Graph: 3.5: Percentage of adolescent women consuming daily food by household wealth status of adolescent women in India, 2019-21



Graph: 3.6: Percentage of adolescent women consuming daily food by different regions of India, 2019-21



Graph: 3.7: Percentage of adolescent women consuming daily food by place of residence in India, 2019-21



The table 3.4 provides the percentage of moderately/severely thin women reported consuming different food items by background characteristics in different states in India. These food items were in terms of frequency of consuming various food items on a daily or weekly basis. It was converted into binary as explained in chapter 2. The table also includes additional breakdowns based on adolescent women' age, education level, marital status, number of children ever born, place of residence, wealth index, sanitation facilities, religion, ethnicity, and region.

The percentage of women taking milk or curd daily or weekly ranges vary in different age groups from 68.4% (age 19) to 70.4% (age 15). The percentage of women with a Food Score of 6 or more ranges from 17.8% (age 15) to 18.9% (age 19).

The percentages of moderate/severely thin women consuming certain food items differ based on their background characteristics such as educational attainment [Graph 3.4], marital status, caste, religion, region [Graph 3.6], place of residence [Graph 3.7] and household economic status [Graph 3.5]. The adolescent women aged 15-19 years were more likely to consume the WHO recommended food items compared to their counterpart adolescent women who belong to lower socio-economic status. The percentage of women with higher education or above, who eat eggs, is 45.7% compared to 38.1% for women with primary education [Graph 3.4]. Other socio-demographic characteristics like marital status were statistically significantly associated with types of food items consumed. The 48.0 percent widowed adolescent compared to about 70.0 percent never married adolescent women were consuming the milk and curd related items in India. Notably, the 97 percent widowed were consuming green leafy vegetables compared to 89-90 percent other women. Similarly, by the place of residence [Graph 3.7].

On the other hand, when a female gets married and plan for the family, she needs more nutritious food so that her baby and her health stays in good condition. Strikingly, the married adolescent with 1+ children were reportedly consuming a smaller number of recommended food items than those without any children. The women with 1+ children who eat eggs is 56.8% compared to 40.9% for women with zero children. The percentage of urban women taking milk or curd daily or weekly is 75.4%, compared to 67.1% for rural women [Graph 3.7].

The percentage of women in the richest wealth index category who eat dark green leafy vegetables is 89.6%, compared to 90.2% for the poorest category. The percentage of women with improved sanitation who eat fish is 31.4%, compared to 38.5% for women with unimproved sanitation. The percentage of Hindu women who eat eggs is 37.5%, compared to

69.3% for Christian women. The percentage of women in the North region who eat fish is 5.9%, compared to 47.6% for women in the South region.

Table 3.5: OR of consuming food items among THIN adolescent women in India, 2019-21

	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Age of Adolescent									
15 [Ref.]	1	1	1	1	1	1	1	1	1
16	0.88*** [0.82,0.94]	0.81*** [0.73,0.89]	0.93 [0.85,1.01]	0.95 [0.90,1.01]	1.01 [0.93,1.09]	1.03 [0.97,1.10]	1.10** [1.03,1.18]	1.02 [0.96,1.09]	1 [0.92,1.08]
17	0.85*** [0.79,0.91]	0.9 [0.81,1.00]	0.96 [0.87,1.05]	1.01 [0.96,1.08]	1.01 [0.93,1.09]	1.06 [0.99,1.13]	1.06 [0.99,1.14]	1.02 [0.95,1.10]	1 [0.92,1.08]
18	0.89*** [0.83,0.95]	1.02 [0.91,1.14]	1.08 [0.98,1.19]	0.93* [0.87,0.99]	0.96 [0.88,1.04]	1 [0.93,1.07]	1.03 [0.95,1.11]	1 [0.93,1.08]	1.02 [0.94,1.11]
19	0.79*** [0.73,0.86]	0.91 [0.80,1.04]	1.09 [0.97,1.23]	0.96 [0.89,1.03]	0.98 [0.89,1.08]	0.96 [0.88,1.04]	1.02 [0.94,1.11]	1.04 [0.96,1.13]	0.95 [0.86,1.04]
Educational Status									
No education [Ref.]	1	1	1	1	1	1	1	1	1
Primary	0.96 [0.84,1.09]	1.03 [0.82,1.29]	0.94 [0.76,1.15]	1.01 [0.89,1.15]	0.75** [0.62,0.90]	0.94 [0.82,1.08]	1.02 [0.88,1.19]	0.89 [0.77,1.03]	0.92 [0.77,1.11]
Secondary	0.95 [0.86,1.06]	1.01 [0.85,1.21]	1.08 [0.91,1.27]	1.27*** [1.15,1.41]	0.89 [0.77,1.02]	0.93 [0.83,1.03]	1.01 [0.90,1.14]	0.80*** [0.71,0.90]	1.01 [0.88,1.16]
Higher or above	1 [0.86,1.16]	0.96 [0.77,1.22]	1.05 [0.85,1.29]	1.33*** [1.16,1.52]	0.92 [0.77,1.10]	1.04 [0.90,1.20]	1.01 [0.86,1.18]	0.76*** [0.66,0.89]	1.09 [0.91,1.30]
Marital Status									
Never Married [Ref.]	1	1	1	1	1	1	1	1	1
Married	0.95 [0.86,1.06]	0.91 [0.77,1.07]	0.94 [0.81,1.10]	1.08 [0.98,1.19]	1.09 [0.96,1.24]	1.05 [0.94,1.16]	1.04 [0.93,1.15]	1.1 [0.98,1.22]	1.15* [1.01,1.30]
Widowed	0.68 [0.33,1.40]	1 [1.00,1.00]	3.14 [0.49,19.98]	2.03* [1.02,4.05]	2.12 [0.96,4.69]	1.25 [0.59,2.64]	1.26 [0.57,2.79]	1.62 [0.76,3.43]	1.6 [0.66,3.85]
Number of Children ever born									
Zero [Ref.]	1	1	1	1	1	1	1	1	1
1+	1.18* [1.01,1.37]	1.11 [0.86,1.43]	1.48** [1.15,1.91]	1.08 [0.93,1.24]	0.82* [0.67,1.00]	1.38*** [1.19,1.61]	1.50*** [1.28,1.75]	1.45*** [1.25,1.70]	1.20* [1.01,1.43]
Place of Residence									
Urban [Ref.]	1	1	1	1	1	1	1	1	1

	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Rural	1.14*** [1.07,1.21]	0.88* [0.80,0.97]	1.12** [1.03,1.21]	0.92** [0.87,0.97]	0.88*** [0.83,0.94]	0.69*** [0.66,0.74]	0.86*** [0.81,0.91]	0.75*** [0.71,0.80]	0.77*** [0.72,0.83]
Wealth									
Poorest [Ref.]	1	1	1	1	1	1	1	1	1
Poorer	1.30*** [1.22,1.38]	1.09 [0.98,1.21]	1.08 [0.98,1.18]	1.15*** [1.08,1.22]	1.19*** [1.09,1.30]	1.18*** [1.10,1.25]	1.08* [1.01,1.16]	1.14*** [1.07,1.22]	1.25*** [1.15,1.36]
Middle	1.51*** [1.41,1.62]	1.25*** [1.12,1.40]	1.22*** [1.10,1.35]	1.17*** [1.10,1.25]	1.40*** [1.28,1.53]	1.18*** [1.10,1.26]	1.01 [0.94,1.09]	1.22*** [1.13,1.32]	1.39*** [1.27,1.52]
Richer	2.11*** [1.94,2.28]	1.40*** [1.23,1.59]	1.25*** [1.11,1.40]	1.44*** [1.34,1.54]	1.60*** [1.45,1.76]	1.14** [1.05,1.24]	1.19*** [1.10,1.30]	1.23*** [1.13,1.33]	1.86*** [1.68,2.05]
Richest	2.81*** [2.54,3.11]	1.59*** [1.36,1.86]	1.47*** [1.28,1.69]	1.58*** [1.45,1.72]	1.97*** [1.77,2.21]	1.15** [1.05,1.27]	1.25*** [1.13,1.39]	1.27*** [1.15,1.41]	2.23*** [1.99,2.50]
Religion									
Hindu [Ref.]	1	1	1	1	1	1	1	1	1
Muslim	0.74*** [0.70,0.80]	0.88* [0.78,0.98]	0.84*** [0.76,0.92]	1.18*** [1.11,1.26]	1.14** [1.05,1.24]	3.38*** [3.16,3.62]	2.75*** [2.56,2.95]	3.74*** [3.49,4.01]	2.25*** [2.09,2.42]
Christian	0.73** [0.61,0.88]	0.51*** [0.41,0.64]	0.54*** [0.44,0.66]	1.40*** [1.19,1.65]	0.94 [0.76,1.15]	1.43*** [1.19,1.71]	1.43*** [1.21,1.68]	1.51*** [1.27,1.78]	1.11 [0.93,1.33]
Others	0.68*** [0.59,0.80]	0.80* [0.65,0.99]	1.24 [0.98,1.57]	0.69*** [0.60,0.80]	0.95 [0.79,1.13]	0.79** [0.67,0.92]	0.68*** [0.55,0.82]	0.88 [0.74,1.05]	0.72** [0.58,0.90]
Ethnicity									
SC [Ref.]	1	1	1	1	1	1	1	1	1
ST	0.68*** [0.63,0.74]	0.89* [0.78,1.00]	1.06 [0.95,1.20]	0.77*** [0.72,0.83]	0.82*** [0.73,0.91]	1.07 [0.99,1.16]	0.99 [0.91,1.08]	1 [0.92,1.09]	0.83*** [0.75,0.92]
OBC	1.32*** [1.25,1.39]	1.03 [0.94,1.13]	1.03 [0.95,1.12]	0.86*** [0.82,0.91]	0.94 [0.88,1.00]	0.60*** [0.57,0.64]	0.63*** [0.60,0.67]	0.59*** [0.55,0.62]	0.72*** [0.67,0.76]
None	1.16*** [1.08,1.24]	1.11 [0.99,1.24]	1.08 [0.97,1.20]	0.96 [0.91,1.03]	0.99 [0.91,1.08]	0.64*** [0.60,0.69]	0.77*** [0.71,0.83]	0.65*** [0.60,0.70]	0.75*** [0.69,0.81]
Region									
North [Ref.]	1	1	1	1	1	1	1	1	1
North East	0.35*** [0.32,0.38]	1.88*** [1.67,2.13]	1.68*** [1.50,1.89]	1.78*** [1.66,1.91]	1.35*** [1.23,1.49]	5.28*** [4.85,5.74]	18.48*** [16.36,20.88]	6.77*** [6.12,7.48]	5.18*** [4.60,5.82]
East	0.78*** [0.69,0.88]	1.15 [0.98,1.35]	0.84* [0.73,0.97]	0.68*** [0.61,0.75]	1.64*** [1.45,1.85]	1.07 [0.94,1.21]	2.53*** [2.15,2.98]	1.82*** [1.58,2.10]	1.24* [1.04,1.48]

	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
West	0.52*** [0.47,0.57]	0.79*** [0.69,0.90]	0.96 [0.84,1.09]	0.64*** [0.58,0.70]	1.05 [0.93,1.17]	4.09*** [3.72,4.50]	6.90*** [6.04,7.87]	6.65*** [5.95,7.42]	2.99*** [2.62,3.41]
Central	0.42*** [0.39,0.46]	1.65*** [1.47,1.85]	1.61*** [1.44,1.79]	1.37*** [1.29,1.47]	0.82*** [0.75,0.91]	1.81*** [1.67,1.97]	3.14*** [2.77,3.55]	1.99*** [1.79,2.20]	1.90*** [1.69,2.14]
South	1.22*** [1.10,1.35]	1.1 [0.97,1.24]	0.55*** [0.50,0.61]	1.11** [1.03,1.20]	1.57*** [1.43,1.73]	13.71*** [12.52,15.01]	16.17*** [14.28,18.30]	15.37*** [13.86,17.06]	7.00*** [6.22,7.87]
N	41076	41037	41076	41076	41075	41076	41076	41076	41076

3.6 Result from Logistic Regression

The table 3.5 shows the data on various factors related to daily food consumption and their indexed scores. The data on frequency of food items consumed was on 4 scale [Never, daily, weekly, and occasionally]. The frequency of food items consumed daily or weekly was recoded as Yes = 1 otherwise No = 0.

The table show the odds ratio of adolescent women consuming specific food item. The 95% confidence interval of the OR is presented in parenthesis. The odds of consuming milk or curd product was significantly lower at age of 16 years [OR: 0.88, p< 0.001] compared to their counterpart adolescent thin women aged 15 years. Similarly, the odds of consuming pulses and beans were statistically significantly lower among 16 years age thin adolescent women [OR: 0.81, p< 0.001] compared to their counterpart thin aged 15 years. The values in these rows indicate the estimated effect sizes or odds ratios for each category compared to the reference category (usually indicated as 1 or the first category).

Overall, the table provides information on the relationship between various factors and food consumption habits, allowing for comparisons between different groups or categories. The effect sizes and confidence intervals help assess the strength and precision of the associations. The asterisks indicate the statistical significance of the estimates.

The odds of consuming milk, curd product was lower at the age of 19 years old thin adolescent women (OR: 0.79, p<0.001) compared to those adolescents of aged 15. The consumption of varied food items was statistically not significant at all ages. However, those who were non-vegetarian, thin adolescent women aged 16 years were more likely to consume fish (OR: 1.10 [1.03,1.18], p<0.01) compared to those of aged 15 years old thin adolescent. The result of logistic regression among thin adolescent women were significantly estimating the odds of consuming food items for fried food and fish items when controlling only educational attainment. The odds of consuming milk and curd, dark green leafy vegetables were more likely in rural than their counterpart adolescent women residing in urban India. The household economic status and place of residence were found to estimate its effect on consumption of the recommended daily food items in India and similar settings. The wealth quintile was statistically significantly associated with consumption of the type of food items. The richer adolescent women were more likely to consume the milk and other WHO recommended daily food items compared to those of poorest. The odds of consuming any 6 daily food items were statistically significantly higher among richer (OR: 2.23, p<0.001) compared to those who were poorest in India, 2019-21.

Table 3.6: OR of consuming food items among THIN women by place of residence combined wealth, religion and ethnicity in India, 2019-21

	Frequency takes milk or curd	Frequency eats pulses or beans	Frequency eats dark green leafy vegetables	Frequency eats fried food	Frequency takes aerated drink	Frequency eats eggs	Frequency eats fish	Frequency eats chicken or meat	Food Score 6 or more
Wealth Residence Combined									
Urban Poorest [Ref.]	1	1	1	1	1	1	1	1	1
Urban Poorer	1.15 [0.92,1.45]	0.68 [0.44,1.05]	0.9 [0.65,1.26]	1.19 [0.95,1.49]	0.79 [0.59,1.06]	1.42** [1.13,1.79]	1 [0.79,1.27]	1.31* [1.03,1.65]	1.65*** [1.23,2.22]
Urban Middle	1.48*** [1.20,1.83]	0.76 [0.51,1.14]	0.96 [0.71,1.31]	0.92 [0.75,1.13]	0.93 [0.71,1.20]	1.36** [1.10,1.68]	0.89 [0.71,1.10]	1.41** [1.13,1.75]	1.51** [1.14,1.99]
Urban Richer	3.18*** [2.59,3.92]	0.88 [0.59,1.31]	1.01 [0.75,1.36]	1.16 [0.95,1.41]	1.09 [0.85,1.40]	1.29* [1.05,1.58]	0.92 [0.74,1.13]	1.32* [1.07,1.63]	2.07*** [1.58,2.71]
Urban Richest	3.97*** [3.23,4.89]	1.02 [0.68,1.51]	1.13 [0.84,1.53]	1.2 [0.99,1.47]	1.34* [1.04,1.72]	1.05 [0.86,1.29]	0.67*** [0.54,0.83]	1.07 [0.87,1.32]	2.02*** [1.54,2.64]
Rural Poorest	0.99 [0.82,1.20]	0.75 [0.51,1.10]	1.34* [1.00,1.79]	0.96 [0.79,1.16]	0.56*** [0.44,0.72]	0.74** [0.61,0.91]	0.83 [0.68,1.02]	0.76** [0.62,0.93]	0.92 [0.70,1.19]
Rural Poorer	1.55*** [1.28,1.89]	0.73 [0.50,1.07]	1.2 [0.90,1.61]	0.99 [0.81,1.20]	0.70** [0.55,0.89]	0.85 [0.70,1.03]	0.76** [0.62,0.93]	0.84 [0.69,1.03]	1.06 [0.82,1.38]
Rural Middle	2.21*** [1.81,2.69]	0.76 [0.52,1.12]	1.16 [0.87,1.56]	0.96 [0.79,1.16]	0.85 [0.66,1.09]	0.91 [0.74,1.11]	0.67*** [0.54,0.82]	0.94 [0.77,1.16]	1.23 [0.94,1.60]
Rural Richer	2.83*** [2.31,3.47]	0.75 [0.51,1.10]	1.02 [0.75,1.37]	1.03 [0.84,1.26]	0.98 [0.76,1.26]	0.81* [0.66,1.00]	0.62*** [0.50,0.76]	0.88 [0.71,1.09]	1.37* [1.05,1.80]
Rural Richest	3.94*** [3.12,4.97]	0.75 [0.50,1.14]	1.36 [0.98,1.90]	1.15 [0.93,1.43]	1.03 [0.79,1.35]	0.58*** [0.46,0.72]	0.51*** [0.41,0.65]	0.64*** [0.51,0.81]	1.22 [0.91,1.64]
Religion									
Hindu [Ref.]	1	1	1	1	1	1	1	1	1
Muslim	0.70*** [0.65,0.75]	0.95 [0.85,1.06]	0.90* [0.82,0.99]	1.23*** [1.16,1.31]	1.13** [1.04,1.22]	2.95*** [2.77,3.14]	2.55*** [2.40,2.72]	3.19*** [3.00,3.39]	2.20*** [2.06,2.36]
Cristian	0.86 [0.73,1.03]	0.53*** [0.43,0.67]	0.41*** [0.34,0.50]	1.56*** [1.33,1.83]	1.18 [0.97,1.45]	3.50*** [2.95,4.15]	3.17*** [2.70,3.71]	3.40*** [2.89,3.99]	2.11*** [1.77,2.52]
Others	0.77*** [0.67,0.89]	0.70*** [0.57,0.86]	1.29* [1.02,1.62]	0.61*** [0.53,0.70]	0.87 [0.72,1.04]	0.58*** [0.50,0.67]	0.48*** [0.40,0.57]	0.65*** [0.55,0.76]	0.49*** [0.40,0.61]
Ethnicity									
SC [Ref.]	1	1	1	1	1	1	1	1	1

	Frequency takes milk or curd	Frequency eats pulses or beans	Frequency eats dark green leafy vegetables	Frequency eats fried food	Frequency takes aerated drink	Frequency eats eggs	Frequency eats fish	Frequency eats chicken or meat	Food Score 6 or more
ST	0.72*** [0.67,0.78]	0.81*** [0.72,0.91]	1.02 [0.91,1.15]	0.68*** [0.63,0.73]	0.84** [0.76,0.94]	0.95 [0.88,1.02]	0.87*** [0.80,0.94]	0.95 [0.88,1.03]	0.75*** [0.68,0.83]
OBC	1.27*** [1.21,1.35]	1.06 [0.97,1.15]	1.02 [0.94,1.10]	0.88*** [0.84,0.93]	0.96 [0.90,1.03]	0.70*** [0.66,0.73]	0.73*** [0.69,0.77]	0.68*** [0.64,0.71]	0.78*** [0.73,0.83]
None	1.04 [0.97,1.11]	1.08 [0.96,1.21]	1.19*** [1.07,1.31]	0.95 [0.89,1.01]	0.97 [0.89,1.06]	0.65*** [0.61,0.69]	0.82*** [0.77,0.88]	0.67*** [0.63,0.72]	0.73*** [0.67,0.79]
N	**41076**	**41076**	**41076**	**41076**	**41075**	**41076**	**41076**	**41076**	**41076**

The table 3.6 show the interaction effect between wealth status and place of residence. The place of residence and wealth status was considered to have the interaction effect because, the residence is the proxy of available preferred daily food items [availability] while, on the other hand, wealth status triggers the accessibility of the food. The table shows that the odds of consuming milk and curd product was significantly higher among urban middle [OR: 1.15, p<0.001] compared to their counterpart adolescent women from urban poorest. It is important to note that the urban richer [OR: 3.18, p< 0.001] and richest [3.97, p<0.001] thin adolescent women were more likely to consume the milk and curd product on daily and weekly basis compared to their counterpart women of Urban poorest.

Similarly, the odds of consuming green leafy vegetables were higher among rural poorest [OR: 1.34, p<0.05] compared to their counterpart women of urban poorest. The odds of consuming any 6 daily food items were statistically significantly higher among urban richest (OR: 2.02, p<0.001) and rural richer (OR: 1.37, p<0.05) compared to those who were poorest in India, 2019-21. The religious disparity in consumption of daily food items indicates that the Muslim (OR: 2.20, p<0.001) and Christian (OR: 2.11, p<0.001) adolescent thin women were statistically significantly likely to consume meat and meat product compared to their counterpart thin women belonging to Hindu religion.

3.7 Conclusion

In conclusion, the findings of this study provide insights into the consumption patterns of various food items among moderately/severely thin women in different regions of India. The results highlight significant variations in dietary practices across the country.

Milk or curd consumption shows a wide range of prevalence, with the percentage of daily or weekly consumers varying from 27.2% in Odisha to 94% in Chandigarh. The national average stands at 69.2%. Pulses or beans consumption, on the other hand, exhibits a higher prevalence, ranging from 82.6% in Meghalaya to 99.6% in Sikkim, with a national average of 91.6%.

The consumption of dark green leafy vegetables is relatively lower compared to pulses or beans, with percentages ranging from 42% in Lakshadweep to 98.3% in Arunachal Pradesh. The national average stands at 89.2%. Fried food consumption is prevalent to varying degrees, ranging from 29.3% in Telangana to 57.7% in Arunachal Pradesh, with a national average of 44.4%.

Aerated drink consumption reflects a significant variation across regions, with percentages ranging from 10.2% in Chhattisgarh to 73.4% in Lakshadweep. The national average is relatively low at 16.6%. Eggs consumption displays substantial differences as well, with percentages ranging from 20.3% in Madhya Pradesh to 87.3% in Puducherry. The national average stands at 41.4%.

Fish consumption varies greatly, with percentages ranging from 9.3% in Ladakh to 99.8% in the Andaman & Nicobar Islands. The national average is 30.8%. Lastly, chicken or meat consumption showcases a moderate prevalence, ranging from 31.2% in Ladakh to 79.5% in the Andaman & Nicobar Islands. The national average is 31.9%.

These findings emphasize the heterogeneity in dietary patterns among moderately/severely thin women in India. Understanding these variations can inform targeted interventions and policies to address the double burden of malnutrition among adolescent women. It is crucial to promote the consumption of nutrient-rich foods, such as milk, pulses, dark green leafy vegetables, and eggs, while discouraging the consumption of fried foods and aerated drinks. Further research and efforts are needed to explore the cultural, socioeconomic, and geographical factors that influence these consumption patterns and to develop context-specific strategies for improving nutrition among adolescent women in India.

Chapter 4: Obesity among adolescent women in India

4.1 Introduction

It is critical to look at the prevalence of obesity or overweight among adolescent women in India. It helps the seriousness of the problem and to comprehend the associated covariates. Recent research shows an unsettling increase in its prevalence rates, pointing to a growing public health concern. Age, socioeconomic status, location, and cultural influences are a few of the elements that contribute to the notable regional variations in obesity rates that are seen across the nation.

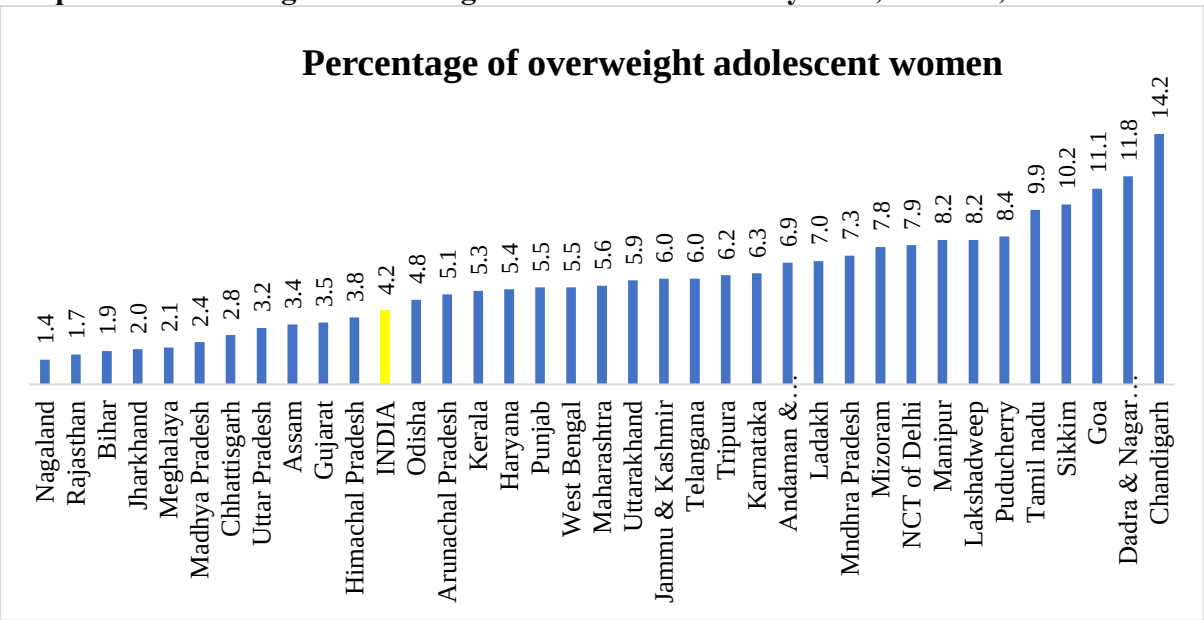
4.2 Causes and Contributing Factors

Obesity among adolescent women in India can be attributed to a multitude of factors, including genetic predisposition, dietary patterns, physical inactivity, sedentary behaviours, and psychosocial factors. The traditional Indian diet, once rich in whole grains, fruits, and vegetables, has witnessed a shift towards calorie-dense, processed foods, leading to an increased consumption of unhealthy fats, sugars, and refined carbohydrates. The lack of access to nutritious foods, coupled with limited nutrition education, exacerbates the problem. Additionally, reduced physical activity due to the influence of technology, inadequate sports facilities, and safety concerns further contribute to the rising prevalence of obesity.

4.3 Health Consequences

Obesity poses serious health consequences for adolescent girls, both in the short and long term. Physical health issues such as type 2 diabetes, cardiovascular diseases, hypertension, musculoskeletal disorders, and respiratory problems are prevalent among obese individuals.

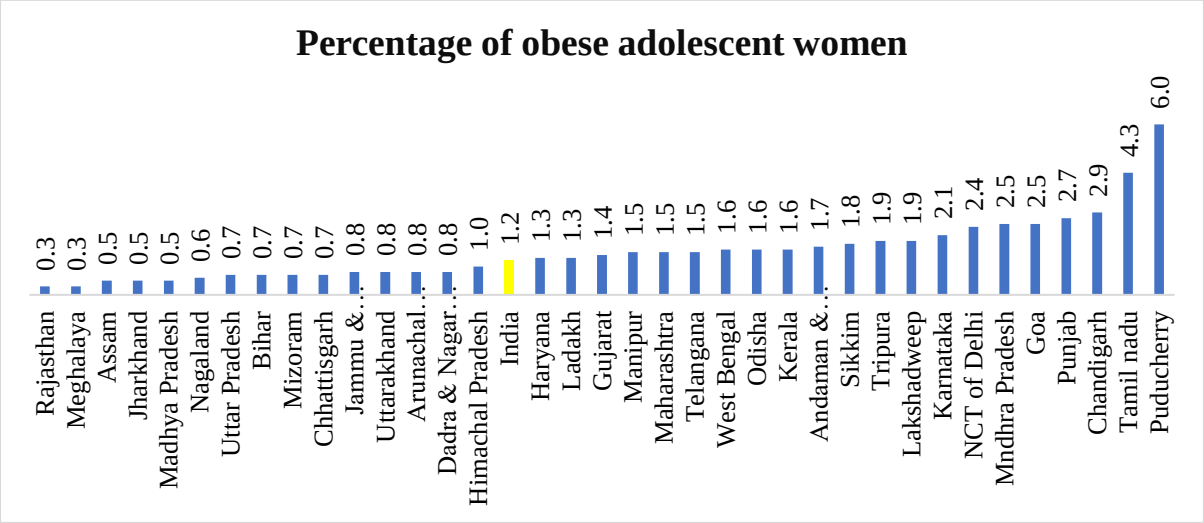
Graph 4.1: Percentage of overweight adolescent women by state, 2019-21, India



The graph 4.1 shows the percentage of overweight adolescent women by different states in India, 2019-21. In India, on average at 4.2 per cent of adolescent women were reportedly overweight. The majority of the states were found have higher percent of adolescent overweight women. These states were West Bengal (5.5), Telangana (6.0), Punjab (5.5), Tamil Nadu (9.9) were among bigger states. Among union territory, Chandigarh (14.2) and Ladakh (7.0). Among smaller states, Tripura (6.2), Goa (11.1), Sikkim (10.2).

While on the other hand, some other states were found to have lower percentage of adolescent thin women than the national average. These states were Bihar (1.9), Jharkhand (2.0), Gujarat (3.5).

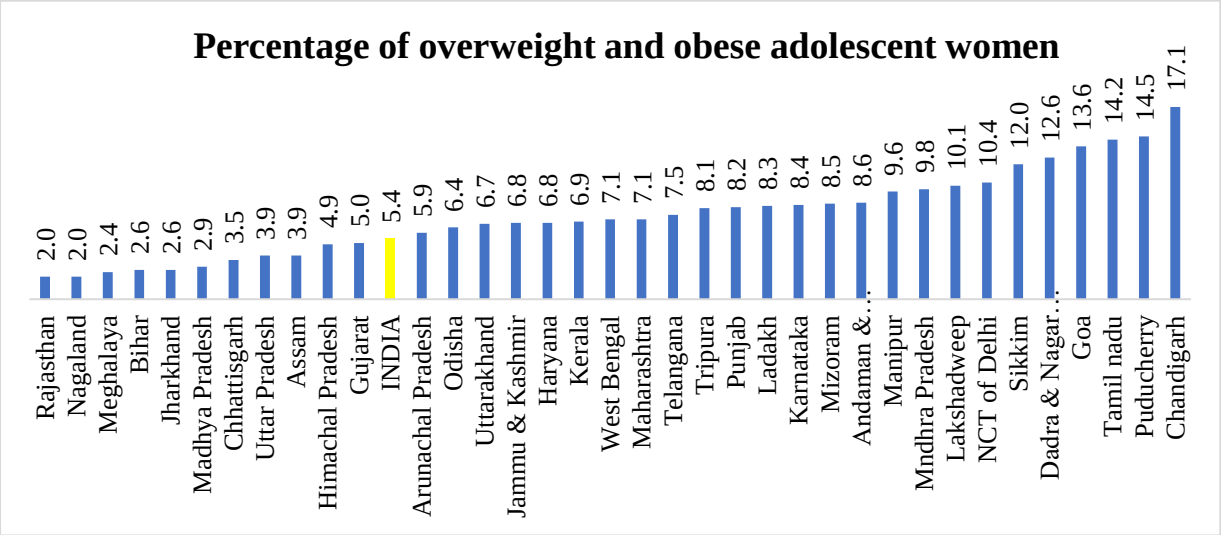
Graph 4.2: Percentage of obese adolescent women by state, 2019-21, India



The graph 4.2 shows the graphical representation of overweight adolescent women by different states in India. In India, on average at 1.2 per cent of adolescent women were reportedly overweight. The majority of the states were found have higher percent of adolescent obese women. These states were West Bengal (1.6), Telangana (1.5), Punjab (2.7), Tamil Nadu (4.3) were among bigger states. Among union territory, Chandigarh (2.9) and Ladakh (1.3). Among smaller states, Tripura (1.9), Goa (2.5), Sikkim (1.8).

While on the other hand, some other states were found to have lower percentage of adolescent thin women than the national average. These states were Bihar (0.7), Jharkhand (0.5), and Rajasthan (0.3).

Graph 4.3: Percentage of overweight and obese adolescent women by state, 2019-21, India



The graph 4.3 shows the graphical representation of overweight adolescent women by different states in India. In India, on average at 5.4 per cent of adolescent women were reportedly overweight. The majority of the states were found have higher percent of adolescent overweight and obese women. These states were West Bengal (6.9), Telangana (8.1), Punjab (6.8), Tamil Nadu (12.6) were among bigger states. Among union territory, Chandigarh (17.1) and Ladakh (8.5). Among smaller states, Tripura (8.2), Goa (14.2), Sikkim (13.6).

On the other hand, the overweight among adolescent women of Himachal Pradesh (1.0%), Uttar Pradesh (0.7%), Madhya Pradesh (0.5%) and Rajasthan (0.3%) were less compared to national average.

Table 4.1: Obesity among adolescent women by states, 2019-21, India

State	Overweight BMI-women	Obese BMI-women	Overweight or Obese BMI-women	*N*
	p > 0.001	p > 0.001	p > 0.001	
Jammu & Kashmir	6.0	0.8	6.8	924
Himachal Pradesh	3.8	1.0	4.9	502
Punjab	5.5	2.7	8.2	1905
Chandigarh	14.2	2.9	17.1	88
Uttarakhand	5.9	0.8	6.7	914
Haryana	5.4	1.3	6.8	2018
NCT of Delhi	7.9	2.4	10.4	1500
Rajasthan	1.7	0.3	2.0	7971
Uttar Pradesh	3.2	0.7	3.9	23500
Bihar	1.9	0.7	2.6	12810
Sikkim	10.2	1.8	12.0	40
Arunachal Pradesh	5.1	0.8	5.9	89
Nagaland	1.4	0.6	2.0	102
Manipur	8.2	1.5	9.6	171
Mizoram	7.8	0.7	8.5	72
Tripura	6.2	1.9	8.1	281
Meghalaya	2.1	0.3	2.4	310
Assam	3.4	0.5	3.9	2860
West Bengal	5.5	1.6	7.1	8781
Jharkhand	2.0	0.5	2.6	3171
Odisha	4.8	1.6	6.4	3193
Chhattisgarh	2.8	0.7	3.5	2844
Madhya Pradesh	2.4	0.5	2.9	6711
Gujarat	3.5	1.4	5.0	4900
Dadra & Nagar haveli and daman & Diu	11.8	0.8	12.6	39
Maharashtra	5.6	1.5	7.1	8444
Andhra Pradesh	7.3	2.5	9.8	3155
Karnataka	6.3	2.1	8.4	4962
Goa	11.1	2.5	13.6	146
Lakshadweep	8.2	1.9	10.1	7

State	Overweight BMI-women	Obese BMI-women	Overweight or Obese BMI-women	*N*
Kerala	5.3	1.6	6.9	2311
Tamil Nadu	9.9	4.3	14.2	5339
Puducherry	8.4	6.0	14.5	93
Andaman & Nicobar Island	6.9	1.7	8.6	23
Telangana	6.0	1.5	7.5	2033
Ladakh	7.0	1.3	8.3	17
N	**4.2**	**1.2**	**5.4**	**112223**

The table 4.1 shows the prevalence of different levels of obesity among women by states of India. The table includes the percentage of women who are "overweight" (based on BMI), "obese", and "overweight or obese", for each states as well as total number of women included in the analysis. The statistical analysis of the data is presented in the form of p-values for the chi-square test, which is a measure of the association between the variables. The total cases were statistically insufficient, in case of Ladakh [N =7]. Therefore, the generalization needs extra care. The results show that the overall prevalence of overweight or obesity among women in India is 5.4%. The prevalence of overweigh is 4.2%, while the prevalence of obese is 1.2%. The state with the highest prevalence of overweight or obesity is Chandigarh, with 17.1%, followed by Puducherry with 14.5% and Sikkim with 12%. The state with the lowest prevalence of overweight or obesity is Nagaland, with 2%, followed by Meghalaya with 2.4% and Jharkhand with 2.6%. The statistical analysis shows that there is a significant association between the variables, with a p-value of less than 0.001 for all categories. This indicates that the prevalence of overweight or obesity among women varies significantly across different states of India. The state with the highest prevalence of overweight is Chandigarh with 14.2%, while the state with the highest prevalence of obese is Tamil Nadu with 4.3%.

Table 4.2: Percentage of obese, overweight, overweight/obese women in India, 2019-21.

	Overweight BMI - women	Obese BMI - women	Overweight or obese BMI - women	*N*
Age of adolescent	p < 0.001	p < 0.001	p < 0.001	
15	3.1	0.9	3.9	23284
16	3.6	1.1	4.7	23100
17	4.7	1.4	6.1	22088
18	4.4	1.1	5.4	23904
19	5.4	1.9	7.3	19848
Highest educational level	p < 0.001	p < 0.001	p < 0.001	
No education	2.5	0.5	3.0	4566
Primary	2.5	0.7	3.2	5636
Secondary	4.2	1.2	5.4	93772
Higher or above	5.8	2.1	7.9	8249
Marital Status	p < 0.001	p = 0.771	p = 0.771	
Never Married	4.0	1.2	5.3	100999
Married	5.5	1.4	6.8	11068
Widowed	3.5	2.2	5.7	156
Number of children ever born	p < 0.001	0.555	0.555	
Zero	4.1	1.2	5.4	107981
1+	5.6	1.2	6.9	4242
Place of residence	p < 0.001	p < 0.001	p < 0.001	
Urban	6.7	2.2	8.9	31207
Rural	3.2	0.9	4.1	81016
Wealth index	p < 0.001	p < 0.001	p < 0.001	
Poorest	1.8	0.4	2.2	25035
Poorer	2.7	0.6	3.4	25770
Middle	4.4	1.0	5.5	23752
Richer	5.6	1.7	7.4	21000
Richest	7.8	3.1	10.9	16667
Sanitation facility	p < 0.001	p < 0.001	p < 0.001	
Improved sanitation	4.7	1.4	6.1	83949
Unimproved sanitation	3.5	1.0	4.5	2597
Open defecation	2.2	0.6	2.9	23112
Religion	p < 0.001	p = 0.052	p = 0.052	
Hindu	3.8	1.2	5.0	90050
Muslim	5.6	1.3	6.9	17406
Christian	7.0	1.9	9.0	2245
Others	4.4	1.7	6.1	2522
Ethnicity	p < 0.001	p < 0.001	p < 0.001	
SC	3.6	1.0	4.6	25911
ST	2.4	0.6	2.9	10746
OBC	4.0	1.1	5.1	49352
None	6.1	2.1	8.2	21046

	Overweight BMI - women	Obese BMI - women	Overweight or obese BMI - women	*N*
India Region	p < 0.001	p < 0.001	p < 0.001	
North	3.9	1.0	4.9	15838
NE	3.4	1.0	4.4	31881
East	3.5	1.4	5.0	4900
West	5.7	1.6	7.2	8629
Central	3.0	0.7	3.7	33055
South	7.4	2.7	10.1	17921
N	**4.2**	**1.2**	**5.4**	**112223**

The table 4.2 shows various demographic and socioeconomic factors that are potentially associated with obesity among adolescent women in India, with varied statistical significance level. The result is organized into several categories, including age of adolescent, highest education level, marital status, number of children born, place of residence, wealth index, sanitation facility, religion, ethnicity, and region. For each category, the table presents the prevalence of overweight and obesity among women, by three categories of BMI: overweight, obese and overweight and obese for each demographic factor.

The prevalence of overweight and obese BMI significantly increases with age. As table 4.2 shows that at age 15, 3.1% of adolescent women are overweight, and 0.9% are obese. At age 19, the numbers increase to 5.4% and 1.9%, respectively. The combined prevalence of overweight or obese BMI rises from 3.9% at age 15 to 7.3% at age 19, indicating a general trend of increasing weight-related issues with age.

The educational level, which is divided into four categories: no education, primary, secondary, and higher and above, women with higher educational levels tend to have a higher prevalence of overweight or obese BMI. For instance, those with a higher education or above have a combined prevalence of 7.9%, compared to 3.0% for those with no education. This suggests a positive association between educational attainment and overweight or obesity risk, possibly due to lifestyle factors associated with higher education.

The number of children ever born is significantly associated with overweight or obese BMI ($p< 0.001$). Women with 1 or more children have a higher combined prevalence (6.9%) compared to those with zero/no children (5.4%). Childbearing and family responsibilities may contribute to changes in weight and BMI among women.

Women in urban areas have a significantly higher prevalence of overweight or obese BMI (8.9%) compared to rural areas (4.1%, $p < 0.001$). Urban settings may offer more access to processed and high-calorie foods, leading to higher rates of overweight and obesity.

The wealth index is significantly associated with overweight or obese BMI ($p < 0.001$). The prevalence increases with wealth, ranging from 2.2% for the poorest to 10.9% for the richest, higher economic status may lead to better access to energy-dense foods and sedentary lifestyles, contributing to increased overweight and obesity.

Improved sanitation facilities are associated with a significantly higher prevalence of overweight or obese BMI (6.1%, $p < 0.001$) compared to unimproved sanitation (4.5%) and

open defecation (2.9%). This association may indicate better living conditions and potential lifestyle factors that contribute to overweight and obesity.

Religion shows a significant association with overweight or obese BMI ($p < 0.001$), with the highest prevalence among Christian women (9.0%) and the lower among Muslim women (6.9%) whereas, Hindu women are at lowest with (5.0%). Religious and cultural practices might influence dietary habits and physical activity levels, contributing to the differences.

Ethnicity is significantly associated with overweight or obese BMI ($p < 0.001$). Women categorized as "None" have the highest prevalence (8.2%), followed by OBC (5.1%), SC (4.6%), and ST (2.9%). Ethnicity-based dietary practices and lifestyle factors may influence variations in overweight and obesity rates.

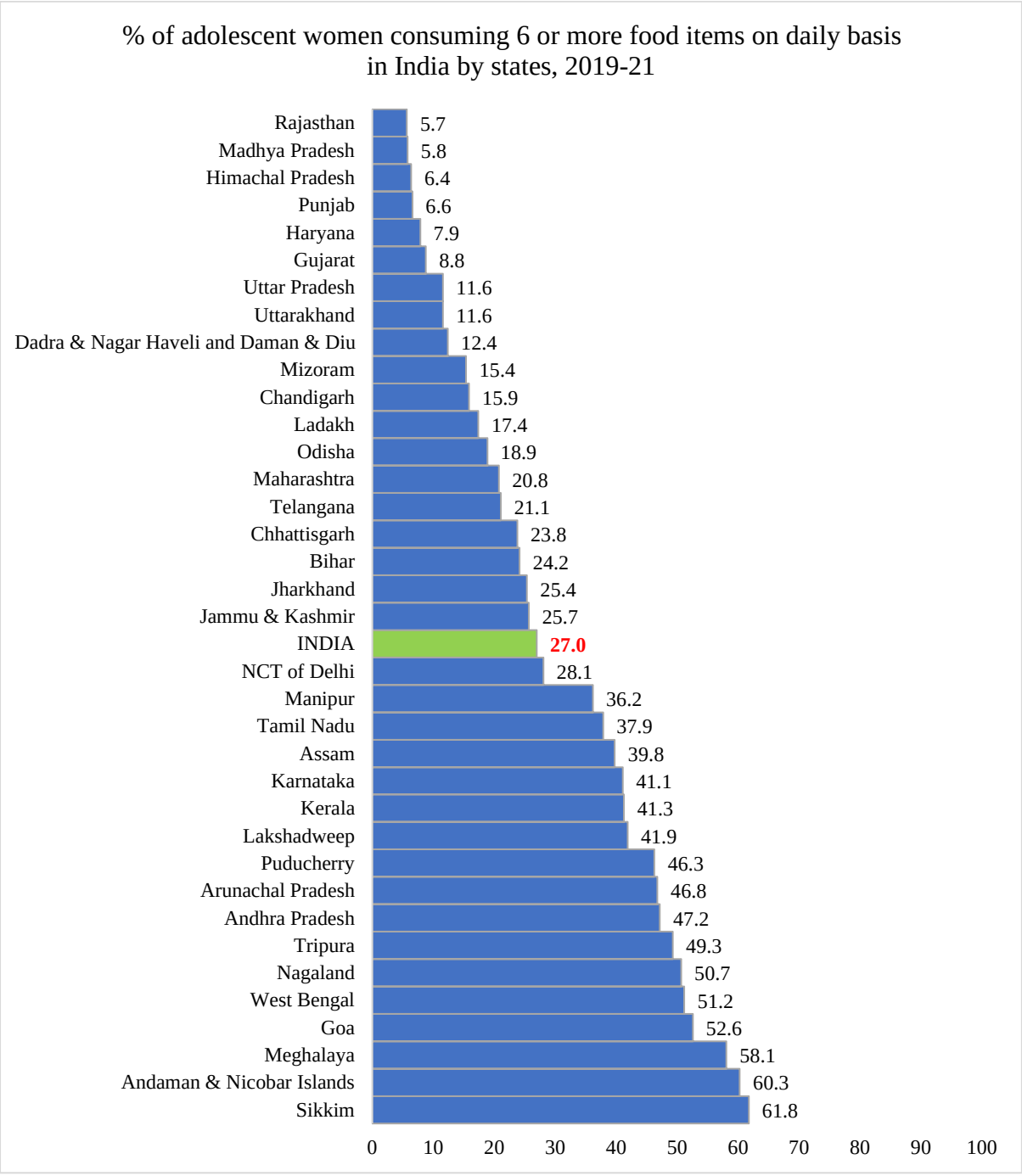
Region is significantly associated with overweight or obese BMI ($p < 0.001$). The southern region of India has the highest prevalence (10.1%), while the central region has the lowest (3.7%). Regional differences in dietary habits, cultural practices, and lifestyle choices can contribute to the observed variations.

Table 4.3: Percentage of moderately/severely thin women reporting consuming food items on daily or weekly by states in India, 2019-21

States	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Jammu & Kashmir	82.9	85.3	88.9	42.7	31.3	38.1	19.1	42.9	25.7
Himachal Pradesh	84.6	98.5	93.8	43.5	40.4	11.7	1.1	5.7	6.4
Punjab	84.5	89.3	92.0	31.6	15.4	20.4	8.0	13.3	6.6
Chandigarh	94.3	98.5	100.0	31.6	32.4	15.9	3.8	15.9	15.9
Uttarakhand	56.8	97.1	87.3	41.2	10.7	29.1	14.2	17.5	11.6
Haryana	88.8	94.5	93.8	43.8	29.8	13.0	4.3	10.8	7.9
NCT of Delhi	78.2	93.6	92.8	61.0	31.6	55.8	23.1	35.3	28.1
Rajasthan	83.7	92.8	91.2	38.7	19.4	10.8	4.1	6.5	5.7
Uttar Pradesh	72.9	93.8	92.0	50.9	14.9	28.4	15.7	18.7	11.6
Bihar	64.5	93.7	89.6	47.7	29.2	39.5	35.6	34.4	24.2
Sikkim	88.7	99.1	92.5	50.7	60.0	79.2	49.3	78.7	61.8
Arunachal Pradesh	63.9	83.7	96.3	64.6	34.7	69.3	56.5	64.2	46.8
Nagaland	77.8	60.1	96.5	65.3	38.9	54.5	53.4	60.7	50.7
Manipur	47.2	85.0	98.5	62.5	28.4	68.4	66.2	55.7	36.2
Mizoram	34.9	56.2	97.4	81.5	6.6	56.6	15.9	48.1	15.4
Tripura	48.3	79.0	93.5	81.2	31.5	84.5	93.7	83.5	49.3
Meghalaya	49.6	81.4	86.5	84.9	31.4	78.4	71.5	66.8	58.1
Assam	53.6	89.5	83.3	78.3	35.7	72.0	78.1	62.1	39.8
West Bengal	58.2	96.4	97.8	67.7	25.5	89.2	87.1	69.0	51.2
Jharkhand	63.9	97.8	99.6	47.3	13.7	54.5	44.2	40.8	25.4
Odisha	37.0	93.2	99.4	55.4	11.5	61.8	67.2	50.6	18.9
Chhattisgarh	46.2	93.0	99.6	41.4	14.7	41.1	33.4	34.6	23.8
Madhya Pradesh	67.1	98.7	93.3	39.1	10.7	21.5	6.7	9.5	5.8
Gujarat	72.7	89.9	87.4	39.3	28.1	19.6	14.6	19.3	8.8
Dadra & Nagar Haveli and Daman & Diu	63.3	98.4	94.2	14.5	18.0	27.9	31.1	28.7	12.4
Maharashtra	72.4	88.1	80.4	35.0	17.8	53.7	33.6	44.6	20.8

States	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Andhra Pradesh	92.4	94.8	80.1	44.4	29.7	82.0	53.3	79.2	47.2
Karnataka	95.6	96.2	98.0	48.3	31.5	67.9	33.7	57.0	41.1
Goa	66.2	95.5	95.8	59.9	51.7	74.9	92.8	28.1	52.6
Lakshadweep	76.1	100.0	47.5	46.7	31.2	52.6	94.6	76.2	41.9
Kerala	74.9	83.7	58.7	61.2	23.7	72.5	89.1	51.3	41.3
Tamil Nadu	85.8	88.7	80.5	45.2	16.9	76.8	59.5	58.2	37.9
Puducherry	86.2	76.3	71.7	51.0	10.3	82.6	75.3	70.8	46.3
Andaman & Nicobar Islands	58.9	100.0	100.0	43.6	38.2	96.9	85.1	77.1	60.3
Telangana	84.4	90.5	70.9	31.2	16.3	71.5	16.2	66.1	21.1
Ladakh	88.4	89.9	80.9	54.4	31.0	31.1	9.8	28.0	17.4
N	**74.0**	**92.3**	**88.4**	**48.3**	**21.6**	**53.8**	**39.9**	**42.7**	**27.0**

Graph 4.4: Percentage of moderately/severely thin adolescent women by state, 2019-21, India



The table 4.3 provides categorical information on various food consumption among women by states of India, 2019-21.

The percentage of women who consume milk or curd ranges from 34.9% in Mizoram to 94.3% in Chandigarh, with a national average of 74%.

The proportion of women who consume pulses or beans varies from 60.1% in Nagaland to 100% in Chandigarh and Andaman & Nicobar Islands, with an overall average of 92.3%, while the consumption of dark green leafy vegetables ranges from 47.5% in Lakshadweep to 100% in Chandigarh and Andaman & Nicobar Islands, with an average of 88.4% across the country.

On the other hand, the prevalence of fried food consumption varies from 31.2% in Telangana to 81.5% in Mizoram, with a national average of 48.3%. and the percentage of women who consume aerated drinks ranges from 6.6% in Mizoram to 96.9% in Andaman & Nicobar Islands, with an overall average of 21.6%.

These categories indicate the consumption of eggs, fish, and chicken or meat, respectively. The data shows varying proportions of consumption across states, with Andaman & Nicobar Islands, Sikkim, and Nagaland having higher percentages for these food items.

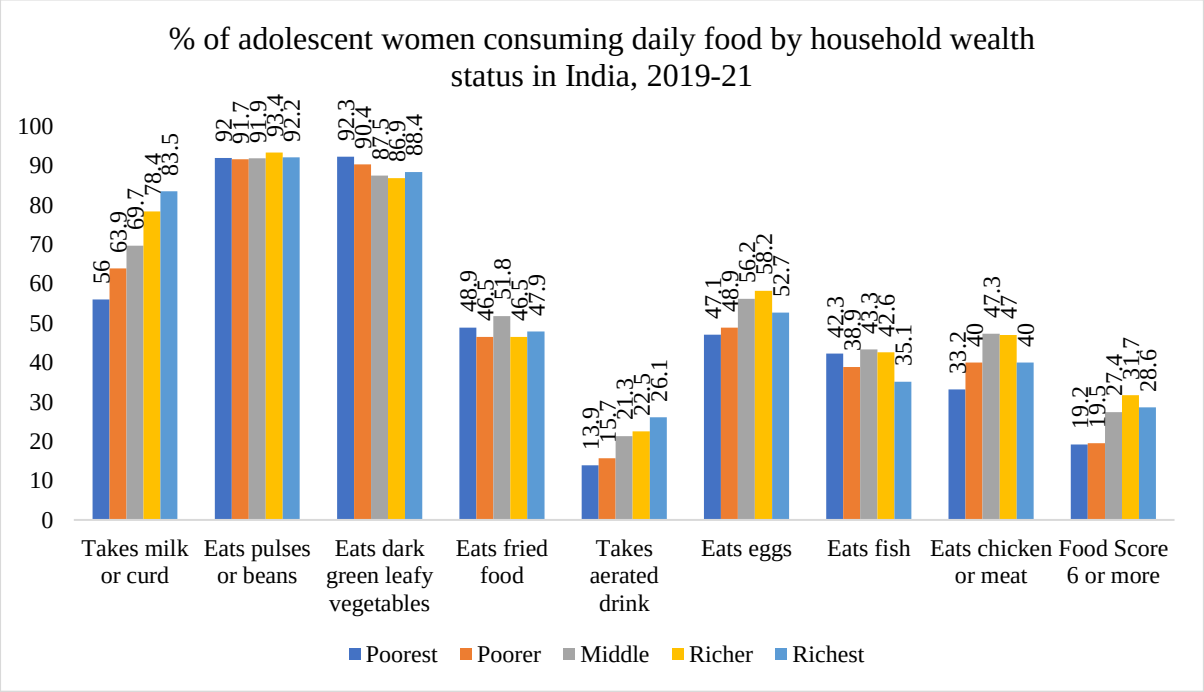
Food score 6 or more: This category represents the percentage of women who found to have food score of 6 or more. Chandigarh has the highest prevalence of a food score of 6 or more, with 15.9% of women meeting this criterion. Other states with high prevalence include Sikkim (61.8%), Andaman & Nicobar Islands (60.3%), and Tripura (49.3%). Whereas, Mizoram has the lowest prevalence of a food score of 6 or more, with only 15.4% of women meeting this criterion. Other states with low prevalence include Dadra & Nagar Haveli and Daman & Diu (12.4%), Odisha (18.9%), and Chhattisgarh (23.8%)

Table 4.4: Percentage of overweight and obese women reporting consuming food items on daily or weekly by states in India, 2019-21

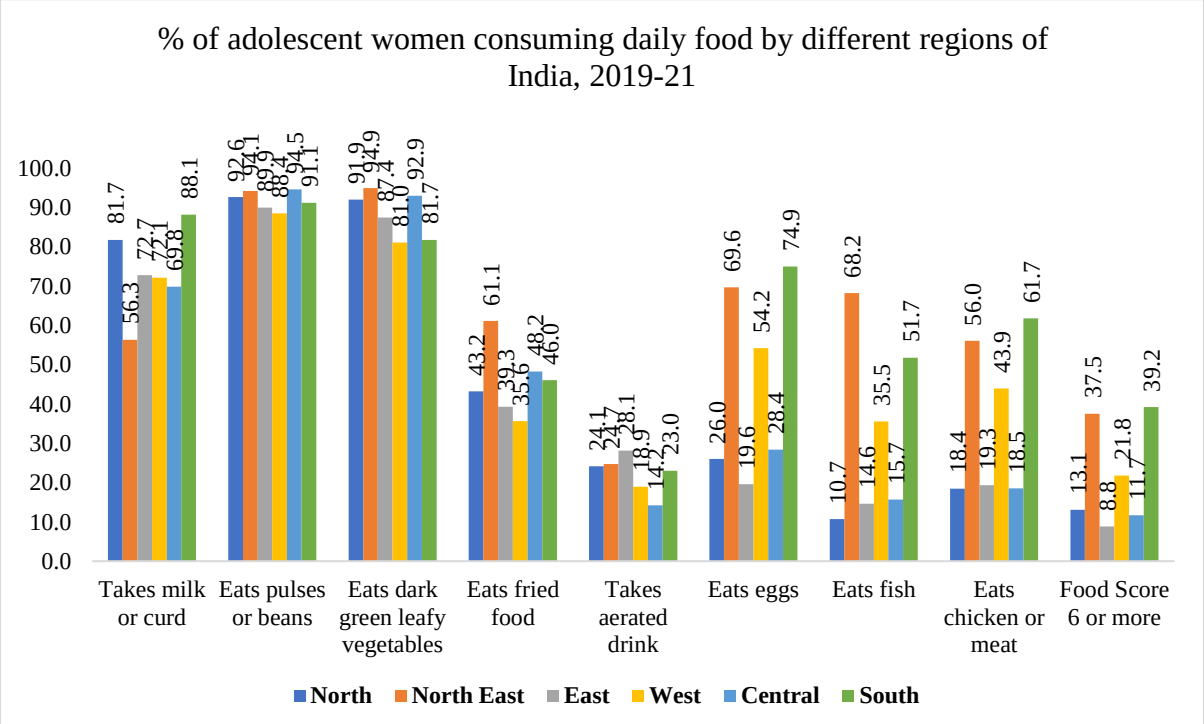
	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Age of Adolescent									
15	69.5	91.8	86.8	46.5	21.4	56.6	38.9	41.3	24.4
16	76.9	93.4	87.8	47.6	20.8	50.1	37	39.6	25.7
17	72	92.6	88.4	49.3	22.4	54.6	41.5	43.1	27
18	75.3	92.2	91.5	51.1	21.6	50.6	40.3	41.7	26.8
19	75.2	91.8	87.2	46.4	21.4	56.9	41	46.5	29.7
Educational Status									
No Education	69.3	94.7	87.5	38.6	16.4	43.7	33.4	41.2	20.8
Primary	59.5	88.6	87.4	47	16.3	42.3	31.2	37.7	20.1
Secondary	73.9	92.2	88.6	48.6	21.8	54.2	40.4	43	27.3
Higher	79	94.1	88	48.3	22.1	56.1	40	41.9	28
Marital Status									
Never Married	74.8	92.4	88	48	22	52.2	38.2	41.1	26.2
Married	68.2	92	91.5	49.5	18.4	64.8	51.8	53.6	31.9
Widowed	72.8	95.6	100	75.3	48.8	86.9	46.6	60.4	65.3
Number of children ever born									
Zero	74.1	92.3	88.2	48.3	22	53.1	39.1	42.0	26.6
1+	70.1	93.1	94.1	48.3	12.1	67.5	57.4	56.4	33.8
Place of Residence									
Urban	79.2	93.1	88	50.5	25.2	59.7	41.2	47.2	31.4
Rural	69.6	91.7	88.8	46.4	18.5	48.9	38.9	39.0	23.2
Wealth Index									
Poorest	56	92	92.3	48.9	13.9	47.1	42.3	33.2	19.2
Poorer	63.9	91.7	90.4	46.5	15.7	48.9	38.9	40	19.5
Middle	69.7	91.9	87.5	51.8	21.3	56.2	43.3	47.3	27.4
Richer	78.4	93.4	86.9	46.5	22.5	58.2	42.6	47	31.7

	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Richest	83.5	92.2	88.4	47.9	26.1	52.7	35.1	40	28.6
Sanitation Facility									
Improved sanitation	75.3	92.5	88.5	48.6	22.3	54.9	41	43.5	28.4
Unimproved sanitation	72.6	91.2	95	54.2	28.9	53.8	40.6	45	34.4
Open defecation	66.1	91.3	86.5	43.5	13.8	46.1	31.7	37.1	15.4
Religion									
Hindu	74.7	93.4	89.9	47.8	20.4	50	36.9	38.1	24.8
Muslim	69.3	89.2	84.6	51.7	24.8	69.9	52.4	59.2	34.9
Christian	77.9	87.7	80.7	45.9	30.8	69.3	59.9	69.9	44.8
Others	82.2	93.3	86.4	37.6	18.2	19.2	6.6	14.2	5.9
Ethnicity									
SC	75.2	94	88.5	48.9	20.9	56.4	42.9	47.8	30.4
ST	57.3	88.5	91.4	46.2	18.1	47.7	32.9	38.2	20.3
OBC	77.6	92.2	89	49	20.1	53.9	39.4	43.5	28.4
None	73.2	92.2	87.2	47	23.9	50.2	35.2	36.9	23.5
Region									
North	81.7	92.6	91.9	43.2	24.1	26	10.7	18.4	13.1
North East	56.3	94.1	94.9	61.1	24.7	69.6	68.2	56	37.5
East	72.7	89.9	87.4	39.3	28.1	19.6	14.6	19.3	8.8
West	72.1	88.4	81	35.6	18.9	54.2	35.5	43.9	21.8
Central	69.8	94.5	92.9	48.2	14.2	28.4	15.7	18.5	11.7
South	88.1	91.1	81.7	46	23	74.9	51.7	61.7	39.2
N	**74**	**92.3**	**88.4**	**48.3**	**21.6**	**53.8**	**39.9**	**42.7**	**27**

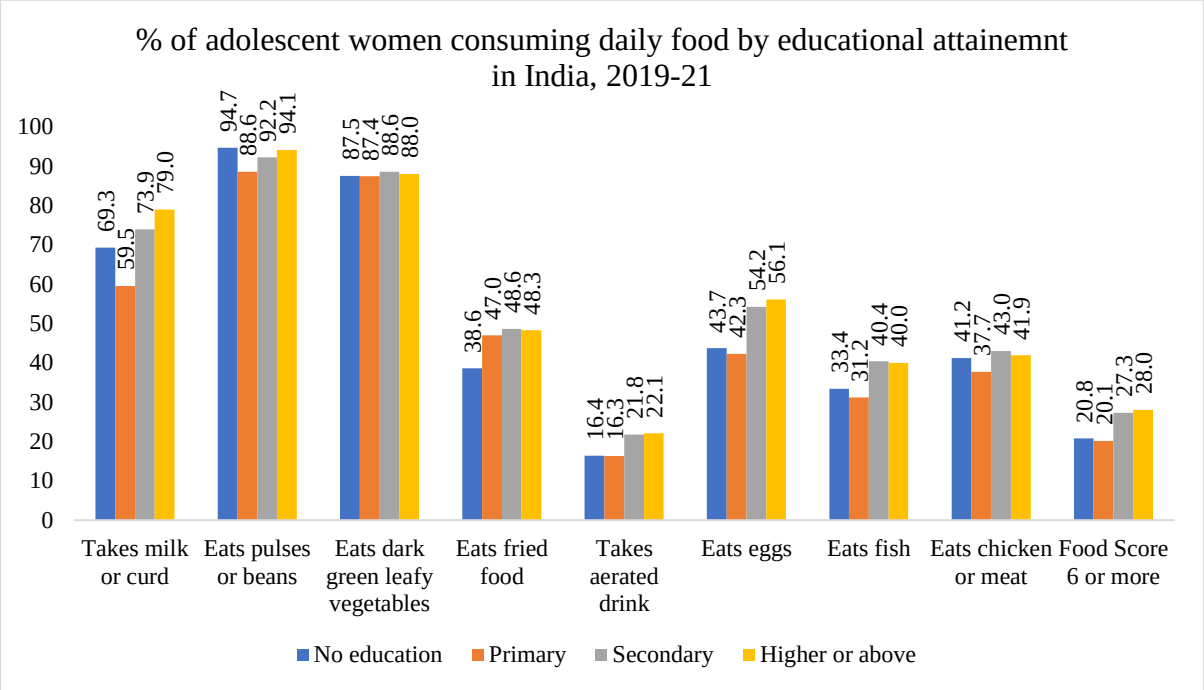
Graph 4.5: Percentage of overweight and obese adolescent women by state, 2019-21, India



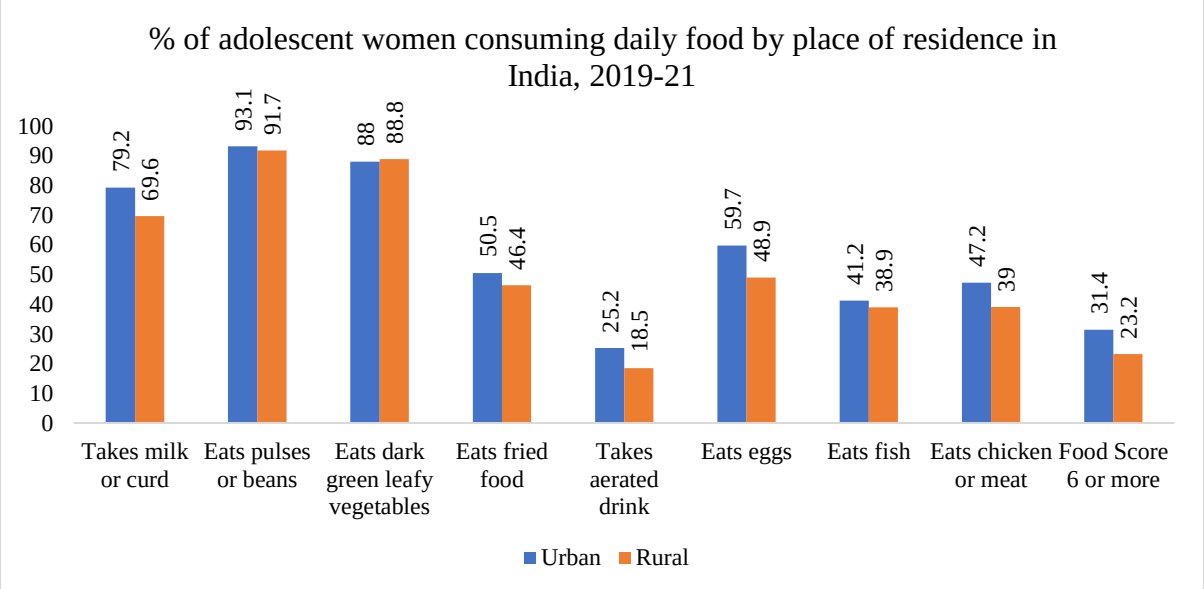
Graph 4.6: Percentage of overweight and obese adolescent women by state, 2019-21, India



Graph 4.7: Percentage of overweight and obese adolescent women by state, 2019-21, India



Graph 4.8: Percentage of overweight and obese adolescent women by place of residence, 2019-21, India



The table 4.4 provides valuable insights into consuming various food items by background characteristics in India, 2019-21. These food items were in terms of consuming various food items on a daily or weekly basis. It was converted into binary as explained in chapter 2. The table also includes additional breakdowns based on adolescent women' age, education level, marital status, number of children ever born, place of residence, wealth index, sanitation facilities, religion, ethnicity, and region.

The percentage of women taking milk or curd daily or weekly ranges vary in different age groups from 69.5% (age 15) to 75.2% (age 19). The percentage of women with a Food Score of 6 or more ranges from 24.4% (age 15) to 29.7% (age 19).

The percentages of overweight and obese women consuming certain food items differ based on their background characteristics such as educational attainment [Graph 4.7], marital status, caste, religion, region [Graph 4.6], place of residence [Graph 4.8] and household economic status [Graph 4.5]. The adolescent women aged 15-19 years were more likely to consume the WHO recommended food items compared to their counterpart adolescent women who belong to lower socio-economic status. The percentage of women with higher education or above, who eat eggs, is 56.1% compared to 42.3% for women with primary education. Other socio-demographic characteristics like wealth index were statistically significantly associated with types of food items consumed. The 14 percent poorest adolescent compared to about 22.5 percent richer adolescent women were consuming the aerated drinks related items in India. Notably, the 61.7 percent women living in south region were consuming meats compared to 18.4 percent women living in north. Similarly, by the religion.

The percentage of women consuming eggs ranges from 47.1% (poorest wealth index combined) to 58.2% among richer adolescent women in India, 2019-21. The percentage of women consuming fish ranges from 38.2% (never married) to 46.6% (widowed). The percentage of women consuming chicken or meat ranges from 42.0% (zero children) to 56.4% (1 or more children). The percentage of women consuming milk or curd ranges from 39.0% (rural) to 47.2% (urban). The percentage of women consuming dark green leafy vegetables ranges from 88.4% (richest) to 90.4% (poorer). The percentage of women consuming fried food ranges from 48.6% (improved sanitation) to 54.2% (unimproved sanitation). The percentage of women consuming fish ranges from 36.9% (Hind) to 59.9% (Christian).

Table 4.5: OR of consuming food items among overweight/obese adolescent women in India, 2019-21

	takes milk or curd	eats pulses or beans	eats dark green leafy vegetables	eats fried food	takes aerated drink	eats eggs	eats fish	eats chicken or meat	Food Score 6 or more
Age of Adolescent									
15 [Ref.]	1	1	1	1	1	1	1	1	1
16	1.42** [1.14,1.77]	1.27 [0.90,1.81]	0.99 [0.74,1.31]	1.05 [0.88,1.27]	1.09 [0.87,1.37]	0.76* [0.62,0.94]	1.06 [0.86,1.30]	1.03 [0.84,1.27]	1.16 [0.93,1.45]
17	1.06 [0.86,1.30]	1.05 [0.76,1.46]	1.01 [0.77,1.34]	1.11 [0.93,1.33]	1.15 [0.93,1.43]	0.9 [0.74,1.11]	1.15 [0.94,1.41]	1.14 [0.93,1.39]	1.12 [0.90,1.39]
18	1.28* [1.03,1.58]	0.96 [0.68,1.34]	1.3 [0.97,1.76]	1.19 [0.99,1.43]	1.19 [0.95,1.49]	0.72** [0.59,0.89]	1.24* [1.01,1.53]	1.07 [0.87,1.32]	1.2 [0.96,1.49]
19	1.13 [0.90,1.42]	0.88 [0.62,1.25]	0.84 [0.62,1.13]	0.98 [0.81,1.19]	1.17 [0.92,1.49]	0.88 [0.71,1.10]	1.17 [0.94,1.46]	1.25* [1.00,1.55]	1.32* [1.05,1.67]
Educational Status									
No Education [Ref.]	1	1	1	1	1	1	1	1	1
Primary	0.63 [0.38,1.03]	0.36* [0.15,0.87]	0.79 [0.40,1.57]	1.23 [0.77,1.95]	0.84 [0.45,1.55]	0.78 [0.47,1.30]	0.62 [0.36,1.07]	0.69 [0.41,1.16]	0.69 [0.38,1.26]
Secondary	0.86 [0.58,1.27]	0.58 [0.27,1.25]	1.29 [0.75,2.22]	1.46* [1.02,2.09]	1.01 [0.63,1.62]	1.07 [0.72,1.59]	0.83 [0.54,1.25]	0.67* [0.45,0.99]	0.86 [0.55,1.36]
Higher and above	0.79 [0.51,1.24]	0.85 [0.36,2.00]	1.54 [0.84,2.84]	1.72** [1.15,2.58]	0.94 [0.56,1.58]	1.22 [0.78,1.89]	0.83 [0.52,1.32]	0.63* [0.41,0.99]	0.81 [0.49,1.34]
Marital Status									
Never Married [Ref.]	1	1	1	1	1	1	1	1	1
Married	0.87 [0.68,1.11]	1.04 [0.71,1.52]	1.29 [0.90,1.84]	1.01 [0.82,1.26]	1.02 [0.78,1.32]	1.42** [1.11,1.82]	1.02 [0.80,1.30]	1.33* [1.05,1.68]	1.08 [0.84,1.39]
Widowed	1.01 [0.19,5.38]	1.92 [0.08,48.02]	1 [1.00,1.00]	4.18 [0.80,21.80]	3.64 [0.86,15.39]	6.45 [0.65,64.28]	0.73 [0.16,3.38]	1.64 [0.34,8.00]	5.56* [1.16,26.75]
Number of Children ever born									
Zero [Ref.]	1	1	1	1	1	1	1	1	1
1+	1.57* [1.08,2.30]	1.09 [0.61,1.94]	1.56 [0.86,2.85]	0.98 [0.71,1.35]	0.42*** [0.26,0.67]	1.02 [0.70,1.47]	1.19 [0.84,1.70]	1.08 [0.76,1.53]	1.03 [0.72,1.48]
Place of residence									
Urban [Ref.]	1	1	1	1	1	1	1	1	1
Rural	0.87 [0.75,1.01]	0.67** [0.53,0.85]	0.83 [0.69,1.02]	0.76*** [0.67,0.86]	0.83* [0.72,0.97]	0.63*** [0.54,0.72]	0.84* [0.73,0.96]	0.68*** [0.59,0.78]	0.74*** [0.64,0.85]
Wealth Index									

	takes milk or curd	eats pulses or beans	eats dark green leafy vegetables	eats fried food	takes aerated drink	eats eggs	eats fish	eats chicken or meat	Food Score 6 or more
Poorest [Ref.]	1	1	1	1	1	1	1	1	1
Poorer	1.28* [1.01,1.63]	1.06 [0.69,1.62]	1.17 [0.77,1.76]	1.18 [0.94,1.49]	1.33 [0.96,1.85]	1.24 [0.96,1.61]	1.17 [0.89,1.53]	2.01*** [1.53,2.63]	1.51** [1.11,2.07]
Middle	1.30* [1.03,1.64]	1.1 [0.73,1.65]	1.05 [0.71,1.54]	1.45** [1.16,1.81]	1.73*** [1.27,2.35]	1.39** [1.09,1.79]	1.30* [1.01,1.68]	2.22*** [1.72,2.88]	2.09*** [1.56,2.80]
Richer	1.85*** [1.44,2.36]	1.32 [0.86,2.02]	1.2 [0.81,1.78]	1.28* [1.02,1.61]	1.79*** [1.30,2.46]	1.60*** [1.24,2.07]	1.49** [1.15,1.94]	2.19*** [1.68,2.86]	2.76*** [2.04,3.73]
Richest	2.52*** [1.93,3.28]	1.06 [0.68,1.66]	1.27 [0.84,1.92]	1.28* [1.01,1.63]	2.25*** [1.62,3.12]	1.63*** [1.24,2.13]	1.44* [1.09,1.90]	2.01*** [1.52,2.67]	2.91*** [2.13,3.99]
Religion									
Hindu [Ref.]	1	1	1	1	1	1	1	1	1
Muslim	0.85 [0.71,1.00]	0.55*** [0.43,0.70]	0.60*** [0.48,0.74]	1.14 [0.98,1.32]	1.24* [1.04,1.47]	3.39*** [2.85,4.03]	2.23*** [1.89,2.64]	3.32*** [2.82,3.92]	2.08*** [1.76,2.46]
Christian	0.78 [0.52,1.15]	0.55* [0.35,0.87]	0.73 [0.49,1.09]	0.86 [0.63,1.17]	1.29 [0.92,1.81]	1.01 [0.72,1.43]	1.70*** [1.24,2.34]	2.33*** [1.65,3.29]	1.43* [1.05,1.96]
Others	1.31 [0.84,2.05]	1 [0.51,1.97]	0.53* [0.32,0.88]	0.78 [0.55,1.11]	0.76 [0.49,1.18]	0.51** [0.33,0.79]	0.29*** [0.14,0.57]	0.58* [0.36,0.95]	0.35** [0.18,0.71]
Ethnicity									
SC [Ref.]	1	1	1	1	1	1	1	1	1
ST	0.66** [0.50,0.88]	0.54** [0.35,0.83]	1.27 [0.81,1.99]	0.92 [0.71,1.20]	0.92 [0.66,1.29]	0.81 [0.60,1.08]	0.53*** [0.39,0.72]	0.67** [0.50,0.91]	0.64** [0.46,0.89]
OBC	1.11 [0.93,1.32]	0.81 [0.61,1.09]	1.14 [0.90,1.43]	0.97 [0.84,1.12]	0.86 [0.72,1.03]	0.64*** [0.55,0.76]	0.68*** [0.58,0.80]	0.63*** [0.53,0.74]	0.71*** [0.60,0.84]
None	0.96 [0.79,1.16]	0.82 [0.59,1.13]	0.77 [0.60,1.01]	0.85 [0.72,1.00]	0.99 [0.81,1.21]	0.63*** [0.53,0.76]	0.60*** [0.50,0.73]	0.51*** [0.42,0.61]	0.56*** [0.46,0.69]
Region									
North [Ref.]	1	1	1	1	1	1	1	1	1
North East	0.43*** [0.34,0.54]	1.46 [0.98,2.17]	1.57* [1.06,2.33]	2.22*** [1.82,2.71]	1.37** [1.09,1.73]	7.03*** [5.61,8.81]	16.82*** [12.76,22.18]	6.56*** [5.16,8.34]	5.53*** [4.24,7.20]
East	0.66* [0.47,0.94]	0.76 [0.45,1.29]	0.52** [0.32,0.83]	0.82 [0.60,1.12]	1.19 [0.84,1.67]	0.62* [0.42,0.91]	1.32 [0.85,2.05]	0.97 [0.66,1.43]	0.59* [0.36,0.99]
West	0.71* [0.54,0.94]	0.62* [0.42,0.93]	0.41*** [0.28,0.58]	0.72** [0.57,0.91]	0.60*** [0.45,0.80]	3.12*** [2.43,4.00]	4.05*** [3.00,5.46]	2.93*** [2.25,3.82]	1.68*** [1.23,2.28]
Central	0.68** [0.54,0.86]	1.57* [1.05,2.32]	1.08 [0.75,1.56]	1.29* [1.06,1.57]	0.62*** [0.49,0.80]	1.24 [0.99,1.55]	1.52** [1.14,2.03]	0.99 [0.77,1.28]	1.02 [0.76,1.36]

	takes milk or curd	eats pulses or beans	eats dark green leafy vegetables	eats fried food	takes aerated drink	eats eggs	eats fish	eats chicken or meat	Food Score 6 or more
South	1.92*** [1.50,2.47]	0.77 [0.54,1.10]	0.32*** [0.23,0.44]	1.04 [0.86,1.26]	1.02 [0.82,1.27]	9.31*** [7.50,11.56]	8.20*** [6.30,10.66]	6.89*** [5.48,8.65]	4.20*** [3.27,5.41]
N	**5,209**	**5,209**	**5,198**	**5,209**	**5,209**	**5,209**	**5,209**	**5,209**	**5,209**

4.5 Result from Logistic Regression

The table 4.5 shows the data on various factors related to food consumption habits and their scores. The data on frequency of food items consumed was on 4 scale [Never, daily, weekly, and occasionally]. The frequency of food items consumed daily or weekly was recoded as Yes = 1 otherwise No = 0.

The table show the odds ratio of adolescent women consuming specific food item. The 95% confidence interval of the OR is presented in parenthesis. The odds of consuming milk or curd product was significantly higher at age of 16 years [OR: 1.42, p< 0.001] compared to their counterpart overweight/obese adolescent women aged 15 years. Similarly, the odds of consuming pulses and beans were statistically significantly higher among 16 years age overweight/obese adolescent women [OR: 1.27, p< 0.001] compared to their counterpart overweight/obese aged 15 years and 17, 18 and 19 years. The values in these rows indicate the estimated effect sizes or odds ratios for each category compared to the reference category (usually indicated as 1 or the first category).

Overall, the table provides information on the relationship between various factors and daily food consumption habits, allowing for comparisons between different groups or categories. The effect sizes and confidence intervals help assess the strength and precision of the associations. The asterisks indicate the statistical significance of the estimates.

The odds of consuming milk, curd product was higher at the age of 16 and 18 years old overweight/obese adolescent women (OR: 1.42, p<0.01) and (OR: 1.28, p<0.05) compared to those adolescents of aged 15 respectively. However, those who were non-vegetarian, overweight/obese adolescent women aged 16 years were more likely to consume fish (OR: 1.24 [1.01,1.53], p<0.05) compared to those of aged 15 years old thin adolescent. The result of logistic regression among overweight/obese adolescent women were significantly estimating the odds of consuming food items for fried food and fish items when controlling educational attainment. Additionally, the odds of fried food items was higher among overweight/obese adolescent women having education with higher and above (OR: 1.72 [1.15,2.58], p<0.01). Notably, obese/overweight secondary educated adolescent women those who eat non-vegetarian food items on daily basis were less (OR: 0.67* [0.45,0.99], p<0.05) likely to consume chicken or meat compared to those with illiterate. The odds of consuming pulses or beans, dark green leafy vegetables, eggs, fish were less likely in rural than their counterpart adolescent women residing in urban India. The household economic status and place of residence were found to estimate its effect on consumption of the recommended daily food items in India and

similar settings. The wealth quintile was statistically significantly associated with consumption of the type of food items. The richer adolescent women were more likely to consume the milk and other WHO recommended daily food items compared to those of poorest. The odds of consuming any 6 daily food items were statistically significantly higher among richer (OR: 1.85*** [1.44,2.36], p<0.001) compared to those who were poorest in India, 2019-21. The similar pattern were noted when it controlled for aerated drinks, eggs, fish and chicken or meat. The Muslims (OR: 2.23*** [1.89,2.64], p<0.001) and Christian (OR: 1.70*** [1.24,2.34], p<0.001) were more likely to consume non-vegetarian food items on daily basis compared to those who follow Hindu religion in India, 2019-21. Similarly, the obese/overweight adolescent women from South India were more likely to consume non-vegetarian food items on daily basis compared to North region in India.

Table 3.6: OR of consuming food items among overweight/obese women by place of residence combined wealth, ethnicity, and religions in India, 2019-21

	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
Wealth Residence Combined									
Urban Poorest [Ref.]	1	1	1	1	1	1	1	1	1
Urban Poorer	2.05* [1.02,4.14]	0.46 [0.06,3.43]	1.35 [0.45,4.00]	0.74 [0.38,1.46]	3.20* [1.02,10.02]	1.81 [0.91,3.60]	0.78 [0.40,1.55]	2.73** [1.34,5.55]	1.42 [0.61,3.27]
Urban Middle	1.46 [0.80,2.67]	0.27 [0.04,1.74]	0.98 [0.39,2.47]	0.76 [0.42,1.39]	3.99* [1.37,11.66]	1.58 [0.86,2.90]	0.72 [0.39,1.30]	2.35** [1.24,4.43]	1.96 [0.93,4.14]
Urban Richer	3.80*** [2.09,6.91]	0.48 [0.08,3.06]	0.93 [0.38,2.28]	0.73 [0.41,1.32]	3.13* [1.08,9.07]	1.87* [1.04,3.36]	0.75 [0.42,1.35]	2.26** [1.21,4.19]	2.62** [1.26,5.45]
Urban Richest	4.37*** [2.43,7.85]	0.33 [0.05,2.03]	1.09 [0.45,2.65]	0.73 [0.41,1.30]	4.82** [1.68,13.85]	1.48 [0.83,2.64]	0.59 [0.33,1.05]	1.74 [0.94,3.20]	2.26* [1.09,4.67]
Rural Poorest	0.96 [0.53,1.74]	0.29 [0.05,1.85]	1.47 [0.58,3.73]	0.57 [0.32,1.04]	1.93 [0.66,5.70]	0.76 [0.42,1.39]	0.55 [0.30,1.01]	0.83 [0.44,1.58]	0.86 [0.40,1.83]
Rural Poorer	1.47 [0.82,2.65]	0.27 [0.04,1.72]	1.21 [0.49,3.00]	0.62 [0.34,1.11]	2.18 [0.75,6.34]	0.8 [0.44,1.44]	0.50* [0.28,0.90]	1.24 [0.67,2.31]	1.08 [0.52,2.27]
Rural Middle	2.01* [1.12,3.61]	0.3 [0.05,1.87]	0.86 [0.35,2.10]	0.74 [0.41,1.32]	2.91* [1.01,8.41]	1.16 [0.65,2.08]	0.65 [0.36,1.16]	1.73 [0.94,3.20]	1.64 [0.79,3.40]
Rural Richer	2.36** [1.31,4.26]	0.26 [0.04,1.66]	0.96 [0.39,2.37]	0.57 [0.32,1.02]	3.62* [1.25,10.48]	1.12 [0.62,2.01]	0.6 [0.34,1.08]	1.51 [0.81,2.81]	1.72 [0.82,3.58]
Rural Richest	3.70*** [1.98,6.91]	0.27 [0.04,1.72]	1.03 [0.41,2.60]	0.52* [0.28,0.94]	3.04* [1.04,8.92]	0.86 [0.47,1.57]	0.44** [0.24,0.81]	1.08 [0.57,2.04]	1.56 [0.73,3.31]
Religion									
Hindu [Ref.]	1	1	1	1	1	1	1	1	1
Muslim	0.79** [0.67,0.93]	0.55*** [0.43,0.69]	0.64*** [0.52,0.78]	1.1 [0.96,1.27]	1.18 [1.00,1.40]	2.50*** [2.15,2.91]	1.87*** [1.62,2.15]	2.67*** [2.30,3.09]	1.82*** [1.56,2.13]
Cristian	1.04 [0.72,1.50]	0.49** [0.31,0.77]	0.49*** [0.34,0.73]	0.85 [0.63,1.14]	1.47* [1.06,2.05]	2.15*** [1.56,2.97]	2.78*** [2.05,3.77]	4.08*** [2.93,5.68]	2.19*** [1.61,2.97]
Others	1.32 [0.85,2.03]	1 [0.52,1.92]	0.71 [0.44,1.14]	0.68* [0.48,0.96]	0.77 [0.50,1.18]	0.26*** [0.17,0.39]	0.14*** [0.07,0.26]	0.30*** [0.19,0.47]	0.19*** [0.10,0.38]
Ethnicity									
SC [Ref.]	1	1	1	1	1	1	1	1	1
ST	0.55*** [0.42,0.72]	0.56** [0.36,0.87]	1.37 [0.88,2.14]	0.94 [0.73,1.22]	0.93 [0.67,1.29]	0.75* [0.58,0.97]	0.61*** [0.46,0.80]	0.67** [0.51,0.88]	0.64** [0.46,0.87]

	Takes milk or curd	Eats pulses or beans	Eats dark green leafy vegetables	Eats fried food	Takes aerated drink	Eats eggs	Eats fish	Eats chicken or meat	Food Score 6 or more
OBC	1.06 [0.90,1.26]	0.85 [0.64,1.13]	1.12 [0.89,1.40]	0.99 [0.86,1.14]	0.86 [0.72,1.03]	0.75*** [0.65,0.87]	0.78*** [0.67,0.90]	0.70*** [0.61,0.82]	0.76*** [0.65,0.89]
None	0.71*** [0.59,0.86]	0.88 [0.64,1.21]	0.99 [0.77,1.26]	0.89 [0.76,1.05]	0.97 [0.80,1.18]	0.57*** [0.49,0.67]	0.63*** [0.53,0.74]	0.47*** [0.40,0.56]	0.52*** [0.44,0.63]
N	**5209**	**5209**	**5209**	**5209**	**5209**	**5209**	**5209**	**5209**	**5209**

4.6 Result of Interaction Models

The table 4.6 show the interaction effect between wealth status and place of residence controlling religion and ethnicity of overweight/obese adolescent women in India, 2019-21. The place of residence and wealth status was considered to have the interaction effect because, the residence is the proxy of availability of preferred daily food items [availability] while, on the other hand, wealth status triggers the accessibility of the food. The table shows that the odds of consuming milk and curd product was significantly higher among urban poorer [OR: 2.05, $p<0.05$] compared to their counterpart adolescent women from urban poorest. It is important to note that the urban richer [OR: 3.80, $p< 0.001$] and richest [4.37, $p<0.001$] overweight/obese adolescent women were more likely to consume the milk and curd product on daily and weekly basis compared to their counterpart women of Urban poorest. Similarly, the obese/overweight adolescent women who reside in urban poorer, urban middle, urban richer and urban richest were more likely to consume aerated drinks than those who are from urban poorest. On the other hand, urban richer were more likely to consume the chicken or meat on daily/weekly basis compared to urban poorest. The odds of rural and wealth index were found to be statistically non-significant.

4.7 Conclusion

In conclusion, the findings of this thesis highlight the significant variations in dietary habits and preferences among overweight or obese women in relation to different demographic factors. The percentages of individuals consuming specific food items were observed to vary based on factors such as age, educational level, marital status, number of children ever born, place of residence, wealth index combined, improved sanitation, and religion.

The analysis shows the percentage of overweight or obese women who consumed milk or curd daily or weekly ranged from 69.5% to 75.2% across different age groups. Similarly, the consumption of eggs ranged from 42.3% to 69.3% based on the educational level, while the intake of fish varied from 38.2% to 86.9% depending on marital status. The number of children ever born also influenced dietary choices, with chicken or meat consumption ranging from 26.6% to 56.4%.

Furthermore, variations in dietary preferences were observed between urban and rural areas, with milk or curd consumption ranging from 69.6% to 79.2%. The wealth index combined had an impact on the consumption of dark green leafy vegetables, with percentages varying from 86.9% to 92.3% across different wealth categories. The type of sanitation also played a role, as the consumption of fried food ranged from 43.5% to 54.2% based on the sanitation facilities.

Lastly, religion influenced dietary choices, with the percentage of overweight or obese women consuming fish ranging from 36.9% to 69.9% across different religious groups.

These findings highlight the importance of considering various demographic factors when examining dietary habits among overweight or obese women. Understanding these variations can help develop targeted interventions and policies to address the nutritional needs of specific population subgroups, ultimately promoting healthier lifestyles and reducing the prevalence of overweight and obesity. Further research and longitudinal studies are warranted to explore the underlying factors contributing to these variations and to assess the effectiveness of interventions aimed at improving dietary behaviours.

Chapter 5: Conclusion

5.1 Introduction

The double burden of malnutrition refers to the coexistence of undernutrition and overnutrition within the same population, household, or individual. This means that while some segments of the population suffer from hunger and insufficient nutrient intake, others experience excessive calorie consumption and a rise in obesity and diet-related chronic diseases. This dual burden poses a complex public health challenge that affects low-, middle-, and high-income countries alike.

The prevalence of the double burden of malnutrition has escalated rapidly, particularly in low- and middle-income countries undergoing nutrition transitions. These transitions are characterized by shifts in dietary patterns, lifestyle changes, and urbanization. As societies become more affluent, there is an increase in the consumption of processed and energy-dense foods, accompanied by reduced physical activity levels. As shown in this thesis,

the double burden of malnutrition perpetuates a vicious cycle of poverty and ill-health. Undernourished individuals are less likely to reach their full potential, leading to reduced productivity and diminished human capital. On the other hand, obesity-related health conditions impose a substantial economic burden on healthcare systems and can further push families into poverty due to high medical costs and reduced work capacity.

5.2 Conclusion

The double burden of malnutrition among adolescent women in India is a complex issue that requires urgent attention and targeted interventions. This thesis has shed light on the multifaceted nature of the problem, highlighting the coexistence of undernutrition and overweight/obesity among this vulnerable population group. The findings presented here have underscored the need for a comprehensive and integrated approach to address the double burden of malnutrition, taking into account the underlying determinants and socio-cultural factors that contribute to this phenomenon.

One of the key findings of this research is the persistence of undernutrition among adolescent women in India. Despite progress in reducing overall rates of undernutrition in the country, the prevalence of underweight, and micronutrient deficiencies remains alarmingly high among this specific population group. This underscores the importance of investing in nutrition-specific interventions, such as improving access to nutritious food. Additionally, addressing the

underlying causes of undernutrition, such as poverty, inadequate healthcare, and lack of education, is crucial for sustained progress in reducing undernutrition among adolescent girls.

The rising prevalence of overweight and obesity among adolescent women in India is another important finding of this study. Increased consumption of processed and energy-dense foods has been attributed to rapid urbanization, sedentary lifestyles, and the nutrition transition. This has resulted in excessive weight gain and associated health risks. It is critical to put into place strategies that will encourage healthy eating, boost physical activity levels, and guard against the onset of overweight and obesity in this vulnerable population. To create an environment that supports healthy decisions and active lifestyles, collaboration is needed across a number of sectors, including health, education, agriculture, and urban planning.

Furthermore, this research has highlighted the interconnectedness between undernutrition and overweight/obesity among adolescent girls in India. The coexistence of these two forms of malnutrition within the same individual or community presents a significant challenge for policy and programmatic interventions. Traditional approaches that solely focus on addressing undernutrition or overweight/obesity in isolation are insufficient. Instead, there is a need for integrated interventions that address the underlying determinants and root causes of both forms of malnutrition, recognizing the complex interactions between socioeconomic factors, cultural practices, and individual behaviours.

5.3 Discussion

The results of the current study showed that the majority of adolescent females were double malnourished. In contrast, Gupta et al. recently conducted a similar study in North India and found that the prevalence was relatively lower (47.0%), with proportions of underweight and overweight/obese adolescent females being 30.3% and 10.4%, respectively(30). When the proportions of underweight and overweight adolescent females were separately examined, the proportion of underweight individuals (47.0%) was found to be higher. Another study that was done in India at 10 different locations found that there were 27.1% of underweight adolescents and 8.5% of overweight adolescents(31). Additionally, Singh et al. found that in Manipur, the percentages of underweight and overweight adolescents were, respectively, 28.3% and 5.1%(32). Additionally, the proportions of underweight and overweight individuals revealed in the current study were significantly higher when compared to those found in studies carried out in other nations. The prevalence of obesity and overweight, however, was in some ways quite comparable to those found in earlier studies carried out in other regions of India. Additionally, a study by Vohra et al. in a district adjacent to the current study settings found

that obesity and overweight affected 3.1% and 1.2% of school-aged adolescents, respectively(33). Different methods, tools, and criteria (such as WHO BMI standards, Khadilkar's BMI cutoff, and International Obesity Task Force cutoff) have been used for the assessment purpose, which may account for the large variation in prevalence. Additionally, the differences in the study population's baseline characteristics across various study contexts, which previously varied from region to region and nation to nation, may also play a significant intervening role(34).

In the current study, women in wealthy and more educated groups had a lower risk of being underweight than girls in poorer and less educated groups. The ability of educated, higher caste, wealthy, and urban groups to eat in accordance with needs and their greater accessibility toward food intake as and when required, leading to better nutritional status, is indirectly reflected in this. Associations with age groups, however, are also a factor in nutritional status. Generally speaking, there are a variety of multifaceted causes for both under- and overnutrition that are frequently connected to one another and serve as intermediaries. Adolescents in the current study who did not identify as Hindu were more likely to be overweight and obese than Hindu women. However, no prior studies had reported any such findings. Additionally, women who fell into the general category were less likely to gain weight. The different dietary and lifestyle patterns of the individuals and families in typical Indian settings, which used to vary with religion and caste, could be used to explain this biosocial predisposition. When data were analysed in relation to socioeconomic status, those who belonged to economically wealthy groups had a preponderance of 30 times greater odds of becoming obese and about 12 times greater odds of becoming overweight. Similar results were reported in earlier Indian studies(33). Additionally, adolescents who lived in urban areas had a comparatively higher likelihood of becoming overweight or obese. This finding may be explained by the fact that families from higher socioeconomic status have a bit more access and freedom to select and consume contemporary food items as they please. Additionally, in line with the finding that there is a correlation between socioeconomic status and a higher likelihood of being overweight or obese, it was discovered that adolescents who belonged to a relatively higher income group and had a job were more likely to have an increased abnormal BMI for age. Additionally, those who reside in urban areas consume processed food more frequently and at a higher rate than those who do not, which increases the risk of adolescent obesity. Higher education has been linked to a higher likelihood for adolescents to become overweight or obese(33). Despite having comparatively more knowledge about the risks associated with being overweight, this

inadvertently demonstrates inadequate concern for the significance of nutrition and its effects on health. The findings are consistent with those of earlier studies(33). Regular consumption of carbonated drinks with a lot of sugar increases the risk of becoming overweight because these soft drinks also contain a lot of extra calories. According to the results of the current study, consuming these readily available local street foods frequently is directly linked to both a lower risk of becoming overweight and an increase in the likelihood of becoming underweight. However, despite being less dangerous than traditional junk food, consumption of these foods was found to have a profound impact on normal dietary patterns, which in turn had an impact on reducing BMI by removing both quantity and frequency of typical nutritious household foods from adolescents' diets.

5.4 Limitations of the study

- Lack of control over data collection as the data is collected from NFHS 5.
- NFHS surveys are conducted periodically, and the data used in secondary research may not reflect the most recent situation. Changes in socioeconomic conditions, health policies, and demographic trends may occur between survey rounds, affecting the accuracy and relevance of the data for addressing current issues.

5.5 Recommendation

- To effectively tackle the double burden of malnutrition among adolescent women in India, a multi-sectoral and multi-stakeholder approach is essential and the data can be used to inform policy and planning efforts aimed at reducing the double burden of malnutrition among women in India.
- Government agencies, civil society organizations, academic institutions, and international partners must collaborate to develop evidence-based policies, programs, and interventions that prioritize the nutritional needs of adolescent girls. This includes investing in nutrition-sensitive sectors, such as agriculture, education, and women's empowerment, to address the underlying determinants of malnutrition.
- Empowering adolescent girls through education and skill development is critical for breaking the intergenerational cycle of malnutrition.
- Education not only provides knowledge and awareness about nutrition and health but also enhances the socio-economic opportunities for girls, enabling them to make informed choices and improve their own and their families' well-being.

- Engaging communities and fostering behaviour change through culturally appropriate and gender-sensitive interventions can contribute to sustainable improvements in nutrition outcomes among adolescent girls.

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Appendices
Appendix 1: Plagiarism Report

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Ms. Aradhana Singh

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