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"Prevalence of Overweight and Obesity in Balangir District: Age and Sex Analysis"

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Abstract: Overweight and obesity have emerged as major public health concern worldwide due to their increasing prevalence and association with various diseases. Excess body weight is linked to cardiovascular diseases, diabetes, hypertension and reduced quality of life. Developing countries are experiencing a rapid rise in obesity rates because of changes in dietary habits, urbanization and sedentary lifestyles. A sectional study was conducted among people in Western Odisha, Balangir district. The study revealed thatoverall16% of people were overweight and obese as per BMI classification. Among them, 11.6% were overweight and 4.4% were obese. Gender-wise analysis showed that 20.33% of males and 11.96% of females were affected by overweight and obesity. Using WHO factors such as age, marital status, drink, calorie intake and physical adequacy all were significantly associated with overweight and obesity. The study highlights the contribution of these socio-biological factors to the increasing prevalence of overweight and obesity in the population.

Keywords: Overweight; Obesity; Body Mass Index (BMI); Prevalence; Age and Sex Differences; Socio-biological Factors.

INTRODUCTION

Overweight and obesity are emerging as serious public health problems not only in urban areas but also in rural regions of India. Traditionally, rural populations were associated with undernutrition and high physical activity. However, in recent years, rapid changes in lifestyle, dietary patterns, and socio-economic conditions have strongly evidenced to a noticeable rise in overweight and obesity even in rural districts like Balangir, Odisha.

Overweight is defined as abnormal or excessive accumulation of body weight in relative to phenotypic markers as height, waist and hip measurements that is sufficiently about the normal range of body weight threshold. Obesity, on the other hand, is a chronic disease characterised by abnormal or excessive accumulation of body fat (adiposity) sufficient to impair health. According to the WHO (World Health Organization) overweight and obesity effect major risk factor for rising blood glucose level, bad cholesterol and high blood pressure causing several diseases such as diabetes, hypertension and cardiovascular diseases. These conditions not only reduce quality of life but also increase morbidity and mortality.

The most commonly used method to quantify overweight and obesity is the Body Mass Index (BMI). BMI is a simple and widely accepted index calculated by making a ratio of a person's weight in kilograms to the square of their height in meters.(Fryar et.al, 201`6)

$$BMI = \text{weight (kg)} / \text{height (m)}^2$$

TABLE I. BMI RANGE TABLE

Based on BMI values, individuals are classified as:

BMI Category	BMI Range
Underweight	<18.5
Normal Weight	18.5-24.9
Overweight	25.0-29.9
Obese	≥30.0

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The prevalence of overweight and obesity varies significantly with age and sex. Age-related differences occur due to metabolic changes, hormonal variations, and lifestyle habits at different stages of life. For example, middle-aged adults are often at higher risk due to reduced physical activity and unhealthy dietary practices. Similarly, sex-specific differences arise due to biological factors, hormonal influences and socio-cultural practices. In rural areas, woman may be more prone to obesity due to limited mobility and household – based lifestyle, while men may show different patterns due to occupational activities.

In rural areas of Balangir district, there is a growing concern of a double burden of malnutrition, where undernutrition and overnutrition co-exist. Despite this, overweight and obesity often remain under-recognized and under studied. Lack of awareness, limited healthcare access, and changing food habits further contribute to this issue.

Therefore, studying the age-specific and sex-specific prevalence of overweight and obesity in rural areas of Balangir district is important to understand the distribution and determinants of these conditions. Such a study will help in identifying vulnerable groups and will provide a scientific basis for developing targeted health inventions, awareness programs, and preventive strategies to improve the overall health status of the rural population.

Overweight and obesity in Odisha

Odisha, a predominantly rural state in eastern India, has traditionally been associated with problems of undernutrition and poverty. However, in recent years, the state is undergoing a nutritional transition due to rapid urbanization, changing dietary patterns and reduced physical activity. As a result, overweight and obesity are emerging as significant public health concerns in Odisha. Along with undernutrition, the rising prevalence of overweight and obesity reflects a double burden of malnutrition, which poses serious challenges to the overall health status of the population. According to the National Family Health Survey (NFHS-4, 2015-16), about 12-15% of adults in Odisha were either overweight or obese. This prevalence has shown a rising trend in the NFHS-5(2019-21) data, where approximately 20-24% of women and 18-20%of men were reported as overweight or obese.

The prevalence of overweight and obesity has been rising across both urban and rural regions of Odisha, including district such as Balangir, mainly due to reduced physical activity, unhealthy food habits, and sedentary lifestyle. Females show slightly higher prevalence than males (Das et. al ,2018). These conditions are linked to an elevated risk of diseases including diabetes, hypertension and cardiovascular disorders highlighting the need for continuous monitoring and effective preventive strategies.

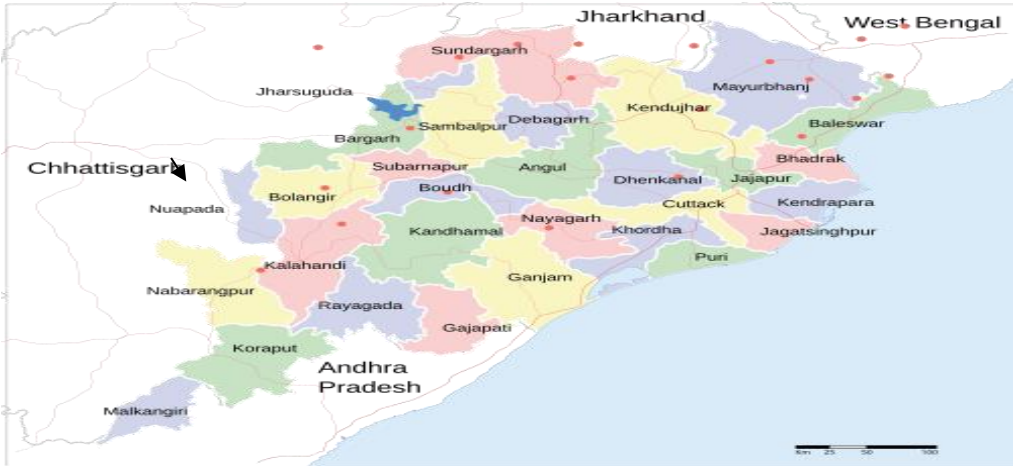

Fig. 1. Map of Odisha

In Balangir

Balangir district of western Odisha is mainly rural, where people traditionally depend on agriculture and physical labour for their livelihood. Overweight and obesity in Balangir district are relatively low compared to urban areas but are gradually increasing, showing a shift in nutritional reports about 2% of children under 5 years in Balangir are affected by overweight or obesity. At the same time, among women (15-49 years), a significant proportion around 11-12% are

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overweight and obese, indicating a rising trend in adults. Earlier estimates also suggest that adult obesity in the district was around 1.8-2.6%, showing a slow but steady increase over time. The increase in overweight and obesity is mainly due to high carbohydrate diet (rice based), low protein intake, reduced physical activity and changing lifestyle patterns in rural areas.

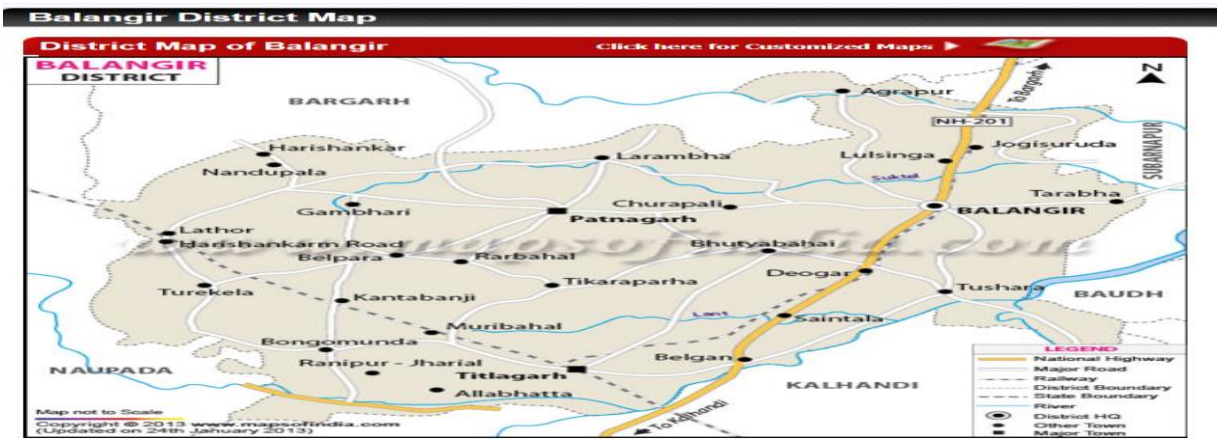
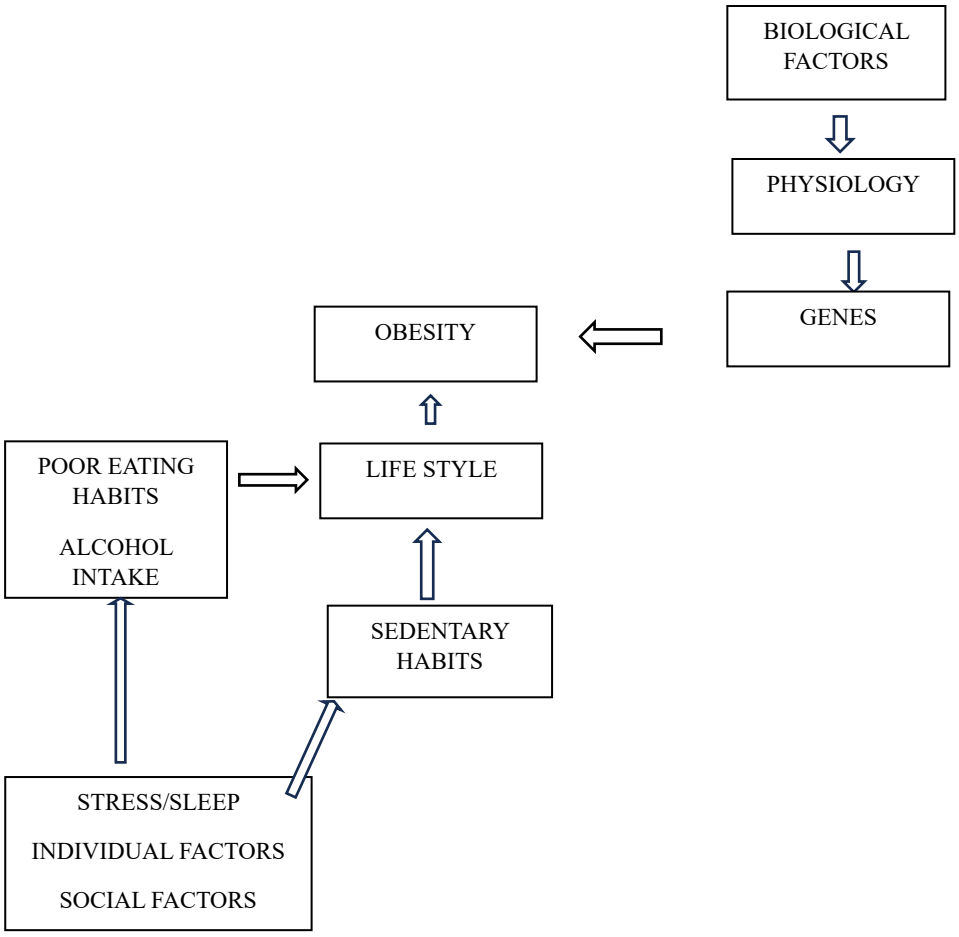


Fig. 2. Map of Balangir District

The red points indicate the blocks of Balangir district where we collect samples of overweight and obesity

CONCEPTUAL FRAMEWORK



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OBJECTIVES

General objectives

The objectives of the reportwere to identify the significantfactors associated with and effecting overweight and obesity in the Balangir demography between the ages of3-60+ years.

Specific objectives

The specific objective of the study was given as follows: -

1. To assess the Body Mass Index (BMI) of individuals in the selected rural population of Balangir and determine overweight and obesity within the demography.
2. To study the possible influence of lifestyle and dietary intakes, physical activity level and health factor on overweight and obesity in Balangir.
3. To create awareness about the health risks associated with overweight and obesity in rural population.
4. To analyse and compare the age-specific and sex-specific prevalence of overweight and obesity among different age groups and between males and females.

REVIEW OF LITERATURE

1. OVERWEIGHT AND OBESITY

Overweight is a noticeable phenotypic condition characterised by the numerical ratio of body weight to body height ratio. Such characteristic factors are subjected to socio-economic and genetic predispositions. It is epidemiologically verified that heritability of overweightness is nearabout 40-70% for BMI in many populations. (Keller et. al, 2023). Important correlates included age, marital status, socio-economic status and substance abuse like tobacco and alcohol consumptions. (Verma et. al, 2021).

Obesity is a quantitative, polygenic phenotypic character of the body's operational accumulation of excess adiposity. BMI is the standardised quantifying measurement. The underpinning correlations and causations are exposed to genetic, sociological, physiological, metabolically and environmental factors. Our most assured understanding is the impact of Insulin and leptin regulation of body weight. Obesity in Indian children as dictated by MC4R gene (Dwaipayan Bhardwaj, OP Dwivedi CSIR-IGIB: *Journal of Human Genetics* 2012**)**, increased risk of Type II diabetes and obesity concluded from the FTO and MC4R polymorphism **(**Kapil Dev, JMI**)** and variants of FTO rs9939609 increases BMI and body weight in Indian demography which may amplify genetic susceptibility to obesity **(**A.E. Taylor MRC Centre for Causal Analyses in Translational Epidemiology, Bristol, UK, G.R. Chandak, CSIR-CCMB)are some obesity genes studied on Indian population.

Based on data from the National family health survey and district nutrition profiles, Balangir district in western Odisha is experiencing a rising trend in overweight and obesity among its population.

2.PREVALENCE AND TRENDS OF OVERWEIGHT AND OBESITY

According to national surveys like NFHS Odisha lower than national average, but steadily increasing generally 15-20% range in adult depending on subgroup, from NFHs datasets. Literature shows that high BMI is strongly associated with increased risk of diseases such as typeI hypertension and cardiovascular disorders.Overweight and obesity prevalence is rising rapidly due to sedentary lifestyles and poor dietary habits. BMI is useful for large-scale screening but has limitations in distinguishing fat from muscles.

Studies recommend combining BMI with other measures for accurate assessment and effective prevention strategies. Obesity is due to a sustained positive energy balance which means a prolonged consistent intake of calories exceeds the expenditure of energy. An increase in visceral fat due to adipocyte hypertrophy promotes weight gain and increase health risks.The waist circumference becomes the primary site of central obesity due to the preponderance of abdominal adipose tissue. This histological advantage is used to access the amount of visceral obesity.

Various study done regionally and nationally proves the fact of growing prevalence of overweight and obesity. BMI has been extensively applied in epidemiology, clinical practice and public health policy as a simple and cost-effective screening tool. Keys demonstrated that BMI correlates reasonably well with body fat at the population level, which led to its global adoption. In general overweight and obesity indicate a weight greater than what is considered healthy. Insulin and leptin affect the regulation of body weight. The hormone promotes negative energy balance by surpassing appetite and increasing the energy expenditure.

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METHODS AND METHODOLOGY

Research instruments:
The following tools were employed to collect relevant data for the study

I. Weighing Machine: A digital weighing scale (Model W-50) with a maximum capacity of 180kg and a minimum precision of 0.1kg (1 piece), procured from the central campus of Technology with code NDW:001.
II. Stadiometer: To measure height in centimetre (cm) with the respondents standing barefoot in an erect posture.

Research design: A cross-sectional analytical design was adopted to examine the relationship between body weight and nutritional status among individuals aged 3-60 years.

Study variables:
Dependent variables:
The outcome variable of interest in this study was:
Body Mass Index (BMI)
BMI is measured by using formula
= Body weight (kg)/ Height (m^2)
Participants were categorized based on their BMI as follows: Values below 25.0kg/m^2were classified as normal weight, while those between 25.0 and 29.9kg/m^2were considered overweight, and values of 30.0 kg / m^2or higher were classified as obese according to WHO criteria.

Study of justification:
Balangir district is located in the western part of Odisha, India. It is predominantly rural and social-economically backward district, with a large proportion of the population depending on agriculture and daily wage labour for livelihood. According to district nutrition data, Balangir shows a dual burden of malnutrition, where under nutrition coexist with increasing cases of overweight and obesity. Balangir is a rural district with limited data on overweight and obesity prevalence. Understanding the local prevalence can inform targeted interventions. High prevalence of poverty and malnutrition in Balangir makes it an interesting area for studying the double burden of malnutrition.

TABLE II. Categories of BMI

SL. NO	BMI Category	BMI Range (kg/$m^{2)}$
1	Normal weight	18.5- 24.9
2	Overweight	25.0- 29.9
3	Obese	≥30.0_

Target population:
The targeted population of the study was of 3-60+ years of age.

Inclusion and exclusion criteria:
Inclusion criteria:
Here people of different age groups were included in the study.

Exclusion criteria:
• Pregnant or lactating women
• Individuals with severe medical condition
• Physical disabilities affecting anthropometric

Sample Size Determination
The required sample size was estimated using standard statistical procedures and evidence from previous literature. The calculation was designed to ensure adequate representation of the target population and to provide reliable estimates of overweight and obesity prevalence. Assumingan expected prevalence of 20%, a confidence level of 95%, and a margin of error of 5%, the minimum sample size required for the study was calculated to be 500 participants.

The sample size was determined using the following formula
$n = z^2pq / d^2$
n = required sample size

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z = standard normal vitiate
p =anticipated prevalence of overweight/ obesity
q = 1- p
d = allowable error (precision)

Sample technique:
Random sampling method was used for four administrative blocks of Balangir district. Four blocks (Saintala, Muribahal,Titilagarh,Patnagarh) have been selected for the study. A total of 500 individuals were selected for the study. A multi stage random sampling techniques was used.

Random sampling methods:
Random sampling was employed to ensure that each eligible member of the target population had an equal opportunity to be selected for participation. This approach helps minimize selection bias and enhances the representativeness of the study sample.
In sample random sampling, every eligible individual has the same probability of being included in the study. A comprehensive list ofall eligible individuals was prepared in selected area. Assign numbers to each individual and is used a lottery method or random number table to select participants.

Systematic Random sampling:
Thismethod involves selecting participants at regular intervals.

- List all households in a village
- Calculate sampling intervals

K = total households / required sample

- Then select every K^{th} household.

Data collection procedure:
Data collection was instituted in two sequential stage. The first stage involved establishing contact with eligible participants and obtaining informed consent. The second stage included administration of a semi structured questionnaire and collection ofanthropometric measurements. The anthropometricvariables part involved asking the respondents about their age, height, weight, health status and other relevant study variables. The economical variable was accounted in the survey site – urban, semi-urban or rural. The other variable and data on anthropometric measurements were recorded following standardized procedure.

1. Weight:
Body weight was measured using a calibrated digital weighing scale and recorded to the nearest 100kg. Each time between subject data collection the measurement was taken after calibrating it to zero, removal of shoes and excess clothing to ensured closest true weight. To eliminate error both weight and height were taken twice. In order toensure quality data, the weighing scale was calibrated betweenevery five measurements during the data collection time and even before measuring of weight every day.

2. Height:
A stadiometer was used to measure height. The stadiometer used had the precision to the closest0.1 cm. The subject was instructedto stand on a horizontal platform with theheelsjoined together and with the Frankfort Horizontal Plane. The subject stands straight by drawingthemselves to their full height without raising the shoulders. They were instructed to stand erect with arm relaxed at their sides and feet flat on the ground while the measurement was taken.

Data management:
Collected data was recorded as per the required metrices for the study. Unreliability and inaccuracy was checked by repeating rounds of observers who not only managed the data collection carefully but also ensuredwith its safety from error and alteration as rawdata collected had a paramount importance.

Data analysis:
The completed questionnaire wasreviewedaily.Data were edited, encoded and entered into a computerised database for analysis. Descriptive statistics was used to explain percentage and distribution of subjects by their socio demographic variables, physical activity patterns, medical characteristics. Qualitative variableswere categorizedand coded under labels to variables categories. Statistical tests were applied to examine the association between selected variables and indicators of overweight and obesity.

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RESULT

This study examine the relationship between excess body weight, obesity and various risk factors and lifestyle characteristics among individuals in the western region of Odisha, Balangir district. Information was collected on key variables including age, sex, dietary habit, physical activity, residential setting. The collected data were analysedand results obtained are explained below:

Prevalence of Overweight and Obesity

The finding of the study was analysed according to international BMI categorisation as given by WHO. This figure Illustrate the fact that some people are overweight or obese.

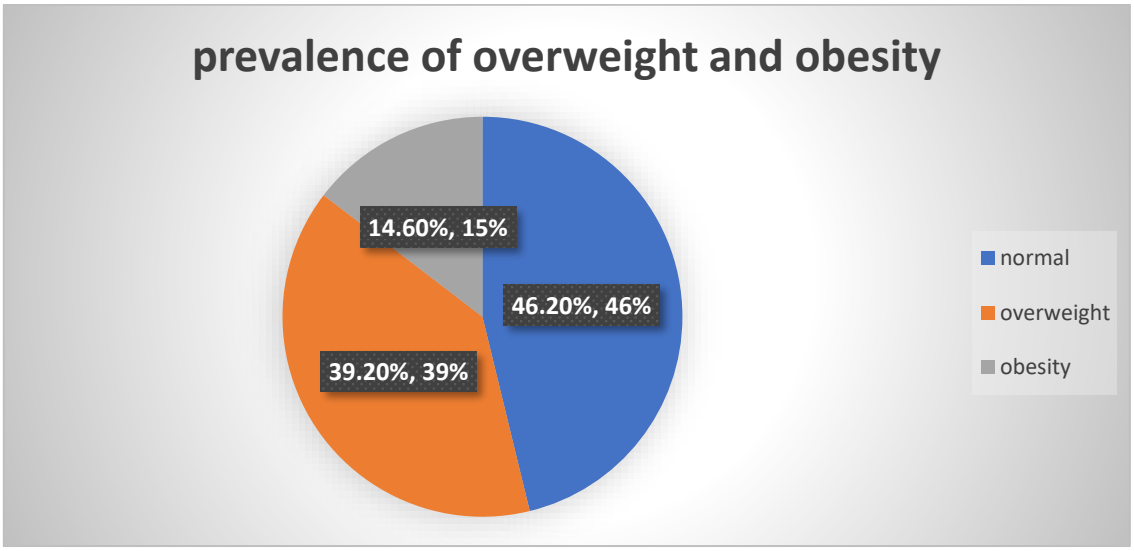

Fig. 3. Prevalence of Overweight and Obesity

According to WHO BMI classification, 39.2% (112) were found to be overweight while 14.6% (42) were obese, thus the prevalence of overweight and obesity was found to be far more than national data 16% overweight and 3.5% respectively (MOHP, 2016). The total prevalence of overweight and obesity in the finding was 53.8%.

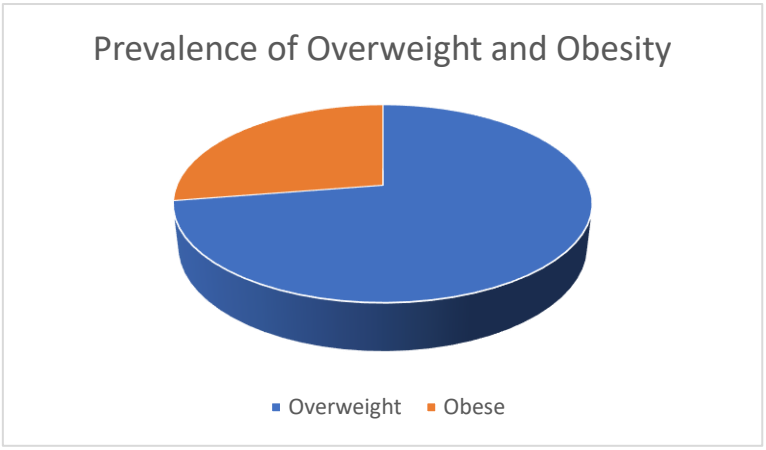

Fig. 4. Prevalence of Overweight and Obesity

In comparison with findings reported from other studies conducted in Western Odisha, the prevalence of overweight and obesity observed in the present study was 11.6% and 4.4% respectively. The proportion of overweight individuals was higher than that of obese individuals. Similarly, trends have been reported in studies carried out across four blocks of Balangir district.

It was found that 22.4% of overweight and obesity found in Saintala, 13.77% of overweight and obesity found in Muribahal,9.33% of overweight and obesity found in Titilagarh and 18.66% of overweight a in Patnagarh

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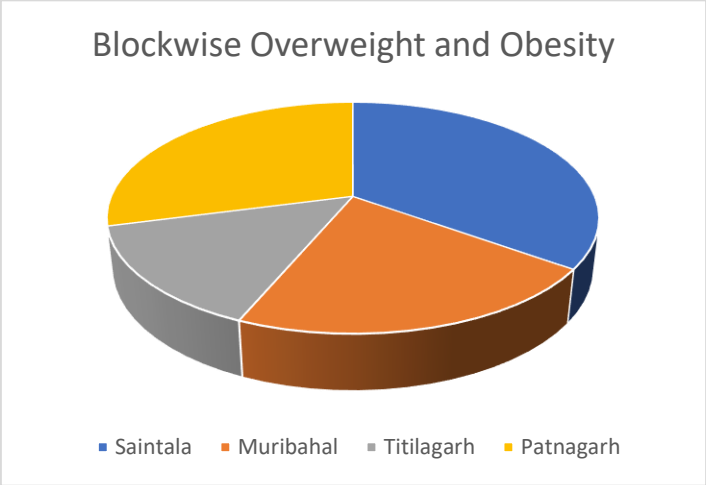

Fig. 5. Blockwise Overweight and Obesity

TABLE III. Mean BMI in Saintala:

Age	Male BMI Mean	Female BMI Mean
1 - 3 Year		
3-12 Year	26.07	19.55
12-18 Year	18.54	18.62
18-60 Year	24.70	22.51
60+	26.19	22.19

As shown in the Table III and Fig. 6, the mean BMI values of participants from Saintala varied across age groups and between sexes. Among children aged 3-12 years, the average BMI was higher in males (26.07 kg/m^2) compared to females (19.55 kg/m^2). In the 12-18 years age group, mean BMI values were relatively similar, with males showing a BMI of (18.54 kg/m^2)females (18.62 kg/m^2). Among adults aged 18-60 years, males had a higher mean BMI (24.70 kg/m^2) than females (22.51 kg/m^2). A similar trend was observed in the 60 years and above age group, where the BMI was (26.19 kg/m^2) for males and (22.19 kg/m^2) for females (Table III).

Overall, males exhibited higher mean BMI values than females in most age categories, except among adolescents (12-18 years), where female BMI was marginally higher. The highest mean BMI was recorded among elderly males (60+ years), while the lowest mean BMI was observed among adolescents of both sexes.

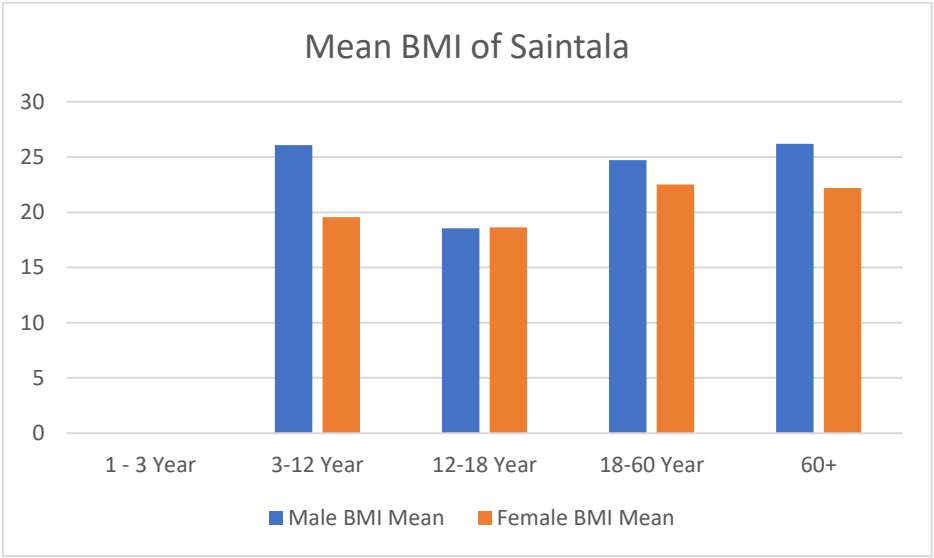

Fig. 6. Mean BMI of Saintala

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TABLE IV. Overweight and obesity in Saintala

AGE	MALE	FEMALE	OVERWEIGHT	OBESE1	OBESE2
1-3					
3-12	3		OVERWEIGHT		
12-18		1	OVERWEIGHT		
18-60	15	7	OVERWEIGHT	OBESE1	OBESE2
60+	2	1	OVERWEIGHT	OBESE1	

The table shows the age-wise and sex- wise distribution of weight and obesity in Saintala, including different age groups and categories of overweight and obesity.

From the table IV and Fig. 7, it is observed that overweight cases are present in almost all age groups except 1-3 years. In the 3-12 years group, 3 males are overweight, and in the 12-18 years group, 1 female is overweight. The highest number of cases is found in the 18-60 years group, with 15 males and 7 females, where both obese1 and obese2 categories are also present. In the 60+ age group, 2 males and 1 female are overweight, with obese1 cases observed. This indicates that overweight and obesity are more common among adults, through some cases are also seen in younger and older age groups.

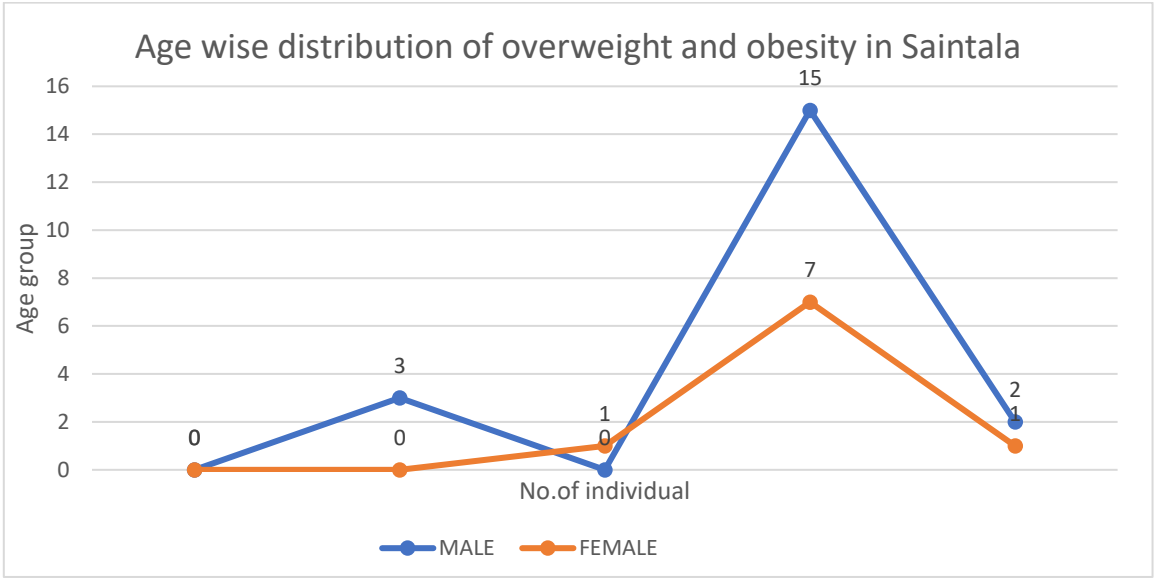

Fig. 7. Age wise distribution of Overweight and Obesity in Saintala

TABLE V. Mean BMI of Muribahal

Age	Male Mean BMI	Female Mean BMI
1 - 3 Year		
3-12 Year	11.61	16.91
12-18 Year	19.11	18.24
18-60 Year	22.58	20.80
60+	18.54	17.50

As shown in Table V and Fig. 8, the mean BMI values of males and females across different age groups in Muribahal. The findings indicate noticeable variations in BMI according to both age and gender.

Among children aged 3-12 years, the mean BMI was considerably higher in females (16.91 kg/m^2) compared to males (11.61 kg/m^2). In the 12-18 years age group, the mean BMI increased for both sexes, with males recording a slightly higher value (19.11 kg/m^2) than females (18.24 kg/m^2). The highest mean BMI values were observed in the 18-60 years age category. Adult males had a mean BMI of 22.58 kg/m^2, while adult females showed a mean BMI of 20.80 kg/m^2.

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This suggests that BMI tends to increase with age and reaches its peak during adulthood.In the 60 years and above age group, a decline in mean BMI was noted for both genders. The mean BMI decreased to 18.54 kg/m^2 among males and 17.50 kg/m^2 among females. This reduction may be associated with age-related physiological changes, decreased muscle mass, and nutritional factors in older adults.

Overall, the data demonstrate an age-related increase in BMI from childhood to adulthood, followed by a decline in older age. Except for the 3-12 years age group, males exhibited higher mean BMI values than females across all age categories. These findings highlight the influence of age and gender on BMI patterns within the study poulation of Muribahal.

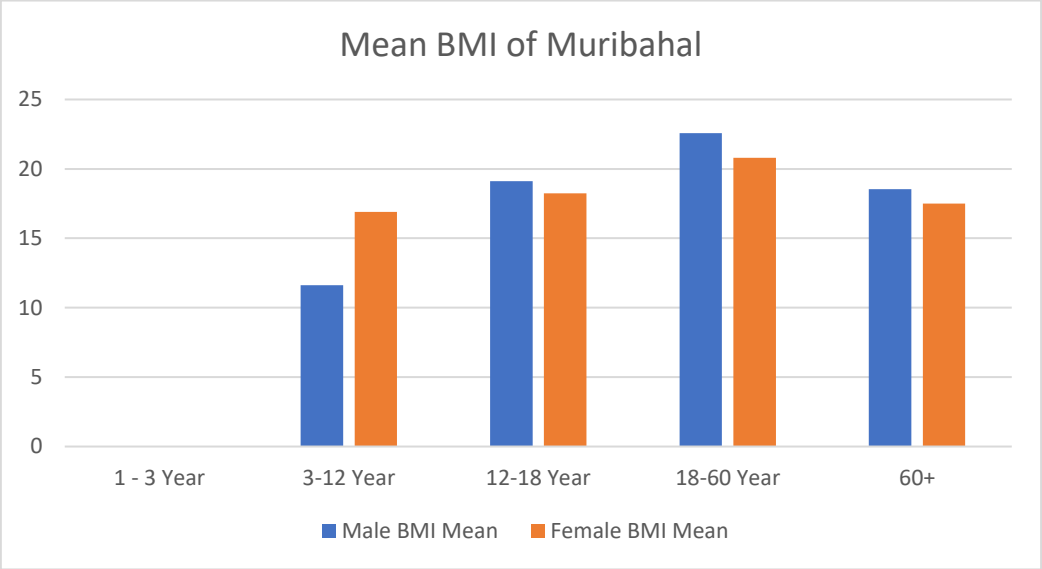

Fig. 8. Mean BMI of Muribahal

TABLE VI. Overweight and obesity in Muribahal

AGE	MALE	FEMALE	OVERWEIGHT	OBESE1	OBSES2	OBESE3
1-3						
3-12						
12-18	2	3	OVERWEIGHT	OBESE1	OBESE2	
18-60	17	13	OVERWEIGHT	OBESE1	OBESE2	OBESE3
60+						

As shown in Table VI and Fig. 9, the age-wise and sex-wise distribution of overweight and obesity, along with different categories such as overweight, obese1, obese2, and obese3.

From the table, it is observed that no cases are found in the 1-3 and 3-12 age groups. In the 12-18 years group, 2 males and 3 females are affected, with the cases of overweight, obese1, and obses2. The highest number of cases is seen in the 18-60 years group, with 17 males and 13 females, where all categories including overweight, obese1, obses2, and obese3 are present. No data is recorded for the 60+ age group. This indicate that overweight and obesity are more prevalent among adults, while lower age group show fewer cases.

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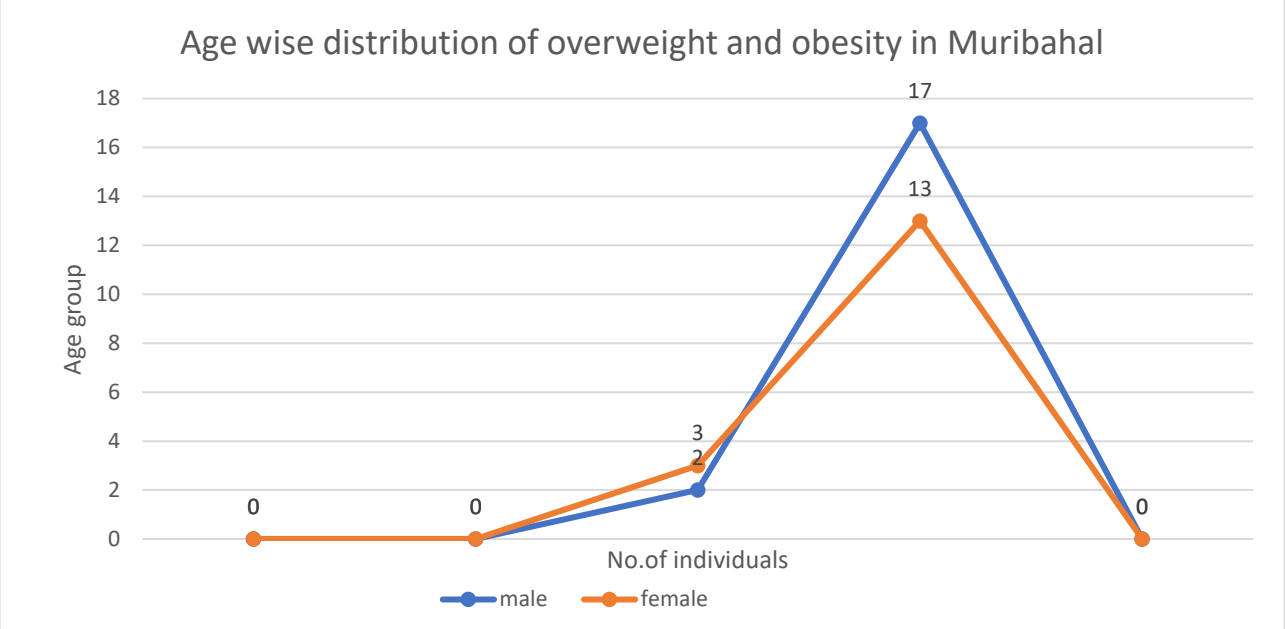

Fig. 9. Age wise distribution of Overweight and Obesity in Muribahal

TABLE VII. Mean BMI of Titilagarh

Age	Male BMI Mean	Female BMI Mean
1 - 3 Year		
3-12 Year	15.63	14.61
12-18 Year	15.72	17.78
18-60 Year	23.27	22.73
60+	20.93	21.20

As shown in Table VII and Fig. 10, the mean BMI values of males and females across different age groups in Titilagarh. The results indicate variations in BMI according to age and sex, reflecting changes in nutritional and health status throughout the life course.

In the 3-12 years age group, the mean BMI was slightly higher among males (15.63 kg/m^2) compared to females (14.61 kg/m^2). During adolescence 12-18 years, females exhibited a higher mean BMI (17.78 kg/m^2) than males (15.72 kg/m^2), suggesting differences in growth patterns and body composition during this developmental stage.

The highest mean BMI values for both sexes were observed I the 18-60 years age group. Adult males recorded a mean BMI of (23.27 kg/m^2), while adult females had a mean BMI of (22.73 kg/m^2). This increase may be associated with age-related changes in lifestyle, dietary habits and reduced physical activity during adulthood.

Among individuals aged 60 years and above, BMI values declined slightly compared with the adult age group. The mean BMI was (20.93 kg/m^2) among males and (21.20 kg/m^2) among females. The reduction in BMI among older adults may be linked to physiological ageing processes, including loss of muscle mass and changes in nutritional intake.

Overall, the findings reveal a gradual increase in BMI from childhood to adulthood, followed by a modest decline in older age. While males had higher mean BMI values in childhood and adulthood, females showed higher BMI during adolescence and in the elderly age group. These observations suggest that both age and gender play important roles in determining BMI patterns within Titilagarh population.

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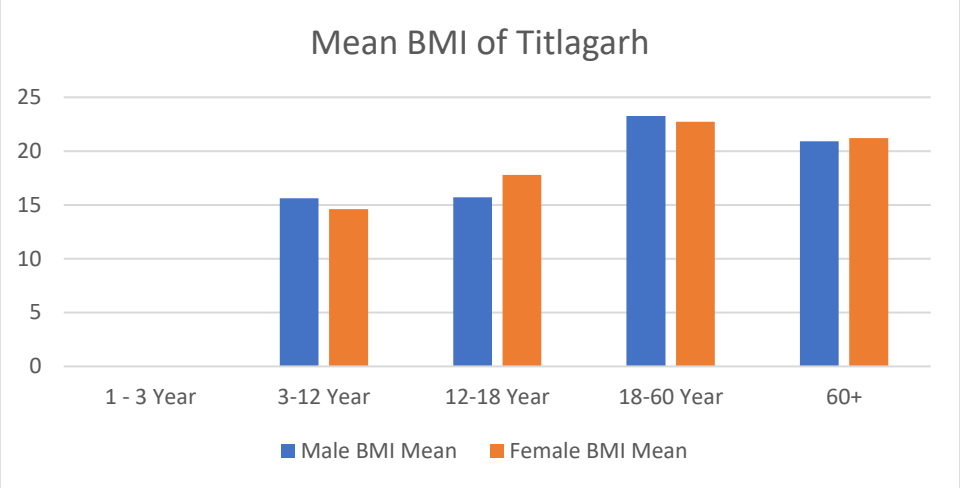

Fig. 10. Mean BMI of Titilagarh

TABLE VIII. Overweight and obesity in Titilagarh

AGE	MALE	FEMALE	OVERWEIGHT	OBESE1	OBESE2	OBESE3
1-3						
3-12						
12-18						
18-60	5	1	OVERWEIGHT	OBESE1		OBESE3
60+						

The Table VIII shows the age-wise and sex-wise distribution of overweight and obesity in Titilagarh. The population is divided into different age groups such as 1-3 years, 3-12 years, 12-18 years, 18-60 years, and 60+ years, with separate data for males and females along with categories of overweight and different levels of obesity.

From the table and Fig. 11, it is observed that cases are present only in the 18-60 years age group, where 5 males and 1 female are affected. Overweight and obesity (obese1 and obese3) are reported in this group, while no cases are found in the other age groups. This indicates that overweight and obesity are mainly prevalent among adults, with very low or no occurrence in children, adolescents and the elderly.

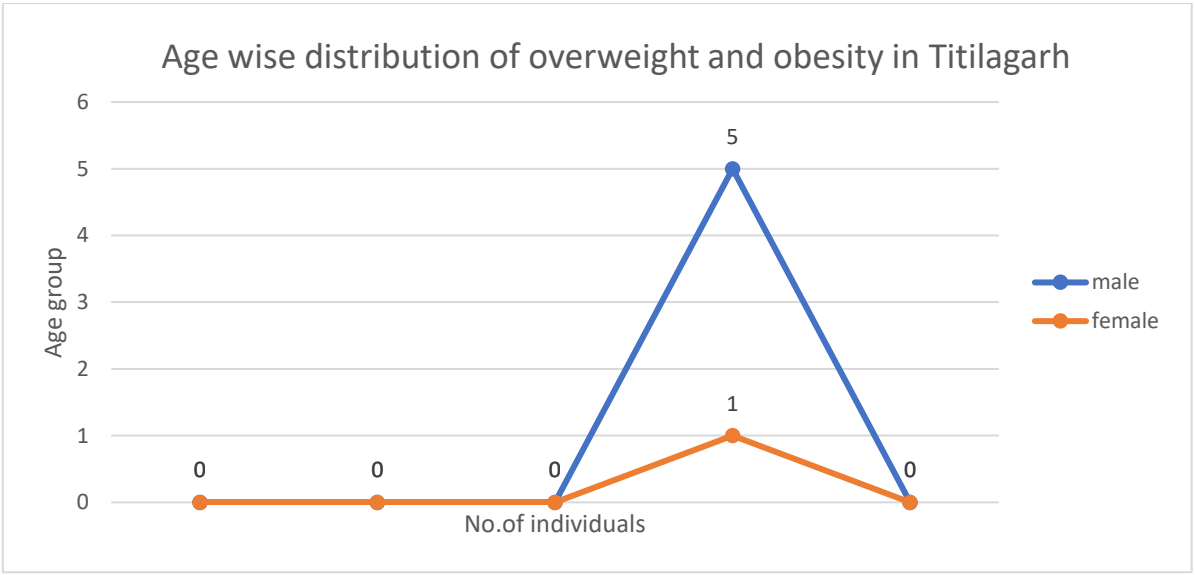

Fig. 11. Age wise distribution of Overweight and Obesity in Titilagarh

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TABLE IX. Mean BMI of Patnagarh:

Age	Male BMI Mean	Female BMI Mean
1 - 3 Year		
3-12 Year		
12-18 Year	16.74	19.30
18-60 Year	20.93	21.20
60+	20.93	23.18

As shown in Table IX and Fig. 12, the mean BMI values of males and females across different age groups in Patnagarh. BMI values were available for the age groups of 12-18 years, 18-60 years and 60 years and above, while data for children aged 1-3 years and 3-12 years were not recorded.

Among adolescents 12-18 years, the mean BMI was (16.74 kg/m^2) for males and (19.30 kg/m^2) for females. Female adolescents exhibited a higher average BMI compared to their male counterparts.

In the adult age group 18-60 years, the mean BMI increased to (20.93 kg/m^2) among males and (21.20 kg/m^2) among females. The difference between the sexes was relatively small, although females maintained a slightly higher BMI.

For individuals aged 60 years and above, the mean BMI among males remained (20.93 kg/m^2), whereas females showed a further increase to (23.18 kg/m^2). This indicates that elderly females had the highest average BMI among all age groups studied.

Overall, the findings suggest an increasing trend in BMI with age for both sexes. Across all reported age categories, females demonstrated higher mean BMI values than males, with the greatest difference observed in the elderly population.

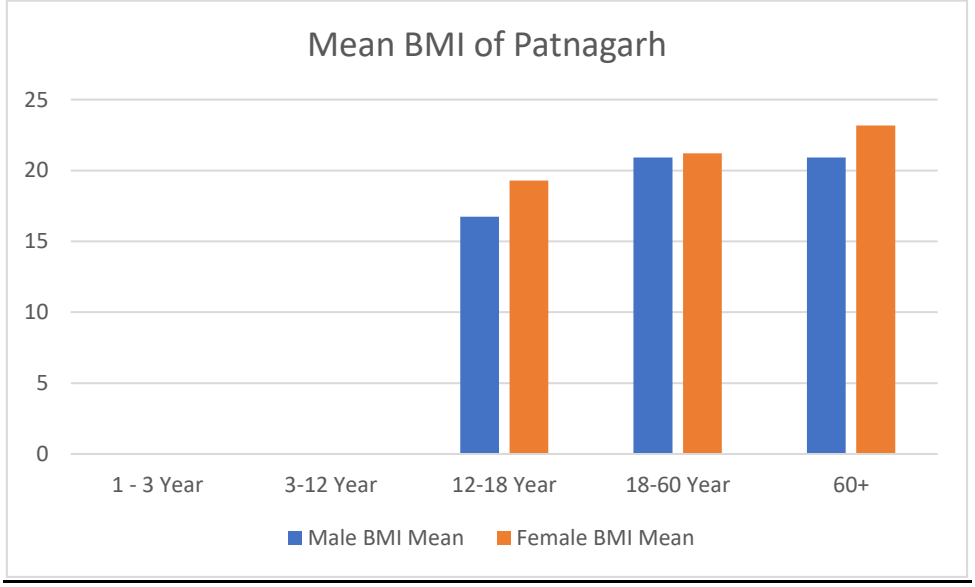

Fig. 12. Mean BMI of Patnagarh

TABLE X. Overweight and obesity in Patnagarh

AGE	MALE	FEMALE	OVERWEIGHT
1-3			
3-12			
12-18			
18-60	3	10	OVERWEIGHT
60+			

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The table X shows the age-wise and sex-wise distribution of overweight individuals in Patnagarh. The population is divided into different age groups such as 1- 3 years, 3-12 years, 12-18 years, 18-60 years and 60+ years, with separate data for males and females.

From the table X and Fig. 13, it is observed that no overweight cases are found in the age groups 1-18 years and 60+ years. Overweight is present only in the 18 -60 years age group, where 3males and 10 females are affected.This indicates that overweight is more common among adults, especially females.

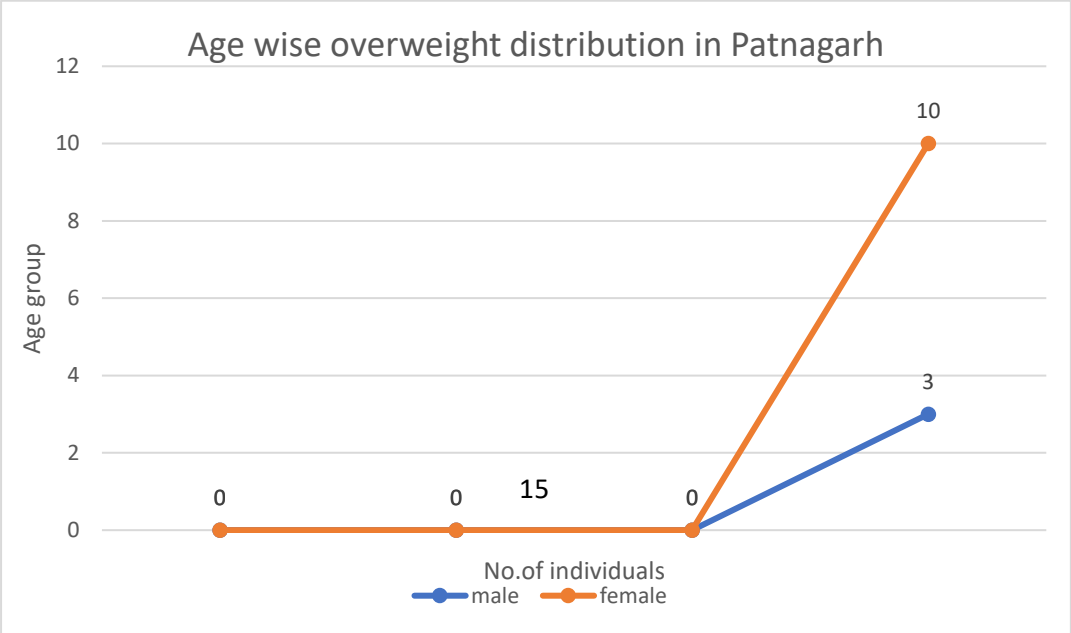

Fig. 13. Age wise distribution of Overweight in Patnagarh

TABLE XI. Mean BMI in the population of Balangir

Block	Male Mean	Female Mean
Saintala	19.10	16.57
Muribahal	14.37	14.69
Titilagarh	10.96	10.62
Patnagarh	11.72	12.74

As shown in Table XI and Fig. 14, the Body Mass Index (BMI) of male and female participants across four blocks of Balangir district, namely Saintala, Muribahal, Titilagarh and Patnagarh. The findings reveal noticeable variations in BMI between blocks as well as between genders.

The highest mean BMI among males was observed in Saintala (19.10 kg/m^2), followed by Muribahal (14.37 kg/m^2), Patnagarh (11.72 kg/m^2) and Titilagarh (10.96 kg/m^2). Similarly, among females, the highest mean BMI was recorded in Saintala (16.57 kg/m^2), followed by Muribahal (14.69 kg/m^2), Patnagarh (12.74 kg/m^2) and Titilagarh (10.62 kg/m^2).

A comparison between genders indicates that males had a slightly higher mean BMI than females in Saintala and Titilagarh, whereas females exhibited higher mean BMI values in Muribahal and Patnagarh. Overall, Saintala recorded the highest average BMI for both sexes, suggesting comparatively better nutritional status in this block. In contrast, Titilagarh showed the lowest BMI values among both males and females, indicating a comparatively lower nutritional profile.

These results highlight the existence of inter-block differences in BMI distribution within Balangir district and suggest that nutritional status may vary according that nutritional status may vary according to local demographic, socioeconomic and environmental factors.

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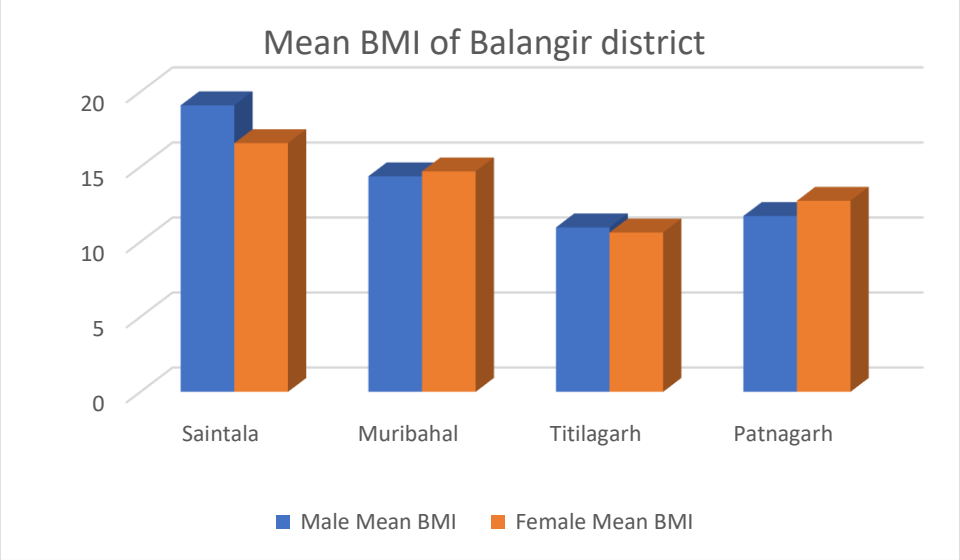

Fig. 14. Mean BMI of Balangir District

TABLE XII. Obesity in Balangir district

Block	Male	Female
Saintala	13.33%	15.38%
Muribahal	4.20%	2.83%
Titilagarh	11.42%	
Patnagarh		

As shown in Table XII and Fig. 15, the prevalence of obesity among males and females across selected blocks of Balangir district. The findings indicate notable variations in obesity prevalence between blocks and genders.

Among the surveyed blocks, Saintala recorded the highest prevalence of obesity in both sexes, with 13.33% among males and 15.38% among females. The female prevalence in Saintala was slightly higher than that of males, suggesting a greater burden of obesity among women in this block.

In Muribahal, obesity prevalence was comparatively low, accounting for 4.20% among males and 2.83% among females. Unlike Saintala, the prevalence was higher among males than females in this block.

The data for Titilagarh show an obesity prevalence of 11.42% among males, indicating a relatively high occurrence of obesity among men compared with Muribahal. Female obesity data for Titilagarh were not available in the table. Similarly, no obesity prevalence values were reported for Patnagarh, making comparison difficult.

Overall, the available data suggest that obesity prevalence differs considerably across blocks of Balangir district. Saintala exhibited the highest levels of obesity, whereas Muribahal showed the lowest prevalence. Gender-wise differences were also observed, with females showing higher obesity prevalence in Muribahal. These variations may be influenced by differences in dietary habits, physical activity patterns, socioeconomic conditions and lifestyle factors across the study areas.

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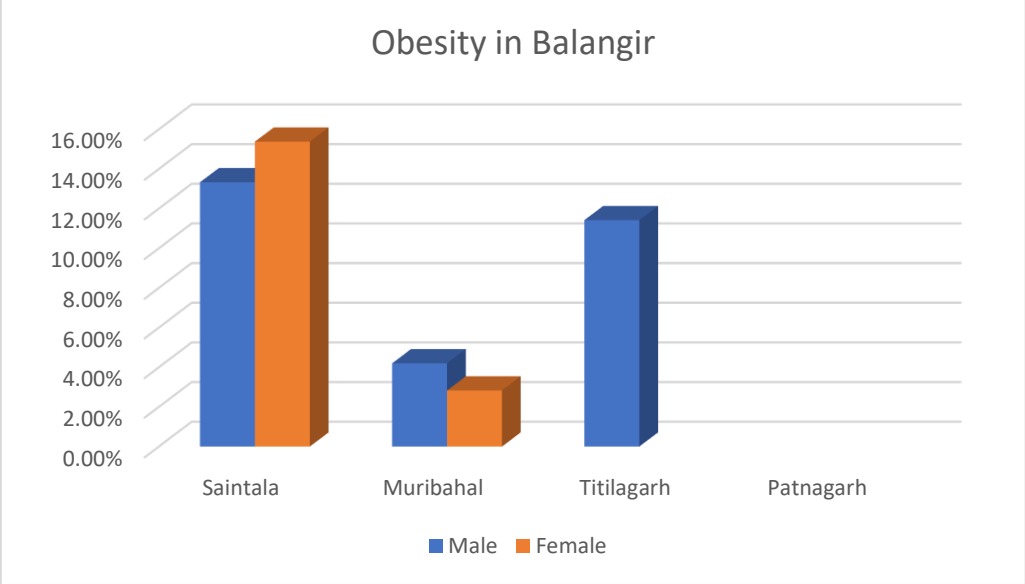

Fig. 15. Obesity in Balangir

TABLE XIII. Overweight in Balangir district

Block	Male	Female
Saintala	16.92%	10.76%
Muribahal	12.60%	7.54%
Titilagarh	2.85%	5%
Patnagarh	18.58%	18.75%

As shown in Table XIII and Fig.16, the prevalence of overweight individuals among males and females across four blocks of Balangir district, namely Saintala, Muribahal, Titilagarh and Patnagarh.

The findings indicate considerable variation in overweight prevalence between the blocks and between genders. Among males, the highest proportion of overweight individuals was observed in Patnagarh (18.58%), followed by Saintala (16.92%) and Muribahal (12.60%). Titilagarh recorded the lowest prevalence among males at 2.85%

A similar pattern was observed among females, where Patnagarh reported the highest prevalence (18.75%). Saintala and Muribahal showed moderate levels of overweight prevalence at 10.76% and 7.54% respectively, while Titilagarh had the lowest prevalence (5.0%).

Comparison between genders reveals that overweight prevalence was higher among males than females in Saintala and Muribahal. In contrast, females showed a slightly higher prevalence than males in Patnagarh and Titilagarh. Overall, Patnagarh emerged as the block with the greatest burden of overweight individuals among both sexes, whereas Titilagarh exhibited the lowest prevalence.

These findings suggest geographical and gender-based differences in overweight prevalence within Balangir district, highlighting the need for block-specific interventions aimed at promoting healthy dietary practices and physical activity.

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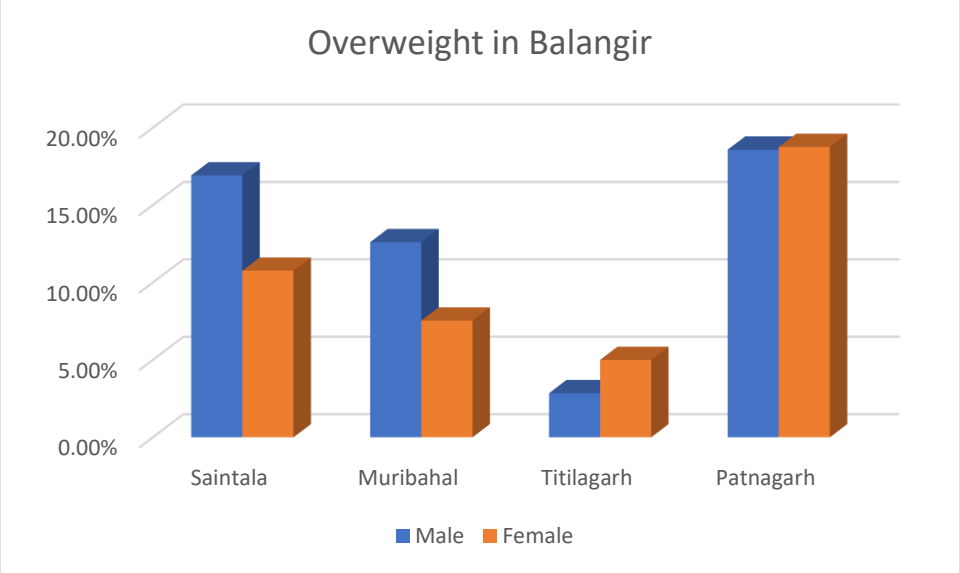

Fig. 16. Overweight in Balangir

DISCUSSION

The present study assessed the age- and sex-wise distribution of Body Mass Index (BMI), overweight, and obesity among participants from four blocks of Balangir district, namely Saintala, Muribahal, Titilagarh, and Patnagarh. The findings reveal substantial variations in BMI patterns across age groups, sexes, and geographical locations, highlighting the influence of demographic and local factors on nutritional status.

The analysis of mean BMI demonstrated a clear age-related trend. In all study blocks, BMI generally increased from adolescence to adulthood, with the highest values observed among adults and older individuals. In Saintala, adult males (18–60 years) exhibited a mean BMI of 24.70 kg/m², while females had a mean BMI of 22.51 kg/m². Similarly, individuals aged 60 years and above showed relatively high BMI values, particularly among males (26.19 kg/m²). These findings suggest that body weight accumulation tends to increase with age, likely due to reduced physical activity, lifestyle changes, and metabolic alterations occurring during adulthood and old age.

The adolescent age group (12–18 years) generally exhibited lower BMI values compared to adults across all blocks. In Saintala, male and female adolescents showed comparable BMI levels (18.54 kg/m² and 18.62 kg/m², respectively), indicating relatively balanced nutritional status between sexes during this developmental stage. Similar observations were noted in Muribahal and Patnagarh, where adolescent BMI values remained within the normal range. These findings may reflect higher energy expenditure and growth-related nutritional demands during adolescence.

Considerable differences in BMI were observed between study areas. Saintala recorded the highest mean BMI values among adults, whereas Muribahal and Patnagarh demonstrated comparatively lower BMI levels. For example, adult males in Muribahal had a mean BMI of 22.58 kg/m², while adult females had a mean BMI of 20.80 kg/m². In Patnagarh, adult male and female BMI values were 20.93 kg/m² and 21.20 kg/m², respectively. These regional differences may be associated with variations in dietary practices, socioeconomic conditions, occupational patterns, access to food resources, and levels of physical activity among the populations studied.

The prevalence of overweight and obesity also varied substantially among the blocks. Saintala exhibited the highest burden of obesity, with obesity prevalence reaching 13.33% among males and 15.38% among females. This indicates that excess body weight is emerging as a significant public health concern in this block, particularly among women. The higher prevalence among females may be attributable to reduced physical activity, hormonal influences, cultural practices, and differences in body fat distribution. Furthermore, the relatively high mean BMI values observed in Saintala support the greater occurrence of overweight and obesity within this population.

Muribahal demonstrated a lower prevalence of obesity compared to Saintala, with obesity affecting 4.20% of males and 2.83% of females. Although obesity levels were lower, overweight individuals were still identified, particularly within

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adolescent and adult age groups. These findings suggest that Muribahal may currently be experiencing an early stage of nutritional transition, where excess body weight is present but has not yet reached the levels observed in Saintala.

In Titilagarh, obesity was predominantly concentrated among adults aged 19–60 years. The prevalence of obesity among males was 11.42%, while female obesity was negligible or absent in the available data. The occurrence of obesity categories extending from Obese Class I to Obese Class III among adults indicates the presence of severe obesity in certain individuals. This pattern suggests that lifestyle-related factors, such as reduced physical activity and increased caloric intake, may be contributing to the development of obesity among adults in this block.

Patnagarh displayed a distinct pattern characterized by a relatively low prevalence of obesity but the highest prevalence of overweight. Overweight affected 18.58% of males and 18.75% of females, whereas obesity was not prominent. This finding suggests that a significant proportion of the population may be in a transitional stage between normal weight and obesity. Consequently, Patnagarh represents an important target for preventive interventions aimed at reducing future obesity-related health risks.

Age-wise analysis further indicated that overweight and obesity were largely concentrated among adults aged 19–60 years. Only a small number of overweight individuals were observed among children and adolescents. The clustering of excess body weight within adulthood may be explained by occupational transitions, sedentary lifestyles, economic improvement, and dietary changes that commonly occur during this stage of life. The presence of overweight and obesity among a few adolescents in Saintala and Muribahal, however, suggests that unhealthy lifestyle patterns may begin early and warrant attention.

The findings collectively indicate that Balangir district is experiencing a dual nutritional scenario. While some age groups and regions maintain BMI values within the normal range, a growing proportion of adults exhibit overweight and obesity. This shift may reflect changing dietary habits, urbanization-related influences, reduced physical activity, and socioeconomic development. If these trends continue, the burden of obesity-related disorders such as hypertension, diabetes mellitus, cardiovascular disease, and metabolic syndrome may increase in the future.

Overall, the study highlights significant inter-block, age-related, and sex-specific variations in BMI and obesity status. Saintala showed the greatest obesity burden, Patnagarh exhibited the highest prevalence of overweight, while Muribahal and Titilagarh displayed intermediate patterns. These findings emphasize the need for block-specific public health strategies focusing on nutrition education, promotion of physical activity, routine BMI screening, and early lifestyle interventions to prevent the progression of overweight to obesity and associated non-communicable diseases among the population of Balangir district.

Strengths and Limitations

A major strength of this study is the inclusion of participants from multiple blocks of Balangir district, allowing comparison of BMI and obesity patterns across different geographical areas and age groups. However, the study is limited by its cross-sectional design, which does not permit causal interpretation of observed associations. In addition, information on dietary intake, physical activity, socioeconomic status, and medical history was not incorporated into the analysis, which may influence BMI and obesity outcomes. Future studies incorporating these variables and larger sample sizes would provide a more comprehensive understanding of the determinants of obesity in the district.

CONCLUSION

The present study assessed the prevalence of overweight and obesity among different age groups in four blocks of Balangir district, namely Saintala, Muribahal, Titilagarh, and Patnagarh. The findings indicate that overweight and obesity were predominantly observed among adults aged 18–60 years, while very few cases were recorded among children and adolescents. This suggests that excess body weight is primarily an adult health concern in the study area.
Among the four blocks, Muribahal reported the highest number of overweight and obese individuals, followed by Saintala, whereas Titilagarh and Patnagarh showed comparatively lower numbers. Obesity of varying severity (Class I, Class II, and Class III) was observed mainly in Muribahal and Saintala, indicating a greater burden of obesity in these blocks. Titilagarh recorded only a few cases of obesity, while Patnagarh showed cases of overweight without any recorded obesity.

The analysis of mean BMI revealed notable variation between blocks. Saintala had the highest mean BMI among males (19.10), whereas female mean BMI was highest in Saintala (16.57). Titilagarh and Patnagarh showed comparatively lower mean BMI values, reflecting differences in nutritional and lifestyle patterns across the district.

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Gender-wise analysis demonstrated that the prevalence of overweight and obesity varied between males and females across blocks. Overweight prevalence was relatively higher among males in Saintala, Muribahal, and Patnagarh, while obesity prevalence showed a mixed pattern, with females exhibiting a slightly higher burden in Saintala and males showing higher obesity prevalence in Titilagarh.

Overall, the study highlights the emerging burden of overweight and obesity in Balangir district, particularly among the adult population. The concentration of cases in specific blocks underscores the need for targeted public health interventions focusing on healthy dietary practices, regular physical activity, and community-based awareness programs. Early identification and management of excess body weight are essential to prevent the future rise of obesity-related non-communicable diseases and to improve the overall health status of the population.

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