TRENDS IN TRIPLE BURDEN OF NUTRITION AMONG WOMEN AND CHILDREN IN INDIA: A PARADOX

Tejal Lakhan[1], Sayeed Unisa[2], Chandana Maitra[3]

[1]Ph.D. Scholar, International Institute for Population Sciences (IIPS), Mumbai, India

[2]Professor Department of Mathematical Demography and Statistics International Institute for Population Sciences, Mumbai, India

[3]Researcher, University of Sydney, Australia

Background: In the recent days there has been a tremendous change in the nutritional landscape of the world which can be attributed to economic and income growth, urbanization, demographic change and globalization, and according to WHO due to all these factors diet-related epidemiology has seen a significant shift in recent decades. This epidemiological shift has coined the phrase "Triple Burden of Nutrition" which refers to the co-existence of under-nutrition, over-nutrition and micro nutrient deficiencies. Even as India continues to struggle with the burden of under nutrition and micro nutrient deficiencies, problems associated with over nutrition are rapidly emerging as major public health concerns also; Overweight has shown an increasing trend and is an essential risk factor for many of the Non-communicable diseases. Under nutrition, Micro-Nutrient deficiency and over nutrition is a leading precursor of poor metabolic health in India and has an adverse impact on body function, disease predisposition, morbidity and mortality, and health care costs. It is therefore not surprising that nutritional status is one of the key Millennium Development Goals. According to WHO, nutritional anaemia is a major public health problem in India and is primarily due to iron deficiency. Anaemia in children often leads to impaired cognitive and motor impaired cognitive and motor development. In 21 out of 41 countries more than one third of girls aged 15-19 years are anaemic. It causes cognitive and physical deficits in young children and reduces productivity in adults. Hence considerable attention is needed during the childhood and reproductive period of life since it has long run effect on the future aspects of individual health. Women and girls are most vulnerable to anaemia due to insufficient iron in their diets, menstrual blood loss and periods of rapid growth. Nutrition-related factors contribute to about 45% of deaths in children under 5 years of age and also one of the 10 leading causes of deaths among women is due to protein energy malnutrition (WHO). Leading causes of death in post neonatal

children are low birth weight, malnutrition, non breastfed children, overcrowded condition, unsafe drinking water/food and poor hygiene practices. The 2017 Global Hunger Index (GHI) Report ranked India 97th out of 118 countries with a serious hunger situation. The combination of people living in poverty and the recent economic growth of India has led to the co-emergence of these three types of malnutrition: under-nutrition, over nutrition and micro nutrient deficiency (Yach, D., Hawkes, C., Gould, C. L. et al. 2004).therefore it is important to study the prevalence of Triple burden of Nutrition in India for strengthening public health interventions and for effective implementation and evaluation of the strategies at regional level.

Methods: Using the data of nationally represented sample of women aged 15-49 years and children aged below 5 years collected in the last 3 rounds of National Family Health Survey (1998-99, 2005-06, 2015-16), the study is aimed to determine: (1) The extent to which India is experiencing the problem of 'triple burden of nutrition' as far as children (below 5 years) are concerned? (2) The extent to which India is experiencing the problem of 'triple burden of nutrition' as far as women (aged 15-49 years) are concerned (3) What are the drivers of under nutrition, over nutrition and hidden hunger for children (below 5 years)? (4) What are the drivers of under nutrition, over nutrition and hidden hunger for women (aged 15-49 years)?

Data were analysed using SPSS software. Bivariate and multivariate analysis has been carried out to investigate the relationship between dependent and independent variables. Chi-Square test and Fishers Exact Test is done for each pair to find out if there any association exists in them. The level of confidence and alpha values are prefixed with 95% and 0.05, respectively. As the dependent variable is the dichotomous and polytomous use of binary logistic regression and multinomial logistic regression respectively is justified.

 Results: Among children, a slight increase has been found in the Triple Burden of Nutrition [Figure 3, 4]. Also it is found that there is an increase in the percentage of children with no nutritional problem signifying improvements in the nutritional condition of children, but an opposite scenario has been observed among women with significant increase in the dual and triple burden of nutrition [Figure 5, 6, 7]. Increase in mild anaemia and a decrease is observed in moderate and severe anaemia among women has been found which is indicative that it may be due to the presence of WIFS programme which target adolescent by providing IFA tablets. Factors associated with Triple Burden of Nutrition among children are related with nutritional status of mothers documenting trans-generational impact of maternal under and over-nutrition on the offspring [Table 1] .Among women dietary and lifestyle habits along with socio economic status are playing a major role [Table 2]. Currently over-nutrition rates

are relatively low among children but increasing trend suggests prevention, early detection and effective management of obesity.

Conclusion: Triple Burden of Nutrition is an emerging problem that needs careful assessment, timely intervention, and appropriate treatment. Measures should be undertaken which focuses efforts to prevent or reduce stunting on the periods of intrauterine and early growth and the extent to which overweight/obesity overlaps with micronutrient deficiencies provides insights into the state of diet quality in countries. Prevalence of anaemia among children and women with obesity emphasizes the need to also screen them for anaemia, educate them about these complications and motivate them to practice healthy lifestyles. When designing interventions and feeding programs, the quality of food, supplements as well as the energy content must be considered. Even though there is improvement in nutritional status of children and women but the prevalence of Under-nutrition, Over-nutrition and micro nutrient deficiencies in India is much above the standards provided by WHO i.e. 15% indicating a critical public health problem.

Figure1: Prevalence of Under-nutrition, Over-nutrition and micro nutrient deficiency among children (below 5 years)

Prevalence of Undernutrition, Overnutrition and micro nutrient deficiency among children (below 5 years)

Figure2: Prevalence of Under-nutrition, Over-nutrition and micro nutrient deficiency among women (aged 14-49 years)
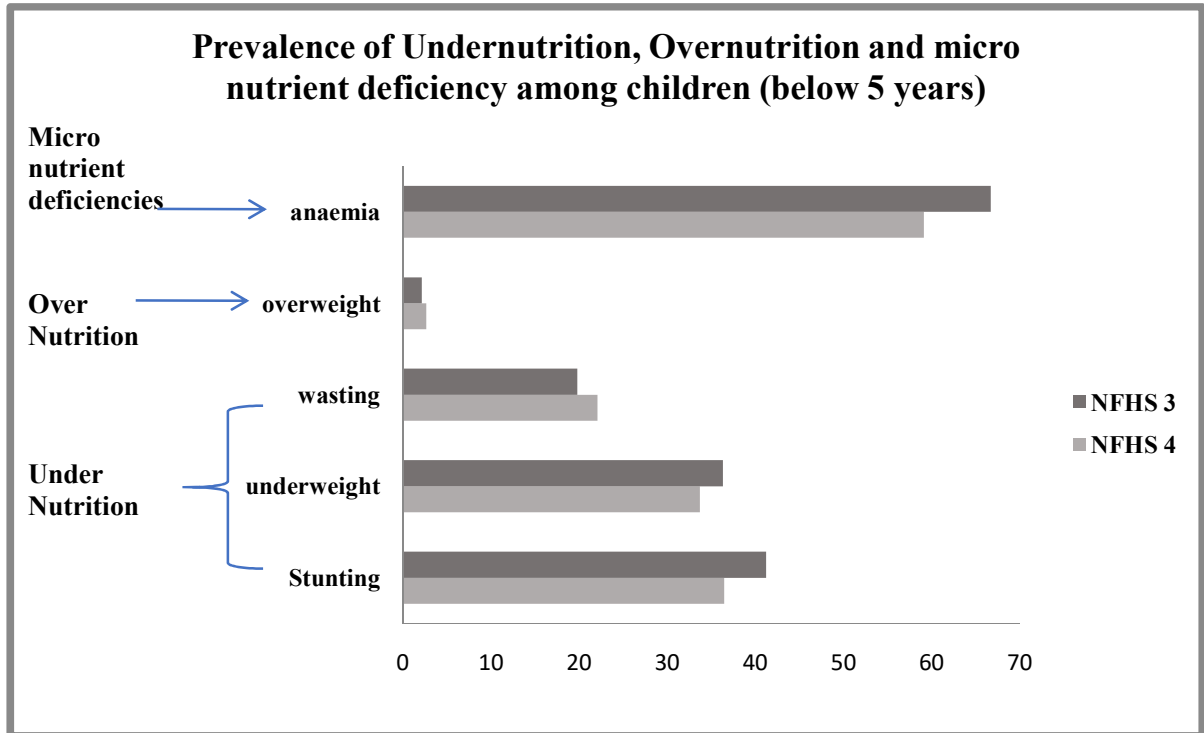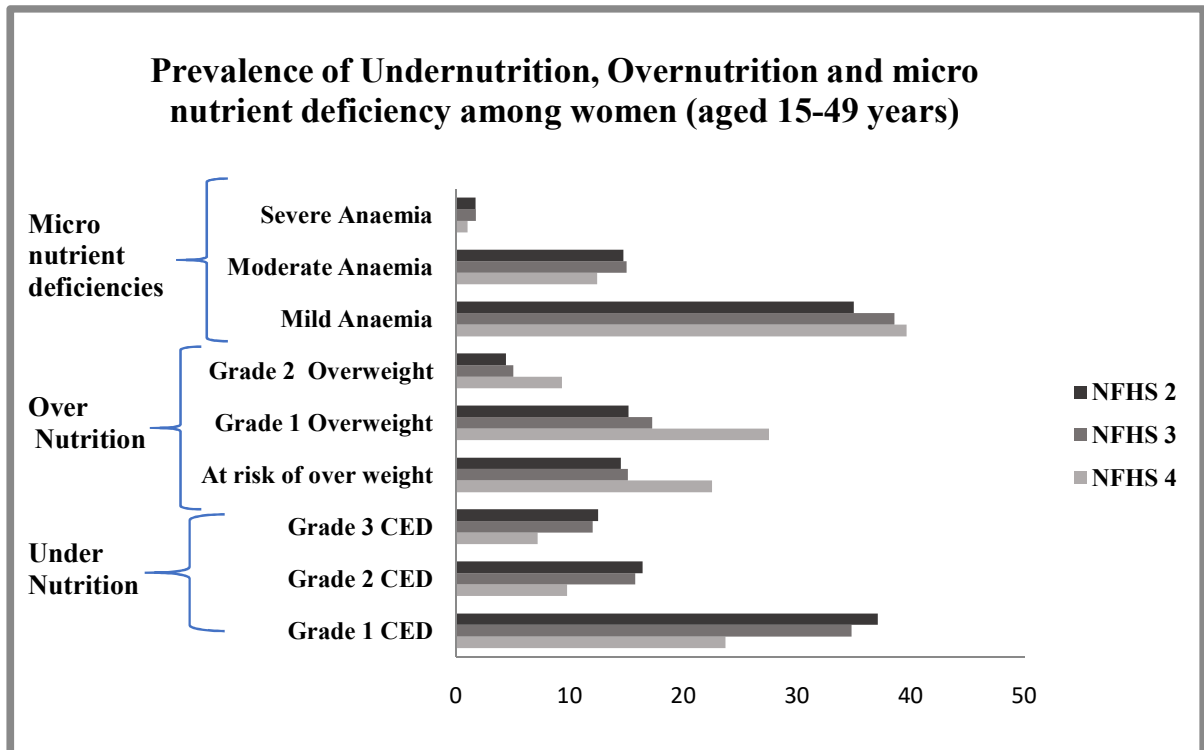

Prevalence of Undernutrition, Overnutrition and micro nutrient deficiency among women (aged 15-49 years)

Definitions

Stunting, or low height for age, is defined as the percentage of children under five whose heights are less than two standard deviations below the median height for age of the standard reference population.

Over nutrition results in overweight and obesity, and is defined as abnormal or excessive fat accumulation that may impair health. (i) 'At risk of overweight' BMI=23.0-24.99, (ii) 'Grade 1 overweight' BMI=25.0–29.99 and (iii) 'Grade 2 overweight' BMI >= 30.0.

Underweight children are those under five whose weight for age is less than two standard deviations below the median weight for age of the international reference population.

Wasting, or low weight for height, is defined as weight for height less than two standard deviations below the WHO child growth standards mean weight for height and is often associated with acute starvation or severe disease.

Chronic Energy Deficiency (CED) was defined as (i) 'Grade 1 CED' BMI=17–18.49, (ii) 'Grade 2 CED' BMI=16–16.99 and (iii) 'Grade 3 CED' BMI<16.0

Figure3: Prevalence of Triple Burden of Nutrition among children
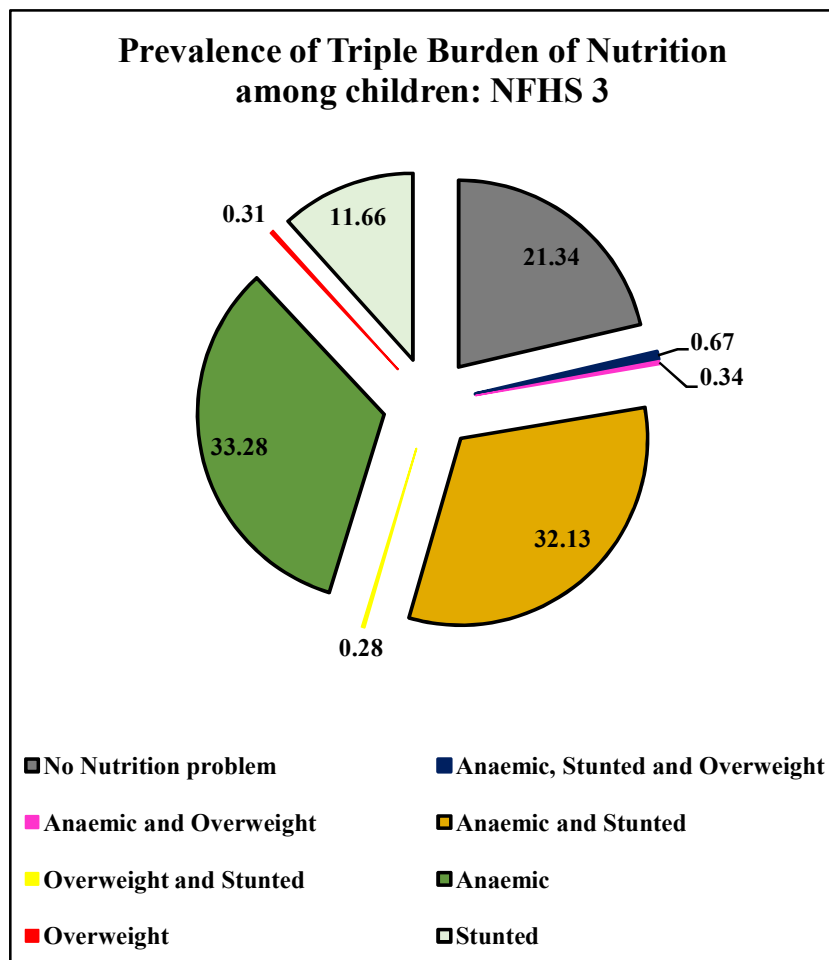
Figure4: Prevalence of Triple Burden of Nutrition among children

Prevalence of Triple Burden of Nutrition among children: NFHS 3

0.31   11.66   21.34
0.67
0.34
33.28
32.13
0.28

- ■ No Nutrition problem
- ■ Anaemic, Stunted and Overweight
- ■ Anaemic and Overweight
- ■ Anaemic and Stunted
- ■ Overweight and Stunted
- ■ Anaemic
- ■ Overweight
- ▢ Stunted

Prevalence of Triple Burden of Nutrition among children: NFHS 4

0.46   13.34   26.85
0.74
0.42
33.55
24.17
0.48

- ■ No Nutrition problem
- ■ Anaemic, Stunted and Overweight
- ■ Anaemic and Overweight
- ■ Anaemic and Stunted
- ■ Overweight and Stunted
- ■ Anaemic
- ■ Overweight
- ▢ Stunted

Figure5: Trends in Dual Burden of Nutrition among women

Trend in Dual Burden of Nutrition among women (aged 15-49)

- ☐ No problem
- ☐ Anaemic and Overweight
- ☐ Anaemic and Underweight
- ☐ Anaemic
- ■ Overweight
- ■ Undernutrition

NFHS 2   NFHS 3   NFHS4

Figure6: Trends in Triple Burden of Nutrition among women

Trend in Triple Burden of Nutrition among women (aged 15-49)

Triple burden of Nutrition
- •Women's height less than 145 cm
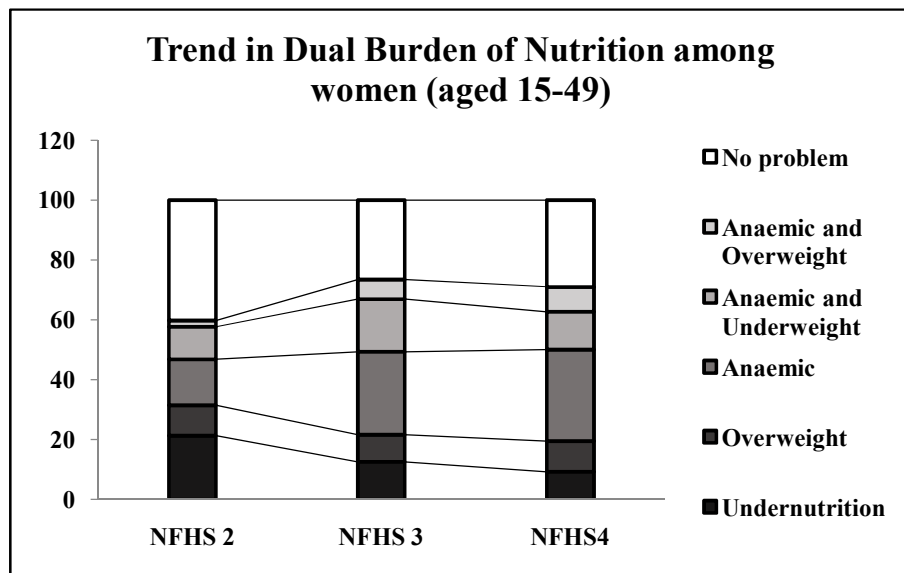- •Underweight
- •Anaemic

NFHS2   NFHS3   NFHS4
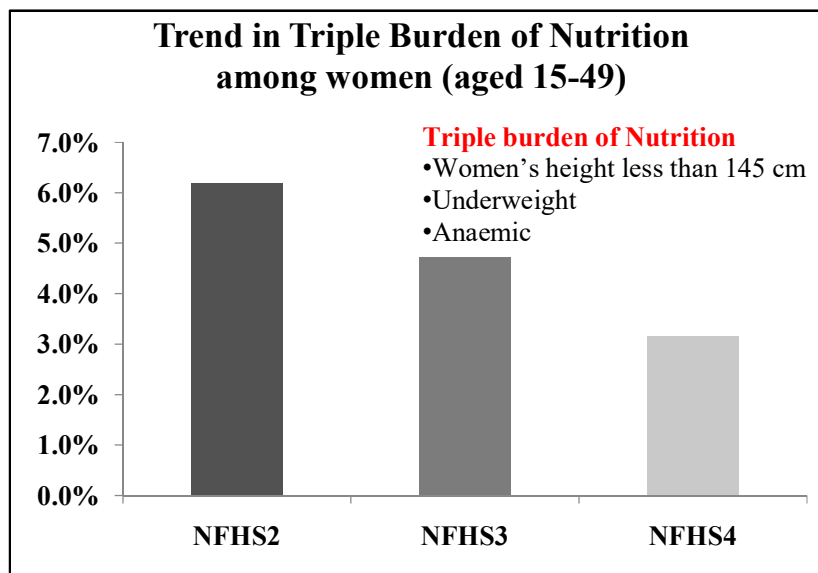
Figure7: Trends in Triple Burden of Nutrition among women (aged 15-49)

Trend in Triple Burden of Nutrition among women (aged 15-49)

Triple burden of Nutrition
- •Women's height less than 145 cm
- •Overweight
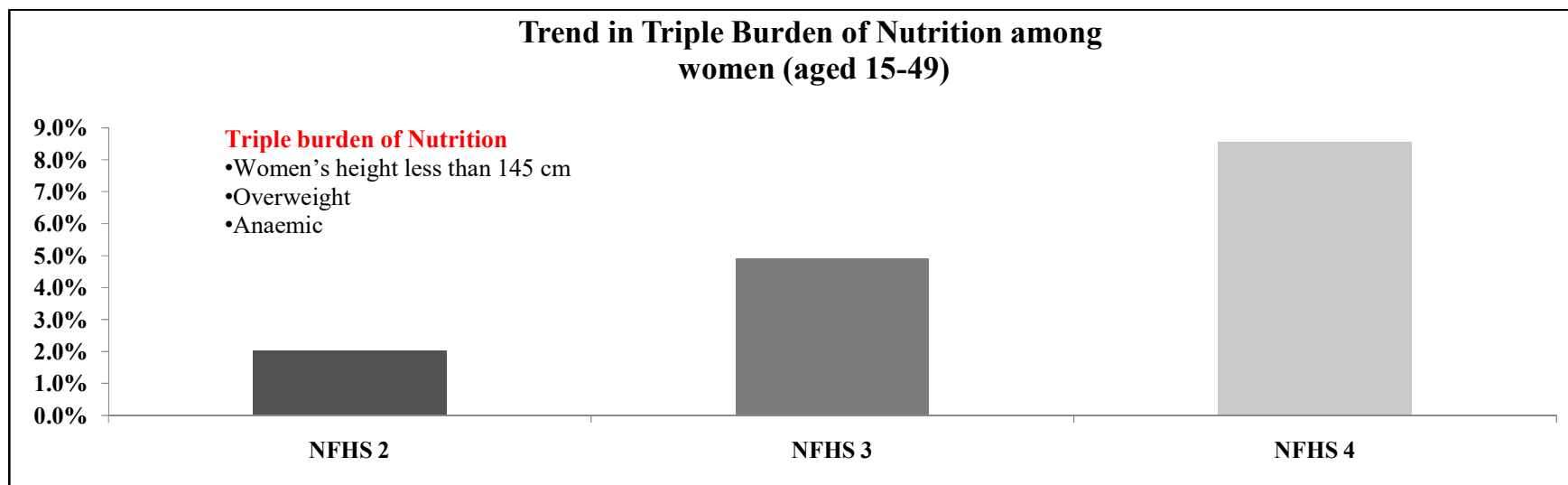- •Anaemic

NFHS 2   NFHS 3   NFHS 4

Table 1. Risk of triple burden of nutrition among children under 5 years of age

Background characteristics	Stunting			Wasting			Underweight		
	Odds Ratio	95% C.I.		Odds Ratio	95% C.I.		Odds Ratio	95% C.I.	
		Lower	Upper		Lower	Upper		Lower	Upper
Children Characteristics									
Sex of child									
Male	1.141[*]	1.08	1.205	1.132[*]	1.064	1.203	1.103[*]	1.042	1.166
Female[®]									
Current age of child									
0 years	1.191[*]	1.167	1.215	.871[*]	0.851	0.892	1.142[*]	1.118	1.166
Birth Order									
1	.820[*]	0.712	0.945	0.944	0.804	1.109	.851[*]	0.736	0.984
2-3	.872[*]	0.763	0.996	0.972	0.835	1.131	0.91	0.794	1.043
4-5	0.939	0.815	1.082	0.924	0.785	1.087	0.87	0.752	1.006
6+[®]									
Size at Birth									
Very small	.695[*]	.630	.766	.748[*]	.671	.834	.594[*]	.537	.656
Small	.728[*]	.672	.789	.809[*]	.740	.884	.650[*]	.599	.705
Average or Larger[®]				0.924	0.785	1.087	1.398[*]	1.133	1.725
Diarrhoea									

No				1.015	0.922	1.116	.883*	0.809	0.964
Yes®									

Mothers Characteristics

Education

No education	1.433*	1.249	1.644	1.214*	1.044	1.411	1.623*	1.406	1.872
Primary	1.355*	1.179	1.557	1.147	0.983	1.337	1.415*	1.223	1.637
Secondary	1.264*	1.126	1.418	1.116	0.985	1.264	1.318*	1.167	1.488
Higher®									

Nutritional status of women#

Underweight	1.721*	1.561	1.896	1.780*	1.592	1.99	2.590*	2.336	2.871
Normal	1.305*	1.199	1.421	1.289*	1.167	1.425	1.576*	1.436	1.728
Overweight®									

Anemia status among Mothers

Absent	0.988	0.935	1.045	0.955	0.897	1.017	.896*	0.847	0.949
Present®									

Womens Height <145 cm

No	0.529	0.487	0.575	.843*	0.768	0.926	.510*	0.468	0.555
Yes®									

Age at Marriage Mother

<20	0.675	0.371	1.227	0.756	0.382	1.499	1.216	0.6	2.466
20-24	0.648	0.356	1.178	0.809	0.408	1.603	1.189	0.586	2.412

25-29	0.567	0.309	1.038	0.729	0.365	1.457	0.936	0.458	1.913
30-34	0.581	0.302	1.119	0.489	0.227	1.055	0.919	0.427	1.981
>35[®]									
Fathers Education									
No education	1.318[*]	1.166	1.489	.953	.832	1.092	1.138[*]	1.003	1.290
Primary	1.253[*]	1.113	1.411	1.012	.887	1.155	1.133[*]	1.002	1.280
Secondary	1.154[*]	1.049	1.269	.922	.830	1.023	1.023	.927	1.129
Higher[®]									
Socio Economic Characteristics									
Place of Residence									
Urban	1.059	0.985	1.139	1.119[*]	1.032	1.215	1.167[*]	1.083	1.259
Rural[®]									
Religion									
Hindu	1.148	0.993	1.326	1.254[*]	1.062	1.48	1.230[*]	1.057	1.431
Muslim	1.291[*]	1.098	1.518	1.125	0.933	1.356	1.225[*]	1.033	1.452
Christian	0.981	0.823	1.171	.676[*]	0.547	0.835	.692[*]	0.572	0.837
Others[®]									
Caste									
Scheduled caste	1.246[*]	1.139	1.363	1.205[*]	1.088	1.334	1.357[*]	1.237	1.490
Scheduled tribe	1.108[*]	1.005	1.220	1.351[*]	1.211	1.506	1.264[*]	1.143	1.398
Other backward caste	1.118[*]	1.036	1.205	1.154[*]	1.058	1.259	1.262[*]	1.166	1.366
None of them[®]									
Wealth Index									
Poorest	1.735[*]	1.503	2.002	1.198[*]	1.021	1.407	1.752[*]	1.511	2.031

Poorer	1.517*	1.34	1.718	1.065	0.926	1.224	1.418*	1.247	1.614
Middle	1.287*	1.151	1.44	1	0.882	1.134	1.238*	1.102	1.391
Richer	1.151*	1.035	1.279	1.011	0.899	1.136	1.076	0.963	1.203
Richest®									
Toilet facility									
Improved®									
Not improved	1.079*	1.005	1.159	1.119*	1.032	1.213	1.120*	1.04	1.205
Mass Media Exposure									
No	1.027	0.955	1.104	1.011	0.932	1.098	1.029	0.956	1.108
Yes (at least once a week)®									
Constant									

* p- value<0.05. CI: Confidence Interval

® Reference category

Nutrition status is calculated only for Non pregnant women

Table 1 continued…

Background characteristics	Anaemia			Overweight		
	Odds Ratio	95% C.I.		Odds Ratio	95% C.I.	
		Lower	Upper		Lower	Upper
Children Characteristics						
Current age of child						
0	.726*	.709*	.742*	.678*	.636*	.723*
Birth Order						
1	0.897	0.768	1.048	1.539	0.941	2.518
02-Mar	0.964	0.832	1.117	1.222	0.754	1.982
04-May	0.939	0.803	1.097	0.935	0.551	1.588
6+®						
Size at Birth						
Very small	.856*	.772	.949	1.177	.876	1.582
Small	.932	.854	1.017	1.110	.858	1.435
Average or Larger®						
Diarrhoea						
No	0.916	0.835	1.005	1.15	0.902	1.465
Yes®						
Mothers Characteristics						
Education						
No education	1.472*	1.286*	1.684*	0.803	0.569	1.133
Primary	1.319*	1.152*	1.510*	0.848	0.6	1.197

Secondary	1.169*	1.052*	1.300*	0.907	0.706	1.164
Higher[®]						
Nutritional status of women[#]						
Underweight	1.175*	1.067*	1.295*	.435*	.330*	.574*
Normal	0.984	0.908	1.066	.786*	.647*	.956*
Overweight[®]						
Anemia status among Mothers						
Absent	.593*	.561*	.628*	1.175*	1.010*	1.368*
Present[®]						
Womens Height <145 cm						
No	1.033	0.942	1.132	1.580*	1.173*	2.128*
Yes[â]						
Age at Marriage Mother						
<20	0.897	0.479	1.681	0.638	0.193	2.11
20-24	0.84	0.448	1.574	0.609	0.185	2.013
25-29	0.815	0.432	1.535	0.781	0.234	2.607
30-34	0.761	0.387	1.494	0.91	0.249	3.329
>35[®]						
Fathers Education						
No education	1.056	.932	1.197	.982	.690	1.397
Primary	.956	.848	1.078	.899	.643	1.257
Secondary	.960	.877	1.051	.993	.789	1.249
Higher[®]						
Socio Economic Characteristics						

Place of Residence						
Urban	1.038	0.965	1.116	1.200*	.999*	1.440*
Rural®						
Religion						
Hindu	0.872	0.756	1.005	0.738	0.536	1.014
Muslim	1.006	0.855	1.183	0.729	0.5	1.064
Christian	.381*	.320*	.454*	0.734	0.493	1.092
Others®						
Caste						
Scheduled caste	1.167*	1.066	1.279	.910	.707	1.172
Scheduled tribe	1.198*	1.084	1.324	1.175	.904	1.525
Other backward caste	1.091*	1.012	1.175	.849	.692	1.042
None of them®						
Wealth Index						
Poorest	0.928	0.802	1.075	1.075	0.728	1.589
Poorer	0.935	0.826	1.059	1.091	0.791	1.503
Middle	0.926	0.831	1.032	1.103	0.838	1.451
Richer	.902*	.817*	.996*	1.144	0.898	1.459
Richest®						
Toilet facility						
Improved®						
Not improved	1.144*	1.062*	1.232*	0.931	0.766	1.132
Mass Media Exposure						
No	1.04	0.962	1.126	0.938	0.755	1.166

Yes (atleast once a week) [R]

Constant   .000   4.207

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* p- value<0.05. CI: Confidence Interval

® Reference category

Nutrition status is calculated only for Non pregnant women

Table 2: Risk of triple burden of nutrition among Women (aged 15-49)

		Nutritional Status Of Women			**Anaemia**		
			95% C.I			95% C.I	
		RRR	Lower Bound	Upper Bound	**RRR**	Lower Bound	Upper Bound
	Women Characteristics						
	Womens Age						
	15-19	2.221[*]	2.16	2.283	1.165[*]	1.139	1.191
	20-29	1.581[*]	1.549	1.615	1.108[*]	1.091	1.124
	30-39	1.105[*]	1.082	1.129	1	0.985	1.014
	40-49[®]						
	Marital status						
	Never married	1.371[*]	1.286	1.462	.859[*]	0.817	0.902
Underweight	Currently Married	.861[*]	0.809	0.916	.940[*]	0.897	0.985
	Widowed	0.96	0.893	1.033	1.008	0.954	1.065
	Divorced/Separated/Deserted[®]						
	Socio Economic and Demographic Characteristics						
	Place of Residence						
	Urban	.929[*]	0.913	0.945	0.989	0.976	1.001
	Rural[®]						
	Education						
	No education	1.391[*]	1.351	1.433	1.212[*]	1.186	1.239
	Primary	1.242[*]	1.204	1.281	1.140[*]	1.114	1.166

Secondary	1.167*	1.138	1.196	1.093*	1.073	1.112
Higher®						
Religion						
Hindu	1.554*	1.501	1.609	1.080*	1.055	1.106
Muslim	1.416*	1.36	1.473	1.005	0.978	1.034
Christian	.615*	0.588	0.643	.567*	0.551	0.585
Others®						
Caste/Tribe						
Schedule caste	1.113*	1.089	1.137	1.175*	1.156	1.194
Schedule tribe	1.048*	1.024	1.073	1.332*	1.308	1.357
OBC	1.113*	1.093	1.133	1.074*	1.06	1.089
None of them						
Wealth Index						
Poorest	1.793*	1.736	1.853	1.167*	1.138	1.196
Poorer	1.558*	1.514	1.604	1.026*	1.005	1.048
Middle	1.379*	1.343	1.416	1	0.982	1.019
Richer	1.245*	1.214	1.277	1.005	0.988	1.022
Richest®						
Mass Media Exposure						
No	1.058*	1.041	1.076	1.007	0.993	1.021
Yes®						
Toilet facility#						
Not improved	1.150*	1.131	1.17	1.090*	1.076	1.105
Improved®						

Water facility						
Not improved	.948*	0.931	0.965	.971*	0.957	0.985
Improved®						
Dietary Characteristics						
Curd/milk						
Occasionally/never	1.048*	1.03	1.066	1.042*	1.028	1.057
Daily	.937*	0.921	0.953	0.987	0.974	1.001
Weekly®						
Pulses/beans						
Occasionally/never	.928*	0.909	0.947	.876*	0.861	0.89
Daily	1.015	1.001	1.03	1.036*	1.024	1.048
Weekly®						
Green vegetables						
Occasionally/never	1.014	0.994	1.033	1.078*	1.061	1.095
Daily	.944*	0.93	0.958	.949*	0.938	0.96
Weekly®						
Fruits						
Occasionally/never	1.033*	1.017	1.05	1.041*	1.029	1.054
Daily	.943*	0.918	0.968	0.989	0.972	1.008
Weekly®						
Eggs						
Occasionally/never	0.99	0.973	1.008	.983*	0.97	0.997
Daily	1.056*	1.011	1.102	1.032*	1.001	1.065
Weekly®						

	Fish/Chicken						
	Occasionally/never	1.023	1.003	1.043	0.985	0.97	1
	Daily	.846[*]	0.812	0.881	.839[*]	0.815	0.862
	Weekly[®]						
	Chicken/meat						
	Occasionally/never	1.023[*]	1.003	1.043	1.025[*]	1.01	1.04
	Daily	1.028	0.957	1.103	.935[*]	0.889	0.982
	Weekly[®]						
	Fried Food						
	Occasionally/never	1.042[*]	1.027	1.058	1.044[*]	1.032	1.056
	Daily	.974[*]	0.951	0.997	.926[*]	0.91	0.943
	Weekly[®]						
	Aeriated Drinks						
	Occasionally/never	1.008	0.99	1.026	.907[*]	0.895	0.919
	Daily	0.973	0.94	1.007	.938[*]	0.914	0.962
	Weekly[®]						
	Lifestyle Habits						
	Use Tobacco						
	No[®]						
	Yes	1.317[*]	1.288	1.345	0.994	0.976	1.011
	Drinks Alcohol						
	Yes	1.267[*]	1.214	1.323	1.254[*]	1.214	1.295
	No[®]						
Overweight	**Women Characteristics**						

Womens Age

15-19	.165*	0.158	0.172
20-29	.335*	0.329	0.342
30-39	.717*	0.705	0.73
40-49®			

Marital status

Never married	.608*	0.568	0.652
Currently Married	1.143*	1.072	1.218
Widowed	1.067	0.992	1.148
Divorced/Separated/Deserted®			

Socio Economic and Demographic Characteristics

Place of Residence

Urban	1.295*	1.274	1.316
Rural®			

Education

No education	.855*	0.83	0.88
Primary	0.987	0.958	1.017
Secondary	1.065*	1.04	1.089
Higher®			

Religion

Hindu	.808*	0.784	0.833
Muslim	1.072*	1.034	1.112
Christian	.807*	0.774	0.841

Others[®]

Caste/Tribe

Schedule caste	.893[*]	0.873	0.913
Schedule tribe	.672[*]	0.653	0.691
OBC	.915[*]	0.899	0.932

None of them[®]

Wealth Index

Poorest	.238[*]	0.229	0.248
Poorer	.381[*]	0.37	0.393
Middle	.565[*]	0.552	0.579
Richer	.797[*]	0.781	0.814

Richest[®]

Mass Media Exposure

No	.807[*]	0.789	0.825

Yes[®]

Toilet facility[#]

Not improved	.938[*]	0.92	0.956

Improved[®]

Water facility

Not improved	1.055[*]	1.033	1.077

Improved[®]

Dietary Characteristics

Curd/milk

Occasionally/never	1.080[*]	1.059	1.103

Daily	1.036[*]	1.017	1.056
Weekly[®]			
Pulses/beans			
Occasionally/never	1.038[*]	1.013	1.064
Daily	0.989	0.973	1.005
Weekly[®]			
Green vegetables			
Occasionally/never	.973[*]	0.95	0.995
Daily	1.053[*]	1.036	1.071
Weekly[®]			
Fruits			
Occasionally/never	.946[*]	0.93	0.962
Daily	1.101[*]	1.076	1.126
Weekly[®]			
Eggs			
Occasionally/never	1.004	0.985	1.024
Daily	1.086[*]	1.044	1.129
Weekly[®]			
Fish/Chicken			
Occasionally/never	.916[*]	0.897	0.936
Daily	1.025	0.99	1.062
Weekly[®]			
Chicken/meat			
Occasionally/never	.903[*]	0.885	0.922

Daily	1.031	0.968	1.099
Weekly[®]			
Fried Food			
Occasionally/never	1.032[*]	1.016	1.049
Daily	1.039	1.014	1.066
Weekly[®]			
Aeriated Drinks			
Occasionally/never	1.006	0.987	1.025
Daily	0.982	0.948	1.017
Weekly[®]			
Lifestyle Habits			
Use Tobacco			
No®	.833[*]	0.812	0.855
Yes			
Drinks Alcohol			
Yes	0.978	0.931	1.027
No[®]			

The reference category is: Women with Normal BMI

* p- value<0.05. CI: Confidence Interval

® Reference category

Nutrition status is calculated only for Non pregnant women