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Hidden Hunger: The Effects of Malnutrition on Women's Health in the Mumbai Metropolitan Region (MMR)

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Abstract:

Goal: The purpose of this study is to investigate the frequency and consequences of malnutrition on women's health in the Mumbai Metropolitan Region (MMR), with an emphasis on reproductive and menstrual health, general well-being, and understanding of nutrition and dietary habits.
Aim: To evaluate the nutritional status and eating patterns of women in MMR, as well as the relationship between malnutrition and health problems such anaemia, menstruation irregularities, and reproductive problems.
Approaches: cross-sectional poll.
Results: 46% of women had bad diets, characterized by a high intake of processed foods and low protein and micronutrient intake. Anaemia (60%), PCOS (14.7%), and menstrual abnormalities (14%) were prevalent, particularly among low-income populations with limited access to nutritious food.
Conclusion: Poor nutrition has a substantial impact on reproductive health issues, such PCOS and menstruation problems, especially among women from lower socioeconomic backgrounds.
Reproductive health, menstruation, PCOS, and PCOD are the main terms.

Introduction

Background

Undernutrition and overnutrition are still major public health issues around the world. Socioeconomic inequities and shifting lifestyles exacerbate this double burden in urban areas such as the Mumbai Metropolitan Region (MMR). Nutritional imbalances have a major impact on women's reproductive and hormonal health, affecting menstrual cycles, fertility, and metabolic processes. Urban stressors, such as irregular work hours, sedentary lifestyles, unhealthy diets, and restricted access to preventive healthcare, worsen these problems and increase the likelihood of illnesses like Polycystic Ovary Syndrome (PCOS) and Polycystic Ovarian Disease (PCOD).
Despite the high prevalence of PCOS/PCOD among Indian women of reproductive age, the true burden may be underestimated due to ignorance, stigma, and inadequate screening. In order to create successful public health programs in urban communities, it is necessary to study the nutritional and socioeconomic factors that contribute to these diseases.

Why

Due to the conflict between traditional duties and modern life, urban women frequently engage in erratic health practices. Despite increasing awareness, urban malnutrition—which is caused by fast food consumption, stress, and a neglect of balanced diets—gets little attention. In addition to being physically incapacitating, PCOS and associated menstrual problems also raise long-term risks for infertility, metabolic illnesses, and mental suffering. Early intervention and prevention depend on knowing which dietary and lifestyle variables can be changed.

Urban malnutrition

In MMR, malnutrition manifests in a variety of ways:
• Undernutrition: Insufficient protein and calorie intake, notably among lower income populations, resulting in weakened immune system and menstrual abnormalities.
• Overnutrition: An overabundance of processed, high-calorie meals leads to obesity and insulin resistance, two major factors in PCOS.
• Micronutrient Deficiency: Lack of iron, vitamin D, magnesium, and zinc affects hormone and reproductive function.
• Nutritional Transition: The early onset of hormonal problems is exacerbated by a shift from traditional diets to processed foods, particularly among teenagers.

Diet, Menstrual Irregularities, and PCOS

Diet and lifestyle have a significant impact on the increasing prevalence of PCOS and associated menstrual abnormalities. These disorders include hormonal imbalances, insulin resistance, and metabolic dysfunction, which are frequently associated with a sedentary lifestyle and inadequate diet. The role of gut health and chronic inflammation, both of which are impacted by food, in the formation of PCOS is also highlighted by recent research.

The Effects of Socioeconomics on MMR

The nutritional condition of women is impacted by Mumbai's varied socio-economic environment. Significant barriers to sufficient nutrition and preventative care include gender norms, cultural food customs, time constraints, and low levels of health literacy. Due to the fact that women frequently put the needs of their families ahead of their own, they may have unhealthy eating habits and put off seeking medical care.

Research Gap

Despite the fact that numerous studies have looked at PCOS and malnutrition separately, there is little data on their intersection in urban Indian women. Among the most significant gaps are:

• Insufficient data in PCOS patients pertaining to micronutrients.
• An overemphasis on medical intervention rather than preventative measures based on lifestyle.
• Inadequate research on reproductive health for unmarried women and teenagers.
• Insufficient inclusion of dietary instruction in public health initiatives.

The goal of this research is to address these gaps by looking at the nutritional, lifestyle, and socioeconomic variables that contribute to PCOS and associated health problems in women in the MMR, with the intention of informing specific preventative treatments.

Literature Review

Malnutrition continues to be a significant determinant of women's health, especially in urban settings where eating behaviors are evolving quickly. This review summarizes pertinent research on the link between malnutrition and female reproductive health, notably in the Mumbai Metropolitan Region (MMR).

1. Consequences of Poor Nutrition on Women's Health

Because of menstruation, pregnancy, and breastfeeding, women's dietary requirements are greater, which increases their risk for malnutrition-related issues. Iron deficiency anaemia, which affects more than 30% of women worldwide, is a factor in maternal mortality, infertility, and tiredness (Black et al., 2013).

2. Dietary Changes and Urbanization

Dietary habits have been significantly impacted by urbanization, which has increased the intake of processed and high-calorie foods. Overnutrition-related illnesses like obesity and PCOS are more prevalent in higher-income populations, while undernutrition is a frequent problem for women from lower socioeconomic classes (Popkin, 2014).

3. Reproductive Outcomes and Nutritional Deficiencies

Menstrual abnormalities and fertility problems are linked to nutritional deficiencies in vital elements like iron, folate, calcium, and zinc. Unbalanced diets can worsen hormonal imbalances and insulin resistance in women with PCOS (Ramakrishnan et al., 2014).

4. Cultural and socioeconomic factors

Nutritional inequalities are caused by cultural norms and socioeconomic disparities. According to the National Family Health Survey (NFHS-5, 2019–21), anaemia rates are high among women of childbearing age. In many families, conventional gender roles restrict women's access to sufficient nutrition (Kadiyala et al., 2014).

5. Dietary Habits and Awareness

A major factor in making bad food choices is still a lack of nutritional understanding. Due to a lack of awareness of the significance of balanced diets and vital supplements, many urban women frequently eat poorly (Deshmukh-Taskar et al., 2007).

6. The Mumbai Metropolitan Area suffers from malnutrition.

The MMR presents a dual burden of malnutrition. Due to a lack of resources, women in slum areas are undernourished, while those in wealthy communities are more likely to develop obesity and metabolic illnesses due to lifestyle factors (Joshi et al., 2020).

Studies Hypotheses

Hypothesis 1:

Among women in the Mumbai Metropolitan Region (MMR), malnutrition is strongly correlated with the prevalence of Polycystic Ovary Syndrome (PCOS), Polycystic Ovarian Disease (PCOD), and menstrual irregularities.

Hypothesis 2:

In Mumbai, nutritional deficits have a negative impact on women's overall health, specifically contributing to problems with their physical and reproductive health.

Hypothesis 3:

In metropolitan Mumbai, higher rates of malnutrition and associated female health issues are closely related to socioeconomic variables like income, education, and job.

Objective

The goal of this research is to investigate the complex relationship between malnutrition, which includes both undernutrition and overnutrition, and the frequency of female-specific health issues like Polycystic Ovary Syndrome (PCOS), Polycystic Ovary Disease (PCOD), and menstrual abnormalities among women in the Mumbai Metropolitan Region (MMR). With the goal of informing more focused public health interventions, the study assesses how nutritional status, dietary practices, and socioeconomic inequalities play a role in the development and course of these illnesses.
"In truth," I told myself, "this is my reality."

Goals

1. To determine the nutritional intake and dietary patterns of women in MMR
To find patterns that contribute to dietary imbalances, look at daily eating habits, food choices, portion sizes, and nutrient diversity.
2. To analyze the prevalence of malnutrition in various socioeconomic groups
Examine the relationship between income, education, profession, and undernutrition and overnutrition trends among women from different socioeconomic backgrounds.
3. To investigate the connection between malnutrition and women's health problems
Examine the effects of malnutrition on diseases like infertility-related illnesses, PCOS, menstrual abnormalities, anaemia, and P0043OD.
4. To determine the impact of nutritional deficiencies on physical and mental well-being.
Determine how a lack of iron, folate, vitamin D, zinc, and calcium impacts mental and physical well-being.
5. To examine the availability of nutritional counselling and medical care.
Get a sense of how much women use dietary counselling and healthcare services to treat malnutrition and associated health problems.
6. To assess the effects of urbanization and socio-cultural values on nutrition.
Investigate the effects of shifting urban lifestyles, economic disparities, and gender norms on women's dietary choices and access to nutritional education.
7. To pinpoint obstacles to maintaining a healthy diet
Consider the psychological, social, and financial barriers to good nutrition, such as time limitations, affordability, cultural conventions, and a lack of knowledge.
8. To ascertain the prevalence of PCOS, PCOD, and menstrual irregularities in MMR
Record the rates of reproductive health problems among women in the area from various socioeconomic and demographic groups.
9. To evaluate how reproductive health is impacted by poor nutrition
Examine how inadequate nutrition and excessive nourishment both contribute to hormonal imbalances, insulin resistance, and menstrual irregularities.
10. To assess how certain dietary habits affect hormonal health
Look at the impact of diets high in glycaemic load, low in protein, and high in processed foods on women's metabolic and reproductive health.
11. To investigate how social, economic, and cultural factors affect nutritional outcomes
Examine the impact of variables like income, household food distribution, education, and media exposure on women's dietary knowledge and health practices.

Techniques

Research Methodology: The Survey Method of research design, which is well-suited for gathering first-hand data from a big sample of the population, is used in the current work. The goal of this approach was to learn about women's eating patterns, nutritional consumption, and health concerns, with a particular emphasis on PCOS, PCOD, and menstrual irregularities in the Mumbai Metropolitan Region (MMR).
In order to reach a wide audience of women from various socioeconomic backgrounds, a structured questionnaire was created using Google Forms and disseminated online. Data on lifestyle variables, reproductive health issues, and malnutrition may be systematically gathered and analyzed using the survey approach.
This study may use the survey approach since it allows the researcher to:
• Gather a lot of information fast and effectively.
• Examine patterns and trends between various demographic groups.
• Draw generalizations and draw data-driven conclusions about the connection between malnutrition and women's health issues.
This study design is especially helpful in social and public health research because it allows for problem identification, awareness assessment, and the development of potential interventions based on observed trends.
The study focuses on the Mumbai Metropolitan Region (MMR), which consists of Mumbai city and its surrounding urban and semi-urban areas, such as Thane, Navi Mumbai, Kalyan-Dombivli, Vasai-Virar, and other adjacent locations. One of the most populous and socio-economically diverse areas in India is the MMR, which provides a valuable setting for researching issues related to public health. It includes a wide range of residents, including low-income families residing in informal settlements and middle- and high-income families living in planned metropolitan areas. This diversity makes it the perfect place to investigate how malnutrition, in all its manifestations, impacts women's health across different economic, educational, and cultural groups. The study particularly concentrates on women between the ages of 14 and 50 because they are the population most affected biologically and socially by reproductive and nutritional health problems, such as menstrual irregularities, PCOS, and PCOD.

Number of Samples

The sample for this study included 136 women from the Mumbai Metropolitan Region. Although small, this sample size offers enough information to determine patterns and trends related to malnutrition and its relationship to disorders affecting women's reproductive health. The sample includes women from various age groups, income brackets, educational backgrounds, and professions, which guarantees a comprehensive and inclusive viewpoint on the subject. The information gathered from these 136 participants is used to do statistical analysis and reach insightful findings about how dietary variables affect health issues like PCOS, PCOD, and menstrual irregularities.

Length of the Study

The research, which comprised several stages such as questionnaire design, pilot testing, data collecting via digital methods, participant follow-up for clarification (where necessary), and data analysis, took place over around three months. The length of this period was determined by the time needed for respondents to answer spontaneously and for data quality to be maintained via cross-checks and respondent verification, as needed. The three-month timeline also gave the researcher time to account for any possible delays in online survey participation and to target a larger sample of the population.

Plan for sampling

Target Group

The target demographic for this study is women between the ages of 14 and 50 who live in the Mumbai metropolitan area. The period from puberty through menopause, which is a crucial time in a woman's reproductive life when hormonal and nutritional imbalances are most likely to manifest and have lasting effects on health, is included in this age range. The chosen demographic comprises women from a variety of socioeconomic statuses, such as students, stay-at-home moms, working professionals, and hourly workers, in order to provide a wide and thorough perspective on the topic at hand.

Method of Sampling

A non-probability sampling technique called the Convenience Sampling Technique was used in the research. The selection of participants was based on their accessibility through online platforms, their readiness to take part, and their availability. Although this approach may not completely remove sampling bias, it is especially useful for early public health studies where time is of the essence and resources are few. The researcher was able to include women from various areas of the MMR in a comparatively short amount of time thanks to the ease of data collection in the digital age.

The Method of Data Collection

A self-administered online questionnaire was created using Google Forms, a platform that facilitates the creation of tailored surveys for data collection that is both effective and user-friendly. Email, WhatsApp, Instagram, Facebook, and several community organizations geared towards women were among the digital channels used to share the survey link. These platforms were selected to reach a diverse audience of city women with different educational and professional backgrounds.

The questionnaire was thoughtfully created with a combination of closed-ended and multiple-choice questions that addressed topics including dietary habits, meal frequency, knowledge of nutrition, indicators of PCOS or PCOD, regularity of the menstrual cycle, lifestyle choices, and healthcare-seeking behaviour. At the start of the form, there were clear instructions and consent information to guarantee ethical participation. Additionally, respondents were made aware of the voluntary character of their participation and their anonymity.

Participants were urged to provide honest and thorough answers in order to increase data reliability. In the event that answers were ambiguous or incomplete, follow-up contact was made (if necessary). The internet design provided flexibility, allowing respondents to finish the poll whenever it was convenient for them, which improved the overall response rate and data accuracy.

- **The Questionnaire's Format**
- The questionnaire, which is completed by the respondent, is organized into six well-organized parts that are intended to gather pertinent information for analysis.
-
- As a result, the quantity of available data is increasing.
- **Demographic data is included in Section 1.**
- • Age: _____
- • Sex: _____
- • Marital State:
- o ☐ Not married
- o □ Married
- **The Structure of the Questionnaire**
- **The questionnaire, which is completed by the respondent, is organized into six methodical sections that are intended to gather pertinent data for analysis.**
- _____
- **Demographic Data, Section 1**
- • Age: _____
- • Gender: _____
- • Relationship Status:

- o One
- o ☐ Married
- o ☐ Divorced
- o ☐ A widow
- o Other (please specify**): _____**
- **• Employment: _____**
- **• Extent of Education:**
- o ☐ Illiterate
- o ☐ Main
- o ☐ Secondary
- o Higher secondary
- o Graduate
- o ☐ After graduation
- o ☐ Degree in a Professional Field
- **• Monthly household income:**
- o ☐ Under ₹10,000
- o ₹10,000–₹20,000
- o ₹20,000–30,000
- o ₹30,000 – ₹40,000
- o ☐ ₹40,000–₹50,000
- o ☐ Over ₹50,000
- **• Neighbourhood:**
- o □ Urban slum
- o ☐ Urban, non-slum
- o A rural region
- _____
- **Section 2: Eating Habits**
- • Average daily meal count: _____
- • Main food group:
- o Vegetarian
- o □ Not vegetarian
- o ☐ Diverse
- **• Consumption frequency (Daily, weekly, rarely, or never):**
- o Fruits: _____
- o Vegetables: _____
- o Milk products: _____
- o Meat, fish, eggs, legumes: _____
- o Processed foods:
- o Sugary beverages: _____
- • Dietary restrictions or allergies:
- o Yes, but please tell me what it is: _____
- o ☐ Not at all
- **• Concerns about food security:**
- **o** Do you miss meals because of financial or other reasons? ☐ Yes ☐ No
- o Have you ever been hungry or run out of food?
- **• Employing dietary supplements:**
- o Yes (Please specify): _____
- o ☐ None
- _____
- **Menstrual Health - Section 3**
- • Age at which menstruation began: _____
- • Regularity of the cycle:
- o □ Extremely consistent
- o ☐ More or less consistent
- o ☐ Erratic
- o Extremely erratic
- • Length of period (in days): _____
- • Intensity of flow:
- o ☐ Extremely light
- o The Light
- o ☐ Average
- o ☐ Heavy
- o □ Extremely heavy
- **• Discomfort or agony during menstruation:**
- o ☐ Yes ☐ No
- o If so, please describe: **_____**
- **• Menstrual hygiene product used:**
- o Sanitary napkins
- o Menstrual cups
- o Cloth pads
- o ☐ Other: _____
- **• Access to safe drinking water for sanitation: ☐ Yes ☐ No**

- **• Experience of menstrual problems (PCOS, PCOD, endometriosis):**
- **o ☐ Yes ☐ No**
- **o If yes, kindly state: _____**
- **Section 4: Reproductive Health**
- • Prior pregnancies:
- o Are you ever been pregnant? ☐ Yes ☐ No
- o If so, the number of pregnancies is as follows:
- o Children count: _____
- **o Are miscarriages or abortions included? ☐ Yes ☐ No**
- **o If so, how many? _____**
- **• Concerns regarding fertility:**
- **o ☐ Yes ☐ No**
- **o If so, please provide a description:**
- **• Use of contraception:**
- **o ☐ No ☐ Yes**
- **o If so, what method(s) did you employ?**
- _____
- **Section 5: Overall Health**
- **• General condition of health:**
- o ♦ Exceptional
- o Very Good
- o ☐ Excellent
- o ☐ Fair
- o ☐ Bad
- **• Medical issues or chronic diseases:**
- **o ☐ Yes (Please specify): _____**
- **o ⁞ No**
- **• Access to healthcare:**
- o How often do you see a doctor?
- o Availability of nearby healthcare facilities: ☐ Yes ☐ No
- **o Do you have health insurance? ☐ Yes ☐ No**
- _____
- **Chapter 6: Socioeconomic Considerations**
- **• Kind of accommodation:**
- **o** ☐ House ownership
- o Rented residence
- o The slums
- o ☐ Other: _____
- **• availability of basic amenities:**
- o Is the drinking water safe? Yes or no
- **o Sanitary amenities: ☐ Yes or No**
- • Education level of parents:
- o Father: _____
- o Mom: _____
- • Parental occupation:
- O Father: _____
- o Mama: _____
- • Number of people in the family:
- o The household's overall population: _____

Data Analysis

Google Forms responses were exported to Excel for cleaning and organization. Quantitative data pertaining to age, dietary patterns, menstrual abnormalities, and health conditions such as PCOS/PCOD were analyzed using descriptive statistics (percentages, means, frequencies). Relationships between malnutrition and reproductive health were examined using correlation studies. Thematic analysis of open-ended responses was used to identify important themes about diet and health knowledge.

Ethical Factors

• Informed Consent: Prior to beginning, participants voluntarily gave their consent through the Google Form.
• Privacy: Data was anonymous, and no personally identifying information was gathered.
• Voluntary Participation: Participants were allowed to miss questions or withdraw at any time without fear of retaliation.
Throughout, ethical standards of justice, beneficence, and autonomy were upheld.

Restrictions

• The possibility of recall or social desirability bias might result from relying on self-reported data.
• Not all women in the Mumbai Metropolitan Region (MMR) may be adequately represented by convenience sampling.
• The sample is skewed by digital surveys that exclude women who lack digital literacy or internet access.

Inclusion Requirements

• Women between the ages of 14 and 50 who reside in the MMR.

• Participants with internet access who freely gave their consent.

Exclusion Requirements

• People who live outside the MMR, those who completed the survey partially, those who are not female, those who are outside the age range, and those who provided duplicate replies were all excluded.

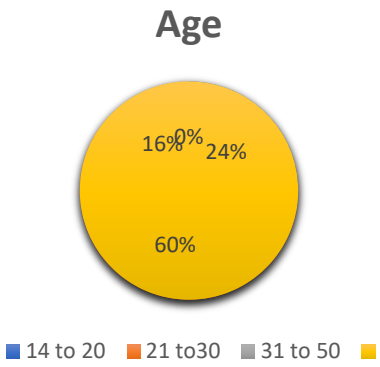
Results

Important findings on the diet, nutrition, health, and awareness of 136 women between the ages of 14 and 50 in the Mumbai Metropolitan Region (MMR) were obtained through a survey.

Demographics:

• 60% were between the ages of 21 and 30, 24% were between the ages of 14 and 20, and 16% were between the ages of 31 and 50.

• 69.2% were graduates, while 58.8% came from lower-income households..



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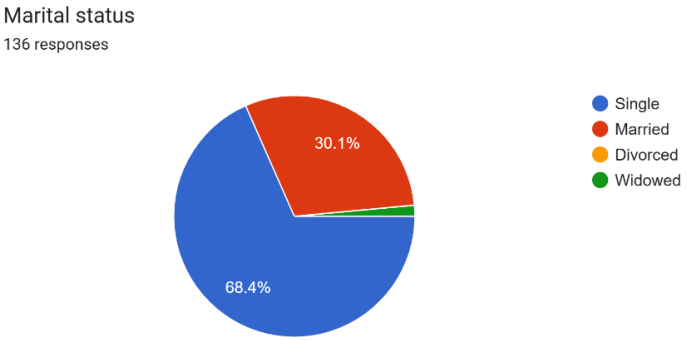

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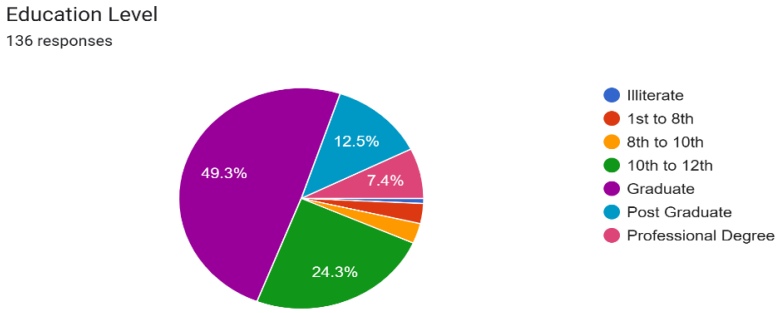

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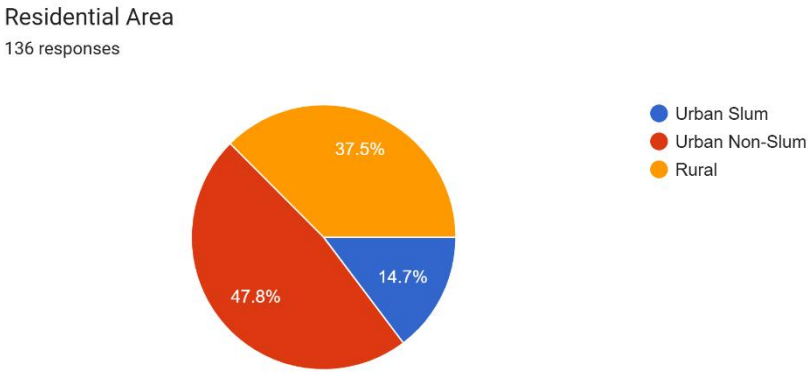


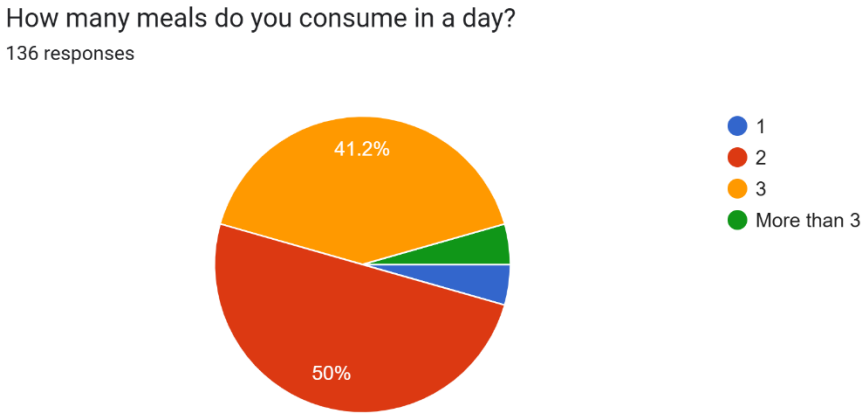
- **Fig 1.4**

Dietary Patterns:

• 46% had diets high in carbohydrates and low in protein and micronutrients, while 54% ate a well-balanced diet.

• Around half (49.9%) consumed processed/fast food more than three times a week.

• 73.5% took supplements, primarily multivitamins and iron.



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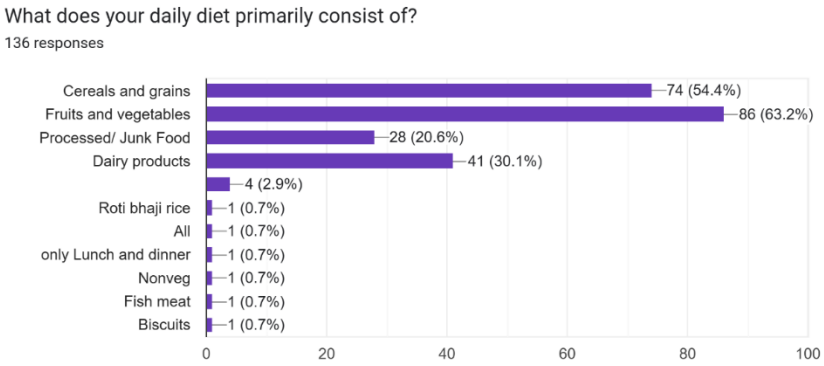

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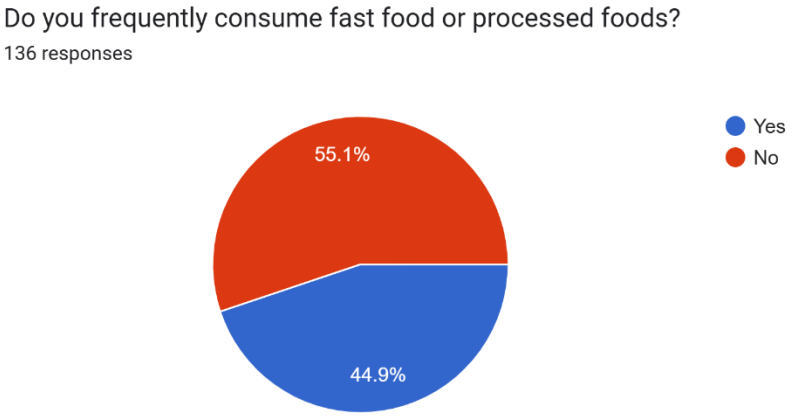

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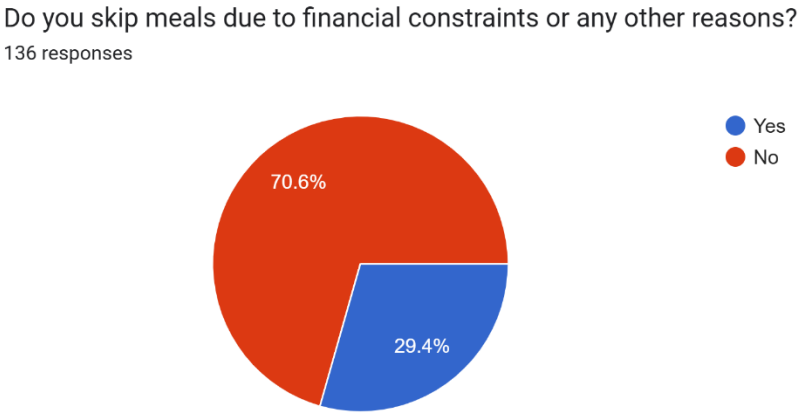

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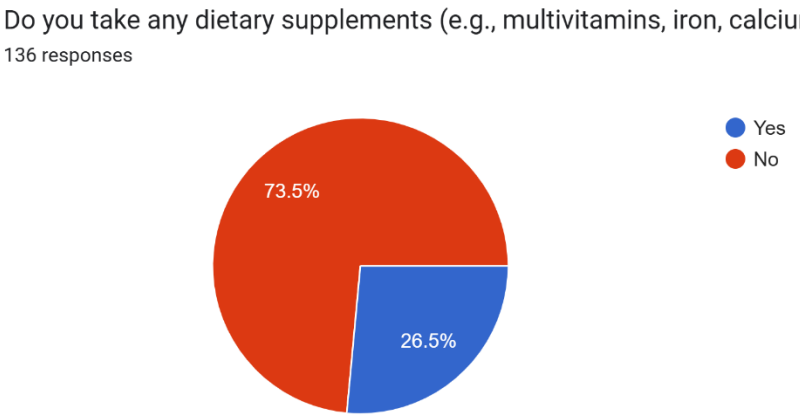


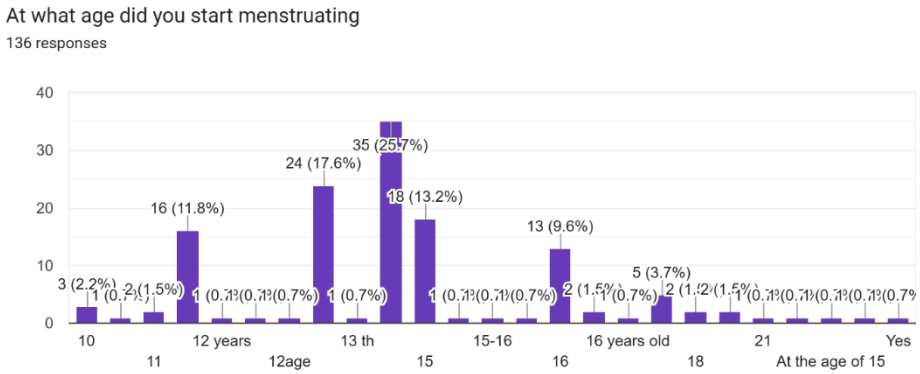
- **Fig 2.5**

Health Issues:

• Self-reported anaemia was prevalent.

• 8.09% experienced infertility, 14% reported irregular periods, and 14.7% suffered from PCOS

• Further grievances include tiredness, hair loss, skin disorders, and weight gain.



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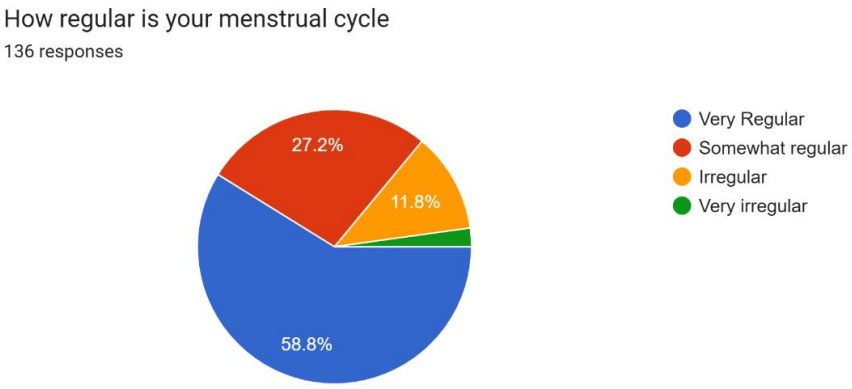

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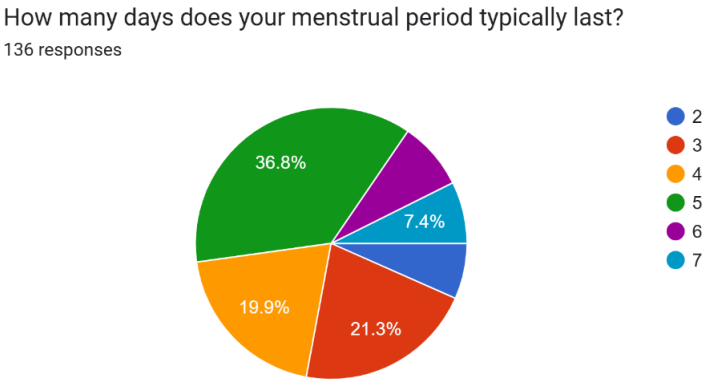

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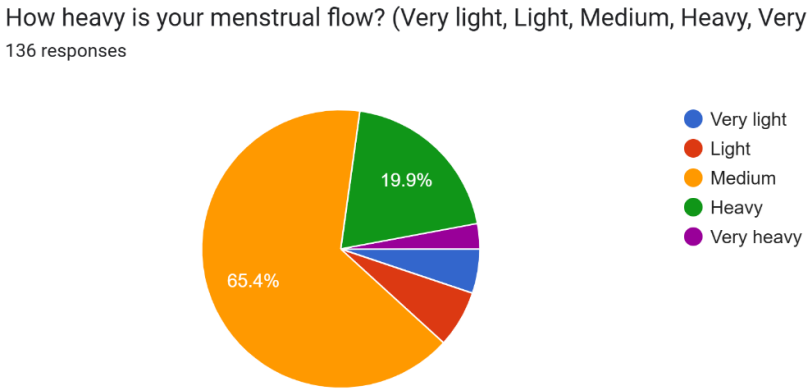

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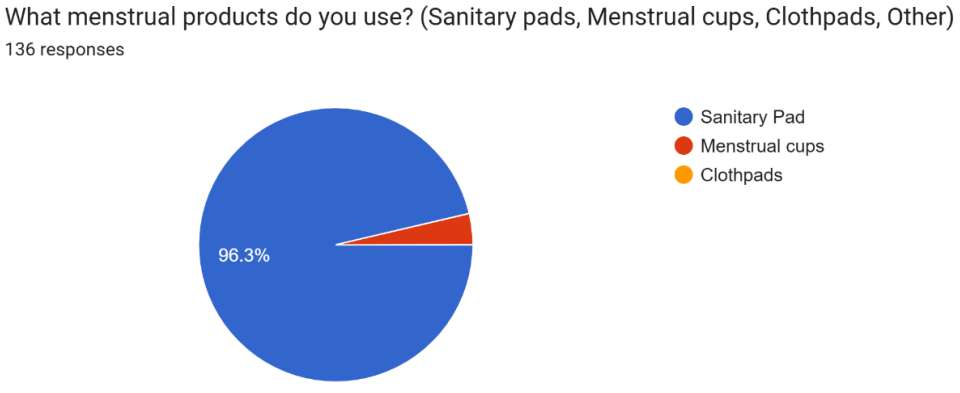

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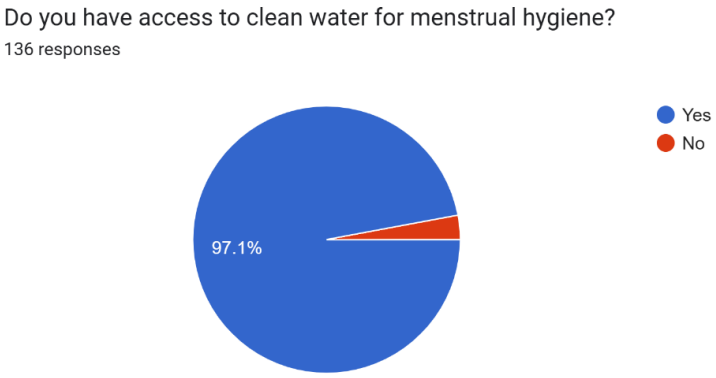

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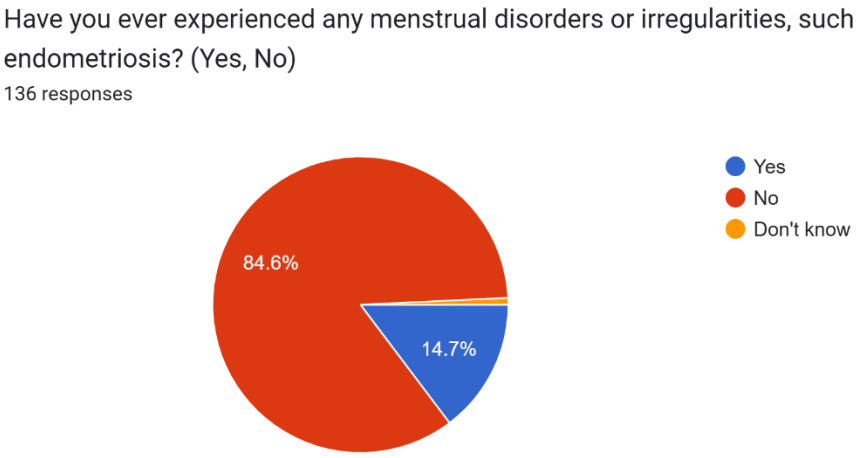

- **Fig 3.7**

Nutritional Awareness and Barriers:

- Awareness was higher in middle/upper-income groups.
- Lower-income women cited financial constraints and cultural practices limiting healthy eating.

Urbanization Impact:

- Urban lifestyle contributes to both undernutrition and overnutrition, linked to processed foods, inactivity, and poor access to affordable nutritious food.

- **Tables**

- **Table 1.1**

DEMOGRAHIC PROFILE	
Age distribution	
14 to 20	**24%**
21 to 30	**60%**
31 to 50	**16%**
Socio-Economic Status	
Lower-income group	**58.8%**
Middle-income group	**16.2%**
Higher-income groups.	**25%**
Educational Background	
Graduate degree	**69.2%**
High school education	**24.3%**
No formal education	**6.5%**

- **Table 1.2**

DIETARY HABITS	
Meal Frequency	
Three meals a day	**45.6%**
Two meals a day	**50%**
Skips meal regularly	**4.4%**
Diet composition	
Balanced diet	**54 %**
Diets high in carbohydrates but low in proteins and micronutrients	**46%**
Fast food consumers	**49.9%**
Nutritional supplements	
Take supplement	**73.5%**

- **Table 1.3**

HEALTH CONDITIONS	
Prevalence of Anaemia	
60% of respondents reported being diagnosed with anaemia.	
Reproductive Health Issues	
menstrual irregularities	**14 %**
had been diagnosed with PCOS.	**14.7%**
Socio-Economic Influences	
Income vs. Diet Quality:	
Lower-income groups (29.4%) reported limited access to nutritious food due to financial constraints.	

Discussion:

1.Demographics and socioeconomic factors Women between 21 and 30 face nutritional hazards throughout their reproductive years. Economic restrictions deny people a balanced diet despite their high education, therefore highlighting income inequality as a major determinant of health.

2. Eating habits Regular fast food as well as diets rich in carbs and low in nutrients that many people depend on raises their risk of getting PCOS, diabetes, and obesity. The use of supplements seems responsive, pointing to gaps in preventative nutrition.

3. Implications for One's Health In line with global trends connecting dietary deficits to reproductive issues, which have an impact on both physical and mental health, there are high rates of anaemia, PCOS, and menstrual disorders.

4. Awareness and Availability Financial limitations and falsehood stop people from preparing healthy meals even if some knowledge of nutrition exists. Especially for at-risk groups, well-planned, culturally sensitive education is essential.

5. Socioeconomic considerations In accordance with the bigger body of literature on gender and poverty in India, economic hardship, cultural food customs, and the difficulties of city life all help to sustain malnutrition cycles.

Recommendations and Consequences

• Establish community nutrition initiatives targeted at low-income areas.

• Carry out public health projects promoting balanced diets and supplementation.

• Improve healthcare access for screening and complimentary supplementation.

• Reform policies to promote healthy foods and combine nutrition with poverty reduction.

• To maximize community participation, use culturally relevant messaging.

In essence, this study highlights the significant influence malnutrition and socioeconomic inequalities have on women's health in the Mumbai Metropolitan Region (MMR). Young women between the ages of 21 and 30 are disproportionately affected by poor diets and associated diseases like anaemia, PCOS, menstrual irregularities, and fertility problems. Financial limitations prevent access to nutritious meals despite high levels of education. The widespread consumption of processed meals high in carbs and erratic eating schedules demonstrates a clear need for dietary change. Many people use supplements, yet they frequently conceal underlying problems with limited dietary choices and food insecurity. Nutritional knowledge differs; several people depend on social media and other informal channels, which emphasizes flaws in public health education and expert consultation availability. Health inequalities are still made worse by systematic obstacles connected to poverty, urban living, and gender-based prejudice that disproportionately impact lower-income women. Strategies tackling the causes and effects of malnutrition in many spheres are therefore vital. The main

steps include: Solving these issues will help governments, medical professionals, and societies to move toward a more equitable future for women in the MMR. Long-term planning and focused interventions targeting women's health and nutrition derive from this research.

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