

# **Prevalence of Overweight and Obesity and its relationship with Anemia among the Working Adults in Urban Area of Maharashtra**

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**September**  
**2018-19**

(A Report prepared for the Ministry of Health and Family Welfare, Government of India, New Delhi)

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## Abbreviation

WHO – World Health Organization

MoHFW – Ministry of Health and Family Welfare

NFHS – National Family Health Survey

CAB – Clinical Anthropometric and Biomedical

CAPI – Computer Assisted Personnel Interviewing

BMI – Body Mass Index

OR – Odds Ratio

AOR – Adjusted Odds Ratio

# Chapter 1

## Background of the Study

### 1.1 Introduction

In the last few decades, the rising prevalence of obesity in the globe is an important Public Health (PH) concern for the World. It constitutes an important threat to national and world concerning prevalence, incidence and economic burden. In many western countries, fat acceptance is now gaining ground. In India, some people fret about gaining a kilo, while others are nonchalant about carrying a body weight that is higher than ideal. Obesity may be defined as an unusual increase of the adipose tissue due to an expansion of fat cell size or a rise in fat cell number. It is expressed in terms of Body Mass Index (Narahari P et al. 2014). The issue of overweight and obesity is becoming a major public health concern throughout the world for the last few decades. Obesity is one of today's most blatantly visible, yet most neglected public health problems. Globally, the prevalence of obesity nearly tripled between 1975 and 2016. In 2016, 39% of adults aged 18 years and over were overweight, and 13% were obese. Most of the world's population lives in countries where overweight and obesity kills more people than underweight. Additionally, obesity is significantly related to other metabolic illnesses, including diabetes, hypertension, dyslipidaemia, cardiovascular disease. World Health Organization (WHO) identifies overweight and obesity are the fifth leading peril for global deaths. Owing to overweight or obese, about 2.8 million adults die each year. 44% of the diabetes burden, 23% of the ischaemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity (Obesity Facts & Figures: World Health Organization Factsheet, 2018).

Obesity is not a fatal disease by itself, but it is the risk factor for a wide range of non-communicable disease. The increase in overweight and obese population in India may pose another task of NCDs, even if health promotion effort has been progressing in India, which may lead to more pressure on the current universal health care coverage system. Nutrition is the core pillar of human development and concrete, large-scale programme not only can reduce the burden of undernutrition and deprivation, but also advances the progress of nations (Pandve & Singru, 2012). It can be good, fair or poor (Mudambi et al. 2012). We can interpret the nutrition as a balance between the intakes of nutrients by an organism and the investment of these in the processes of growth, reproduction, and health maintenance. A number of health risks have been associated with overweight or obesity, including hypertension,

respiratory disease, several orthopaedic disorders, diabetes mellitus and elevated serum lipid concentrations (Gortmaker et al. 1990).

## **1.2 Literature Review**

Numerous factors such as socio-economic, demographic, dietary behaviour, psychological factors, hereditary factors, and environmental factors have been linked to overweight and obesity. Research in developed and developing countries have widely scrutinized the linkages of socio-economic, demographic and lifestyle factors with underweight and overweight (Danaei G. et al., 2009; Ewing R., 2003; Janseen et al., 2005; Rengma et al., 2015). Studies highlighted that older age, lower education level and poverty are positively associated with underweight whereas, younger age, female gender, higher education level, affluence and urban residence are positively associated with overweight (Khan & Talukder, 2013). A significant increase in obesity with an increase in age has also been noticed. Research from advanced countries, it has been found that there occurs an increase in the body weight with ageing, at least up to 50-60 years old, but the maximum rates of obesity tend to be reached at an earlier age (i.e. 45 years old). Studies found that older women were relatively more overweight and obese than younger one, even in low and middle socio-economic conditions (Dhurandhar and Kulkarni, 1992; Arroyo et al., 1995). Evidence from Sri Lanka showed that older age, higher family income and higher education level are positively associated with overweight and obesity (Jayawardana et al., 2017).

In a recent study among women in northern India by Agrawal and Mishra (2004) found that urban residence has a significantly higher risk of obesity. The transformation from a rural to an urban lifestyle is related to the obesity, which has been linked with dramatic alterations in lifestyles (e.g. increased consumption of high energy dense foods and decreased in physical activity). Urban residence and greater income were associated with lower energy intake, higher fat intake, and lower physical activity level compared to the rural residence and other income categories (Sobngwi et al., 2002; al-Mannai et al., 1996;). Decreased physical activity has been witnessed in urban than its counterparts of a rural area in Kiribati (King et al., 1984). Evidence also suggests that unintended urbanization in developing countries leads to a higher fraction of people to live below the poverty line. Additionally, they live in those poor areas which have limited availability and accessibility to basic public services (Baker, 2008). Moreover, they show different disease and health patterns from their counterparts living in high economic strata or in better-off areas (Montgomery et al., 2000).

In the Indian context, the study showed that lower socioeconomic status increased the risk of being underweight while higher socioeconomic status increased the risk of being overweight (Subramanian & Smith, 2007). Higher socio-economic status has been consistently related to more risk of obesity and diabetes, but the association with educational level seems to be fickle (Gupta, 1994; al-Mannai et. al., 1996). Further, it was found that women working as professional or technical were more likely to be overweight and obese compared to those working in other sectors (Agrawal, 2002).

Wealth status is a significant factor influencing food habits and nutrition. With a substantial increase in income, more expensive foods are purchased and eaten. A recent research elicits that higher household wealth is associated with an increased likelihood of being overweight and obese among adult women in Bangladesh and Nepal (Bishwajit, 2017). Interestingly, contrary to the findings from developing countries, overweight/obesity have been found to be more prevalent among the population with lower Socio-economic Strata in developed countries (Wardle, 2002; Ogden et al., 2014). The underlying mechanism being the unequal access to and affordability of healthy food among the lower Socio-economic strata neighbourhoods.

Food practices are the way in which people or societies reactions to social and cultural pressures, choose, consume, and make use of available foods. As populations become more westernized and urbanized, dietary composition changes to include more saturated fat and less fibre. Garine (1969) stated that urban food habits depend first on traditional food habits at home and second on new influences, for instance eating in workers' canteens. Further, an urban population has a distinctly different diet from a rural community (Popkin, 1996). Increases in the Western-style foods, refined foods, and high-calorie foods, and a decrease in physical activity have been strongly associated with BMI status of the population (Paradis et al., 2009; Schulze et al., 2006). The studies conducted in the Western population have also shown that plant-based dietary pattern was negatively and a Western-style dietary pattern was positively associated with weight status (Center for Nutrition Policy and Promotion, 2014). Studies from Asian countries have also proved that diet is correlated with weight changes (Kimokoti et al., 2012), with most of these studies indicating a positive relationship between the diet rich in meat and obesity (Wang Z et al., 2014; Xu F et al., 2007).

A shift from the traditional way of life to modern one, that is characterized by easy access to dense calorie food and a sedentary lifestyle has led to a prompt increase in the occurrence of obesity, followed by the appearance of other lifestyle diseases such as diabetes and cardiovascular diseases. The significance of obesity as a risk factor for a number of diseases including type 2 diabetes, cardiovascular

disease, hypertension, gallstones and certain cancers, is well documented (WHO, 2018). The risk of developing diabetes and hypertension increases as the degree of overweight or obesity increases. The prevalence of diabetes and hypertension is significantly positively associated with the overweight and obesity (Patel et al., 2016; Babu et al., 20-18). Identification of modifiable lifestyle factors with nutritional status from population-based studies is critically important to design public health interventions to prevent the impending epidemic of overnutrition in low and middle-income countries.

### **1.3 Need for the Study**

Like other developing countries, India is struggling to abolish the problem of undernutrition and anaemia. Meanwhile, the country already witnessed the overweight and obesity problem. In the latest report of the National Family Health Survey (NFHS -4) for 2015-16 indicates that the obesity or overweight may be the next major public health challenge in the country. According to the NFHS-4 national report, one-fifth Indian women or more than 20.7 per cent of age group 15-49 years are overweight. What is shocking in that the overall obesity figure of 20.7 per cent for women is jumped from 12.6 per cent in 2005-06 when the last National Family Health Survey was conducted. It's nearly a 60 % jump. While the figure for men with the proportion of overweight men being doubled over the last 10 years. As per the survey reports, as much as 18.6 per cent of men (15-49 years) are obese – up from 9.3 in 2005-06. NFHS – 4 reports also show that 31.4 per cent or almost one- third of the urban women obese, while 15.1 per cent rural women are overweight.

Maharashtra is one of the most urbanized states of India with an urban population of 45% of the whole population (Census, 2011). It has the largest economy in India. The State economy is projected to grow by 7.3 per cent during 2017-18 over the previous year; this growth is against the 10.0 per cent growth during 2016-17. The rate of in-migration from other states to Maharashtra is also very high due to a large volume of employment opportunities, and mostly these immigrants belong to working age groups. About 68 per cent of total Maharashtra's populations are above 18 years or more, and for the urban area, this proportion is 70 per cent. Due to higher industrial growth and an increase in the service sector jobs and most of the urban adult population of Maharashtra is working on an average of 7-8 hours in a day. In this given backdrop, this study is an attempt to find the existing gap in the adult health research in the urban setting, particularly, focusing on the overweight/ obesity situation in the state. Therefore, the study tried to find out the prevalence and determinant of obesity/overweight and its adverse effect on health status. The specific objectives of the present study are given below:



## **1.4 Objectives**

This study was mainly focused on the prevalence of overweight and obesity among the adults in urban areas of Maharashtra. The specific objectives are;

1. To estimate the prevalence of overweight and obesity and its determinants among the adults in urban area of Maharashtra and its regions.
2. To examine the food diversity patterns among the adults in the regions of Maharashtra and its association with BMI status of the adults.
3. To study the level and patterns of hypertension and its relationship with overweight/obesity among adults of urban Maharashtra.

## Chapter 2

### Data and Methodology

#### 2.1 Data Source

Data for this study is extracted from the fourth round of National Family Health Survey data (NFHS – 4) conducted during 2015-16. It is a nationally representative, large-scale, multi-round cross-sectional survey conducted in a representative sample of households covering more than 99 per cent of the population throughout India and has collected detailed information related to population, health, nutrition of children and women. The NFHS-IV is the outcome of a combined attempt of many organizations such as the International Institute for Population Sciences, UNICEF, UNFPA, DFID and BMGF. ICF International provided the technical assistance through the DHS Program, which is funded by USAID. The NFHS-4 sample is a stratified two-stage sample. The 2011 census served as the sampling structure for the selection of PSUs. PSUs were villages in rural areas and Census Enumeration Blocks (CEBs) in urban areas. PSUs with fewer than 40 households were joined to the nearest PSU. Within each rural stratum, villages were selected from the sampling framework with probability proportional to size (PPS). In each stratum, six approximately equal substrata were created by crossing three substrata, each created based on the estimated number of households in each village, with two substrata, each created based on the percentage of the population belonging to scheduled castes and scheduled tribes (for details regarding sampling, see IIPS & ORC Macro, 2017). Under the NFHS – 4, Clinical, Anthropometric and Biomedical (CAB) component were designed to provide vital estimates of the prevalence of malnutrition, anaemia, hypertension, HIV, and high blood glucose level through series of biomarker tests and measurements.

For the study purpose, the household member data file of the Maharashtra state is used. In this survey, information of 26,890 households, 29,460 women age 15-49, and 4,811 men age 15-54 were captured. Survey response rates were 96 per cent for households, 94 per cent for women, and 89 per cent for men.

#### 2.2 Study Population

The study population of this study is adult women age of 15-49 years and adult men age of 15-54 years from urban Maharashtra (NFHS 4).

### **2.3 Assessment of Nutritional Status and dietary diversity consumption**

Assessment of nutritional status of a community is one of the first steps in the formulation of any public health policy to fight malnutrition. The principal aim of such an assessment is to determine the type, magnitude and distribution. In the assessment of the nutritional status of individuals and communities, anthropometric measurement plays a significant role for the following reasons; departures from normal can be often detected earlier, by anthropometry than by clinical examination; and anthropometric figures are more objective than clinical assessments (Baily and Ferro-Luzzi, 1995).

The nutritional assessment may require encompassing nations, communities, vulnerable segments of communities or individuals. It may be done as a part of an exercise to document current status as compared with past status or as specific attempt to evaluate the, impact of an intervention program. (Ramachandran, 1987).

### **2.4 Anthropometric Measurement**

Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue for the assessment of growth, development and health parameters. Anthropometric measurements, including length or height, weight, and head circumference, help to determine if a child is growing properly and can indicate when the child's health and well-being are at risk (NFHS III, 2005). The 2015-16 NFHS collected anthropometric data on the height and weight of women age 15-49 and men age 15-54 years. These data were used to calculate several measures of nutritional status such as body mass index (BMI) of the respondents.

**Body Mass Index (BMI)** was measured as the ratio of weight in kilograms to the square of height in meters. It was categorized into thin ( $BMI < 18.5 \text{ kg/m}^2$ ), normal (18.5 to 24.9) overweight ( $BMI 25- 29.9 \text{ kg/m}^2$ ) and obese ( $>29.9 \text{ kg/m}^2$ ).

**Hypertension:** In the NFHS-4, for the first time the measurement of blood pressure was included. Blood pressure was measured for eligible women age 15-49 and (in the state module subsample of households only) eligible men age 15-54, using an Omron Blood Pressure Monitor to determine the prevalence of hypertension. Blood pressure measurements for each respondent were taken three times with an interval of five minutes between readings. Respondents whose average systolic blood pressure (SBP) was  $>140 \text{ mm Hg}$  or average diastolic blood pressure (DBP) was  $>90 \text{ mm Hg}$  were considered to have elevated blood pressure readings and they were encouraged to see a doctor for a full evaluation.

*An individual is classified as having hypertension if he/she has a systolic blood pressure level greater than or equal to 140 mmHg, or a diastolic blood pressure greater than or equal to 90 mmHg, or he/she is currently taking antihypertensive medication to lower his/her blood pressure.*

**Dietary Diversity (Food Intake):** The consumption of a wide variety of nutritious foods is important for the health of the population. A well-balanced diet is required for adequate amounts of protein, fat, carbohydrates, vitamins, and minerals. The 2015-16 NFHS asked women and men how often they consume various types of food (daily, weekly, occasionally, or never). In the survey, consumption of selected foods group was assessed by asking, 'How often do you yourself consume the following items: daily, weekly, occasionally or never?' related to fish consumption, milk or curd, pulses and beans, green leafy vegetables, other vegetables, fruits, eggs, chicken or meat, fried food and aerated drinks. However, NFHS-4 data do not contain consumption data for some of WHO food group (e.g. grain, roots and tubers). Although, for analysis purpose, we have collated daily or weekly into one and coded as "1", and '0' code was given to those who consumed any food item occasionally or never. Means if a respondent consumed any food from any of the above-mentioned categories, he would get one point in that food category. Simple counting of food items was done to arrive at individual food scores, which ranged from 0 to 9. After that this score has been divided into three food group category as low ( $\leq 3$  FG), Medium (4 FG) and High ( $\geq 5$  FG).

## **2.5 Statistical Analysis**

The statistical analysis was performed using STATA software, version 14. Bivariate and multivariate techniques are used to analyzed the data. Descriptive statistics and multivariate technique are used to find out the significant association between predictor and outcome variables. In Descriptive statistics, chi-square test is used, and in multivariate technique binary logistic regression has been used to find out the significant effect of the predictor variables on outcome variables.

## Chapter 3

### Prevalence of Overweight and Obesity in Maharashtra

#### 3.1 Introduction

This chapter presents the overall prevalence rate of overweight and obesity among the working adult population of urban Maharashtra and its five regions. First, this chapter access the overall prevalence of overweight and obesity at the state level and then see it's level and patterns with selected socio-economic characteristics of the population. After examining the prevalence of overweight and obesity at the state level, we analyzed the data at the regional level of the state to see the regional variation in the prevalence of overweight and obesity and its covariates at the same level.

#### 3.2 Background characteristics of the study population

Table 3.1 presents the percentage distribution of adult respondents by their background characteristics. The majority of respondents (30.7% & 27.8%) belongs to 15-24 age group and 25-34 age group respectively and least (18.1%) in the 45-54 age group. About 51% of respondents were male and the majority of them were Hindu (65.7%). About 4/5<sup>th</sup> of the respondents completed secondary education or more while 7.5% were illiterate. A large proportion (43.8%) of the respondents belongs to richest wealth quintile. The proportion of respondents belonging to the poorest and poorer wealth quintiles was about 1.7% and 5.9%, respectively. Moreover, about 30.1% of respondents belong to Vidarbha region followed by Konkan (24%) and Marathwada (18.5%). A Significant number of respondents (1835) has been observed in not working group.

**Table 3.1 Socio-economic characteristics of the respondents of urban Maharashtra.**

Background characteristics	Sample	%
<b>Age</b>		
15-24	8,563	30.7
25-34	7,753	27.8
35-44	6,512	23.4
45-54	5,052	18.1
<b>Gender</b>		
Male	14,211	50.9
Female	13,669	49.0
<b>Religion</b>		
Hindu	18,330	65.7
Muslim	6,336	22.7
Others	3,214	11.5
<b>Education S</b>		
No education	2,081	7.5
Primary	2,942	10.5
Secondary	16,224	58.2
Higher	6,633	23.8
<b>Occupation</b>		
Not in work force/no	1,835	50.1
Professional/technical	283	7.7
Clerical	93	2.5
Sales	283	7.4
Agricultural	207	5.6
Services/household an	287	7.8
Manual - skilled and	675	18.4
<b>Wealth Index</b>		
Poorest	466	1.7
Poorer	1,669	5.9
Middle	4,552	16.3
Richer	8,957	32.1
Richest	12,236	43.8
<b>Region</b>		
Khandesh	3,576	12.8
Vidarbha	8,381	30.1
Marathwada	5,163	18.5
Konkan	6,730	24.1
Pune	4,030	14.5
<b>Total</b>	<b>27880</b>	<b>100</b>

Table 3.2 shows the statistical summary measures of anthropometric characteristics of the adults' population of urban Maharashtra. The mean weight of all respondents of the study was 54.4±12.3 kg with heaviest was 152 kg and thinnest was 23.1kg. The male respondents (61.4±13.0 kg) were found heavier than female respondents (53.3±11.8 kg). Similarly, the male respondents (1.6±0.08 meters) were taller than female respondents (1.5±0.1) with the tallest one was 2.1 meter among the males and 1.98 meters among the female. The average height of individuals were 1.5±0.1 meters and ranging from 0.99 meters to 2.1 meters. The BMI of the female respondents (23.0±4.9 kg/mtr<sup>2</sup>) was high as compared to the male respondents (22.9±4.5 kg/mtr<sup>2</sup>). The mean age of the respondents was 32.2±11.0 years. The male counterparts (31.0±11.0) were one year younger than the female counterparts (32.3±11.0 years). With regards to the Hemoglobin level of the eligible respondents, the mean haemoglobin level for all eligible respondents was 12.2±1.8 d/gl and ranging from 3.8 d/gl to 21.4 d/gl. The male respondents (14.5±1.6) were having higher haemoglobin than the female respondents (11.9±1.6).

**Table 3.2: Summary Statistics of the anthropometric characteristics of working population of urban Maharashtra**

Characteristics	All		Male		Female	
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
<b>Weight (kg)</b>	54.4±12.3	(23.1 - 152.0)	61.4±13.0	(30.4 - 152)	53.3±11.8	(23.1 - 147.3)
<b>Height (mtr)</b>	1.5±0.1	(0.99 - 2.1)	1.6±0.08	(0.99 - 1.98)	1.5±0.1	(1 - 2.09)
<b>BMI</b>	22.9±4.9	(8.33 - 67.89)	22.9±4.5	(13.2 - 60.0)	23.0±4.9	(8.33 - 67.89)
<b>Age (Years)</b>	32.2±11.0	(15 - 54)	31.0±11.0	(15 - 54)	32.3±11.0	(15 - 54)
<b>Hemoglobin Level (d/gl)</b>	12.2±1.8	(3.8 - 21.4)	14.5±1.6	(6 - 20.8)	11.9±1.6	(3.8 - 21.4)

### 3.3 Differentials in overweight and obesity in urban Maharashtra and its regions

Table 3.3 shows the prevalence of thin, overweight and obesity among the adult population of urban Maharashtra. Overall, 7.8% of the respondents were obese while 21.9% of the respondents were overweight in urban Maharashtra. Most of the respondents were belongs to normal BMI classification (52.2%). The prevalence of overweight and obesity was increasing with increase in age as older respondents were in high risk of being overweight and obese as shown in the table 3.3. The male respondents with prevalence 23.5% were more overweight than the female respondents, whereas the female with prevalence 8.18% were more obese than the male. The prevalence of overweight was almost equally distributed among the all religious group whereas the Muslim respondents with prevalence 10.2% were more obese than the respondents belonging to Hindu and other religions. The

prevalence of overweight was almost similar among the non-educated respondents and higher educated respondents (22.8% and 22.8% respectively) with higher among the primarily educated respondents (24.3%). The similar pattern was followed for the prevalence of obesity with higher obese (10.2%) were from the primarily educated respondents. Among the occupation group, the prevalence of overweight was higher for respondents working in a Professional/Technical/Managerial group (34.7%) followed by Sales group and Clerical group (30% and 27% respectively).

Similarly, the prevalence of obesity was higher among the respondents working in a Professional/Technical/Managerial group (11.3%) followed by respondents working in Services/Household and Domestic group and Clerical (9.3% and 7.4 respectively). The prevalence of overweight was high among the widow/widower respondents with 26.7% whereas the prevalence of obesity with 10% was high among the separated respondents. The prevalence of overweight and obesity shows the increasing relationship with wealth index as the prevalence of overweight and obesity was high among the richest respondents (25.2% and 10.1% respectively) and low among the poorest respondents (10.1% and 1.1% respectively). Respondents from the Konkan region were more overweight and obese as the prevalences were high in this region (24.1% and 9.7% respectively) followed by Pune region with prevalence 23.6% and 9.6% respectively.

**Table 3.3: Prevalence of Overweight and Obesity among the adults' population of urban Maharashtra by their selected socio-demographic characteristics**

Characteristics	Body Mass Index group				N
	BMI<18.5	BMI 18.5-24.9	BMI 25 -29.9	BMI>=30	
	Thin	Normal	Overweight	Obese	
<b>Overall Prevalence</b>	18.1	52.2	21.9	7.8	12522
<b>Age Group</b>					
15 – 24	34.3	53.5	9.8	2.5	4,041
25 -34	14.1	55.9	23.0	7.0	3,728
35 – 44	8.2	48.5	30.3	13.0	3,318
45 -54	5.8	47.8	33.7	12.7	1,435
<b>Sex</b>					
Male	16.4	54.8	23.5	5.3	1,701
Female	18.4	51.8	21.6	8.2	10,821
<b>Religion</b>					
Hindu	17.7	53.3	21.9	7.1	8,268
Muslim	19.0	49.0	21.7	10.2	2,774
Others	18.8	52.3	22.0	7.0	1,480
<b>Respondent's education status</b>					
No Education	14.5	53.5	22.8	9.3	1,027
Primary	15.2	50.3	24.4	10.2	1,351
Secondary	21.0	50.9	21.0	7.2	7,410
Higher Secondary	13.1	56.4	22.8	7.6	2,734



Characteristics	Body Mass Index group				N
	BMI<18.5	BMI 18.5-24.9	BMI 25 -29.9	BMI>=30	
	Thin	Normal	Overweight	Obese	
<b>Respondent's occupation</b>					
No Work	23.0	49.8	20.3	6.9	1,728
Professional/Tech./Manag.	6.1	48.0	34.7	11.3	248
Clerical	18.5	46.9	27.2	7.4	81
Sales	12.7	50.2	30.0	7.1	253
Agricultural	17.0	60.5	18.0	4.5	200
Services/Household and Domestic	15.7	50.0	25.0	9.3	268
Manual -Skilled and Unskilled	15.0	60.8	20.8	3.3	600
<b>Marital Status</b>					
Never Married	35.8	51.9	9.3	3.0	3,172
Married	12.1	52.2	26.3	9.4	8,696
Widow/Widower	12.6	50.9	26.7	9.9	446
Divorced	13.2	54.4	23.5	8.8	68
Separated	11.4	61.4	17.1	10.0	140
<b>Wealth Index</b>					
Poorest	29.1	59.8	10.1	1.1	189
Poorer	28.9	56.2	10.6	4.4	730
Middle	23.3	54.2	17.3	5.2	2,027
Richer	20.1	50.8	22.3	6.9	4,045
Richest	12.9	51.8	25.2	10.1	5,531
<b>Regions</b>					
Khandesh	17.5	51.4	23.1	8.1	1,631
Vidarbha	20.1	53.8	20.0	6.1	4,010
Marathwada	19.9	52.8	20.5	6.8	2,386
Konkan	15.7	50.5	24.1	9.7	2,675
Pashchim Maharashtra (Pune region)	15.5	51.3	23.6	9.6	1,820

Table 3.4 represents the socio-economic differentials in overweight/obesity among adult in the regions of Maharashtra. For the concise representation of the results and as our main aim to focus on overweight and obesity, we merge the overweight and obesity into one category, means those who were overweight or obese considered as “overweight/obese” and remaining population coded as “other”. In overall, results show that the prevalence of overweight/obesity was highest in Konkan region (33.8%) followed by Pune (33.3%), Khandesh (31.1 %), Marathwada (27.3 %) and least in the Vidarbha region (26.1%). The prevalence of overweight or obesity increasing with increment in the respondent age. More than half of the respondents in the Khandesh, Konkan and Pune belongs to 45-54 age group was overweight or obese and from the same 45-54 age group, 37% respondents in Vidarbha and 44.7 % respondents in Marathwada were overweight or obese. Prevalence of overweight/obesity was higher among the female across all the region, except Pune region, where the prevalence of overweight/obesity was 38 % among male and 33.8 % among female. Muslim were more

overweight/obese in all the region except Vidarbha and Pune region. About one-third of the respondents among Muslim religion were overweight or obese in Khandesh (32.2%) and Konkan (35.8%) whereas in Pune region it was more than one – third of the respondents (38.6) were overweight or obese while in Vidarbha and Marathwada it was 27% and 29% respectively. Moreover, the prevalence of overweight or obesity were less among the never married respondent in all the region. The result shows that the prevalence of overweight or obesity increases with increases the wealth status of the household. Prevalence of overweight or obesity was higher among respondent belongs to richer wealth status in all the region. In Vidarbha region, there is not much difference found among the background characteristics.

**Table 3.4: Prevalence of Overweight/Obesity among the adults (aged 15-54 years) in the region of Maharashtra by socio-demographic characteristics**

Background characteristics	Khandesh	N	Vidarbha	N	Marathwada	N	Konkan	N	Pune	N
<b>Age group</b>										
15-24	9.1	563	10.7	1204	10.7	875	13.5	864	14.5	535
25-34	28.4	460	28.1	1190	29	708	37	803	35.3	567
35-44	50.2	430	37	1103	42.5	594	48.2	706	45.3	485
45-54	58.2	178	37.6	513	44.7	209	56.9	302	51.3	233
<b>Sex</b>										
Male	27.2	233	25.4	543	24.7	320	32.9	346	37.8	259
Female	30.1	1398	26.7	3467	27.2	2066	34.3	2329	33.8	1561
<b>Education level</b>										
No Education	28.4	148	26.4	197	31.9	301	37.0	249	35.6	132
Primary	36.0	211	30.5	410	34.6	283	39.2	268	35.2	179
Secondary	30.9	958	23.9	2,408	25.5	1,430	32.5	1,564	32.6	1,050
Higher Secondary	29.9	314	29.5	995	25.0	372	33.7	594	33.3	459
<b>Occupation</b>										
not in work force/no	30.8	246	22.9	593	24.4	334	31	311	26.5	244
professional/technical	45.9	36	44.6	94	24.8	29	63.8	57	51.7	32
clerical	29.8	14	20.3	25	29.8	13	18	17	42.5	12
sales	57.8	21	21	72	37.1	65	46.3	56	35.6	39
agricultural	28.8	21	28.5	84	21.2	44	0	16	28.6	35
services/household an	17	33	37.5	53	31.9	46	33.3	83	41.6	53
manual - skilled and	20.1	79	18.2	192	31.3	107	22.8	117	37.6	105
<b>Religion</b>										
Hindu	28.1	1062	27.8	2664	26.2	1305	33.8	1818	32.7	1419
Muslim	32.2	437	27	789	28.8	768	35.8	509	38.6	271
Others	29.6	132	21.1	557	26	313	33.2	348	45.6	130
<b>Marital Status</b>										
Never Married	8.1	369	12.2	1096	7.3	528	14	776	18.9	403
Married	35.2	1177	32.3	2699	31.7	1734	42.5	1766	39.6	1320
Widowed	57.7	56	31.8	152	46.5	79	41.6	86	29.7	73
Divorced	15.5	12	23.7	18	14.3	12	58.5	19	25.7	7
Separated	44.5	17	30.8	45	24.7	33	25	28	42.8	17
<b>Wealth status</b>										
poorest	16.1	322	15.8	583	15.9	572	23	451	20.5	242
poorer	28.5	336	17.6	750	25.9	616	34.1	642	26.6	426
middle	31.6	326	26.7	846	32.2	526	31.4	571	32.8	397
richer	34.3	337	27.7	966	31.2	394	41	618	38.4	382

richest	40.3	310	38.8	865	32.6	278	40.9	393	42.5	373
<b>Total (N)</b>	<b>31.1</b>	<b>1631</b>	<b>26.1</b>	<b>4010</b>	<b>27.3</b>	<b>2386</b>	<b>33.8</b>	<b>2675</b>	<b>33.3</b>	<b>1820</b>

### 3.4 Conclusion

This chapter shows that the situation of the overweight/ obesity is alarming among adult of urban Maharashtra and its region as well. About one-third of the adult population of urban Maharashtra either overweight or obese. Moreover, those who are working in the professional/technical sector and belongs to richer wealth status, they are at a higher risk of overweight/obesity. Further, Pune and Konkan region of the state having the higher burden of overweight/obese population.

## Chapter 4

### Regional variation of dietary intake in Maharashtra and its regions and its association with BMI status of the adults

#### 4.1 Introduction

Variety of food consumption has long been recognized as key elements of high-quality diets. A diverse diet increases the probability of nutrient adequacy among people and leads to the positive health outcomes. Lack of diversity is a particularly severe problem among poor populations in the developing countries. Changing from a monotonous diet to one with varied food types has been shown to improve energy and nutrient intakes in the people from the developing world. The demographic and economic transition that many developing countries are undergoing is producing important changes in diet and lifestyle that greatly impact on disease risks. Notwithstanding malnutrition and nutrient deficiencies were important distress in the developing world, recent dietary shift and changes in the physical activity patterns, diet-related metabolic problems have arisen as a disturbing public health puzzle in many developing nations predominantly among urban inhabitants (Caballero & Rubinstein, 1997). Therefore, this chapter deals with the consumption of different food items in the region of Maharashtra. It has also described the pattern and level of food group consumption by socio-economic characteristics of the respondents across all five regions of the state. As India has an interesting socio-economical relationship with obesity. For instance, higher wealth and education is positively associated with obesity among Indian adult (Rengma et al. 2015). Therefore, evaluating the association between diet diversity and obesity would be interesting for the adult population of urban Maharashtra.

#### 4.2 Differential in dietary intake in Maharashtra and its region

Table 4.1 depicts the variation in the dietary intake in the region of Maharashtra. In Maharashtra, the 48.9% of the respondents were consuming milk or curd daily and 57.7% were consuming pulses or beans daily. Only 2.6 percent of the adults consuming the chicken or meat daily, however, a large proportion (43.3%) of respondents were consuming chicken or meat weekly. From the table it can also depict that the daily Consumption of milk or curd was high (59%) in Pune region followed by Konkan (50%), Khandesh (44.2%) Vidarbha (41%) and least in Marathwada region (40.1%). In term of daily consumption of pulses and beans, it was highest in Vidarbha and least in Marathwada (49%). Again, the daily

consumption of green leafy vegetables was higher (59%) and least in the Marathwada region (41%). Moreover, very less proportion of adult daily consuming chicken or meat in all the region, however, the proportion of weekly consumption of chicken or meat was higher (52%) in Khandesh region.

**Table 4.1: Differentials in dietary intake in Maharashtra and its regions**

<b>Dietary intake</b>	<b>Khandesh</b>	<b>Vidarbha</b>	<b>Marathwada</b>	<b>Konkan</b>	<b>Pune</b>	<b>Maharashtra</b>
<b>Milk or curd</b>						
Never	7.2	6.5	7.1	5.1	3.3	5.4
Daily	44.2	41.0	40.1	49.9	59.0	48.6
Weekly	30.1	31.9	35.1	29.6	25.0	29.7
Occasionally	18.5	20.7	17.7	15.4	12.7	16.3
<b>Pulses and beans</b>						
Never	0.4	0.2	0.3	0.7	0.3	0.5
Daily	50.3	66.2	48.9	57.1	61.4	57.7
Weekly	40.9	28.5	40.8	32.4	34.5	34.0
Occasionally	8.5	5.1	10.1	9.8	4.0	7.9
<b>Green leafy vegetables</b>						
Never	0.2	0.1	0.1	0.4	0.3	0.3
Daily	44.7	57.7	41.0	47.6	59.0	50.3
Weekly	47.6	37.7	49.5	42.3	35.7	41.7
Occasionally	7.5	4.5	9.3	9.8	5.0	7.8
<b>Fruits</b>						
Never	1.3	1.6	1.1	1.5	1.5	1.5
Daily	17.9	13.0	12.2	20.4	26.8	19.4
Weekly	43.3	49.0	47.9	45.4	45.0	45.9
Occasionally	37.5	36.4	38.9	32.7	26.7	33.3
<b>Eggs</b>						
Never	23.1	27.9	31.8	17.4	22.0	21.9
Daily	4.1	1.9	3.6	7.2	4.7	5.2
Weekly	47.2	47.8	36.6	44.7	48.8	45.5
Occasionally	25.6	22.4	28.0	30.7	24.6	27.4
<b>Fish</b>						
Never	32.4	40.8	42.8	22.1	35.4	30.6
Daily	1.0	0.3	2.3	3.2	1.4	2.1
Weekly	28.9	26.9	23.4	40.7	30.1	33.6
Occasionally	37.7	32.1	31.5	34.0	33.1	33.8
<b>Chicken or meat</b>						
Never	21.5	32.1	34.1	20.1	25.5	24.4
Daily	2.6	0.7	3.7	3.5	1.5	2.6
Weekly	52.3	42.1	34.6	42.1	45.0	43.3
Occasionally	23.6	25.1	27.7	34.3	28.0	29.8
<b>Fried food</b>						
Never	3.5	2.9	5.3	5.4	4.5	4.6
Daily	5.3	1.8	4.4	4.9	3.2	4.1
Weekly	32.8	31.1	31.8	35.3	42.8	35.4

Dietary intake	Khandes			Konka		Maharashtr
	h	Vidarbha	Marathwada	n	Pune	a
Occasionally	58.3	64.2	58.4	54.4	49.6	55.9
<b>Aerated drinks</b>						
Never	16.6	19.4	24.7	13.1	22.6	17.3
Daily	5.7	2.3	5.7	9.1	5.2	6.6
Weekly	19.9	14.9	14.7	25.7	23.4	21.9
Occasionally	57.8	63.4	54.9	52.1	48.8	54.2
<b>Total (N)</b>	1630	4071	2455	2749	1847	12,752

After accessing the food consumption patterns we have also checked its relationship with the overweight/obesity. For that purpose, all 9 food item merge into one index and again it categorized into three categories namely:  $\leq 3$  Food Group, 4 food group and  $\geq 5$  and more food group (the details methodology given in chapter 2). The bivariate analysis of food group consumption and BMI status has been given in table 4.2. Results show that the about 31% of the respondents were overweight/obesity among those who consumed five and more group of food in a week in Maharashtra and it was 27.2 % among those who were consuming less than or 3 food group in a week. A similar finding has been also obtained in Konkan region. However, results from Vidarbha, Marathwada and Pune show that the prevalence of overweight/obesity was higher (28.1%, 29% and 37% respectively) among those who were consuming at least four good groups in a week.

**Table 4.2: Differentials in the BMI (overweight/obesity) status among adults by their Food group consumption in Maharashtra and its regions.**

Background characteristics	Khandesh		Vidarbha		Marathwada		Konkan		Pune		Maharashtra	
	%	N	%	N	%	N	%	N	%	N	%	N
<b>Food Group (DD)</b>												
Low ( $\leq 3$ F D)	28.1	389	23.9	1096	26.52	616	29.5	483	31.9	340	27.22	2,924
Medium (4 F G)	29.7	301	28.1	836	29.07	533	32.5	402	37.5	352	29.74	2,424
High ( $\geq 5$ F G)	30.6	892	27.3	2018	26.72	1191	36.2	1704	34.2	1095	30.9	6,900

### 4.3 Determinant of overweight/obesity in Maharashtra and it regions

Results of the multivariate analysis reiterate that respondent age, Religion, type of occupation, marital status and wealth index were the significant determinants of overweight and obesity among the adults of urban Maharashtra as shown in table 4.3. The risk of being overweight/obese was higher among those who consumed five or more food group in a week compared to those who consumed less than or equal to three food group in a week, however, this relationship was not significant. Age group of the respondents emerged as a vital determinant of overweight and obesity. The risk of becoming

overweight or obese increased with the increase in age. Respondents in the 45-54 age group were 3.9 ( $p<0.001$ ) times more likely to be overweight or obese than respondents from younger age group (aged 15-24 years). The risk of overweight and obesity was higher among Muslim respondents ( $OR=1.5$ ;  $p<0.001$ ) compared with respondents belonging to the Hindu religion.

As expected, the risk of overweight/obesity was less among those who were working in the agriculture sector and working as manual skilled and unskilled labour. The risk of overweight/obesity was 1.7 times ( $p<0.001$ ) higher among married respondents compared to the never married respondents. The wealth index has a significant impact on the overweight or obesity status among adults' population of urban Maharashtra. The odds for overweight or obesity increased with the increase in household wealth status. Respondents from the richest wealth index were 2.9 times ( $p<0.001$ ) more likely to be overweight and obese compared with respondents from the poorest wealth quintile. The odds ratio of overweight/obesity was higher among the respondents from Konkan and Pune region compared to Khandesh region, but these relationship was not significant.

**Table 4.3: Result of multivariate analysis showing the adjusted odds ratio for overweight/obesity in Maharashtra**

<b>Covariates</b>	<b>Odds ratio</b>	<b>CI</b>
<b>Food Group (DD)</b>		
Low ( $\leq 3$ F D) *		
Medium (4 F G)	0.969	[0.753,1.247]
High ( $\geq 5$ F G)	1.08	[0.881,1.325]
<b>Age group</b>		
15-24*		
25-34	2.572***	[1.942,3.406]
35-44	3.611***	[2.655,4.910]
45-54	3.835***	[2.729,5.388]
<b>Sex</b>		
Male*		
Female	0.946	[0.761,1.175]
<b>Occupation</b>		
Not in workforce/no*		
professional/technical	1.275	[0.912,1.783]
Clerical	0.948	[0.561,1.602]
Sales	1.078	[0.771,1.507]
Agricultural	0.594**	[0.402,0.878]
Services/household an	0.986	[0.715,1.359]
Manual - skilled and	0.653**	[0.495,0.861]
<b>Education level</b>		
No Education		
Primary	0.876	[0.599,1.280]

<b>Covariates</b>	<b>Odds ratio</b>	<b>CI</b>
Secondary	0.827	[0.593,1.153]
Higher Secondary	0.768	[0.522,1.130]
<b>Religion</b>		
Hindu®		
Muslim	1.531***	[1.240,1.889]
Others	0.991	[0.765,1.285]
<b>Marital Status</b>		
Never Married®		
Married	1.738***	[1.321,2.287]
Widowed	1.763	[0.994,3.128]
Divorced	0.852	[0.232,3.134]
Separated	1.026	[0.385,2.738]
<b>Wealth status</b>		
Poorest®		
Poorer	1.589**	[1.190,2.121]
Middle	2.067***	[1.541,2.773]
Richer	2.180***	[1.606,2.958]
Richest	2.902***	[2.110,3.991]
<b>Region</b>		
Khandesh®		
Vidarbha	0.828	[0.639,1.074]
Marathawada	0.963	[0.721,1.286]
Konkan	1.297	[0.977,1.722]
Pune	1.081	[0.806,1.450]

Note: level of significant-\* p<0.05, \*\* p<0.01, \*\*\* p<0.001; ®=reference category

Table 4.4 depicts the significant determinants of overweight/obesity in the region of Maharashtra. From the table, it can be also depicted that there were no significant differentials between consumption of different food group and overweight or obesity of the adults among across all the regions. Furthermore, result shows that age group, occupation, religion marital status and wealth status of the household was significantly associated with the obesity/overweight among the adults. It was observed that the risk of overweight/obesity was significantly higher among the adults belongs to higher age group across all the regions. The female was more likely to overweight/obese in Marathwada and Pune region and less likely to be overweight/obese in Khandesh, Vidarbha and Konkan regions, though the significant relationship has been not observed.

The odds ratio showing that the risk of being overweight or obese was less likely among those who were working as a manual or skilled worker than other occupation categories across all the regions, except Marathawada region. Compared to other religion, Muslim were more prone to overweight/obese across all the region, except Konkan but this relationship was significant only for Vidarbha and Pune. Moreover,



**Table 4.4: Result of multivariate analysis showing the adjusted odds ratio for overweight/obesity in the regions of Maharashtra**

Covariates	Khandesh		Vidarbha		Marathwada		Konkan		Pune	
	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI
<b>Food Group (dietary diversity)</b>										
Low (<=3 F D) ®										
Medium (4 F G)	0.783	[0.372,1.650]	0.83	[0.540,1.275]	1.073	[0.574,2.005]	1.071	[0.568,2.018]	1.402	[0.716,2.745]
High (>=5 F G)	1.066	[0.571,1.988]	1.068	[0.750,1.521]	1.1	[0.650,1.861]	1.423	[0.903,2.244]	0.813	[0.456,1.450]
<b>Age group</b>										
15-24®										
25-34	2.561*	[1.152,5.692]	2.352**	[1.411,3.921]	2.279**	[1.227,4.233]	3.160***	[1.687,5.921]	2.733**	[1.278,5.844]
35-44	5.307***	[2.215,12.71]	3.455***	[1.984,6.014]	2.617**	[1.355,5.056]	3.904***	[1.885,8.086]	4.874***	[2.155,11.02]
45-54	7.529***	[2.873,19.73]	3.456***	[1.885,6.338]	3.462**	[1.594,7.516]	4.068***	[1.853,8.929]	3.715**	[1.531,9.016]
<b>Sex</b>										
Male®										
Female	0.849	[0.451,1.598]	0.816	[0.553,1.205]	1.458	[0.820,2.593]	0.899	[0.547,1.478]	1.008	[0.587,1.731]
<b>Education level</b>										
No Education®	1	[1,1]	1	[1,1]	1	[1,1]	1	[1,1]	1	[1,1]
Primary	1.421	[0.902,2.239]	1.223	[0.836,1.789]	1.131	[0.801,1.597]	1.099	[0.770,1.569]	0.982	[0.614,1.572]
Secondary	1.128	[0.770,1.655]	0.877	[0.630,1.220]	0.732*	[0.559,0.959]	0.821	[0.622,1.084]	0.874	[0.598,1.276]
Higher Secondary	1.078	[0.701,1.660]	1.164	[0.824,1.643]	0.712*	[0.508,0.997]	0.866	[0.636,1.179]	0.904	[0.603,1.357]
<b>Occupation</b>										
not in workforce/no®										
professional/technical	0.55	[0.224,1.352]	1.221	[0.709,2.102]	0.843	[0.299,2.376]	1.693	[0.821,3.493]	1.499	[0.626,3.590]
clerical	0.426	[0.114,1.590]	0.753	[0.274,2.069]	1.105	[0.283,4.321]	0.58	[0.175,1.929]	2.966	[0.755,11.65]
sales	1.78	[0.550,5.757]	0.504*	[0.254,0.997]	1.502	[0.681,3.314]	1.522	[0.739,3.132]	1.603	[0.679,3.783]
agricultural	0.404	[0.120,1.359]	0.924	[0.504,1.694]	0.363*	[0.135,0.977]	1	[1,1]	0.834	[0.329,2.109]
services/household an	0.213**	[0.0689,0.660]	1.284	[0.664,2.486]	1.478	[0.662,3.298]	1.109	[0.576,2.138]	0.712	[0.328,1.549]
manual - skilled and	0.341*	[0.148,0.788]	0.541*	[0.323,0.906]	1.317	[0.670,2.589]	0.604	[0.313,1.166]	0.769	[0.395,1.496]
<b>Religion</b>										
Hindu®										
Muslim	1.608	[0.906,2.853]	2.447***	[1.602,3.738]	1.201	[0.771,1.870]	0.857	[0.502,1.464]	1.866*	[1.066,3.266]
Others	1.076	[0.453,2.555]	0.955	[0.623,1.463]	0.767	[0.375,1.568]	0.668	[0.396,1.128]	3.027*	[1.094,8.372]
<b>Marital Status</b>										
Never Married®										
Married	2.941*	[1.215,7.118]	1.367	[0.851,2.197]	3.450***	[1.698,7.009]	1.415	[0.787,2.545]	1.852	[0.847,4.052]
Widowed	7.017	[0.682,72.15]	1.224	[0.475,3.155]	7.914**	[1.908,32.84]	1.34	[0.336,5.335]	1.377	[0.312,6.082]
Divorced	-	-	0.879	[0.0943,8.196]	-	-	-	-	7.267	[0.532,99.23]
Separated	-	-	2.245	[0.552,9.128]	-	-	-	-	5.403	[0.343,85.21]
<b>Wealth Status</b>										
Poorest®										
Poorer	2.569*	[1.011,6.527]	1.22	[0.684,2.179]	2.094*	[1.163,3.772]	1.869*	[1.003,3.480]	0.746	[0.341,1.633]
Middle	1.796	[0.691,4.665]	1.801*	[1.030,3.152]	3.969***	[2.134,7.379]	1.728	[0.893,3.345]	1.304	[0.626,2.717]
Richer	2.093	[0.856,5.117]	1.823*	[1.048,3.172]	1.468	[0.683,3.156]	3.208***	[1.632,6.306]	2.005	[0.954,4.213]
Richest	3.688**	[1.508,9.021]	2.881***	[1.667,4.982]	1.842	[0.857,3.959]	2.403*	[1.158,4.984]	1.798	[0.826,3.913]

Note: level of significant- \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

in Pune region, adults from other religion were three times more likely to be overweight or obesity than its counterparts. The married adults were three times ( $p < 0.05$ ) more likely for Khandesh and 3.4 times ( $p < 0.001$ ) more likely to be overweight or obese for Marathwada than never-married adults. The findings also say that widowed belongs to Khandesh and Marathwada were seven times more likely to be overweight/obese than never married; this may be because, these adults were belongs to higher age cohort. Wealth has been a significant predictor of overweight or obesity. Finding suggests that the risk of overweight or obesity increases with increase in the wealth status of the households. The odds for overweight or obesity was 3.6 times ( $p < 0.001$ ), 2.8 times ( $p < 0.001$ ) and 2.4 times ( $p < 0.1$ ) more likely among adults belongs to richest wealth status compared to adults belongs to poor wealth status in Khandesh, Vidarbh and Konkan region, respectively. Surprisingly, the odds of overweight/obesity was found significantly higher among the poorer respondents in Khandesh, Marathawada and Konkan region, where adults were 2.6 times ( $p < 0.05$ ), 2.1 times ( $p < 0.05$ ) and 1.9 times ( $p < 0.05$ ) more likely to overweight/obese than the reference group, respectively.

#### **4.4 Conclusion**

The result from this chapter indicates that the consumption of the Non-veg food (Fish, Eggs, chicken or meat) higher in Konkan and Pune region. Also, the daily or weekly consumption of fruits and pulses or bean is higher in Pune region. At a state level, one-third of the population daily or weekly having fruits. It is also found that the prevalence of overweight/obesity varies with consumption of food group. The risk of overweight/obesity is higher among those who were having five or more food group in a week than those who are consuming less than or three food group in a week. However, the relationship is not statistically significant. The analysis of this chapter shows that age, marital status and wealth status of the household are the main significant risk factor of the overweight/obesity.

## Chapter 5

### Prevalence of Hypertension and its association with Overweight/Obesity

#### 5.1 Introduction

Worldwide, hypertension has been evolving as a grave hazard to public health. Hypertension is a major threat that causes nearly 51% of global deaths from stroke and 45% from coronary heart disease (Bhise, 2018). Different factors are accountable for growing the occurrence of hypertension in developed and developing countries and are attributable to rapid conversion of lifestyle practices in developing countries. The speedy economic development in India is accompanied by demographic, lifestyle and cultural changes affecting the health profile of its peoples. There is a strong correlation between changing lifestyle factors and increase in hypertension in India. Besides the socio-economic there are many other factors like obesity, high cholesterol and diabetes mellitus is responsible for hypertension. In the recent past, the prevalence of hypertension has been augmented significantly in India and in its states as well. Therefore, this chapter aims to explore the relationship of overweight/obesity along with other covariates on hypertension in urban Maharashtra.

#### 5.2 Association of BMI with diseases and lifestyle factors in urban Maharashtra

The prevalence of overweight and obesity by some medical conditions of respondents is shown in table 5.1. The prevalence of overweight and obesity was high among the hypertensive (33.18% and 12.68% respectively) as compared to non-hypertensive respondents. Similarly, the prevalence of overweight was high among the respondents having diabetes and heart disease (35% and 30% respectively). The prevalence of obesity among the diabetic respondents was much higher as compared to non-diabetic. It follows the similar pattern among the respondents having heart disease. The prevalence of overweight and obesity was high among the asthmatic respondents (37.91% and 16.11% respectively). The prevalence of overweight and obesity was higher among the non-smoker respondents.

### 5.1 Association of BMI with some diseases and lifestyle variables in urban Maharashtra

Characteristics	Body Mass Index group				Chi-square value
	<18.5 Thin	18.5-24.9 Normal	25 -29.9 Overweight	>=30 Obese	
<b>Hypertension Status</b>					
Non - hypertensive	21.9	54.1	18.0	6.0	$\chi^2 = 681.4^{**}$
Hypertensive	7.7	46.5	33.2	12.7	
<b>Diabetes Status</b>					
Non- diabetic	18.4	52.5	21.7	7.4	$\chi^2 = 242.3^{**}$
Diabetic	4.1	28.2	35.0	32.7	
<b>Heart Disease</b>					
No	18.2	52.2	21.9	7.8	$\chi^2 = 21.1^{**}$
Yes	12.0	40.0	30.0	18.0	
<b>Asthma Status</b>					
Non-asthmatic	18.3	52.3	21.6	7.7	$\chi^2 = 62.1^{**}$
Asthmatic	10.0	36.9	37.9	16.1	
<b>Smoking Status</b>					
Non-smokers	18.1	52.1	21.9	7.9	$\chi^2 = 4.6$
Smokers	15.1	59.9	19.8	5.2	

Note: level of significant- \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

### 5.3 Differentials in presence of Hypertension in urban Maharashtra

Table 5.2 shows the prevalence of hypertension in Maharashtra according to the socioeconomic characteristics of the respondents. In total 16% of the respondents were at the risk of hypertension. It was found that prevalence of hypertension was positively associated with the overweight and obesity of the respondents. The prevalence of hypertension was higher (27%) among overweight/obese category than those who have normal BMI. We have also observed that age was positively correlated with hypertension. About 36% of the adult belongs 45-54 age group had hypertension and 5.2 percent of the respondent had hypertension from younger cohort (aged 15-24 years). Mostly male was the victim of hypertension. The prevalence of the hypertension was 30% among male whereas it was only 13% among female respondents. Interestingly, the prevalence of hypertension decreases with increase in the education level. About one-fourth of the illiterate respondent having hypertension while prevalence of hypertension was 13.6 % among higher educated respondents. We have observed a higher prevalence of hypertension among widow (25.1%) and separated (18.3%) compared to never married. There were not much differences exist in the prevalence of hypertension and wealth status of the household. However, in the richest wealth quintile, the prevalence of hypertension was 17 percent whereas, 14.3 percent of the respondent suffering from hypertension from the poorest wealth quintile. Further, across the five regions, variation in the prevalence of hypertension was also observed. Konkan (17%)

and Pune (16.9%) regions have shown a higher prevalence of hypertension followed by Vidarbha (16.3%) and Marathwada (15.1%) and least in the Khandesh region (14.1%).

**Table 5.2: Prevalence of hypertension among adults by socio-economic and demographic factors in urban Maharashtra**

<b>Background Characteristics</b>	<b>%</b>	<b>n</b>
<b>Overweight/obesity</b>		
Normal	11.3	8,329
Overweight/obesity	27.0	3,564
<b>Age</b>		
15-24	5.2	3,794
25-34	11.6	3,538
35-44	25.4	3,197
45-54	35.7	1,369
<b>Gender</b>		
Male	30.5	1,594
Female	13.8	10,304
<b>Religion</b>		
Hindu	16.1	7,843
Muslim	15.2	2,635
Others	15.8	1,420
<b>Education Status</b>		
No education	24.0	986
Primary	21.8	1,296
Secondary	14.7	7,045
Higher	13.6	2,571
<b>Occupation</b>		
Not in work force/no	13.8	1,693
Professional/technical	30.5	239
Clerical	27.3	77
Sales	30.6	252
Agricultural	25.5	196
Services/household an	30.1	256
Manual - skilled and	29.7	582
<b>Marital Status</b>		
Never Married	7.3	2,978
Married	18.7	8,291
Widowed	25.1	427
Divorced	12.3	65
Separated	18.3	137
<b>Wealth Index</b>		
Poorest	14.3	180
Poorer	15.8	701
Middle	16.3	1,914
Richer	16.5	3,873
Richest	17.1	5,230

Background Characteristics	%	n
<b>Region</b>		
Khandesh	14.1	1,565
Vidarbha	16.3	3,891
Marathwada	15.1	2,270
Konkan	17.0	2,425
Pune	16.9	1,747
Total	16.1	<b>11898</b>

#### 5.4 Determinant hypertension among adult in urban Maharashtra

To understand the significant effect of obesity/overweight and other covariate on hypertension logistic regression has been applied. Table 5.3 represents the adjusted effect of socio-economic and demographic variables on hypertension among adult in urban Maharashtra. It can be seen that respondent's BMI status, age, sex and education status of the respondent was a significantly determinant of hypertension. The risk of hypertension was 2 times ( $p < 0.001$ ) more likely among those who are obese/overweight compared to its counterparts. The odds for hypertension increases with increase in the age. The risk of hypertension was 4 times ( $p < 0.001$ ) more likely among elderly persons (45-54 years) than younger cohort (15-24 years). Female had 70 percent ( $p < 0.001$ ) less chance of being hypertension compared to male. There were no any significant differentials in wealth status of the household and hypertension. Similarly, the risk of hypertension was 1.2 times higher in Vidarbha and Marathwada region, respectively, compared to Khandesh region, though relationship was not significant.

**Table 5.3: Socio-economic and demographic variables showing the adjusted odds ratio for hypertension among adult in Urban Maharashtra.**

Covariates	Odds Ratio	CI
<b>Overweight/obesity</b>		
Normal		
Overweight/obesity	2.066***	[1.704,2.507]
<b>Age</b>		
15-24		
25-34	2.253***	[1.601,3.170]
35-44	4.534***	[3.100,6.632]
45-54	4.644***	[3.102,6.954]
<b>Gender</b>		
Male		
Female	0.318***	[0.247,0.408]
<b>Education Status</b>		
No education		

<b>Covariates</b>	<b>Odds Ratio</b>	<b>CI</b>
Primary	0.739	[0.489,1.118]
Secondary	0.697	[0.486,1.001]
Higher	0.650*	[0.424,0.998]
<b>Occupation</b>		
Not in workforce/no		
Professional/technical	0.981	[0.667,1.443]
Clerical	0.851	[0.479,1.514]
Sales	0.985	[0.686,1.413]
Agricultural	0.829	[0.550,1.248]
Services/household an	1.204	[0.843,1.719]
Manual - skilled and	1.119	[0.834,1.503]
<b>Religion</b>		
Hindu		
Muslim	0.848	[0.666,1.081]
Others	1.024	[0.772,1.359]
<b>Marital Status</b>		
Never Married		
Married	0.781	[0.568,1.074]
Widowed	1.022	[0.533,1.963]
Divorced	0.844	[0.237,2.997]
Separated	0.464	[0.142,1.516]
<b>Wealth Index</b>		
Poorest		
Poorer	1.102	[0.818,1.484]
Middle	1.075	[0.787,1.468]
Richer	1.133	[0.822,1.562]
Richest	1.001	[0.709,1.413]
<b>Region</b>		
Khandesh		
Vidarbha	1.214	[0.903,1.634]
Marathawada	1.283	[0.923,1.782]
Konkan	1.001	[0.717,1.397]
Pune	1.034	[0.735,1.454]

Note: level of significant-\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

## 5.5 Conclusion

A large chunk of the adult population of urban Maharashtra is suffering from hypertension, and the situation is more prone among overweight/obese, older and male population. Even, about one-fourth of the respondent from poorest wealth quintile have hypertension. Further, results of the logistic regression depict that overweight or obesity is the significant predictor of hypertension. The risk of hypertension is two times higher in overweight or obese person than a normal one. Moreover, females are in advantage position terms of hypertension than male.

## Chapter 6

### Discussion and Conclusion

#### 6.1 Discussion and conclusion

The main purpose of our study was to examine the prevalence and determinant of overweight and obesity among adults in the urban area of Maharashtra. In addition to this, the effort has also been made to assess the dietary intake and its association with overweight/obesity among the adult. The National Family Health Survey data has been used to fulfil the aim of the study. Descriptive statistic and multivariate technique have been used for data analysis. The study has been divided into six chapters; the first chapter deals with the basic background of the study consisting of the introduction, need of the study, review of literature, and objective of the study. The second chapter deals with the data and methods used. The next chapter given the prevalence of overweight and obesity among adult in urban area of Maharashtra, the fourth chapter is the regional variation of dietary intake in Maharashtra & its region and its association with BMI status of the adults, fifth chapter is the prevalence of hypertension and its association with overweight/obesity. Finally, the sixth and final chapter gives the overall summary and prove some previous evidence related to the study.

The present study found that the overweight and obesity situation among the adults of urban Maharashtra is alarming. Many adults are either overweight or obese in the state. This condition could well be related to many other developed nations where the prevalence of overweight and obesity is accumulating steadily (World Bank 2011; Gruebner et. Al., 2011). The result of the study found that mean BMI among women is higher than the male adult. The main possible reasons for this gender disparity, one being that physical inactivity is more prevalent among women than men adults. Another factor affecting the greater likelihood of obesity among women is female weight gain related to hormonal transitions (Azarbad & Gonder-Frederick 2010).

Further, we also found that the prevalence of overweight and obesity is higher among the higher age adults. Along with a number of studies, this study uniformly opined that portion of overweight and obesity increases with age. Many research has tried to determine the causes behind this association between overweight or obesity and demographic covariates. Among all studies, physical activity declines, along with metabolic rate, in the middle years of adults. On the other hand, the energy requirement decreases; therefore, even regular or routine eating may lead to weight gain. The study



also shows the relationship between the type of employment status and overweight and obesity. The study findings indicate that respondent working in professional or working in the service sector have higher BMI than respondents working in the agriculture or working as unskilled labour. It is consistent with a recent study that found people with white collar jobs were more likely to be overweight and obese due to their higher dietary caloric and fat intake and low level of physical activity (Siddiqui and Donato 2016).

The prevalence of overweight/obesity was higher among the Muslim adults, as compared with the follower of other religions. One of the cohort study found that meat consumption was significantly associated with obesity (Rouhani et al., 2014) and the consumption of meat is higher among Muslim (Desai et al., 2014) as compared with Hindus, who are more likely to be vegetarian (Bhatti et al. 2007). This may be one of the underline cause of higher BMI among Muslim than other religions. Moreover, the study found that the prevalence of overweight and obesity is higher among currently married, divorced and separated adults compared to never-married adults. This may be because of never-married adults relatively younger and more health-conscious and involved in more physical activity than adults at older ages. Further, people in relationships may eat more regular meals or richer and heavier diets owing to social compulsions, which may arise because of marriage. Respondents belong to Konkan, and Pune regions are in a higher risk of being overweight and obese than other regions. Both regions are more urbanized, and their dietary patterns are also different from the other region of the state. All coastal belt of the state knows as the Konkan region and the consumption of the non-vegetarian food in the region is very high compared to other regions of the state.

The study also found that a large chunk of the adult population of urban Maharashtra is suffering from hypertension and the situation is more prone among overweight/obese, older and male population. Even, about one-fourth of the respondent from poorest wealth quintile have hypertension. Further, results of the logistic regression depict that overweight or obesity is the significant predictor of hypertension. The risk of hypertension is two times higher in overweight or obese person than the normal one. This study is in line with the other study which found that the positive relationship between obesity and hypertension (Bhise & Patra, 2018; Singh et al., 2016). Age was found to be a critical risk factor for hypertension. As the age increases, so did the prevalence of hypertension also increases. Similar findings were reported by a few other studies, where advancing age was positively related to hypertension (Singh et al., 2017; Reddy et al., 2005). With increasing age, the aorta and arteries walls stiffen, and this leads to the high prevalence of hypertension in older age groups. Moreover, females

are in advantage position terms of hypertension than male. This could be partially owing to the biological sex difference and partially due to behavioural risk factors like alcohol consumption, smoking, or physical activity.

In the end, based on the study findings it is essential to address the present scenario of its increasing prevalence of hypertension and overweight/obesity not only in the state but also at the national level. The growing demand which appears before the Government is to address these rising epidemic with equal importance. Timely prevention of these two will reduce the burden of many associated chronic co-morbidities. It can be accomplished either through undertaking separate urban health programme or including a particular clause in the ongoing National Health Mission programme, citing the importance of a healthy diet and physical exercise.

## **6.2 Limitation of the Study**

The study has several limitations. The survey analyzed only the weight and height of respondents to measure the prevalence of overweight/obesity in India. However, there is a different approach/cut-point, which is appropriate to measure the BMI, particularly for the Asian region (Pan & Yeh 2008). The fourth round of National Family Health Survey has collected limited information on food items. Although, the demographic, socioeconomic and diet factors incorporated in this study may capture much of the variation. As the present study is based on only urban adults' population of Maharashtra, so it cannot be generalized at the national level. Moreover, the prevalence of hypertension for this study is estimated only for the participants (aged 18-54 years) of the survey.

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