Maternal Mortality in India: Malnutrition, in Particular and Others

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Abstract

India was to achieve a goal of 109 maternal deaths due to child birth and puerperum per 100,000 live births (MMR) by 2015 as par the guidelines of the Millennium Development Goal (MDG) of the United Nations (UN) and the other international bodies in the year 2000. As there was progress not up to the mark in achieving the target of the MDG after a decade in many developing countries including India a further attempt as SDG (Sustainable Development Goals) was adopted at a mega conference in Rio de Janeiro in 2012. In 2012 the International Food Policy Research Institute (IFPRI), USA while prescribing their 1,000 day window mentioning the MCH condition of India was very precarious. The scientists and experts of the IFPRI were of the opinion and agreed that improving nutrition during the critical 1,000 day window is one of the best investments to achieve lasting progress in health and development of child and mother of India. Although their prescription was not only for India but for global health and development. The Global Nutrition Report 2017 (the first report published in the month of November, 2017) presented at Milan, Italy clearly gives a grim nutritional status of Indian mothers with 51 per cent suffering from anemia and 22 percent overweight in addition to many other countries' situation on the global aspect. Keeping in view of so many comments from different International bodies about the poor condition of India's mother and child, the present author tries to study only to find the reason of the high maternal mortality from the nutritional aspect of mother. In the past different contributable factors through some multivariate statistical analysis was done by the author. Since the government of India Government of India (GOI) a signatory of the MDG tried to achieve the goal by providing inputs to its large number of geographically situated states making into different categories. Still then MMR of India came down to only 167 during 2011-2013. The present author estimated the same only around 150 in 2015, the target year of MDG applying a linear trend from the growth of the earlier period. It was further estimated as 140 in 2018.

Keywords: Millennium Development Goal, Sustainable Development Goals, MMR, JSY

1. Background/ Objectives and Goals

In my earlier works I studied in depth using endogenous and exogenous variables in order to find the cause of high MMR in India through stepwise regression and commonality analysis. Further I

studied relationship between MMR and early female population, early marriage and early pregnancy in order to find the possible cause of high MMR in India. After giving the background of my earlier studies, my objective is now to corroborate into my studies some further variables (malnutrition, anemia etc. of Indian females) which I consider important as The Global Nutrition Report (2017) saying about the grim nutritional status of Indian mothers. As a result I have included further these variables in an attempt to find any impact on high MMR. Finally my goal is to find as far as possible the more attributable factors owing to which India could reduce the death of mothers, in particular young due to child birth and puerperum adopting more and more scheme. GOI though initiated many schemes such as "Janani Suraksha Yojana (JSY)" (mother's protection planning) in 2013, later adding child as well to "Janani-Shishu Suraksha Karyakram (JSSK)" (mother and child protection activities) in order to increase the number of institutional and safe deliveries of mothers. Further as early marriage and pregnancy are still existing, to a great extent in India. GOI tried to control this tendency of Indian people by adopting some further scheme like "Beti Bachao, Beti Padhao Yojana" (increase daughter's education and protect them) in 2015.

2. Methods

Applying statistical multivariate step-wise regression and commonality analyses on a basis of a good number of various endogenous and exogenous variables in order to find the significant contribution of selected variables towards high MMR data in India. Then the product moment correlation coefficient has been calculated between MMR in one side and on the other a number of variables like early age female population, early age marriage and pregnancy in addition some more recent variables like, malnutrition of pregnant and non pregnant women, their food habits and others were included in the study..

3. Results

The present article tries to give a scenario of India so far as India's high maternal deaths (MMR) on one side and on the other the various causes for this untoward situation which so many international organisation and in different international summit's topic of discussion has been chronologically observed. Being a population scientist I have been trying for the last around ten years to point out the grim situation of MMR about which Millennium Development Goal

(MDG) in 2000 set a target of MMR of 109 by 2015. Sustainable Development Goal (SDG) took in 2012 replacing MDG. International Food Policy Research Institute (IFPRI), USA in 2012 while prescribing their 1,000 day window critcised India's health aspects of mother. Finally the Global Nutrition summit in 2017 at Milan, Italy also clearly gives a grim nutritional status of Indian mothers with 51 per cent suffering from anemia and 22 percent overweight. India is a vast country with 1.33 billion population and is boast of having largest democracy and 2nd largest food producing country in the world after Brazil.

Whatever results I got from the paper,-it is vividly clear from the number of tables that a state's position is not the real scenario of that particular region with a people of diversified nature residing particularly in a state where much "pull factor" has dominated. On the other there are states where "push factor" is very well known so the people move outside.

Apart from all these I have studied on High MMR (140), high home delivery (60 per cent, with significant R^2), early female population (the 5 per cent significant correlation coefficient of 0.71 with MMR), marriage (the 10 per cent significant correlation coefficient of 0.53 among non pregnant mother and MMR) and pregnant mother (the 5 per cent significant correlation coefficient of between pregnant mother and MMR is 0.61).

The important items like malnutrition, anemia and food habits of females is given more emphasis.

- India has the dubious distinction of the highest prevalence of anemia (see 3.7.1 and 3.7.2).
- Food habits of Indians are presented (see 3.8.1 for rural and 3.8.2 for urban).

3.1. Formula and Equation

The general multivariate regression equation for any number of variables may be given as:

$$Y = a + b_1X_1 + b_2X_2 + \dots + b_kX_k$$

where a stands for intercept constant and $b_1, b_2, \dots, b_k$ are partial regression coefficients. With adjusted regression coefficients, βs, matrix form of equation may be given as:

$$\begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ - \\ - \\ - \\ - \\ \beta_k \end{pmatrix} = \begin{pmatrix} R_{11}R_{12}R_{13} \dots\dots R_{1k} \\ R_{21}R_{22}R_{23} \dots\dots R_{2k} \\ R_{31}R_{32}R_{33} \dots\dots R_{3k} \\ \dots\dots\dots\dots \\ \dots\dots\dots\dots \\ \dots\dots\dots\dots \\ \dots\dots\dots\dots \\ R_{k1}R_{k2}R_{k3} \dots\dots R_{kk} \end{pmatrix} \begin{pmatrix} R_{y1} \\ R_{y2} \\ R_{y3} \\ - \\ - \\ - \\ - \\ R_{yk} \end{pmatrix}$$

3.2. Stepwise regression analysis

Now each independent variable is deleted from the regression equation one at a time, and loss to R^2 due to the deletion of the variable is studied through two criteria, (i)the significant loss in F value, i.e.,

$$F = \frac{\left(R^2_{y.12\ldots k_1} - R^2_{y.12\ldots k_2}\right) \Big/ (k_1 - k_2)}{\left(1 - R^2_{y.12\ldots k_1}\right) \Big/ (N - k_1 - 1)}$$

where $R^2_{y.12\ldots k_1}$ = the squared multiple correlation coefficient for the regression of Y on k_1 variables (the larger coefficient) and $R^2_{y.12\ldots k_2}$ = the squared multiple correlation coefficient for the regression of Y on k_2 variables, k_2 = the number of independent variables of the smaller R^2. The degrees of freedom for F would be $(k_1 - k_2)$ and $(N - k_1 - 1)$. If the value of F is significant then the deletion of the variable will be a significant loss, hence the variable is not to be deleted. Otherwise, if the F is non significant the variable concerned may be deleted. And (ii) the loss (meaningfulness) in R^2 that occurs as a result of deletion may be assessed through the value of ($R^2_{y.12\ldots k_1} - R^2_{y.12\ldots k_2}$). When both the criteria are considered, a variable considered not to add meaningfully or significantly to prediction is deleted. Otherwise the variable considered would be retained. In this way the process continues, till the entire list of variables are exhausted.

3.3. Commonality analysis

After elimination of the variables through backward process, commonality analysis is performed on the remaining variables. In commonality analysis the variances of dependent variable classified into unique and common factors, so that contributions due to these factors to variances in the dependent variable may be ascertained. If the variables concerned are 1,2,3,…….. the unique and common contributions are denoted by

U(I), U(2), U(3) ……unique contributions,

C(12), C(13), C(14)……...two factor commonalities, and

C(123), C(124), C(2,34)……three factor commonalities.

With two independent variables, the unique contribution of variable 1, as for example is defined as:

$$U(1) = R^2_{y.12} - R^2_{y.2}$$

where $R^2_{y.12}$ = squared multiple correlation of Y with variables 1 and 2; $R^2_{y.2}$ = squared simple correlation of y with variable2. Similarly, the unique contribution of variable 2 is defined as:

$$U(2) = R^2_{y.12} - R^2_{y.1}$$

where $R^2_{y.1}$ = simple squared correlation of y with variable 1. Now the commonalities of variables 1 and 2 may be defined as:

$$C(12) = R^2_{y.12} - U(1) - U(2)$$

In this way all other unique and commonality factors are obtained. There is a simple technique to find out the unique and commonalities (Kerlinger and Pedhazur, 1937). After completion of all the unique and commonality factors of three variables, a summary table is prepared in the following manner:

Summary of commonality analysis of 3 variables 1, 2, and 3

Commonalities	*Variables*		
	1	*2*	*3*
U(1)	U(1)		
U(2)		U(2)	
U(3)			U(3)
C(12)	C(12)	C(12)	
C(13)	C(13)		C(13)
C23)		C(23)	C(23)
C(123)	C(123)	C(123)	C(123)
Σ	$r^2_{y.1}$	$r^2_{y.2}$	$r^2_{y.3}$

The items $r^2_{y.1}$, $r^2_{y.2}$ and $r^2_{y.3}$ in the last line are the summation of each column figures. Now, contribution of variable one with dependent variable y is given by $r^2_{y.1}$ which is now broken down into unique contribution U(1) and 2nd order commonalities of C(12) and C(13) and 3rd order commonality of C(123). In this way, the other two figures in the last line may be defined according to their respective unique factors and commonalities. From this type of analysis total contribution of variable 1, how much contribution is due to unique factor and commonalities may be ascertained so on for others.

3.4. Figures and Tables

Major states in India	**Percent annual growth rate of MMRs, 2015-2018**	**MMRs**	
		2015	**2018**
Andhra Pradesh	-0.1791045	83.73	83.67
Assam	-0.1756758	258.48	258.43
Bihar	-0.1609194	172.01	171.96
Gujarat	-0.1910112	93.42	93.36
Haryana	-0.0403846	224.62	224.61
Karnataka	-0.1449813	107.33	107.27
Kerala	-0.1634616	49.7	49.64
Madhya Pradesh	-0.0891474	185.54	185.49
Maharashtra	-0.0988371	68.04	67.99
Odisha	-0.1981131	207.07	207.04
Punjab	-0.0721650	134.57	134.54
Rajasthan	-0.1866294	187.64	187.57
Tamil Nadu	-0.0721650	81.34	81.32
Uttar Pradesh	-0.1603773	219.34	219.28
West Bengal	-0.1931034	86.88	86.82
India	-0.1603773	139.94	139.89

The figure of around 140 deaths per 100,000 live births in 2018 is estimated from the pattern during 2015-2018 same linear trend as observed in earlier paper. This figure is the same 140 projected by WHO/MoHFW, Govt. of India though in 2015 (Travasso, 2015). The Press

Information Bureau cited 167 MMR of India from SRS data in 2013 (GOI, 2015). Still it was high as per Govt. of India's projection of 135 propounded in 2010 and too high as per MDG goal of 109 in 2000.

From the above table, out of the 15 states major only 6 states possess MMR of the order of less than 100 mark in the current year of 2018. The only state Kerala is boast of minimum number of maternal deaths of 50 per 100,000 live births in the year 2018 followed chronologically by Maharashtra (about 68), Tamil Nadu (81), Andhra Pradesh (84), West Bengal (87) and Gujarat (93).

The condition of EAG (Empowered Action Group) states and Assam as usual show very high MMRs. Punjab's situation showing at per the target proposed by the GOI (2010) of the order of 135 by 2015. However the figure is almost same in 2018. Haryana and Odisha having bad situation as similar as EAG states including Bihar, Madhya Pradesh, Rajasthan and Utter Pradesh.

3.5. Statistical Analysis on home delivery and MMR

Multivariate analysis has been done at two stages. Firstly a stepwise regression analysis is done in order to eliminate the insignificant factors out of the total list of 12 variables, X_1) Literacy of females, age 7+, X_2) Female work participation rate, X_3) Population below poverty line, X_4) Expenditure on medical, public health & FW, X_5) Health worker per 100,000 rural population, X_6) Number of PHCs, X_7) Number of Sub Centres, X_8) Full ante natal check up, X_9) Home delivery without any help, X_{10}) Home delivery assisted by skilled person, 11) Villages electrified and X_{12}) Motor vehicles per100,000 population and then a commonality analysis proposed.

Interestingly out of 12 variables two variables namely home delivery and health worker per 100,000 rural population were found significant. Rest 10 variables were found insignificant. From the present MMR study an unusual finding may be that all exogenous variables become non responding instead the actual variable directly concerned with the delivery becomes more important along with the health personnel available in the village. After doing this the next step was to study the two variables with their independent and common effects on MMR through commonality analysis.

Out of these, health worker singly contributed only around 13 per cent, whereas home delivery has major contribution of 60 per cent variation in MMR. And the commonality between these variables becomes insignificant with only about 1 per cent variation. A recent study (Garg et al, 2010) showed in spite of the fact that Punjab is one of the most prosperous and educated states in India, home deliveries and unsafe deliveries are still widely prevalent in rural Punjab (66 per cent) in overall education groups. This could be attributed to the prevalent psycho-social and cultural beliefs of the villagers.

3.6. Early female population, marriage and pregnancy

3.6.1. Early proportion of population of females of age less than 15

States	Prop.of population	MMR
INDIA	28.8	139.89
Andhra Pradesh	23.8	83.67
Bihar	37.1	171.96
Gujarat	27	93.36
Haryana	27.9	224.61
Karnataka	24.8	107.27
Kerala	21.7	49.64
Madhya Pradesh	31.9	185.49
Maharashtra	26.3	67.99
Odisha	27	207.04
Punjab	24.4	134.54
Rajasthan	31.8	187.57
Tami Nadu	22.6	81.32
Uttar Pradesh	33.2	219.28
West Bengal	25.5	86.82

From the above table one can get an idea about the position of female adolescent population and corresponding maternal mortality ratios (MMR) of the major states in India. Indian overall figures for the two items respectively shows about thirty percent (28.8) of female population and for them the MMR value is around 140 maternal deaths per 100,000 live births around the second decade of 21st century. As far as the diversities of the proportion of population of females of age less than 15 among the states, Kerala shows the lowest figure of around 22 per cent, whereas the maximum (37 per cent) value is for Bihar. These two states have the almost similar pictures for corresponding MMRs (Kerala: around 50 and Bihar: about 172). Some confusion may be raised about Haryana and Uttar Pradesh where when highest MMR (about 225) is found for Haryana but proportion of population of females is not so high. The more important variables

like early marriage and early pregnancy are to be given for effective study at the present moment. The correlation coefficient has been calculated between the two arrays of figures was found of the order of 0.71 which is significant at 5 per cent level of significant.

3.6.2. Proportion of early marriages of females age below 18 years

Major states and India	proportion of married females	MMR
India	22.1	139.89
Andhra Pradesh	28.6	83.67
Assam	20.8	258.43
Bihar	45.9	171.96
Gujarat	18.7	93.36
Haryana	15.9	224.61
Karnataka	22.4	107.27
Kerala	06.8	49.64
Madhya Pradesh	29.0	185.49
Maharashtra	17.6	67.99
Odisha	19.1	207.04
Punjab	05.8	134.54
Rajasthan	39.9	187.57
Tamil Nadu	09.1	81.32
Uttar Pradesh	32.9	219.28
West Bengal	41.3	86.82

From the above table one can get an idea about the position of female adolescent married population and corresponding maternal mortality ratios (MMR) of the major states in India. Indian overall figures for the two items respectively shows about twenty two percent of married female population and for them the MMR value is around 140 maternal deaths per 100,000 live births around the second decade of 21st century. The low figure of only 22 per cent is not the true picture of India since there are number states having very high proportion figures like Bihar, West Bengal, Rajasthan and Uttar Pradesh which counteracted by low figure states like Punjab, Kerala, Tamil Nadu and Maharashtra. From the same table Bihar tops the list with 46 per cent followed by West Bengal (41), Rajasthan (40), Uttar Pradesh (33), Madhya Pradesh (29). Rest follows, but the notable performance is noticed from Punjab with lowest 6 per cent followed by Kerala usually of low value of only about 7 per cent and Tamil Nadu 9 per cent. But the overall Indian figure of only 22 per cent is found in the same table may have some criticism which needs more in-depth study.

3.6.3. Proportion of early age (15-19) pregnancy of women in India

Major states only	Proportion of early pregnant women	MMR
Andhra Pradesh	5.41	158
Bihar	5.68	452
Gujarat	3.74	303
Haryana	4.65	174
Karnataka	4.27	212
Maharashtra	2.89	121
Odisha	4.08	281
Punjab	1.86	189
Tamil Nadu	2.86	104
Uttar Pradesh	3.12	426
West Bengal	5.98	172

From the above table one can get an idea about the position of female adolescent pregnancy and corresponding maternal mortality ratios (MMR) of the major states in India. As there is no Indian figure of proportion of early pregnant women is available hence we are unable to say about the overall status as we have given in the earlier cases. But the above table shows the highest figure of around 6 per cent of early pregnant women for West Bengal followed by Bihar (nearly the same figure as of West Bengal), Andhra Pradesh (around 5 per cent), Haryana (nearly the same as Andhra Pradesh. Kerala figure is also absent but Punjab again has the lowest figure of 1.86 per cent. Tamil Nadu (around 3 per cent) and Maharashtra (marginally higher (2.89 per cent). The correlation coefficient has been calculated between the two arrays of figures was found of the order of 0.61 which is significant at 5 per cent level of significance.

3.7. The most important study of malnutrition and anemia vis-à-vis MMR

Anemia (defined as the lack of sufficient hemoglobin [Hb] concentration in the blood) in many developing countries, is primarily a result of the lack of bio available dietary iron. Both nutritional and non nutritional factors may cause anemia. The most common nutritional cause is iron deficiency. Iron deficiency anemia (IDA) results from a combination of several factors: (1) inadequate iron intake and/or low dietary availability; (2) high physiologic demands in early childhood and pregnancy and periods of rapid growth such as adolescence; (3) chronic iron

losses from parasitic infections such as hookworm and schistomiasis (or known as snail fever and bilharzia, is a disease caused by parasitic flatworms called schistosomes); and (4) deficiencies of vitamin B12, folic acid, and vitamin A.8-10. Non nutritional causes of anemia include malaria, hemorrhage, inherited disorders, and various chronic diseases.

Hemoglobin levels among women have been classified on the basis international standard2 as follows for non pregnant women: normal, ≥12.0 g/dL; mild, 10.0 to 11.9 g/dL; moderate, 7.0 to 9.9 g/dL; and severe, <7.0 g/dL. For pregnant women, the values are as follows: normal, ≥11.0 g/dL; mild, 10.0 to 10.9 g/dL; moderate, 7.0 to 9.9 g/dL; and severe, <7.0 g/dL. Any anemia is defined as the concentration of Hb level <12.0 g/dL in non pregnant women and <11.0 g/dL in pregnant women.

For the present analysis contribution of anemia on the maternal mortality,- tables 3.7.1 for pregnant and 3.7.2 for non pregnant women about the distributions have been shown for the selected 14 major states of India. This is important but it may not be possible to correlate each extent of anemia level with MMR because of dearth of extensive scope of the paper. I've taken "any Anemia" which simply says concentration of Hb level <12.0 g/dL in non pregnant women and <11.0 g/dL in pregnant women. Overall anemic either non or pregnant women is per se.

3.7.1. Distn. of Mean Hb and per cent distribution of anemia among pregnant Women

	<------Hb Level---->			<-----Percentage Distribution of Anemia---->				
Major states	**n**	**Mean**	**SD**	**Severe**	**Moderate**	**Mild**	**Any Anemia**	**Normal**
Andhra Pradesh	170	10.96	1.57	2.4	20.6	18.8	41.8	58.2
Bihar	508	10.77	1.61	2.0	25.6	21.6	49.2	50.8
Gujarat	207	10.84	1.91	3.9	28.0	15.0	46.9	53.1
Haryana	171	10.66	1.88	1.8	32.7	20.5	55.0	45.0
Karnataka	271	10.87	1.78	3.0	24.4	20.2	47.6	52.4
Kerala	139	11.90	1.31	0.0	8.6	10.8	19.4	80.6
Madhya Pradesh	550	10.83	1.79	0.9	30.0	21.1	52.0	48.0
Maharashtra	330	10.71	1.85	3.3	27.6	20.9	51.8	48.2
Odisha	291	10.51	1.56	0.7	32.3	26.8	59.8	40.2
Punjab	163	11.33	1.62	0.6	16.0	20.2	36.8	63.2
Rajasthan	591	10.89	1.77	1.7	26.1	23.6	51.4	48.6
Tamil Nadu	304	10.77	1.61	2.0	26.0	24.0	52.0	48.0
Uttar Pradesh	410	10.97	1.78	2.7	23.4	20.7	46.8	53.2
West Bengal	188	10.58	1.52	1.6	27.7	29.2	58.5	41.5
India	5619	10.93	1.73	1.8	24.5	21.2	47.5	52.5

3.7.2. Distn. of Mean Hb and per cent distribution of anemia among non pregnant Women

< ------Hb Level------>				<----------Percentage Distribution of Anemia------->				
Major states	**n**	**Mean**	**SD**	**Severe**	**Moderate**	**Mild**	**Any Anemia**	**Normal**
Andhra Pd	3648	11.68	1.95	2.3	14.6	33.0	49.9	50.1
har	5672	11.24	1.65	1.4	17.9	45.4	64.7	-
Gujarat	3252	11.88	2.04	2.4	13.3	30.1	45.8	54.2
Haryana	2536	11.86	1.89	1.5	13.4	31.6	46.5	53.5
Karnataka	3777	11.96	1.99	2.3	12.7	27.0	42.0	58.0
Kerala	2568	12.85	1.47	0.5	2.5	19.4	22.4	77.6
Madhya Pd	5942	11.76	1.83	1.0	13.4	37.7	52.1	47.9
Maharashtra	4409	11.86	1.85	1.7	12.4	31.9	46.0	54.0
Orissa	394	11.38	1.61	1.6	14.3	46.4	62.3	-
Punjab	2425	12.08	1.82	0.7	11.8	29.2	41.7	58.3
Rajasthan	5386	11.83	1.88	1.7	12.6	34.2	48.5	51.5
Tamil Nadu	4151	11.48	1.84	2.3	14.6	38.4	55.3	44.7
Uttar Pradesh	4702	11.82	1.87	1.4	13.2	34.1	48.7	51.3
West Bengal	3562	11.39	1.61	1.4	14.8	35.8	45.8	38.0
India	72660	11.78	1.83	1.4	13.0	35.2	49.6	50.4

From the above two tables first of all it is seen that the mean Hb level of both the pregnant and non pregnant women for the state, Kerala, the highest. The same for Bihar and Odisha is the lowest for pregnant and non-pregnant women. Other variations are found from the table. The tables show many categories of percentage distributions of anemia such as severe, moderate, mild and any anemia, lastly normal. The figures are as usual worth notable. However, for statistical analysis, a small attempt has been made to study,- is there any correlation between "Any anemia" and maternal mortality (MMR). "Any anemia" is already defined earlier as Hb level <12.0 g/dL in non pregnant women and <11.0 g/dL in pregnant women. The r value for the former is found to be 0.60 and 0.53 for the latter. In pregnant case the r is significant at 5 per cent and 10 per cent level of significance for non pregnant women. The former result is worth notable as pregnant women will require more iron rich food to recover from anemia. As in earlier paragraph I mentioned about the early pregnancy of Indian girls and consequently the chain occurs as mentioned by Tirumalai (2015) early marriage to early initiation of sexual activity to

repeated early child bearing to recurrent iron loss. This emerges as a major reason for anemia among Indian girls. Anemia is the most widespread yet most neglected micronutrient deficiency disorder. Poor dietary intake of iron and folic acid are the major factors responsible for anemia. Poor bio-availability of iron from the phytate is also to be noted.

The following table gives an all India scenario of anemia of the females according to different categories of age, marital status, pregnancy and lactating status of mothers.

3.7.3 Prevalence of anemia (%) among different age groups

age groups	
All India females	
All women (15–49 years)	55.3
Ever married women (15–49 years)	56.0
Pregnant women (15–49 years)	58.7
Lactating women (15–49 years)	63.2
Adolescent Girls	
12–14 years	8.6
15–17 years	69.7
15–19 years	55.8

*Source: WHO Global Database on Anaemia*2.2.

3.8. Food habits in India (mostly carbohydrates with milk products)

Prof. Angus Deaton, the nobel prize winner (2015) in economics quotes: mal nutrition in India is not just related to calorie intake, but India's dependence on carbohydrate based diet with low protein and fat content. Inadequate sanitation which triggers infection borne deficiencies in nutrients: India's position is even worse than Burkina Faso, Haiti, Bangladesh or North Korea.

In India, the norm, per day calorie intake is supposed to be 2,400 calories in rural areas and 2,200 in urban areas in India. The official poverty line is linked to rural and urban incomes corresponding to this level of calorie intake in 1973. According to official thinking, if you consume less than this level of calories, you are suffering from under-nutrition. I think it is high time we challenged these norms and came up with better ones. I think we need to take a fresh look at our nutritional norms. Some expert committee should be set up by nutritionists and people from other expert professions.

As per Rampal (2018) the Indian states that consume the highest amount of protein from cereals

(vegetable items) include Jammu and Kashmir, Rajasthan, Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh, Jharkhand and Nagaland. States that consume most protein from pulses (also Veg items) are Himachal Pradesh, Uttarakhand, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu. Interestingly, four of these states provide pulses in the Public Distribution System. These are Himachal Pradesh, Andhra Pradesh, Tamil Nadu and quite recently, Karnataka. Punjab, Haryana and Jammu and Kashmir have the highest consumption of protein from milk and milk products.

States that consume the highest quantity of protein from animal sources (Non vegetable items) include Himachal Pradesh, Uttarakhand, Uttar Pradesh, Sikkim, Assam, West Bengal, Jharkhand, Kerala and Tamil Nadu. Here my experiences say that out of 29 states people particularly from North, Central and some part of West and Southern states favour vegetarian food on the other hand states including particularly West Bengal, Odisha, Kerala, Karnataka and North-Eastern states favour non-vegetarian food. The below two tables 3.8.1 and 3.8.2 give the two for rural and urban the different item consumed by the people of major states of India.

3.8.1. Per cent share of protein intake coming from cereals pulses milk & milk products egg, fish & meat other food in Rural India

States	Cereals	Pulses	Milk & milk products	Egg, fish & meat	Other food
Andhra Pradesh	52	9	8	10	21
Assam	60	8	4	12	16
Bihar	68	7	6	4	13
Gujarat	58	9	15	2	16
Haryana	54	7	25	1	13
Karnataka	53	10	10	8	20
Kerala	40	7	7	24	21
Madhya Pradesh	67	9	9	2	14
Maharashtra	57	11	7	4	21
Orissa	65	7	3	6	18
Punjab	54	9	23	1	12
Rajasthan	63	5	18	1	13
Tamil Nadu	50	12	8	10	20
Uttar Pradesh	66	9	10	2	13
West Bengal	57	6	4	14	20
India	60	8	9	6	16

3.8.2. Per cent share of protein intake coming from cereals pulses milk & milk products, egg, fish & meat and other food in Urban India

States	Cereals	Pulses	Milk & milk products	Egg, fish & meat	Other food
Andhra Pradesh	45	11	11	11	22
Assam	53	9	5	16	16
Bihar	63	8	9	5	15
Gujarat	52	12	16	2	18
Haryana	53	9	20	3	15
Karnataka	46	11	12	9	21
Kerala	37	9	9	24	22
Madhya Prades	59	10	11	3	16
Maharashtra	48	12	12	8	21
Orissa	58	8	6	8	19
Punjab	51	11	22	2	14
Rajasthan	61	6	17	2	14
Tamil Nadu	44	13	12	10	20
Uttar Pradesh	60	9	12	3	15
West Bengal	48	7	7	18	20
India	51	10	13	8	18

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