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Malnutrition and Anaemia among Indian Women: Trends and Association with Socio-demographic Factors

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Abstract

Like other developing countries, triple burden of malnutrition (undernutrition, overnutrition and anaemia) are the major health problem among adult women in India. The aim of the study was to investigate the malnutrition and anaemia among adult women in India. We also tried to determine the trends in burden of malnutrition and anaemia of Indian women over time. This was a cross sectional household study. In this study, we used secondary data that was extracted from recent National Family Health Survey (NFHS-5), 2019-21. The paper used unit level data of 609551 non-pregnant women aged 15 to 49 years. The outcome variables of this study were (i) nutritional status and (ii) anaemia. The prevalence of undernutrition, overnutrition and anaemia of Indian adult women were 18.5%, 21.8% and 56.1% respectively. The impact of type of place, education, religion, number of household members, ethnic groups, wealth index, geographical location (zone), diabetes and thyroid on malnutrition and anaemia were significant. The impact of hypertension on malnutrition was significant but not on anaemia. During the last four years, underweight had decreased by nearly 4% and overweight and obesity had increased by 2.4% and 1.0% respectively, and the prevalence of anaemia had increased nearly by 5.0 %. The results clearly pointed out that there exists a dual burden of malnutrition along with high rate of anaemia in India and these are posing a serious challenge for nutritional policy makers. In order to prevent the malnutrition, policy makers should be aware of the fact that the nutritional status of a woman not only depends on household income but also on the environmental status, gender discrimination, level of education, activity status, exposure to social stimulation, decision making power at the household level.

Keywords: Malnutrition; Anaemia; Non-pregnant women; India.

AMS Classification: 62P10, 92D30, 92C80.

1. Introduction

Malnutrition refers to deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients. Double burden of malnutrition (DBM) refers to "characterized by the coexistence of undernutrition along with overweight, obesity or diet-related noncommunicable diseases (NCDs), within individuals, households and populations, and across the life-course" [WHO, 2017]. It is evident that the prevalence of DBM is more than one third of in low and middle income (LMIC) group of countries [Seferid et al., 2022]. The prevalence of overweight and obesity among south Asian women is almost the same as the prevalence of underweight [NCD-RisC, 2016]. In India also due to disproportionate progress, DBM has increased rapidly and overnutrition has become more than undernutrition [IIPS, ICF, 2021].

The nutritional status of the reproductive aged women is indicative of the overall well-being of a population because it has a crucial influence on the health of their own and of the next generation [Black et al., 2008]. Poor nutrition is indicative also of greater health risk to both mother and children and also on birth weight [Woldeamanuel et al., 2019]. Around 450 million women are underweight, and it is due to protein energy malnutrition during their childhood in developing countries [Tzioumis and Adair, 2014]. Undernourished mothers have a great chance to contribute nutrient and vitamin deficiency to their new born babies. Thus, undernutrition may be the most responsible contributor to the under-five mortality rate in India. Another reason of women undernutrition may be due to huge gender gap on accessing food due to intra-household unequal food distribution within the family of adult women and low status in the society or in the family [Wibowo et al., 2015].

DBM has a great influence on gender differentiations because it is more prevalent among women than men. The reason may be the existence of dual burden of malnutrition among women is more than men due to underlying constraints of socio-cultural factors. Nutritional status is dependent on social-cultural factors which are not dependent on standard economic variables such as income, expenditure or consumption and it influences on men and women separately. In the context of scarcity and excess of food, women are more vulnerable to nutritional deficiency than men because due to general traditional factor in India, women eat last and least throughout the whole life. It can contribute nutritional deficiency among them easily than men in poor or low socio-economic group. On the other hand, they may have a great chance to become obese than men in the better socio-economic group due to have constraints in accessing knowledge about balanced diet may be due to less awareness and education or limited mobility etc. [Garn, 1986; Sen and Amartya, 1988; Basu, 1989; IASC, 2005].

Due to DBM, epidemiological changes have also been observed in the distribution of different non-communicable diseases and diabetes [Popkin, 1998; Popkin, 2015; Popkin et al., 2012] among women. More than 80 percent of cardiovascular and diabetes deaths, 90 percent of *chronic obstructive pulmonary disease* (COPD) deaths and two thirds of all cancer deaths occur in developing countries [Ahmed, 2018].

Other most common worldwide nutritional deficiencies among women are anaemia. Globally, it is estimated that in 2019, 30.1% of reproductive aged women are anaemic with wide geographical variation [Dicker et al., 2018]. It is seen that worldwide 38.2 percent of pregnant women and 29.0 percent of non-pregnant women are anaemic [WHO, 2015]. In India, anaemic status among adult women was 51.0 per cent during 2015-16 [Bharati et al., 2019] but during 2019-21 (NFHS-5), it is 57 per cent i.e., it has increased 5-6 percent than previous all India data. So, nutritional deficiency

as well as overnutrition along with the anaemia indicates that at present, adult women of India are suffering from triple burden of malnutrition.

Considering the all over situation, the objectives of the present study are to see (i) prevalence of triple burden of malnutrition (undernutrition, overnutrition and anaemia), (ii) association between malnutrition and anaemia with socio-economic, demographic and other health related factors and (iii) determine the trends in nutritional status over time among adult women in India.

2. Methods

Data source: This was a cross-sectional study, and data was extracted from very recent all India data (National Family Health Survey (NFHS-5) of 'IAIR' files of 2019-21 conducted by International Institute for Population Sciences [IIPS, ICF, 2021]. The data was a unit-level and secondary, all the data was collected by structured schedule made by International Institute for Population Sciences (IIPS) through interview process [IIPS, ICF, 2021].

Inclusion criteria: Only non-pregnant Indian adult women aged 15-49 years currently living in India were considered.

Patient and public involvement: The NFHS-5 (2019-21) sample covered a total 724115 adult Indian women, residing in 36 States and Union Territories and the field work was completed during 2019-21. In this study, we considered 609551 Indian non-pregnant adult women aged 15–49 years. The survey design, sampling technique, survey instruments, measuring system and quality control have been described elsewhere [IIPS, ICF, 2021]. We also considered NFHS-4 [Bharati et al, 2019; WHO, 1986; Dunn and Clark, 1974; Godfrey, 1985; Stevens, 1996; Chan, 2004] for finding the trends in malnutrition and anaemia of Indian adult women of reproductive aged.

Outcome variable: Nutritional status and anaemia were the outcome variable in this study. The nutritional status of adult women was measured by their body mass index (BMI), it was classified into four classless according to the guideline of WHO; (i) underweight (BMI<18.5kg/m^2), (ii) normal (18.5≤BMI<25 kg/m^2), (iii) overweight (25≤BMI<30kg/m^2) and obese (BMI≥30kg/m^2) [WHO, 1986]. For further statistical analysis, we classified our samples as (i) undernutrition (underweight) (code=1), others (code=0); (ii) overweight (code=1), others (code=0) and (iii) obese (code=1), others (code=0). For anaemia testing, blood specimens from eligible women were drawn from a drop of blood taken from a finger prick and collected in a microcuvette. Haemoglobin analysis had been conducted on-site with a battery operated portable Hemo Cue Hb 201+ analyser. Non-pregnant women were taken as anaemic if the haemoglobin level was less than 12.0 g/dl [IIPS, ICF, 2021]. Again, samples were categorized into two groups on the basis of their anaemic status ((anaemic (yes=1); non-anaemic (no=0)).

Independent variables: Some possible associated factors of malnutrition and anaemia like type of residence which was divided into rural and urban, educational status of women were divided into four groups such as illiterate, primary includes from class I –IV, secondary includes class V to X and higher from class XI and onwards, religious group was divided into four such as Hindu, Muslim, Christian and Others, number of household members were grouped into four groups such as 1-3,4-5, 6-7 and 8 & onwards, ethnic groups was constituted of four groups such as scheduled Castes, Scheduled tribe, Other backward classes and none of them, wealth index of the family was divided into three groups such as poor, middle and rich, for regional variations, zone was divided into six groups such as north-east, east, central, west, north and south on the basis of NFHS-5

[IIPS, ICF, 2021] and some comorbidity such as diabetes, hypertension, heart diseases, and thyroid into two groups such as 'yes' and 'no' were considered as independent variables in this study.

Ethics approval and consent to participate: This study has done from the secondary data of NFHS-5 of Demographic and Health Surveys (DHS) and it was obtained through online registration in accordance with their guidelines. The International Institute for Population Sciences (IIPS) in India, a nodal organisation of the host nation, and the ICF Institutional Review Board (IRB) have reviewed and approved the survey protocols and participant confidentiality. Regarding the confidentiality of participants and the protection of human subjects, the ICF IRB abides by the standards set forth by the US Department of Health and Human Services. Therefore, the DHS data was ethically approved, and its use did not require any further ethical approval.

Statistical analysis: We subsequently checked the available data for outliers using an informal technique [Dunn and Clark, 1974] for checking abnormal BMI and haemoglobin level values based on a scatter diagram and removed some subjects from analysis because their data may affect the interpretation of results [Godfrey, 1985; Stevens , 1996]. We used chi-square analysis to see the association between malnutrition, anaemia status and different non-communicable diseases and its relationship with different socio-economic variables and other selected factors. Binary logistic regression model was used to find the impact of independent variables on nutritional status and anaemia.

The magnitude of the standard error (SE) was used for detecting the multicollinearity problem among the independent variables, it was judged that there was no evidence of multicollinearity if the SE lies between 0.001 and 0.5 [Chan, 2004]. The statistical package for the social sciences (SPSS, version 23.0) was used for all the analysis. Levels of significance of $p< 0.01$ and $p<0.05$ were considered.

3. Results

Different aspects of health status among adult women in India namely (i) malnutrition and (ii) anaemia were investigated in this study. In addition, trends in malnutrition and anaemia were observed.

Association between nutritional and anaemic status of Indian adult women and other selected factors: In the present study, we found that the prevalence of chronic energy deficiency, overweight, obese and anaemia among Indian adult women were 18.5%, 16.5%, 5.3% and 56.1% respectively. It was found that more number of rural women suffered from chronic energy deficiency compared to urban women while the prevalence of overweight and obese among urban women were higher than rural women. Also, higher number of rural women suffered from anaemia compared to urban women. Lowest numbers of under nourished and anaemic women were found in higher educated women however highest number of overweight and obese women was in higher educated women compared to other educated groups of women. It was found that highest number of Hindu women suffered from chronic energy deficiency and anaemia compared to other religion groups. Increasing tendency in chronic energy deficiency and anaemia were observed with increasing number of family members while numbers of over nourished and obese were decreased. It was noted that highest number of SC ethnic group were suffering from more chronic energy deficiency and anaemia while highest number of none of ST, SC or OBC group suffered from overweight and obese compared to other groups. The prevalence of chronic energy deficiency and anaemia were indirectly related with the household members and wealth index of the family while overweight and obesity increased were directly related with them. The prevalence of malnutrition

(underweight, overweight, obesity and anaemia) was found significant variation among Zones in India, the highest number of chronic energy deficiency and anaemic women were living in East and West Zones while highest number of overweight and obese women was living in South and North Zones. More than 46% diabetic, 41% hypertensive, 31% heart disease and 50% had thyroid women suffered from over nutrition (overweight and obese). Chi-square test demonstrated that all selected variables were significantly associated with nutritional status and anaemia except heart disease and thyroid; these two variables were not significant with anaemia among Indian adult women (Table 1).

Table 1: Association between malnutrition, anaemia and different socio-economic, demographic and non-communicable diseases among adult women in India

		Malnutrition					**Anaemia**	
	N	Underweight, 18.5% (%)	Normal, 59.7% (%)	Overweight, 16.5% (%)	Obese, 5.3% (%)	Chi-square value	Anaemic, 56.1% (%)	Chi-square value
Type of residence						14520.66**		1176.14**
Rural	461066	20.2	61.2	14.5	4.0		57.3	
Urban	148485	13.1	54.9	22.4	9.5		52.2	
Education								
Illiterate	143478	17.5	62.7	15.6	4.2	3325.44**	59.0	1592.38**
Primary	71553	16.2	60.3	17.8	5.6		57.2	
Secondary	309477	20.6	58.2	15.8	5.4		56.0	
Higher	85043	14.4	59.8	19.2	6.6		50.6	
Religion								
Hindu	477234	20.1	58.8	15.9	5.2	5568.09**	57.5	3619.80**
Muslim	59658	15.0	59.8	18.9	6.3		55.8	
Christian	43825	10.3	70.2	15.8	3.7		42.7	
Others	28834	12.2	58.5	21.2	8.1		54.3	
Number of household members								
1-3	102904	14.5	59.2	19.5	6.8	3626.88**	54.3	202.16**
4-5	268923	17.9	59.6	17.0	5.5		56.0	
6-7	148535	20.8	60.3	14.5	4.4		57.1	
8+	89189	21.2	59.6	14.6	4.6		56.7	
Ethnic groups								
ST	118289	19.2	66.9	11.6	2.3	11010.68**	57.1	553.41**
SC	124620	20.6	58.9	15.6	4.9		58.5	
OBC	248680	19.4	58.2	16.7	5.6		55.2	
None of them	117962	13.6	56.5	21.8	8.2		54.4	
Wealth index								
Poor	258680	24.1	63.6	10.2	2.1	35500.49**	59.6	2498.85**
Middle	129429	17.6	60.3	17.3	4.7		55.4	
Rich	221442	12.5	54.7	23.3	9.5		52.4	
Zones (Regional)								
North-east	76319	10.8	70.3	15.8	3.0	20717.46**	49.1	6840.19**
East	99166	24.0	60.0	12.8	3.3		66.1	
Central	148662	21.5	61.3	13.3	3.9		54.0	

West	62283	24.1	55.7	14.9	5.3		59.6	
North	122895	14.5	59.5	19.0	6.9		56.4	
South	100266	15.9	51.7	23.1	9.3		52.0	
Comorbidity								
Diabetes								75.95**
No	599505	18.7	59.9	16.2	5.1	4584.40**	56.2	
Yes	10046	7.2	46.5	29.5	16.8		51.8	
Hypertension						8509.38**		19.491**
No	582444	18.9	60.2	16.0	4.9		56.2	
Yes	27107	9.5	48.6	27.2	14.7		54.8	
Heart diseases								0.002
No	605348	18.5	59.7	16.4	5.3	281.30**	56.1	
Yes	4203	13.8	54.5	22.5	9.2		56.1	
Thyroid						9317.40**		0.035
No	595938	18.8	60.1	16.1	5.0		56.1	
Yes	13613	6.8	42.1	30.9	20.2		56.0	

N.B.: N: number of women, UN: Under nutrition, OW: Overweight, **: 1% level of significance (%).SC: Scheduled castes, ST: Scheduled tribes and OBC: Other backward classes.

It was found that women living in rural environment had a 1.160 and 1.078-folds higher chance to have under nourished and anemic compared to women living in urban area respectively but urban women are more overweight and obese than rural women. Less than higher educated women were 1.406 and 1.295 times more likely to become under nourished and anemic than higher educated women but the opposite results were found for overweight and obese women. Hindu women are more undernourished compared to all other religious group but all other religion women had more chance to become over nourished and obsess (except Muslim) than Hindu. Hindu women are more anemic than Christian and other religious group. We found that the risk of getting under nutrition increased with increasing household members, but the opposite results were observed for overweight and obese women. Women living in family having 8+ members are more anemic compared to women who were living a family having 1-3 members. ST women are more under nourished and anemic than others ethnic groups but opposite results have found for overweight and obese. It is seen that women living in poor family have a 1.979 and 1.175-folds higher chance to be under nourished and anemic compared to rich women but opposite results were observed for overweight and obese. Women living in South Zone are more overweight and obese than women living in other Zones. Women of South Zone are also more under nourished than East and North Zones but in South zone, women have a less chance to be under nourished compared to North-east, Central and West Zones women. Women in South zone were more anemic than East and West while women in North-east, Central and North Zones had 1.274, 1.575- and 1.168-times higher chance to become anemic than South Zone respectively. Women who have diabetes; hypertension and thyroid were more undernourished than overweight or obese women. It is also noted that diabetic women have 1.133-fold higher chance to become anemic compared who did not have, and women who had thyroid are more likely to become anemic than normal women (Table 2).

Table 2: The impact of socio-economic, demographic and some comorbidity on nutritional and anemic status of Indian adult women

Variables and groups	**Malnutrition**			**Anaemic**
	Under nutrition, AOR (95% CI: Lower-Upper)	**Overweight, AOR (95% CI: Lower-Upper)**	**Obese, AOR (95% CI: Lower-Upper)**	**AOR (95% CI: Lower-Upper)**
Type of residence (Ref. Urban)				
Rural	1.160(1.138-1.182)**	0.879(0.865-0.894)**	0.681(0.664-0.699)**	1.078(1.064-1.092)**
Education (Ref. higher)				
Less than higher	1.406(1.378-1.435) **	0.801(0.786-0.816)0**	0.768((0.745-0.791) **	1.295(1.276-1.314) **
Religion (Hindu)				
Muslim	0.806(0.786-0.826) **	1.070(1.046-1.095) **	0.956(0.921-0.992) *	0.982(0.965-1.000)
Christian	0.668(0.643-0.695) **	1.090(1.053-1.128) **	1.081(1.017-1.150) *	0.525(0.512-0.539) **
Others	0.756(0.728-0.785) **	1.311(1.270-1.353) **	1.598(1.522-1.6780**	0.847(0.825-0.868) **
No. of household members (Ref.8+)				
1-3	0.660(0.644-0.676) **	1.340(1.307-1.374) **	1.363(1.307-1.421) **	0.933(0.916-0.951) **
4-5	0.836(0.820-0.852) **	1.148(1.124-1.174) **	1.123(1.083-1.165) **	0.989(0.973-1.004)
6-7	0.949(0.930-0.969) **	1.029(1.005-1.054) *	1.015(0.975-1.058)	1.005(0.988-1.022)
Ethnic group (Ref. ST)				
SC	0.977(0.955-0.998) *	1.323(1.287-1.360) **	1.488(1.412-1.568) **	0.853(0.838-0.869) **
OBC	0.942(0.923-0.961) **	1.339(1.305-1.374) **	1.561(1.486-1.640) **	0.767(0.754-0.780) **
None of them	0.751(0.732-0.770) **	1.694(1.648-1.741) **	2.056(1.954-2.164) **	0.760(0.745-0.774) **
Wealth index (Ref. Rich)				
Poor	1.979(1.941-2.019) **	0.446(0.437-0.455) **	0.314(0.303-0.326) **	1.175(1.158-1.193) **
Middle	1.403(1.374-1.432) **	0.731(0.718-0.745) **	0.570(0.553-0.589) **	1.175(1.158-1.193) **
Zone (Ref. South)				
North-east	1.544(1.505-1.585) **	0.615(0.599-0.633) **	0.570(0.546-0.595) **	1.274(1.248-1.301) **
East	0.563(0.545-0.582) **	0.925(0.898-0.953) **	0.528(0.499-0.558) **	0.947(0.926-0.969) **
Central	1.201(1.173-1.230) **	0.696(0.678-0.714) **	0.532(0.509-0.556) **	1.575(1.545-1.605) **
West	1.701(1.048-1.095) **	0.676(0.661-0.691) **	0.582(0.561-0.603) **	0.961(0.945-0.977) **
North	0.929(0.906-0.952) **	0.714(0.698-0.730) **	0.616(0.594-0.638) **	1.168(1.147-1.189) **
Comorbidity				
Diabetes (Ref. Yes)				
No	2.033(1.881-2.197) **	0.700(0.668-0.733) **	0.541(0.510-0.574) **	1.133(1.087-1.180) **
Hypertension (Ref. Yes)				
No	1.811(1.736-1.889) **	0.617(0.599-0.635) **	0.410(0.395-0.427) **	1.024(0.999-1.051)
Heart disease (Ref. Yes)				
No	1.002(0.915-1.098)	0.922(0.855-0.996) *	1.080(0.962-1.212)	0.983(0.924-1.047)
Thyroid (Ref. Yes)				
No	2.214(2.068-2.370) **	0.637(0.613-0.662) **	0.362(0.346-0.379) **	0.921(0.889-0.953) **

N.B.: AOR: Adjusted odds ratio, Ref.: Reference category; **: 1% level of significance ($p<0.01$); *: 5% level of significance ($p<0.05$). SC: Scheduled castes, ST: Scheduled tribes and OBC: Other backward classes.

Comparison of malnutrition and anaemia between NFHS 5 and NFHS 4: Fig.1 displays the trends in triple burden of malnutrition among women. We already mentioned that during NFHS-5, the prevalence of underweight, overweight, and obese women were 18.5%, 16.5% and 5.3% respectively. When we compared the corresponding percentages from NFHS-4 data, we observed that during the last four years gap, underweight had decreased by nearly 4% and overweight had

increased by 2.4% and obesity had increased by 1.0%. In NFHS-5 dataset, 56.2% reproductive aged women were suffering from anaemia but it was 51.6% during NFHS-4 (2015-16). So, during four years gap, anaemia had increased nearly by 5.0 % from previous national level study (NFHS-4).

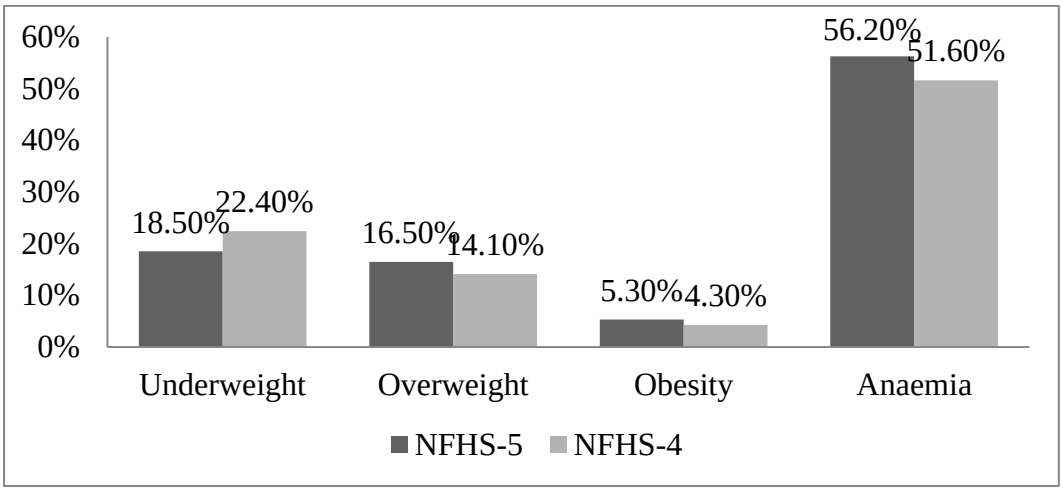

Figure 1: Trends in underweight, overweight, obesity and anaemia among Indian adult women

4. Discussion

This study demonstrated the very recent trends of triple burden of malnutrition among adult women in India and showed 18.5% adult women were underweight, 16.5% were overweight, 5.3% were obese i.e., 21.8% were overweight or obese. From trend analysis between NFHS-4 and NFHS-5, it is seen that by 4-years gap, underweight has decreased by nearly 4 percent points and overweight has increased by 2.4 percent points and obesity has increased by 1.0 percent points. When we looked into zone wise, the lowest under-weight (10.8 %) zone was North-east and the highest underweight zones were East and central zones with 24.0 and 24.1 percent respectively during NFHS-5 [IIPS, ICF, 2021] and during NFHS-4 [Bharati et al, 2019], the trend is also similar, but percentages were higher than NFHS-5. The lowest percentage of overweight or obese women was in East zone (18.9%) and the highest percentage was seen in South zone (32.4%) during NFHS-5 and during NFHS-4, the trend was also similar but percentages was lower than NFHS-5. It is seen that the middle belt of India was affected by CED. High overweight or obesity zones were West then North and South zones. It is very interesting to note that in West zone, there was a co-existence of both high rate of undernutrition and overnutrition during both NFHS-5 and 4. The reason may be that intra- and inter- state inequalities are very high in west zone. Another noticeable feature is that there is more overweight than underweight women in NFHS 5. At present i.e., during 2019-21 (NFHS-5), about 56% women were suffering from anaemia and during NFHS-4, it was 51.6%. During NFHS-4, the trend was similar but magnitude of differences was more by 4.5%. If we compare chronologically the nutritional health and anemic status of women from NFHS-3, 4 and 5, then it is seen that in India, there was improvement in the nutritional status from NFHS-3 through NFHS -5 [IIPS, ICF, 2021; Bharati et al., 2019; IIPS, MI, 2007]. Because from comparison between NFHS-3 and NFHS-4, it is seen that undernutrition has reduced by

12.0% during this period. In the same way, overweight or obesity has also increased by 4.0% from NFHS-3 and in case of anaemia, it has reduced by 5.0%.

Through the literature review about current situation of nutritional status and anaemic condition of adult women in India, it is seen that at present, globally, adult women are affecting from dual burden of malnutrition because low- and middle-income countries are going in the stage of nutritional transition and as a product, double burden of malnutrition (DBM) are increasing abruptly. The study of double burden of malnutrition (DBM) in 55 low- and middle-income countries during 1990 to 2018 shows the present status and future projection (up to 2030) and reveals that the prevalence of under nutrition have decreased in 35 countries and overweight increases in 50 countries. It is also seen that at present Morocco has the highest percentage of under nourished and Nepal has the highest percentage of overweight women. The study also projected that during 2030, more than 20 % underweight women will be in 8 LMIC countries, more than 50 % women will be overweight in 22 LMICs and 24 LMICs will have experiences by double burden of malnutrition [Hasan et al., 2022]. Out of so many studies in India, a study in Kolar district of Kerala shows that 27.2% of the women were overweight, 6.1 % are obese and 14.4% women are underweight [Manjunath et al., 2017]. Similarly, through another study of Mysore, it was found that 18.7% of women were suffering with chronic energy deficiency and 27% were overweight and 12% were obese [Manjunath et al., 2017]. Another recent study also indicates that over nutrition is becoming a problem even in rural population of developing countries because rural population in south India shows that low resources rural region is also experiencing high rate of obesity, hypertension and cardio vascular diseases in the population level as well as individual level [Little et al., 2020]. The burden of anaemic condition among adult women is also very high. From the comparative study of India, Pakistan, Bangladesh and Nepal, through the country level data and reviewed since 1950 to 2016. Data shows that reduction of anaemia has started since 1990, but comparatively low prevalence was observed in Bangladesh and Nepal than India and Pakistan though India and Pakistan had taken more policies than Nepal and Bangladesh. So, it proves that quality is more important than quantity [Waghmare, and Mondal, 2022]. It is also seen that to combat the reduction of anaemia, many policies have taken but still now it is a major public health problem as the reduction is very slow [Nguyen et al., 2018].

Besides this, as India is going into a transitional phase, as a result, experiencing some new arena such as economic development, urbanization, having of more processed food, reduction of physical activities due to shifting occupation etc. So, their food habit is also changing in both rural and urban areas and mostly they are taking (for ex. polished white rice) instead of whole grains. And these polished white races are devoid of fibre, vitamins, low in proteins and other compounds which may not give protection against micronutrient deficiencies, diabetes and other non-communicable diseases [Cordain et al., 2005].

But India is still experiencing poverty, food insecurity and poor access to health facility as a persistent undernutrition problem and its related other deficiencies. Besides these, the inherent causes are gender differences in food allocation among poor households, low economic development, low level of education of women [Piammongkol et al., 2004] etc. Family income, education, and body mass index (BMI) are also associated with nutrient inadequacy among women [Piammongkol et al., 2009]. And it may be due to inequal food distribution because it is estimated that per capita cereal availability in India is adequate but national level surveys shows that 40 percent of the population in India consume less than 80 percent of the energy requirement. Male-female disparities are also responsible because the most vulnerable groups are women [Deaton and

Dreze, 20049]. In this perspective, the question arises whether better health among women in NE India is somehow responsible for matriarchy, women's autonomy and their high literacy rates?

5. Conclusions

It emerges that the situation of dual burden of nutritional disorders as well as high rate of anaemic women in India are posing a serious challenge for nutritional policy makers. Policy makers should be aware that the nutritional status of a woman depends not only on household income but also on the quality of the environment, her vulnerability to gender discrimination, her educational level, her activity status, her exposure to social stimulation, her decision-making power at the household level [Dreze, 1993; Harriss, 1991; Heaver, 1989; Radhakrishna, 1992(a); Radhakrishna, 1992(b)]. Also, it is necessary to prevent child marriage because child marriage leads to high fertility, poor maternal and child health and lower social status of women. Along with these, to resist the prevalence of non-communicable diseases, some policies, and cost-effective interventions such as actions against tobacco use, excessive alcohol use, unhealthy diets etc. Along with these, physical activity intervention programmes must be taken by the Government to reduce the major NCD risk factors. And lastly, it is also recommended for further observational and experimental data to determine the effectiveness of policy and public health interventions in preventing and managing dual burden of malnutrition.

Strength and limitations of the study: This was the first time to investigate triple burden of malnutrition (undernutrition, overnutrition and anaemia) among adult women in India using the nationally representative sample based on the most recent data which was conducted in 2019-2021. However, there were some limitations of the study; (i) due to secondary data, it may had sample bias or selection bias, (ii) the results were based on interventional and prospective observational studies, (iii) about micronutrient a deficiency was not mentioned in the data set, that under nutrition among women could not be understood holistically, (iv) as the present study was a household base, therefore, some age-cohorts may had a lower frequency and (v) due to covid-19 pandemic, some study participants were unavailable or unwilling to provide their anthropometric data.

Abbreviations: BMI: Body mass index; CED: Chronic energy deficiency; COPD: *chronic obstructive pulmonary disease; DHS*: Demographic and Health Surveys; IRB: Institutional review board; LMICs: lifestyles in the low-and-middle-income countries; *NE:* North eastern; NFHS: National Family Health Survey, India; PCA: principal component analysis; SPSS: *Statistical package for the social sciences;* WHO: World health organization.

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