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ARTICLE

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The double burden of 'malnutrition': Under-Nutrition & Obesity

Intraindividual double burden of malnutrition among women (15–49 years) in India, Myanmar, and Nepal: evidence from the recent Demographic and Health Surveys

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BACKGROUND: There is a concurrent increase in anaemia and overweight/obesity among women in the South and South East Asia regions. Despite these, studies on the co-existence of anaemia and overweight/obesity in these countries are abysmally limited. This secondary analysis sought to estimate the burden of the intraindividual double burden of malnutrition (IDBM), i.e., co-existence of anaemia and overweight/obesity among women of reproductive age (15–49 years) in India, Myanmar, and Nepal, and explore the impact of socio-demographic and economic factors on this health outcome.

METHODS: A secondary analysis of the Demographic and Health Surveys (DHS) of India (2019–2021), Myanmar (2015–2016), and Nepal (2016) was conducted. A descriptive analysis of the health outcomes and the risk factors was done with frequencies and percentages. The association between selected socio-demographic (women's age, education status, number of children and place of residence) and economic (occupation status, and wealth quintile) variables with IDBM was found with binary logistic regression analysis.

RESULTS: Around one in ten women of reproductive age group in India and Myanmar had IDBM. In Nepal, it occurs in one in nearly 15 women. Maternal age, education, household wealth, number of children, place of residence, and occupation were found to be significant predictors of IDBM.

CONCLUSION: There is a high prevalence of IDBM in South Asian women and it varies substantially across different socio-demographic and economic predictors. Sufficient evidence from prospective studies is needed to establish causal association and also to implement need-based prevention and curative strategies.

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INTRODUCTION

The double burden of malnutrition (DBM) refers to "the co-existence of undernutrition along with overweight, obesity or diet-related NCDs, within individuals, households, and populations, and across the life course" [1]. When this phenomenon occurs within a person, it is referred to as an intraindividual double burden of malnutrition (IDBM) [2, 3]. An IDBM can exist in different forms: overweight/obesity and stunting; overweight/obesity and micronutrient deficiencies; stunting/underweight and diabetes/high blood pressure; cardiovascular complications and micronutrient deficiencies [4]. One of the most common forms of IDBM reported is the co-existence of anaemia and overweight/obesity, especially among women [5].

Anaemia remains an untracked global health issue with 571 million women affected by it across the world [6]. Anaemia can lead to poor maternal and perinatal outcomes and reduced physical work capacity [7]. In recent global estimates, anaemia amongst women has been reported to be highest in the South Asian regions. The estimated prevalence of anaemia amongst women of reproductive age was reported to be 50% for the South Asia [8] and 46.6% for South East Asia region of World Health Organization (WHO) [9]. Along with this high prevalence of anaemia, the level of overweight/obesity is also increasing rapidly in these countries. The pooled prevalence of overweight/obesity among women in South and South East Asian countries was 29% [10].

According to the Global Nutrition Report of 2020, 56 out of 143 countries experience an overlapping DBM with high levels of anaemia and overweight among adolescent girls and women (15–49 years) [5]. However, very few attempts have been made by researchers to understand how far this overlapping occurs at the individual level and its underlying pathway. To the best of our knowledge, only three nationally representative studies have been carried out to explore the occurrence of IDBM of which two are multi-country studies [10–12]. One study based on 17 population-based surveys reported a median prevalence of 8.6% IDBM among women of reproductive age, with the highest prevalence in

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Afghanistan (18.6%) and the least in Vietnam (1.0%). This study also reported a 15.4% prevalence of IDBM among women from Pakistan [11].

Despite a high prevalence of anaemia and overweight/obesity among women, preliminary evidence on the burden of IDBM is lacking in many South Asian countries. Although there are small-scale epidemiological studies carried out, for instance, a study conducted in a rural area of South India reported that co-morbid anaemia and overweight/obesity was present in 23% of women [13] and another study from Andhra Pradesh reported a prevalence of 9% individual DBM among women of reproductive age [14], such evidence is often not very comprehensive thus minimising their policy impact.

This present analysis was conducted relying on recent data from the Demographic and Health Surveys (DHS) to estimate the burden of IDBM, i.e., the co-existence of anaemia and overweight/obesity in women from India, Myanmar, and Nepal, and its association with various socio-demographic and economic factors. Other South Asian countries such as Bangladesh, Bhutan, Pakistan, and Sri Lanka were not included in the analysis as there was no record of anaemia or haemoglobin level in the DHS data set of those respective countries.

MATERIALS/SUBJECTS AND METHODS

Data source, sampling technique, and population

The present analyses was based on the recent standard DHS of India (2019–2021), Myanmar (2015–2016), and Nepal (2016). DHS are nationally representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition [15]. The sampling occurs via a stratified two-stage cluster design with the first stage being the listing of enumeration areas drawn from national census files whilst in the second stage, there is a sampling of households within the sampled enumeration areas [15].

The DHS provides separate data for women of reproductive age (15–49 years) and is available in the womens' recode file (IR). The datasets for the three countries (India, Myanmar, and Nepal) understudy were not merged as the authors intended to get the country-level statistics.

The DHS data was extracted in (.sav) format. Data cleaning, further coding, and analysis were done using IBM SPSS version 27 [16] whilst the plots were generated using Microsoft Excel and R version 4.2.1. Weighting of the sample was done to adjust disproportional sampling, non-response and to restore the representativeness of the sample. The total number of women in the sample was (1) 724,115 (2) 12,885 and (3) 12,862 from India, Myanmar, and Nepal respectively after applying weightage to them. To estimate the IDBM in the present analysis, anthropometric measurements (height and weight) and haemoglobin and/or anaemia levels of women were required. For that purpose, records without anthropometric, haemoglobin, and/or anaemia measurements were excluded while preparing the data. The sample size drawn after following the exclusion criteria for each of the country were 677,910 for India, 12,393 for Myanmar, and 6378 for Nepal. However, the total sample size was further reduced when performing bivariate analysis as some of the variables had missing values.

The body mass index (BMI) was calculated based on the formula "weight in kilograms/height in square metre (Kg/m^2)" and categorised as per WHO's BMI classification. Since the focus of the analyses was on overweight/obesity, later the variable BMI was classified into Normal (BMI < 24.9 Kg/m^2) and overweight/Obesity (BMI ≥ 25 Kg/m^2) [17, 18]. Similarly, the variable "anaemia level" was also classified into two categories (anaemic and non-anaemic). For non-pregnant women, a haemoglobin measure <12 g/dl is considered anaemic. While, for pregnant women, a haemoglobin level <11 g/dl is considered anaemic [19]. Women were considered to have IDBM if their BMI is more than or equal to 25 Kg/m^2 and anaemic. Country, as well as state/province-level prevalence, were estimated.

Descriptive analysis was done with frequencies and percentages. The association of variables such as women's age, education status, occupation status, number of children, place of residence, and wealth quintile with IDBM was found with Pearson chi-square test and binary logistic regression analysis. The adjusted odds ratios were obtained by carrying out a multiple binary logistic regression, which involved the inclusion of all the predictors into the regression model. The predictors included in the analysis were based on their availability in all three datasets. The variables such as women's occupation and the number of children were recoded to improve statistical feasibility. The DHS data captures data from about 95 occupational categories and groups the data as follows:

(1) Not working/not worked in the last 12 months preceding the survey.
(2) Professional/technical/managerial.
(3) Clerical.
(4) Sales.
(5) Services/household and domestic.
(6) Agricultural.
(7) Skilled and unskilled manual labour.
(8) Other.
(9) Don't know.

Occupation in this analysis was recoded as; not working/not worked in the last 12 months preceding the survey, professional/clerical/sales, agricultural, services/household, and domestic/skilled and unskilled manual labour in the present analysis. Furthermore, the number of children which was recorded as a continuous measure in the DHS data was recoded into no children, one child, two children, and three or more children.

Results with a p value less than or equal to 0.05 were considered statistically significant. Owing to the fact that the present paper was a secondary analysis, ethical clearance was exempted. As per the requirement, the authors registered and accessed the DHS datasets from DHS online archive after receiving the necessary approval.

RESULTS

Figure 1 presents the prevalence of anaemia, overweight/obesity, and IDBM in each country. Around one in ten women of reproductive age group in India and Myanmar had IDBM. In Nepal, it occurs in one in nearly 15 women.

Figures 2–4 show the state/province-wise prevalence of anaemia, overweight/obesity, and IDBM in India, Myanmar, and Nepal respectively.

In nine out of 36 states/union territories of India, the prevalence of IDBM was more than 15% and in eight, more than 10%. This indicates the higher variability in the prevalence of IDBM within the country. Women belonging to developed states (as per the human development index) and Union Territories had a higher prevalence of IDBM than those from less developed states [20].

Myanmar shared a nearly similar burden of IDBM among women with that of India. The highest prevalence is reported in the Yangon region, followed by Taninthayi and Sagaing regions (Fig. 4).

Among the three countries, Nepal had the least prevalence of IDBM (7%). The highest prevalence is reported in Province 1 and the least in Province 6 (Fig. 4)

Distribution of IDBM across socio-demographic and economic factors

Table 1 and Fig. 5 illustrate the association between selected socio-demographic and economic variables and IDBM and Table 2 depicts the effect size in terms of an odds ratio.

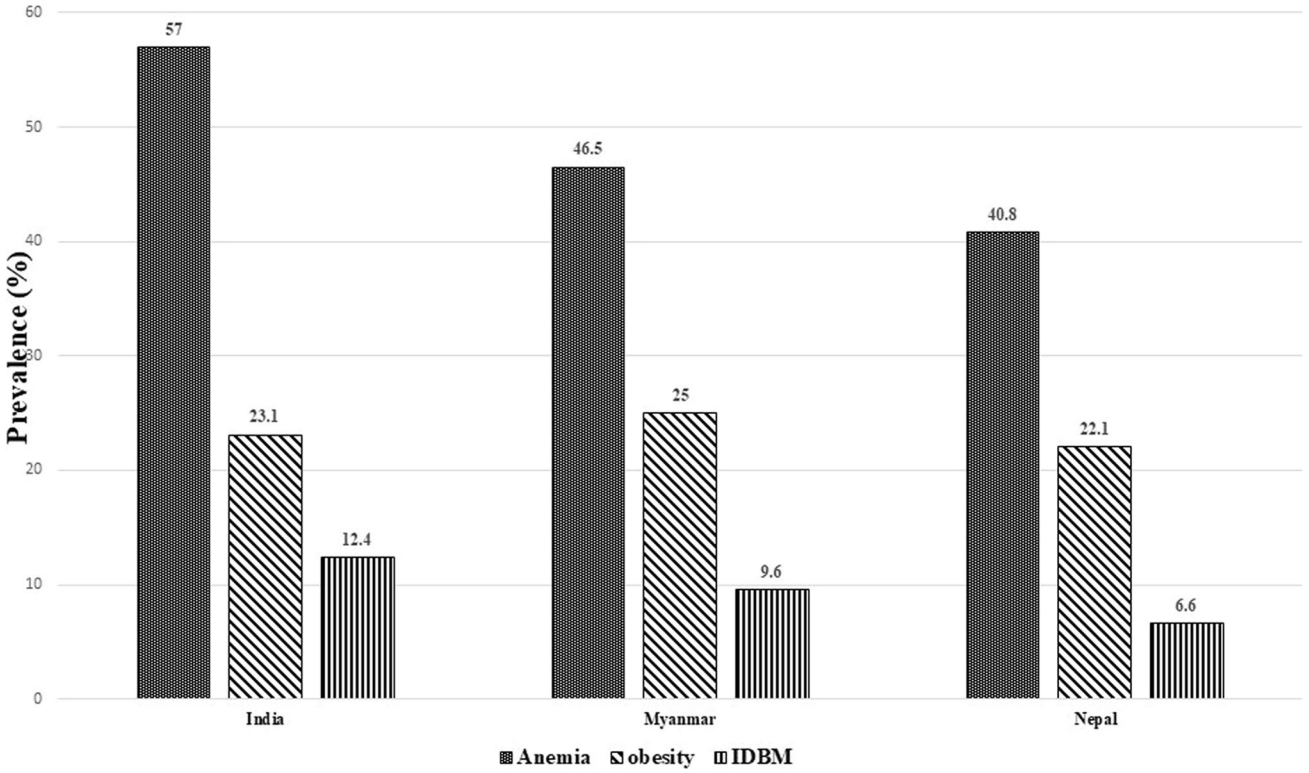

Fig. 1 Distribution of anaemia, overweight/obesity and IDBM. Prevalence of anaemia, overweight/obesity, and IDBM in India, Myanmar, and Nepal.

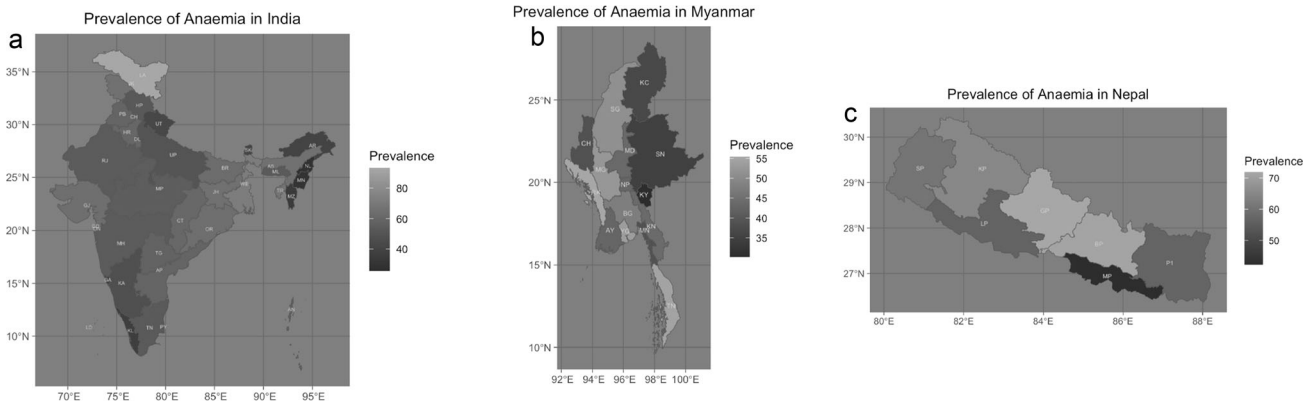

Fig. 2 Distribution of anaemia prevalence amongst women of reproductive age in the countries understudy. a India, **b** Myanmar, **b** Nepal. India: AN Andaman and Nicobar, AP Andhra Pradesh, AR Arunachal Pradesh, AS Assam, BR Bihar, CH Chandigarh, CT Chhattisgarh, DN Dadra and Nagar Haveli, DD Daman and Diu, DL Delhi, GA Goa, GJ Gujarat, HR Haryana, HP Himachal Pradesh, JK Jammu and Kashmir, JH Jharkhand, KA Karnataka, KL Kerala, LA Ladakh, LD Lakshadweep, MP Madhya Pradesh, MH Maharashtra, MN Manipur, ML Meghalaya, MZ Mizoram, NL Nagaland, OR Orissa, PY Puducherry, PB Punjab, RJ Rajasthan, SK Sikkim, TN Tamil Nadu, TG Telangana, TR Tripura, UP Uttar Pradesh, UT Uttaranchal, WB West Bengal. Myanmar: AY Ayeyarwaddy, BG Bago, CH Chin, KC Kachin, KY Kayah, KN Kayin, MG Magway, MD Mandalay, MN Mon, NP NayPyitaw, RK Rakhine, SG Sagaing, SN Shan, TN Taninthayi, YG Yangon. Nepal: P1 Province 1, MP Madhesh Province, BP Bagmati Province, GP Gandaki Province, LP Lumbini Province, KP Karnali Province, SP Sudurpashchim Province.

In India and Myanmar, there was a consistent increase in the occurrence of IDBM with respect to women's age. However, Nepal shows a different trend with the highest prevalence and effect size among women aged 30–34 years. In Nepal, the odds of having IDBM was higher across all age groups compared to the reference category (15–19 years). In India and Nepal, the odds increased with age up to 40 years, and then there is a decline after 40 years whereas, in Myanmar, the odds of IDBM increased consistently with women's age.

Women's education status was found to be a significant predictor of IDBM in India and Nepal. However, the odds ratio increased up to secondary level of education followed by a decrease for higher education status.

The association between the occupation of women and IDBM showed a varying trend in three countries. In Nepal, occupation was not a significant factor in the multivariate analysis (Table 2) whereas, in India, it was observed that women engaged in agricultural work had a reduced odds of developing IDBM,

Table 1. Distribution of IDBM across socio-demographic factors.

Variable	Individual DBM (*n*, %)[a]		
	India	Myanmar	Nepal
Age	*N* = 677,910**	*N* = 12,393**	*N* = 6378**
15–19 years	3324 (2.9)	24 (1.4)	10 (0.8)
20–24 years	7113 (6.4)	70 (3.9)	44 (3.9)
25–29 years	12,368 (11.2)	138 (7.7)	72 (7.0)
30–34 years	14,565 (15.4)	181 (9.2)	105 (11.3)
35–39 years	16,307 (17.9)	220 (11.8)	76 (9.7)
40–44 years	15,028 (19.7)	278 (16.6)	70 (10.4)
45–49 years	15,587 (19.3)	276 (17.8)	46 (8.7)
Education	*N* = 677,910**	*N* = 12,391**	*N* = 6378**
No school education	16,943 (11.1)	131 (8.3)	115 (5.4)
Primary	10,989 (13.7)	541 (10.4)	74 (7.0)
Secondary	42,109 (12.3)	363 (8.0)	150 (6.6)
Higher	13,951 (13.6)	153 (12.1)	83 (9.0)
Occupation	*N* = 100,978**	*N* = 12,357**	*N* = 6378**
Not working (did not work in the last 12 months preceding the survey)	8311 (11.9)	340 (9.9)	142 (6.8)
Professional/ clerical/sales	832 (15.6)	399 (13.0)	114 (12.0)
Agricultural	1292 (8.9)	148 (8.2)	141 (4.7)
Services/ household and domestic/ manual labour	1624 (14.7)	299 (7.1)	25 (6.8)
Number of children	*N* = 677,910**	*N* = 12,393**	*N* = 6378**
0	11,279 (5.4)	291 (5.7)	47 (2.6)
1	14,398 (14.0)	215 (10.5)	71 (6.7)
2	33,147 (17.1)	221 (11.2)	176 (11.6)
≥3	25,168 (14.6)	461 (13.5)	128 (6.6)
Place of residence	*N* = 677,910**	*N* = 12,393**	*N* = 6378**
Rural	48,032 (10.3)	730 (8.1)	113 (4.8)
Urban	35,961 (16.9)	458 (12.8)	309 (7.7)

**p value < 0.01.
[a]Row percentage.

compared to those who were not working. In Myanmar, women employed in services/household and domestic/manual labour sectors had lower odds of having IDBM than those who were not working and the finding was statistically significant.

The odds of IDBM were higher among women with children than those without children and odds ratios did not vary substantially among women with one, two, and three or more children. However, in Nepal, statistically significant higher odds were observed with women having two children only.

The overall trend is that the co-existence of anaemia and overweight/obesity was higher among urban, and wealthy women. The difference between the poorest and richest goes up to five times in India and three times in Myanmar and Nepal (Fig. 3). The rural-urban difference was almost double in India and Nepal in the bivariate analysis (Table 1) and adjusted odds ratios were also found significant. A statistically significant rural-urban difference was not observed in Myanmar.

DISCUSSION

Prevalence of intraindividual double burden of malnutrition (IDBM)

The objective of the analyses was to understand the burden of IDBM in selected South Asian countries and the factors associated with it. The results show that the co-existence of anaemia and overweight/obesity is no more an emerging phenomenon in India, Myanmar, and Nepal, given that a substantial number of women are already living with it. The results also indicate a wide disparity in the occurrence within countries understudy, particularly in India.

The burden IDBM reported in all three countries was found less than what has been reported in other South Asian countries such as Pakistan (15.4%) and Afghanistan (18.6%) [11] but higher when comparing India to Vietnam (10.0%) [12]. Besides this, we found the prevalence of IDBM reported within various regions in these countries to vary from estimates reported in other studies. For instance, in a study conducted in rural Karnataka (India), the prevalence of IDBM was 23.1% [13] whilst we estimated a prevalence of 9.5% for the state of Karnataka. This could be due to the difference in sample size and the measurement of obesity. The study conducted in Karnataka used BMI classification for the Asian population [21] to measure overweight/obesity which is different from the WHO's classification used in this analyses. Using the same criteria, the prevalence of IDBM was 16.8%, 16.4%, and 11.5% respectively for India, Myanmar, and Nepal.

Given the fact that a substantial number of women are already experiencing IDBM and there is scant evidence on how it would impact on health and well-being of women, it is high time to identify its causes and effects to plan pragmatic prevention and management modalities.

Factors associated with IDBM

The findings of the present analyses, to a great extent, are in concordance with the findings of studies by Williams et al. [11], Little et al. [13], Kushitor et al. [22] and Irache et al. [23]. Studies by Williams et al. [11] and Kushitor et al. [22] found that older women are at higher risk of developing IDBM. Williams et al. [11] particularly noted that women from South East Asian and Western Pacific countries showed increased odds of IDBM with higher socio-economic status [11]. A similar finding was observed amongst Ghanaian women by Kushitor et al. [22]. A study by Little et al. [13] also found that women belonging to a higher caste and socio-economic status had increased odds of IDBM [13].

With respect to education and place of residence, Williams et al. also highlighted that women having higher education and living in urban residences were at an increased odds of having IDBM [11]. This was also reported in a recent multi-country study by Irache et al. [23] which identified IDBM prevalence was highest in the rich, educated, and urban women.

It must be noted that although the rich consistently had the highest odds of IDBM across all three countries understudy, poor categories were also at an increased odds of having IDBM. This phenomenon, therefore, indicates a general increase in IDBM prevalence across countries. This increase in burden may be attributed to the changing trends of nutrition transition which has led to increased consumption of fat, salt, sugar, and processed food consumption across the continent of Asia [24]. This nutritional transition has been reported to be driven by factors such as urbanisation and industrialisation [24]. While rich women can afford to access expensive junk foods that have added fat, salt, and sugar content, poor women are forced to consume cheap diets with limited nutrients [11]. This indicates the inequity in the occurrence of IDBM.

Table 2. Effect size of the predictors of IDBM.

Variable	Adjusted OR (95% confidence interval)		
	India	Myanmar	Nepal
Age			
15–19 years	1	1	1
20–24 years	2.119 (1.882–2.386)**	2.697 (1.679–4.332)**	4.512 (2.183–9.323)**
25–29 years	3.599 (3.188–4.062)**	5.125 (3.256–8.066)**	7.797 (3.736–16.274)**
30–34 years	5.071 (4.477–5.744)**	6.072 (3.874–9.517)**	13.296 (6.312–28.010)**
35–39 years	6.282 (5.539–7.123)**	7.468 (4.763–11.710)**	12.782 (5.931–27.548)**
40–44 years	7.268 (6.399–8.255)**	11.047 (7.060–17.286)**	14.342 (6.581–31.255)**
45–49 years	7.167 (6.307–8.145)**	11.274 (7.183–17.693)**	13.570 (6.090–3.237)**
Education			
No school education	1	1	1
Primary	1.208 (1.126–1.295)**	1.189 (0.966–1.464)	1.502 (1.095–2.060)*
Secondary	1.282 (1.209–1.359)**	0.989 (0.783–1.248)	1.851 (1.370–2.501)**
Higher	1.134 (1.046–1.229)*	1.001 (0.748–1.339)	1.797 (1.219–2.648)*
Occupation			
Not working	1	1	1
Professional/clerical/sales and services	0.922 (0.849–1.000)	1.061 (0.902–1.250)	1.134 (0.856–1.501)
Agricultural	0.714 (0.668–0.763)**	0.837 (0.674–1.040)	0.818 (0.623–1.075)
Services/household and domestic/manual labour	1.014 (0.955–1.077)	0.729 (0.614–0.865)**	0.796 (0.504–1.257)
Number of children			
0	1	1	1
1	1.242 (1.147–1.344)**	1.417 (1.165–1.723)**	1.290 (0.850–1.957)
2	1.331 (1.233–1.437)**	1.225 (1.003–1.496)	1.663 (1.100–2.514)*
≥3	1.232 (1.134–1.339)**	1.434 (1.189–1.730)**	1.319 (0.838–2.075)
Place of residence			
Rural (449,657)	1	1	1
Urban (231,238)	1.106 (1.056–1.159)**	1.210 (1.030–1.421)*	1.028 (0.802–1.317)
Wealth Index			
Poorest	1	1	1
Poorer	1.444 (1.331–1.566)**	1.448 (1.118–1.876)*	1.811 (1.137–2.886)*
Middle	2.020 (1.867–2.185)**	2.135 (1.670–2.731)**	1.607 (1.003–2.573)
Richer	2.600 (2.401–2.816)**	2.702 (2.108–3.462)**	2.345 (1.488–3.695)**
Richest	3.008 (2.760–3.277)**	2.847 (2.164–3.746)**	3.331 (2.058–5.392)**

*p value <0.05; **p value <0.001.

The IDBM among women from wealthier quintiles is more likely to be missed out as they often access private health facilities [25, 26] which are not part of the routine community-wide health surveillance and illness prevention programmes. Women from poor households, on the other hand, are often less likely to seek treatment for conditions such as anaemia, obesity, or IDBM unless there are explicit signs and symptoms [26]. Hence, it is important to integrate the health system to cover the private health sector and create awareness among women about IDBM to get diagnosed with the condition.

The increased risk of IDBM among women with children irrespective of the number of children they had was reported by Kushitor et al. [22]. It is difficult to explain this association given the fact that women consistently suffer from anaemia. However, pregnancy and the postpartum period result in substantial demands for iron, which accounts for the biological vulnerability of women to anaemia [22]. In addition, women generally have a higher body fat percentage than men thus making them more likely to have a higher BMI [27]. Pregnancy, which has been reported to be an insulin-resistant condition [28], further increases the risk of weight gain with gestational weight retained after successive pregnancies may lead to obesity [27].

Also, evidence from this analysis indicates that there can be an independent occurrence of anaemia and overweight/obesity in women. This observation seems to somewhat negate the hepcidin-mediated hypothesis, which suggests that obesity leads to anaemia in which it was expected that overweight/obese prevalence should have been higher than anaemia [29]. However, the prevalence of anaemia was found to be relatively higher than that of overweight/obesity across all the countries. Similar trends of this prevalence was observed in the estimates provided for South East Asia in a study by Irache et al. [23].

This observation does not negate the fact that the high prevalence of both conditions could also be attributed to the similarities in the risk factors that may contribute to their occurrence. For instance, dietary practices, socio-demographic and economic conditions are key risk factors that may lead to both conditions [11, 24, 30].

It must be noted that because this analysis involves the use of cross-sectional data, we cannot conclusively establish temporality

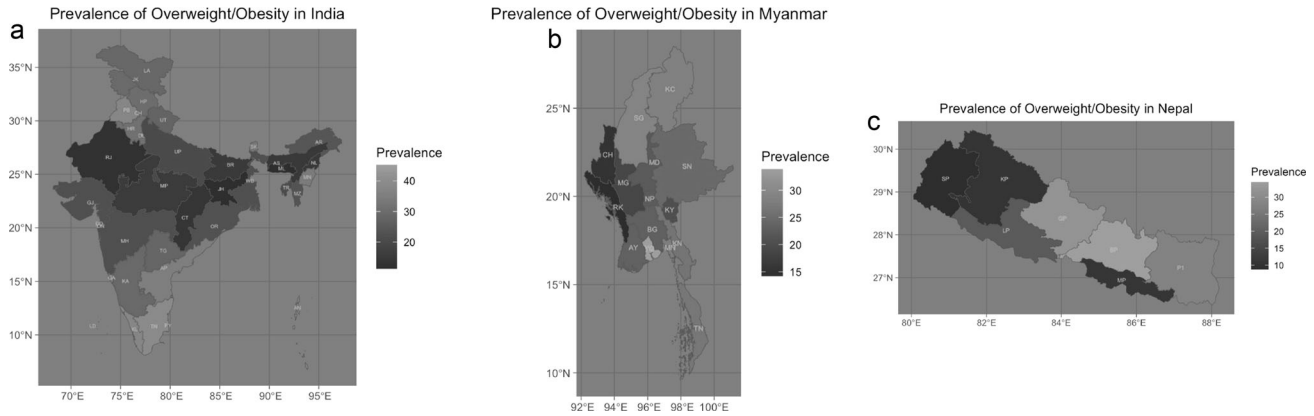

Fig. 3 Distribution of overweight/obesity prevalence amongst women of reproductive age in the countries understudy. a India, **b** Myanmar, **c** Nepal. India: AN Andaman and Nicobar, AP Andhra Pradesh, AR Arunachal Pradesh, AS Assam, BR Bihar, CH Chandigarh, CT Chhattisgarh, DN Dadra and Nagar Haveli, DD Daman and Diu, DL Delhi, GA Goa, GJ Gujarat, HR Haryana, HP Himachal Pradesh, JK Jammu and Kashmir, JH Jharkhand, KA Karnataka, KL Kerala, LA Ladakh, LD Lakshadweep, MP Madhya Pradesh, MH Maharashtra, MN Manipur, ML Meghalaya, MZ Mizoram, NL Nagaland, OR Orissa, PY Puducherry, PB Punjab, RJ Rajasthan, SK Sikkim, TN Tamil Nadu, TG Telangana, TR Tripura, UP Uttar Pradesh, UT Uttaranchal, WB West Bengal. Myanmar: AY Ayeyarwaddy, BG Bago, CH Chin, KC Kachin, KY Kayah, KN Kayin, MG Magway, MD Mandalay, MN Mon, NP NayPyitaw, RK Rakhine, SG Sagaing, SN Shan, TN Taninthayi, YG Yangon. Nepal: P1 Province 1, MP Madhesh Province, BP Bagmati Province, GP Gandaki Province, LP Lumbini Province, KP Karnali Province, SP Sudurpashchim Province.

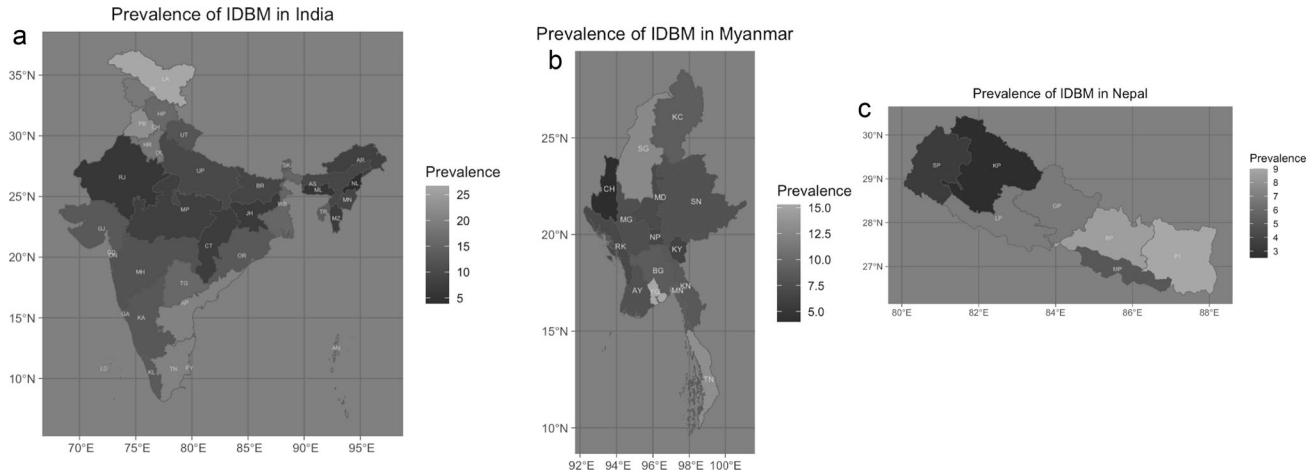

Fig. 4 Distribution of IDBM prevalence amongst women of reproductive age in the countries understudy. a India, **b** Myanmar, **c** Nepal. India: AN Andaman and Nicobar, AP Andhra Pradesh, AR Arunachal Pradesh, AS Assam, BR Bihar, CH Chandigarh, CT Chhattisgarh, DN Dadra and Nagar Haveli, DD Daman and Diu, DL Delhi, GA Goa, GJ Gujarat, HR Haryana, HP Himachal Pradesh, JK Jammu and Kashmir, JH Jharkhand, KA Karnataka, KL Kerala, LA Ladakh, LD Lakshadweep, MP Madhya Pradesh, MH Maharashtra, MN Manipur, ML Meghalaya, MZ Mizoram, NL Nagaland, OR Orissa, PY Puducherry, PB Punjab, RJ Rajasthan, SK Sikkim, TN Tamil Nadu, TG Telangana, TR Tripura, UP Uttar Pradesh, UT Uttaranchal, WB West Bengal. Myanmar: AY Ayeyarwaddy, BG Bago, CH Chin, KC Kachin, KY Kayah, KN Kayin, MG Magway, MD Mandalay, MN Mon, NP NayPyitaw, RK Rakhine, SG Sagaing, SN Shan, TN Taninthayi, YG Yangon. Nepal: P1 Province 1, MP Madhesh Province, BP Bagmati Province, GP Gandaki Province, LP Lumbini Province, KP Karnali Province, SP Sudurpashchim Province.

on whether obesity precedes anaemia or vice-versa. In-depth exploration involving the use of longitudinal studies which incorporate multi-omics perspectives will be needed to explain the micro and macro-level causes and effects of IDBM. Such evidence is required for planning and implementing effective interventions at the population level.

Strengths and limitations

No previous studies have reported the prevalence of IDBM in women from India, Myanmar, and Nepal and hence, the present study provides preliminary evidence. Seeing the above evidence is cross-sectional nature, rigorous evidence from prospective studies is required to understand the causal pathway of occurrence of the phenomenon amongst the affected women.

CONCLUSION

To conclude, there is a high prevalence of IDBM in South Asian women and it varies substantially across different socio-demographic and economic predictors. The study found an increased vulnerability of women from affluent households to suffer from IDBM in all three countries. It is important to generate sufficient evidence on the biomedical as well as social, economic, and political aspects of the phenomenon in order to establish cause and effect association and also to implement need-based prevention and curative strategies. There is a need for strengthening routine health surveillance databases and programmes, integrating with the private health sector so that relevant health indicators of people across all wealth stratifications can be captured enabling the formulation of inclusive policies.

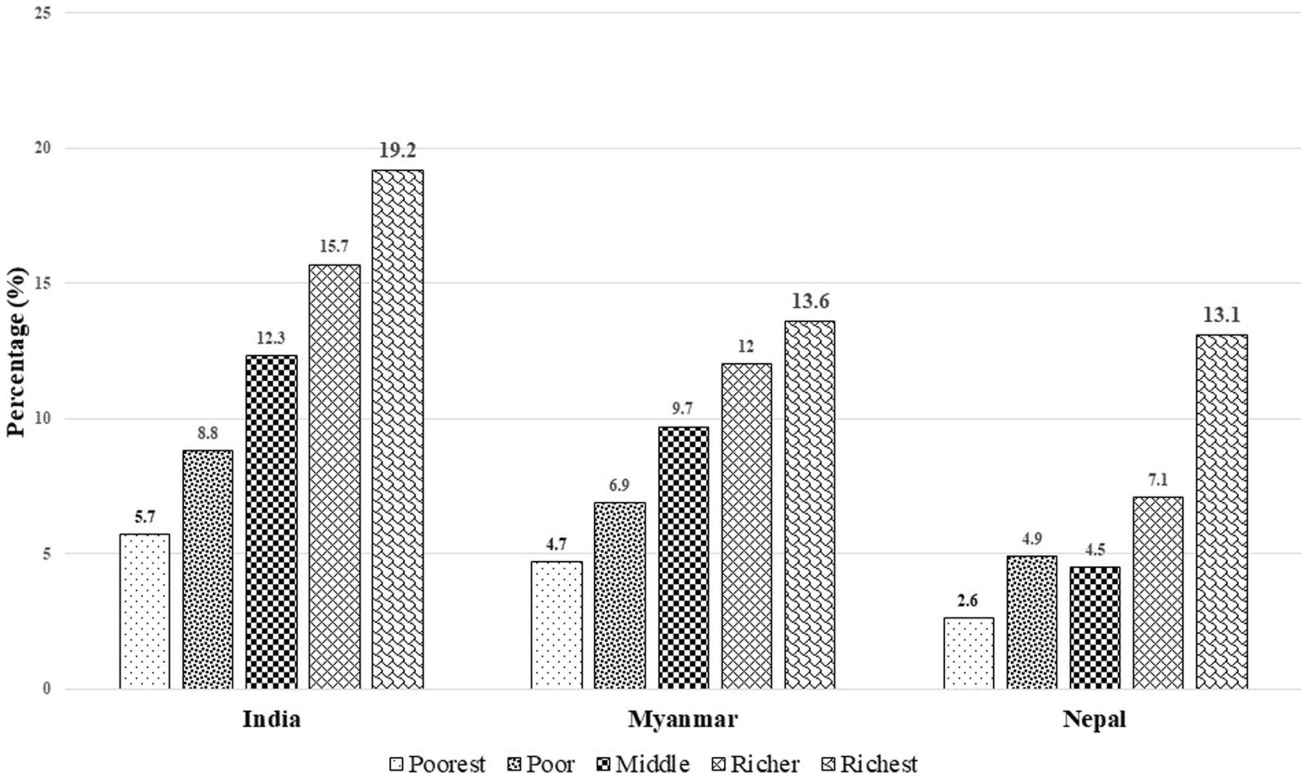

Fig. 5 IDBM across wealth quintiles. Distribution of IDBM based on wealth quintile in India, Myanmar, and Nepal.

DATA AVAILABILITY

The Demographic and Health Survey datasets were available in the public domain (https://dhsprogram.com/data/available-datasets.cfm).

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AUTHOR CONTRIBUTIONS

RJ conceptualised the study, applied for the datasets, analysed the datasets, and wrote the manuscript with CS. SK critically reviewed the manuscript draft. All authors have reviewed and accepted the final manuscript draft.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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