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Double burden of malnutrition among young adult female (18-25 years) of West Bengal, India

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Abstract

Globally, malnutrition affects approximately one-third of the population, manifesting in various forms of undernutrition and overnutrition. This issue is particularly prevalent in developing countries, posing significant health concerns for female. To address this, the present study was undertaken to evaluate the nutritional status and related factors among female in Paschim Medinipur District and North 24 Pargana District of West Bengal, India. This cross-sectional study was conducted involving 337 females selected through a simple random sampling technique with proportional allocation. Data collection utilized a self-administered questionnaire. Nutritional status was determined based on the World Health Organization (WHO) cut off points for underweight and overweight. Statistical significance was set at a $p<0.05$. The study revealed that 16.91% of participants were underweight and 17.80% were classified as overweight or obesity. A significant association ($\chi^2=28.400$; $p<0.01$) was noted between monthly family income (MFI) group and nutritional status among the participants. The BMI of the participants were significantly different ($F= 5.791$; $p<0.001$) in varied MFI group. It was observed that age of the participants was significantly correlated with weight ($r=0.360$; $p<0.01$), height ($r=0.294$; $p<0.01$) and BMI ($r=0.257$; $p<0.01$). The present study clearly documented that age of the female and family income had significant influence on the nutritional status of the young adult female and more than one-third of participants were suffering from double burden of malnutrition.

Keywords: Double burden of malnutrition, female, West Bengal

1. Introduction

The double burden of malnutrition (DBM) remains a significant global public health challenge. It is characterized by the simultaneous presence of both undernutrition and overnutrition or diet-related non-communicable diseases within individuals, households, and populations, across the life courses (WHO, 2017; Shrimpton and Rokx, 2012). Alarmingly, approximately one-third of the global population is affected by some form of malnutrition (WHO, 2021).

India has recently grappled with the DBM, akin to numerous other developing nations. The enduring issue of undernutrition alongside the increasing prevalence of overweight/obesity remains a substantial health concern, disproportionately impacting a large portion of the population. Suboptimal diet, poor dietary habit, sedentary lifestyle, junk food addiction, and extended social media use promote the obesity among young adults (Ke-You and Da-Wei, 2001; Swaya et al., 1995; Money et al., 2016; Akhter et al., 2017). The global surge in obesity has been recognized as an epidemic, with its prevalence escalating not only in developed nations but also in developing countries over the past few decades (Popkin, 2004; Prentice, 2006; Madanat et al., 2008). According to recent data from the World Health Organization (WHO), global obesity rates have tripled since 1975 (WHO, 2021). As economies progress, affluent societies often witness a shift in the burden of overweight and obesity from the wealthy to the less privileged. Factors like industrialization, urbanization, and dietary changes accompany rising national affluence. Obesity correlates directly with various chronic ailments, including hypertension, coronary heart disease, type-2 diabetes mellitus, osteoarthritis, dyslipidaemia, cholelithiasis, and certain cancers affecting various organs (Bhattacharya et al., 2024; Das et al., 2022; Maiti, 2021; Manson et al., 2004; Ogunbode, 2009; Visscher and Seidell, 2001; WHO, 2000). Furthermore, obesity contributes to gynaecological disorders such as amenorrhea, menstrual irregularities, polycystic ovarian syndrome, and infertility etc (Sinha et al., 2022; Visscher and Seidell, 2001). Conversely, underweight/undernutrition typically results from inadequate dietary intake or underlying medical conditions. It compromises the body's immune system, leading to prolonged, severe, and frequent illnesses (Bhutta et al., 2013; Oladoyinbo and Ekerette, 2015).

In developing countries, scant attention has been devoted to addressing obesity, with a predominant focus on the prevalence and ramifications of undernutrition (Oladoyinbo and Ekerette, 2015; Akpa and Mato, 2008). In light of this context, this study was undertaken to ascertain the prevalence of undernutrition and overweight/obesity among female attending a women's college situated in a semi-urban locale.

2. Materials and methods

2.1 Study location and human participants

A community-based cross-sectional study was conducted from November 2022 to January 2023 among adult female aged between 18 and 25 years residing in Paschim Medinipur district and North 24 Pargana district.

2.2 Inclusion criteria

Inclusion criteria encompassed mentally competent, emotionally stable young adult females within the specified age range. Participants with significant health conditions such as diabetes, hypertension, or chronic infectious diseases were excluded from the study.

2.3 Family monthly income

The information regarding the family monthly income (FMI) in rupees was collected from the participants.

2.4 Anthropometric measurements

Anthropometric measurements were meticulously performed by trained professionals using standardized techniques (Lohman et al., 1998). Height was measured to the nearest 0.1 cm while participants stood erect on a flat platform with their head aligned in the Frankfort horizontal plane, employing Martin's anthropometer. Body weight was digitally recorded to the nearest 0.1 kg using a calibrated weighing scale (Doctor Beliram and Sons, New Delhi, India), with participants maintaining a motionless stance. Calculation of body mass index (BMI) followed standard equations: BMI (kg/m^2) = Weight (kg) / Height^2 (m^2). Nutritional status was assessed based on internationally recognized BMI criteria. The following cutoff points were used: Chronic Energy Deficiency (CED) III: BMI < 16.0, CED II: BMI = 16.0-16.99, CED I: BMI = 17.0-18.49, Normal: BMI = 18.50-24.99, Overweight: BMI = 25.0-29.99 and Obesity: BMI>30.0(WHO, 1998). Errors in measurements were diligently monitored to ensure adherence to acceptable limits (Ulijaszek and Kerr, 1999).

2.5 Statistical analysis

The statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) for analysing one-way ANOVA to study impact of family income per month on mean height, weight, BMI. The correlation coefficient was calculated to examine association between intra-parameters of anthropometric measurements and correlation matrix was developed using the "corrplot" package of R version 3.1.4. Maps were generated with Microsoft Office Excel. Statistical significance was considered at $p< 0.05$ in all analyses.

3. Results and Discussion

The study group was consisted of 337 adult young females. The mean and standard deviation of the weight, height and BMI were 52.94±9.43 kg, 155.05±5.97 cm and 21.98±3.46 kg/m^2 respectively. The adult females were segregated into six groups, according to their monthly family income (MFI). The effect of monthly family income on anthropometric measurements were presented in Table 1. The highest BMI was 23.21±3.05 kg/m^2 in the MFI >Rs. 61662 and lowest in BMI was 21.98±3.46 kg/m^2 in the MFI ≤ Rs. 6174 with a significant difference ($F=5.791$; $p<0.001$). This study also showed the significant difference of weight ($F=11.456$; $p<0.001$) and height ($F=8.315$; $p<0.001$) in the different MFI categories.

Table 1: Effect of monthly family income on anthropometric measurements

Monthly family income (Rupees)	N	Weight (kg)	Height (cm)	BMI (kg/m^2)
>61662	29	59.28±9.27	159.64±5.18	23.21±3.05
46129-61662	39	56.71±7.42	157.05±6.52	23.00±2.88
30831-46128	28	56.52±9.20	157.03±5.22	22.94±3.73
18497-30830	41	54.66±10.69	155.47±7.03	22.53±3.62
6175-18496	69	53.43±9.25	154.27±5.18	22.42±3.54
≤6174	131	48.85±7.99	153.29±5.36	20.78±3.25
Total	337	52.94±9.43	155.05±5.97	21.98±3.46
ANOVA		**F=11.456; p<0.001**	**F=8.315; p<0.001**	**F=5.791; p<0.001**

The prevalence underweight and overweight among the participants was 16.91% and 17.80% respectively (Table 2). The prevalence of CED III, CED II, CED I among the adult females were 1.19%, 4.75% and 10.98% respectively (Figure 1). It also reveals that the highest prevalence of underweight (25.19%) was noted among the females of MFI ≤Rs. 6174 while highest prevalence of overweight/obesity (39.29%) was detected among the females of MFI Rs. 30831-46128. Nutritional status was significantly associated with the MFI (χ^2=28.400; p<0.01).

Table 2: Relationship between monthly family income and nutritional status

Monthly Family Income (Rupees)	N	Underweight	Normal	Overweight/ Obesity
>61662	29	0 (0.00)	23 (79.31)	6 (20.69)
46129-61662	39	6 (15.38)	28 (71.79)	5 (12.82)
30831-46128	28	4 (14.29)	13 (46.43)	11 (39.29)
18497-30830	41	6 (14.63)	24 (58.54)	11 (26.83)
6175-18496	69	8 (11.59)	48 (69.57)	13 (18.84)
≤6174	131	33 (25.19)	84 (64.12)	14 (10.69)
Total	337	57 (16.91)	220 (65.28)	60 (17.80)

DBM was found highest (53.57%) in the MFI Rs. 30831 - 46128 and lowest (20.69) in >Rs. 61662 (Figure 2). The findings underscore the socio-economic gradient in nutritional status, where higher income levels are associated with a lower prevalence of underweight but a higher prevalence of overweight/obesity. This gradient is consistent with global trends where economic development often correlates with shifts

towards diets high in energy-dense foods and sedentary lifestyles, contributing to overweight and obesity (Popkin & Gordon-Larsen, 2004). Pearson's correlation matrix (Figure 3) shows the interdependency of the anthropometric measurements. Age of the female participants was significantly correlated with weight ($r=0.360$; $p<0.01$), height ($r=0.294$; $p<0.01$) and BMI ($r=0.257$; $p<0.01$). These findings indicate that as age increases, there is a tendency for both weight and height to increase, consequently affecting BMI. Such correlations highlight the influence of age on anthropometric measurements among women, underscoring the need to consider age-related factors in assessing and understanding variations in body composition and health outcomes within this demographic group. Similar findings was observed in the study conducted by Gallagher et al. (1996). Such association was not observed in our previous study (Manna et al., 2018).

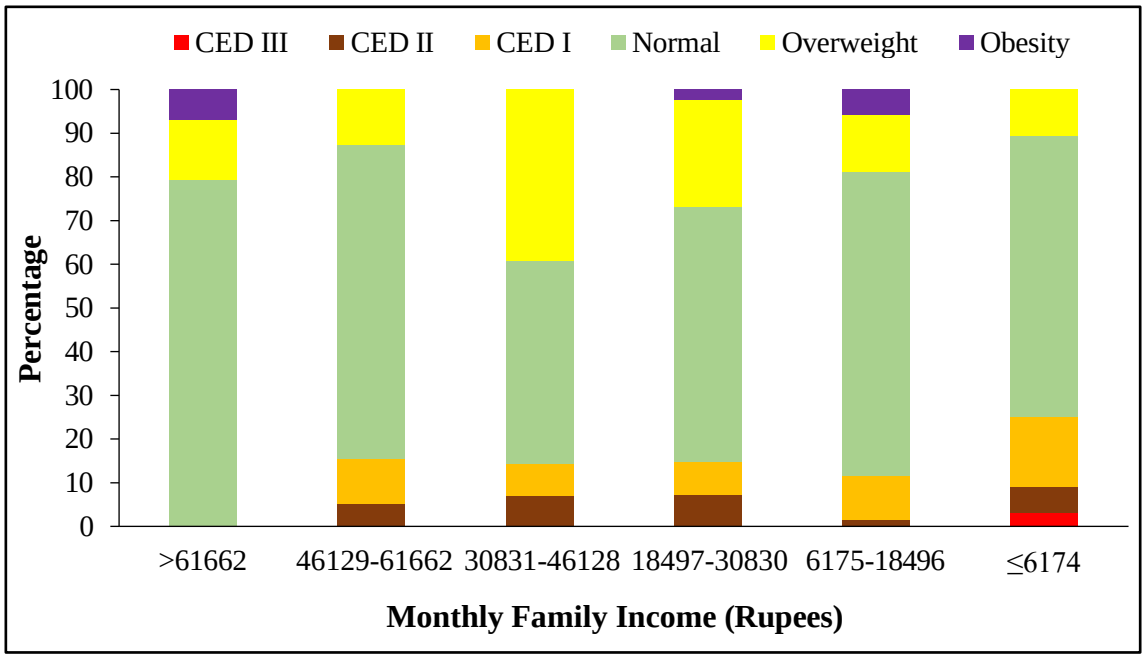

Figure 1: Effect MFI on prevalence of CED, overweight and obesity

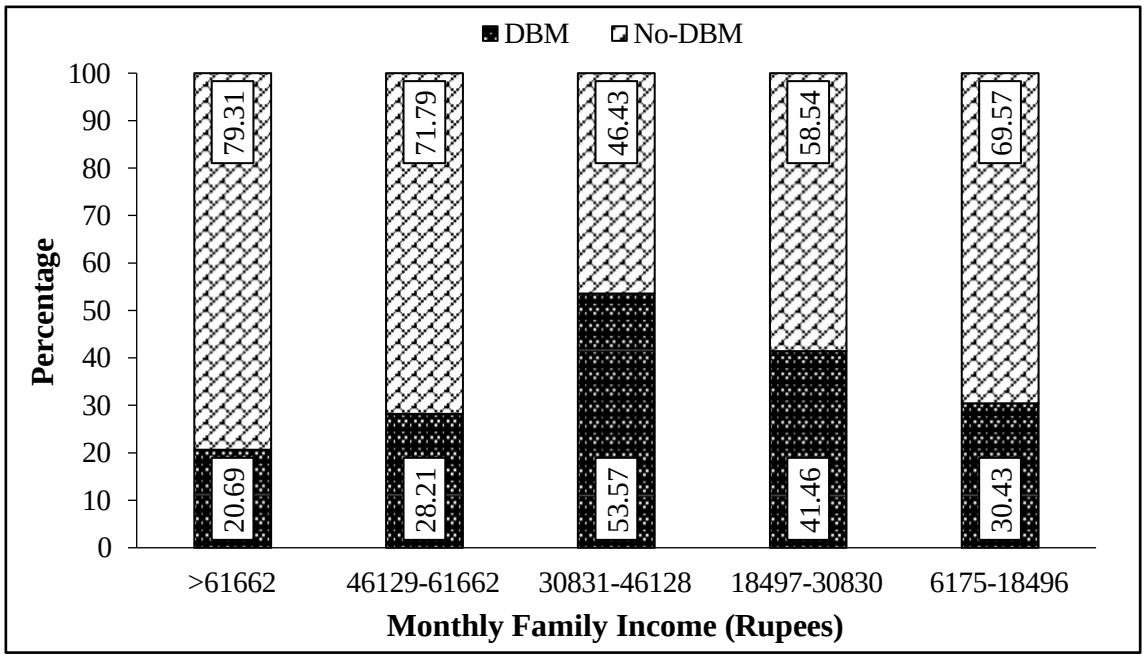

Figure 2: Effect of MFI on prevalence of DBM

The latest report from the World Health Organization highlights the persistent threat of undernutrition and infectious diseases in low-income countries. Paradoxically, overweight and obesity have emerged as significant risk factors for cardiovascular diseases in these same regions (NFHS, 2015). Traditionally, overweight and obesity were believed as an impossible phenomenon in many developing or underdeveloped countries (WHO, 2011). However, their prevalence has surged dramatically over the past few decades, making them major public health concerns alongside the enduring challenge of undernutrition (Oladoyinbo and Ekerette, 2015).

Figure 3: Pearson's correlation matrix of the anthropometric measurements

The current study revealed DBM among young adult females with a higher prevalence of overweight (17.80%) compared to underweight (16.91%) in the two districts of West Bengal, India. Comparative prevalence of DBM of the female of different states/union territory of India with the present study is presented in Figure 4. The prevalence of the different states/union territories was calculated from the prevalence of underweight and overweight/overweight as documented in NFHS-4 report. It shows that the highest DBM (54.7%) was found in Chandigarh and lowest (24.3%) in Meghalaya (Wang et al., 2009). This study also reported that 22 states/union territories of India have higher prevalence of DBM than the present study in West Bengal (34.72%) and 12 states/union territories have lower prevalence of DBM than the present study. Jammu & Kasmir depicted the same prevalence of DBM as in West Bengal. Additionally, the global distribution of overweight is shown in Figure 5. The prevalence of obesity and overweight across different countries and regions reveals significant disparities, reflecting varying socio-economic, cultural, and health-related factors. Present study reported 10.9% prevalence of obesity in India. This is higher than Bangladesh (3.6%), Sri Lanka (5.2%), Pakistan (8.6%) and lower than the developed countries such as UK (27.8%), USA (36.2%), Italy (19.9%) and France (21.6%) (Gupta et al., 2023). These figures highlight the complex interplay of dietary

habits, lifestyle choices, healthcare infrastructure, and genetic predispositions in shaping national obesity trends. Recent findings from the National Family and Health Survey-4 indicate a prevalence of underweight and overweight among adult females in West Bengal at 21.3% and 19.9% respectively (Wang et al., 2009). Our study corroborates the prevalence of overweight but reveals a lower prevalence of underweight compared to previous findings (Wang et al., 2009). In this region the unplanned urbanization, economic transitions, shifted dietary patterns including replacement of traditional diets rich in grains, vegetables, and fruits by more Westernized diets high in refined carbohydrates, sugars, and fats, may be the most prominent components behind the high prevalence of overweight and obesity. Simultaneously, the consequences of undernutrition till persist due to food insecurity, limited access to nutritious foods, and cultural factors affecting dietary practices. Lower-income households often struggle to afford diverse and nutritious foods, relying instead on cheaper, calorie-dense options that may be nutritionally poor. Moreover, the improper dietary knowledge makes the situation more complicated. The condition of the young adult female is vulnerable due to societal pressures, gender disparities in food allocation in the family, and evolving lifestyle habits. Furthermore, this study suggests that the young adult females in in this study had a lower prevalence of underweight and also overweight/obesity compared to adult women nationwide. This contrasts with the global prevalence of underweight (9.4%) and overweight (39.7%) among females (Neupane et al., 2016; Biswas et al., 2017).

The presented data underscores a compelling a significant association (χ^2=28.400; $p<0.01$) between monthly family income levels and nutritional status among adult young females in West Bengal, India. Similar kinds of association were also reported in different studies (Yeshaw et al., 2020; Neupane et al., 2016; Biswas et al., 2017; Bishwajit, 2017). Analysis of the dataset, which encompasses six income categories, reveals significant variations in weight, height, and BMI across different income categories, indicative of the prevalence of DBM within this demographic. Among participants from the lowest income (≤Rs. 6174), the mean weight, height and BMI were 48.85±7.99 kg, 153.29±5.36 cm, and 20.78±3.25 kg/m^2 respectively. For instance, among those in the highest MFI (>Rs. 61662), the mean weight, height and BMI were 59.28±9.27 kg, 159.64±5.18 cm, and 23.21±3.05 kg/m^2 respectively. As family income increases, there was a linear increase in mean weight, height, and BMI, with individuals from higher income groups exhibiting higher mean values across these nutritional indicators. The observed disparities underscore the complex interplay between socioeconomic factors and nutritional outcomes. Individuals from economically disadvantaged backgrounds exhibit lower mean values for weight, height, and BMI, suggesting a higher prevalence of undernutrition within these groups.

Analysis of the dataset reveals distinct patterns in the distribution of underweight, normal weight, and overweight/obesity among participants from varying income backgrounds. Notably, individuals from lower-income households, particularly those earning ≤ Rs. 6174, exhibit a higher prevalence of underweight status, with 25.19% falling into this category. Conversely, participants from higher-income brackets, such as those earning > Rs. 61662, demonstrate a higher proportion (79.31%) within the normal BMI range, reflecting better overall nutritional status and the study also revealed that not a single female of this group were suffering from

underweight. Moreover, a gradient effect is observed, wherein as family income increases, there is a corresponding decrease in the prevalence of underweight status and an increase in the proportion of individuals classified as normal weight or overweight/obese. When considering the different categories of nutritional status, among individuals from the lowest MFI (≤Rs. 6174), 64.12% fall within the normal BMI range, while 10.69% are classified as overweight/obese. In contrast, among participants from the highest MFI (>Rs. 61662), 79.31% are within the normal BMI range, with 20.69% classified as overweight/obese. These figures highlight the stark differences in nutritional status across income groups, with higher-income individuals demonstrating better nutritional outcomes.

As the participants of higher income group are more health conscious, DBM was found lower (20.69%) in higher MFI group (> Rs. 61662). These findings corroborate the hypothesis proposed in earlier research that any policy targeting the enhancement of household income will correspondingly diminish malnutrition. The elevation in monthly income is expected to enhance the intake of calories and essential nutrients by promoting the consumption of foods rich in nutrients, such as meat, fruits, vegetables, and dairy products (Ogundari and Abdulai, 2013; Neupane et al., 2016). The highest prevalence of DBM was most abundant (53.57%) in middle MFI group (Rs. 30831 – Rs. 46128). This result comes due to the higher tendency of taking junk foods in middle income categories (Ogundari and Abdulai, 2013). Young females in the middle-income households were more likely to be overweight or obese (39.29%) compared to those in the lower income households, even in comparison with the high-income groups. Similarly, previous research consistently shows that young females from wealthier households are at a higher risk of being overweight or obese and at a lower risk of being underweight (Neupane et al., 2016; Biswas et al., 2017; Bishwajit, 2017). In a developing country like India, unhealthy behaviors like consuming energy-dense diets and leading sedentary lifestyles vary by socioeconomic status. Additionally, females in the poorest households often lack access to adequate and varied diets. Consequently, individuals in the lowest socioeconomic brackets are at a heightened risk of developing various communicable diseases due to deficiencies in macronutrients or micronutrients, poor hygiene, and inadequate sanitation (Tesema et al., 2021). Conversely, participants from higher-income categories demonstrate better overall nutritional status, with higher mean values across these indicators, indicative of better access to adequate and nutritious food resources. Previous studies also supported this (Biswas et al., 2017; Darmon & Drewnowski, 2008; Jones et al., 2016).

This finding is consistent with previous research demonstrating a higher risk of overweight and obesity among women from affluent backgrounds and a lower risk of underweight (Bishwajit, 2017). In low and middle-income countries, lifestyle behaviors such as consuming energy-dense diets and leading sedentary lives often vary according to socioeconomic status. Additionally, women in the poorest households tend to have limited access to diverse and adequate diets. Consequently, individuals from lower socioeconomic strata face elevated risks of communicable diseases due to deficiencies in macronutrients or micronutrients, as well as poor hygiene and sanitation practices (Alkerwi et al., 2015; Seligman et al., 2010).

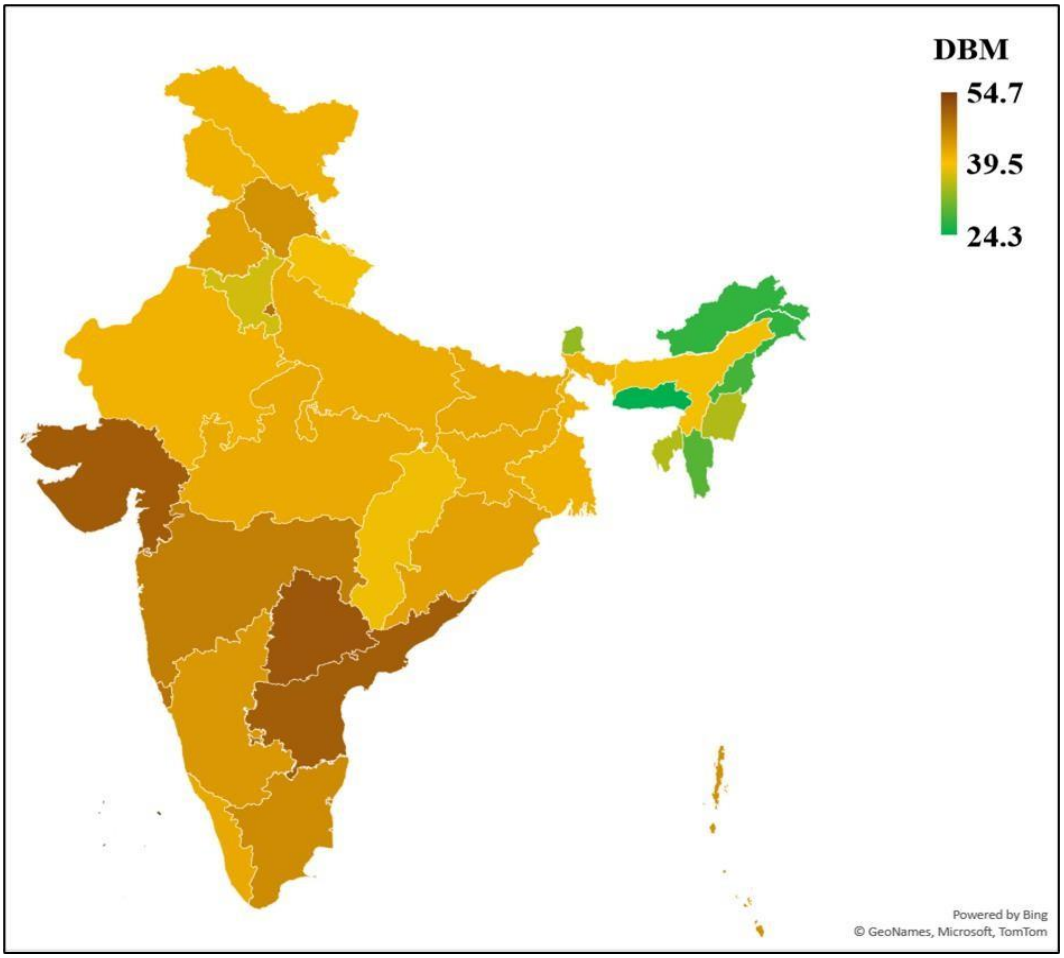

Figure 4: Comparative prevalence of DBM of the female of different states/union territory of India with the present study

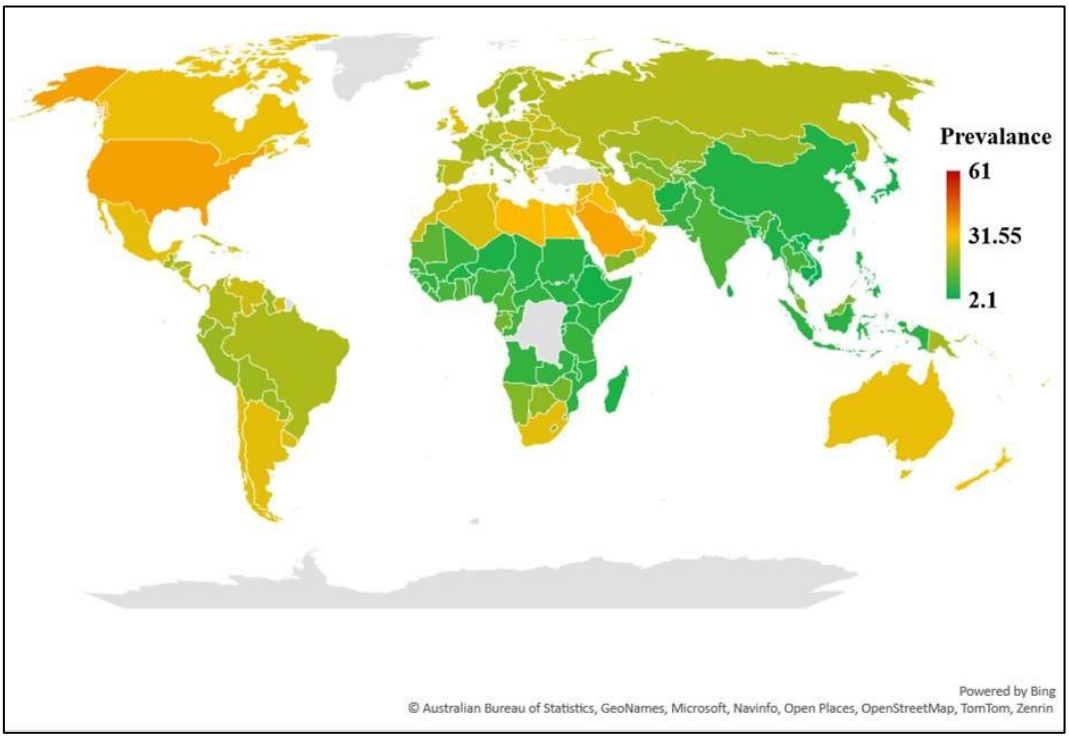

Figure 5: Comparative prevalence of obesity of the female of different countries/ territories with the present study

The study exploring the correlation between family income levels and the nutritional status of young adult females in West Bengal, India, provides crucial insights into the complex dynamics of nutrition and socioeconomic status within this demographic. The findings reveal significant disparities in nutritional outcomes across different income brackets, shedding light on the presence of what is known as the double burden of malnutrition. In the context of West Bengal, the study underscores how economic disparities influence nutritional status, creating distinct patterns of health outcomes among young adult females. The research highlights that individuals from economically disadvantaged backgrounds are particularly vulnerable to undernutrition. This vulnerability stems from limited access to adequate and nutritious food resources. Economic constraints often restrict the ability of low-income households to purchase a diverse range of foods that are essential for maintaining good health. As a result, young females from these backgrounds face a higher prevalence of underweight status. Conversely, young females from higher-income households generally enjoy better nutritional outcomes. They have greater access to a variety of nutrient-rich foods and resources, which contribute to healthier dietary patterns and lower rates of undernutrition. This disparity underscores how socioeconomic factors, such as income levels, shape dietary behaviors and subsequent health outcomes.

The study further emphasizes the intricate interplay between income levels and dietary behaviors. Economic stability enables families to afford not only sufficient quantities of food but also a diverse range of foods that are crucial for meeting nutritional needs. Higher-income households can afford fresh fruits, vegetables, proteins, and other essential nutrients, which contribute to better overall health and lower risks of undernutrition. In contrast, economically disadvantaged families often rely on more affordable but less nutritious food options. These may include processed foods high in sugars, unhealthy fats, and low in essential nutrients. Such dietary patterns can contribute to poor nutritional outcomes, including underweight status among young adult females.

4. Conclusion

The assessment of health standards in the Paschim Medinipur and North 24 Pargana underscores the importance of socio-economic and geographical parameters, which play pivotal roles in determining health outcomes. This study revealed the serious situation of DBM in this area by affecting more than one third of the female population and the most affected income group was the middle income where more than half of the population were suffered. The study also revealed the fact that ten per cent of the female belonging to lower income group had overweight or obesity. These findings underscore the complex interplay between income, nutrition, and health outcomes, necessitating comprehensive policy responses to address disparities and improve population health.

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