A comparison of the Indian Diet with the EAT-Lancet Reference Diet

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Abstract

Background The 2019 EAT-Lancet Commission report recommends healthy diets that can feed 10 billion people by 2050 from environmentally sustainable food systems. This study compares food consumption patterns in India, from different income groups and regions and sectors(rural/urban), with the EAT-Lancet reference diet and highlights the deviations.

Methods The analysis was done using data from consumption expenditure survey of a nationally representative sample of 0.102 million households from 7469 villages and 5268 urban blocks of India by the National Sample Survey Organization (NSSO) in 2011-12. This is the most recent nationally representative data on household consumption in India. Calorie intake (kcal/capita/day) of food groups was calculated using quantity of consumption and nutritional values of food items from the NSSO report. Diet across rural and urban, poor and rich households across different regions were compared with EAT-Lancet reference diet.

Results Average daily calorie consumption in India is below the recommended 2503 kcal/capita/day across all groups compared, except for the richest 5% of the population. Calorie share of whole grains is significantly higher than the EAT-Lancet recommendations while those of fruits, vegetables, legumes, and meat, fish & eggs are significantly lower. The share of calories from protein sources is only 6-8% in India compared to 29% in the reference diet. The imbalance is highest for the households in the lowest decile of consumption expenditure, but even the richest households in India do not consume adequate amounts of fruits, vegetables and non-cereal proteins in their diets. An average Indian household consumes more calories from processed foods than fruits.

Conclusions Indian diets, across states and income groups, are unhealthy. Indians also consume excessive cereals and not enough proteins, fruits and vegetables. Importantly, unlike many countries, excess consumption of animal protein is not a problem in India. Indian policy-makers need to accelerate food system wide efforts to make healthier and sustainable diets more affordable, accessible and acceptable.

Background

Diet is key for optimal nutrition and health outcomes through all stages of the lifecycle. Unhealthy diets are linked to all forms of malnutrition and diseases (1). World Health Organization (WHO) recognizes unhealthy diet along with inadequate physical activity as one of the risk factors for non-communicable diseases. High fat intake, low fruit and vegetable intake, overweight and obesity, physical inactivity, raised blood glucose, raised blood pressure, raised total cholesterol, salt/sodium intake are amongst the exposures that lead to Non-communicable diseases (NCDs) (2). The prevalence of obesity and NCDs has been rising across the world (3)(4)(5) even as undernutrition and communicable disease burden remain high.

An analysis of India's disease burden from 1990–2016 showed that heart diseases cause the most deaths in India while dietary iron deficiency is the biggest contributor to disability (6). High prevalence of both anaemia and heart diseases shows the rising problem of the double burden of undernutrition and overnutrition in India. Unhealthy diets are a major contributor to this syndemic.

The global food system is unhealthy not only for humans, but also for the environment. On one hand, our diets contribute to multiple forms of malnutrition and rising incidence of NCDs. On the other hand, food production has a large deleterious impact on multiple environmental variables like freshwater availability, soil quality, forest cover, biodiversity, coastal eutrophication and climate change. Food, therefore, is as much an environmental issue as it is a health issue. This is the point of departure for the EAT-Lancet Commission. It sets two hard boundaries: first, the quantity and quality of foods and second, the environmental limits or the planetary boundaries. The Lancet Commission report (2019) sets out to answer the following question: What could we eat that would feed 10 billion people in 2050 a healthy diet within the environmental limits.

On the environment front, the commission has set scientific targets for the earth system processes - climate change, nitrogen and phosphorus cycling, freshwater use, biodiversity loss and land-system change to lay the parameters necessary for sustainable food production (7).

On the consumption side, the report lays out a reference diet for individuals aged 2 years and above with reference range for food groups allowing for flexibility in its application while taking nutritional adequacy into account. It consists largely of plant-based foods: vegetables, fruits, whole grains, legumes, nuts and unsaturated oils. It includes moderate amounts of seafood and poultry and no or small quantities of red meat, processed meat, added sugar, refined grains and starchy vegetables (7).

The reference diet as proposed is not aimed at providing national targets and allows for flexibility in its application. It does outline in principle the healthy diet with its relative food group composition. A big difference between the EAT-Lancet reference diet and the existing recommended dietary allowances (RDAs), like the one by the Indian Council of Medical Research (ICMR), is that the former also takes the

environmental footprints of different foods into account while the latter focuses only on the human nutritional requirements. Accounting for environmental footprints makes EAT-Lancet recommend a more vegetarian diet than a typical RDA.

This paper does not discuss the environmental aspect of the reference diet and focusses exclusively on the divergence of the current Indian diets from the composition of the proposed reference diet by EAT-Lancet. From a public health perspective, this can clarify the policy and programmatic changes that might be needed for the transformation to a healthier diet for better nutrition, health and environmental outcomes.

Methods

The EAT-Lancet reference diet is made up of 8 food groups - whole grains, tubers and starchy vegetables, fruits, other vegetables, dairy foods, protein sources, added fats and added sugars. Macronutrient intake (range in g/day) and caloric intake (kcal/day) limits for each food group is given and adds up to a 2500 kcal daily diet (7). We compare the proportional calorie (daily per capita) shares of the food groups in the reference diet with similar food groups in Indian Diets.

The data used to calculate daily per capita calorie consumption of various food groups in India is from the latest round of consumer expenditure survey available, 68th NSS round (2011-12) (8). The NSS-CES collects 30-days recall data on the household consumption of 147 food items. Each of the 147 food items has been aggregated into 10 food groups - 8 food groups like the EAT-Lancet reference diet and two additional food groups (processed food and spices) based on their significant proportions in the Indian diets.

For Indian diets, the food group 'whole grains' has been calculated as an aggregation of cereals like rice, wheat, wheat flour and other cereals like jowar(sorghum), bajra (pearl millet), maize, barley, ragi (finger millets), other millets and other cereals. 'Vegetables' include all vegetables except for potatoes that have been classified separately. 'Fruits' include all fresh fruits and dried fruits like dates, raisins and other dry fruits. Lentils, and groundnuts, have been aggregated as 'Legumes'. Food group 'Tree nuts' includes coconut, coconut-green, coconut-*copra*, walnuts, cashew nuts and other nuts.

The food source 'Added Fats' in the EAT-Lancet reference diet includes palm oil, unsaturated oils, dairy fats and lard(7). NSS-CES uses a different classification for edible oils and fats. For the purpose of comparison with the reference diet, NSS-CES food items *vanaspati* (partially hydrogenated vegetable oil), refined and edible oil have been aggregated as 'palm oil' due to their high content of palm and palm olein oil (9) and mustard, groundnut and coconut oil as 'unsaturated oil' due to higher content of unsaturated fatty acids. It should be noted that many cooking oils used in India are a mixture of saturated and unsaturated oils which presents a limitation in this type of analysis (9).

The EAT-Lancet commission recommends "low" amounts of processed food like refined grains, added sugar and highly processed food. It has not been included as a part of the 2500 kcal reference diet(7). It is however, taken as a separate food group for Indian diets in this study as it forms a significant portion of the total caloric intake by Indians. It consists of products and derivatives of rice and wheat like *chira* (crushed wheat), *muri* (puffed rice) and *maida* (refined wheat flour) along with packaged food like namkeen, chips, chocolates, beverages and food consumed outside of home. Another category of food that is not mentioned in the reference diet but comprises 1-2% of Indian diet is 'spices'. Spices have been mentioned separately for the Indian diets.

For some food items in the NSS data, consumption is quantified as number or amount consumed or expenditure incurred on the food items in place of weight of food item consumed like in case of fruits, packaged food and outside meals. Therefore, calorie intake and not consumption quantity has been used to compare Indian diet with the reference diet. The caloric intake has been calculated by using consumption quantity and the calorie content of each food item i.e. calories per unit of food items in the NSS 68th round report which are based on "Nutritive Values of Indian Foods" by C. Gopalan, B.V. Ramasastry and S.C Balasubramanian, revised and updated by B.S. Narasinga, Y.G. Deosthale and K.C. Pant, 1991 (10).

There are large variations in dietary pattern across urban-rural divide, regions and income groups in India making it difficult to define an average Indian diet (11). Therefore, this study focusses on dietary patterns across regions, urban-rural sectors and income groups. Regional data for India has been calculated by taking weighted averages of rural and urban data state-wise combined and grouped into regions – north, south, east, west, central and north-east India.

Results

The reference diet of 2500 kcal/day corresponds to the average energy requirements of a woman or a man weighing 60 or 70 kg respectively with moderate to high level of physical activity. The EAT Lancet Commission report acknowledges the challenges in defining a global

reference diet owing to differences in body size, physical activity, disease status and needs of vulnerable populations like pregnant women and young children (7).

The average calorie intake/person/day in both rural (2215 kcal) and urban (2150 kcal) India is less than the reference diet (Table 1). In both rural and urban areas, people in rich households (top deciles of monthly per capita consumption expenditure (MPCE)) consume more than 3000 kcal/day i.e 20% more than the reference diet. Their calorie intake/person/day is nearly twice as high as their counterparts among the poorest households (bottom MPCE deciles) who consume 1600 kcals/person/day i.e. less than two third of the reference diet (Table 1).

This indicates calorie deficit and surplus for poorest and richest Indians respectively. The rising obesity in India despite lower average total calorie intake as compared to the EAT Lancet reference diet is beyond the scope of this paper. However, this may be related to the fact that the reference diet is developed for individuals with moderate to high level of activity, whereas available studies estimate high levels of inactivity amongst Indians. A Lancet study looking at trends of insufficient physical activity between 2001-2016 suggested that 34% Indians are not sufficiently engaged in physically activity (12). Similarly, 2014 ICMR-INDIAB study indicates that slightly more than half of all Indians are inactive. Lack of adequate physical activity is found to be more prevalent in urban areas and amongst females (13).

Table 1 Daily per capita calorie intake vis-à-vis EAT-Lancet reference diet

	Total Calorie Intake (% difference)
Urban India	2150 (-14%)
Rural India	2215 (-12%)
Highest MPCE - Urban	3068 (+23%)
Highest MPCE - Rural	3192 (+28%)
Lowest MPCE - Urban	1623 (-35%)
Lowest MPCE - Rural	1620 (-35%)
North India	2376 (-5%)
South India	2276 (-9%)
East India	2261 (-10%)
West India	2054 (-18%)
North East India	2073 (-17%)
Central India	2190 (-13%)

Values in kcal and as % difference with reference diet (2503 kcal)

North: Delhi, Haryana, Himachal Pradesh, J&K, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand Chandigarh

South: Andhra Pradesh, Kerala, Tamil Nadu, Puducherry, Karnataka and Lakshadweep (Telangana included within data for Andhra Pradesh as NSS 68th round data was collected prior to the separation of the two states)

East: Bihar, Jharkhand, Odisha, West Bengal and A&N Island

West: Goa, Gujarat, Maharashtra, D&N Haveli and Daman&Diu

North East: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura

Central: Chhattisgarh and Madhya Pradesh

Calorie Shares of different food groups

The relative caloric intake of each food group is critical for making diets healthier, more diverse and sustainable. Table 2 shows that whole grains (cereals) constitute the majority of caloric intake in India. Additionally, Indians consume more starchy vegetables, dairy foods

and palm oil as compared to the reference diet along with high proportions of processed food. Indian diets across all the sections are deficient in terms of calorie intake from protein sources (both animal and plant-based), fruits and vegetables.

It is also clear that the rural-urban diet does not differ significantly even when analysed for the highest and lowest income groups. This is consistent with the results from a household survey in the state of Punjab that showed no significant rural urban differences in dietary practices and prevalence of overweight and obesity⁽¹⁴⁾.

Table 2 Daily per capita caloric intake comparison by food groups

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	EAT- Lancet	Sectors		Highest MPCE Decile		Lowest MPCE Decile		Regions					
		Urban	Rural	Urban	Rural	Urban	Rural	North	South	East	West	North East	Central
Whole grains ¹	811	1008	1251	846	1320	1050	1138	1147	1031	1293	904	1382	1313
	(32%)	(47%)	(56%)	(28%)	(41%)	(65%)	(70%)	(48%)	(45%)	(57%)	(44%)	(67%)	(60%)
Potato and Cassava	39	52 (2%)	63 (3%)	56 (2%)	58 (2%)	56 (3%)	58						
	(2%)						(4%)	59 (2%)	15 (1%)	77 (3%)	32 (2%)	47 (2%)	46 (2%)
Vegetables	78	53 (2%)	46 (2%)	76 (2%)	77 (2%)	31 (2%)	27						
	(3%)						(2%)	59 (3%)	45 (2%)	52 (2%)	46 (2%)	45 (2%)	49 (2%)
Fruits ²	126	46 (2%)	28 (1%)	121	80 (3%)	10 (1%)	5						
	(5%)			(4%)			-	37 (2%)	50 (2%)	30 (1%)	41 (2%)	29 (1%)	20 (1%)
Dairy Foods	153	183 (9%)	145 (7%)	357	365	49 (3%)	27	303			147		
	(6%)			(12%)	(11%)		(2%)	(13%)	124 (5%)	110 (5%)	(7%)	63 (3%)	89 (4%)
Protein sources	726	164 (8%)	135 (6%)	247	283 (9%)	80 (5%)	65		276		192		
	(29%)			(8%)			(4%)	124 (5%)	(12%)	133 (6%)	(9%)	110 (5%)	121 (6%)
All Animal source proteins	151	34 (2%)	26 (1%)	60 (2%)	67 (2%)	11 (1%)	6						
	(6%)						-	15 (1%)	80 (4%)	40 (2%)	41 (2%)	58 (3%)	14 (1%)
Beef and lamb	15	6	4	8	12	2	0	4	11	3	3	9	1
	(1%)	-	-	-	-	-	-	-	-	-	-	-	-
Pork	15	-	-	-	01	-	-	-	-	-	-		-
	(1%)											13 (1%)	
Poultry (Chicken & other)	62	9	7	17	17	2	1	4	15	10	10	9	6
	(2%)	-	-	-	-	-	-	-	-	-	-	-	-
Eggs	19	11	6	19	13	4	2	6		9			3
	(1%)	-	-	-	-	-	-	-	16 (1%)	-	10 (1%)	11 (1%)	-
Fish	40	9	9	17	24 (1%)	3	3	1					3
	(2%)	-	-	-		-	-	-	38 (2%)	18 (1%)	19 (1%)	17 (1%)	-
Legumes ³	426	108 (5%)	94 (4%)	140	164 (5%)	65 (4%)	57	105 (4%)	108 (5%)	86 (4%)	116	50 (2%)	97
	(17%)			(5%)			(3%)				(6%)		(4%)
Tree nuts ⁴	149	22 (1%)	15 (1%)	47	52 (2%)	4	2	3	88 (4%)	7	34 (2%)	2	10
	(6%)			(2%)		-	-	-		-		-	-
Added fats	450	272	208 (9%)	370	375	138 (8%)	105 (6%)	259	226		313		
	(18%)	(13%)		(12%)	(12%)			(11%)	(10%)	206 (9%)	(15%)	150 (7%)	206 (9%)
Palm Oil ⁵	60	155 (7%)	95 (4%)	223	202 (6%)	55 (3%)	38				244		
	(2%)			(7%)			(2%)	86 (4%)	156 (7%)	65 (3%)	(12%)	34 (2%)	167 (8%)
Unsaturated Fats ⁶	354	102 (5%)	108 (5%)	105	148 (5%)	82 (5%)	66						
	(14%)			(3%)			(4%)	151 (6%)	66 (3%)	139 (6%)	59 (3%)	114 (5%)	34 (2%)
Dairy Fats	0	16	5	43	26	1	0	23	3	2		2	6
	(0%)	-	-	(1.4%)	-	-	-	-	-	-	11 (1%)	-	-
Lard	36												
	(1%)												
All sweeteners	120	114 (5%)	103 (5%)	140	203 (6%)	66 (4%)	48	151 (6%)	113 (5%)	85 (4%)	112	62 (3%)	106 (5%)

	(5%)		(5%)		(3%)		(5%)						
Processed Food ⁷	216	200 (9%)	803	368	121 (7%)	130 (8%)		336	244	231			
	(10%)		(26%)	(12%)			204 (9%)	(15%)	(11%)	(11%)	165 (8%)	208 (10%)	
Spices ⁸	40 (2%)	35 (2%)	51 (2%)	63 (2%)	22 (1%)	18							
						(1%)	32 (1%)	60 (3%)	32 (1%)	38 (2%)	20 (1%)	31 (1%)	
Total	2503	2150	2215	3068	3192	1623	1620	2376	2276	2261	2054	2073	2190

Values in kcal and % of daily total calorie consumption

Lighter font represents sub groups within major food groups

MPCE (Monthly Per Capita Expenditure) signifies classification of population by economic level. Highest and lowest MPCE refers to the richest and poorest 5% of the population respectively.

¹Whole grains consist of cereals like rice, wheat, wheat flour and other cereals like jowar, bajra, maize, barley, millets and ragi

²Fruits consists of all fruits and raisins, dates and other dried fruits

³Legumes consists of all pulses and groundnuts,

⁴Tree nuts consist of coconut, coconut green and coconut-*copra* (dried), cashew nuts, walnuts and other nuts

⁵Palm oil contains vanaspati, refined and edible oil

⁶Unsaturated oil contains mustard, groundnut and coconut

⁷Processed Food includes rice products, chira, khoi, lawa, muri, bread, bakery products, suji, maida, jowar products, besan, other gram products, cold and hot beverages, outside cooked meals including snacks, prepared sweets, namkeen, chips, pickles, sauce, jams, jelly, ice cream, biscuits, chocolates

⁸Spices include all spices like Ginger, garlic, jeera, dhania, turmeric, black pepper, dry chillies, tamarind, curry powder, oilseeds and other spices

- Below 1%

Data not available in NSS on lard

The poorest 5% of the population consumes less than the suggested calories for all food groups except whole grains, tubers and starchy vegetables and processed food. Within this group there is little rural-urban variation.

Cereals and Starchy Vegetables: About one third (811 kcals) of the total calorie content of the EAT Lancet reference diet comes from whole grains. Diets in India derive almost half of its calories from whole grains. Caloric intake of whole grains is greater than the reference diet for all groups but is markedly high for richest 5% in rural areas, North East and Central regions of India (Table 2 and Table 3).

Table 3 Difference in calories consumed in India and proposed by EAT-Lancet reference diet for Whole grains and Tubers and starchy vegetables

	Whole grains	Tubers and Starchy vegetables
Urban India	197	13
Rural India	440	24
Highest MPCE -Urban	35	17
Highest MPCE -Rural	509	19
Lowest MPCE- Urban	239	17
Lowest MPCE -Rural	327	19
North India	336	20
South India	220	-24
East India	482	38
West India	93	-7
North East India	571	8
Central India	502	7

Values in kcal

Whole grains consist of cereals like rice, wheat, wheat flour and other cereals like jowar, bajra, maize, barley, millets and ragi

Protein sources: When compared to the reference diet, low caloric intake from protein source (both plant and animal-based) food can be seen across all sectors, states, regions and income groups (Table 2 and 3 and Fig. 1 and 2). The deficit is more in the rural parts of India where only 6% of the total caloric intake comes from protein sources in comparison to 29% in the EAT-Lancet diet (Table 2).

Fig. 1 Caloric intake* deficit of vegetables, fruits, legumes and animal source proteins (chicken, other poultry, eggs, lamb, beef, pork and fish) as compared to the reference diet.

Darker colour depicts higher calorie difference between actual consumption and reference diet.

*Difference between actual consumption and the daily per capita calorie intake suggested by the EAT-Lancet reference. State level caloric intake calculated using population weights for rural and urban populations. Values for Telangana same as that for Andhra Pradesh.

Even for the richest 5% of the population, calories from protein sources is less than half of the 726 kcal in the reference diet for both rural and urban India. The poorest Indians get below 100 kcal per day from protein sources. Amongst regions, North-east Indian diets get lowest calories from protein sources (Fig. 1 and Table 2).

Table 4 Difference in calories consumed in India and proposed by EAT-Lancet reference diet for Legumes and Tree Nuts

	Legumes	Tree nuts
Urban India	-318	-127
Rural India	-332	-134
Highest MPCE -Urban	-286	-102
Highest MPCE -Rural	-262	-97
Lowest MPCE- Urban	-361	-145
Lowest MPCE -Rural	-369	-147
North India	-321	-146
South India	-318	-61
East India	-340	-142
West India	-310	-115
North East India	-376	-147
Central India	-329	-139

Values in kcal

Legumes consists of all pulses and groundnuts,

Tree nuts consists of coconut, coconut -green, coconut -dried, cashew nuts, walnuts and other nuts

Fig.2 Caloric intake from various animal-based protein sources

Values in kcal

Diets of the highest and lowest income groups also vary when compared for, calories consumed from fruits, vegetables, fats and animal-source proteins and overall calorie consumed (Table 2).

The EAT-Lancet reference diet advocates only “low to moderate” quantities of seafood and poultry and “no to low” amount of red meat or processed meat. Animal-source proteins constitute 6% of the total caloric intake of the reference diet. All types of Indian diets analysed involve less animal-based food than this benchmark. South Indian diets and diets of the highest income group have proportionally higher caloric intake from meat (Fig. 1 and Fig. 2) as compared to other groups largely due to higher consumption of poultry, fish and eggs (Fig.2). Consumption of red meat (beef, lamb and pork) is low in India (Table 2 and Fig.2).

Fig. 3 Difference of Vegetables and Fruits caloric intake between the proposed EAT-Lancet reference diet and sectors, MPCE fractile and regions in India

Values in kcal

Fruits and Vegetables: Dietary diversity is considered key feature for high

quality diets (15)(16). The reference diet is largely plant based with fruits and vegetables accounting for 204 kcal (8%) of the daily calorie intake. All kinds of Indian diets analysed consume less than half of the 126 kcal from fruits recommended in the reference diet (Table 2 and Fig. 3). Diets of the highest income group in urban areas has the highest relative caloric intake of fruits (4%) which is still lower than the reference diet (Table 2). The difference in relative caloric intake of fruits and vegetables is acute in both rural and urban areas and shows little variation across regions.

Oils and fats: Indians get less calories from added fats in comparison to the 18% in the reference diet (Table 2). This is despite increase of 3.5% in the consumption of oils and fats between 1993-94 and 2011-12 in both rural and urban areas as per NSS data. Figure.4 suggests that Indians in general consume less of the healthier oils & fats and more of the unhealthy saturated fats like palm oil.

Palm oil is high in unhealthy saturated fat and is the chief ingredient of the widely consumed *vanaspati* (partially hydrogenated vegetable oil) in India.

Fig. 4 Caloric intake difference for added fats between sector, MPCE fractile classes and regions in India and proposed EAT-Lancet reference diet.

Values in kcal

The consumption of *vanaspati* is known to have risen by 51% between 1993-94 and 2011-12 and it is widely used for cooking at home, restaurants, street vendors and for processed food production. (17). Figure.4 also shows that the highest caloric consumption of palm oil is among the highest income groups. Among regions, highest consumption is in the western and central India.

It should be noted that the consumption of fat in India might be higher than reflected in this data as food group ‘added fat’ does not include fat content of packaged food and meals consumed outside of the home.

Fig. 5 Proportion of daily per capita caloric intake from processed food by sectors, MPCE fractile classes and regions in India

Values in kcal

Processed Food: EAT-Lancet commission suggest small amounts of processed food and it is not included as separate food group in the reference diet. However, it had been regarded as separate group in this analysis owing to its high proportion in the Indian Diets. Based on the food items in the consumption data from NSS 68th round, items like rice products, *chira*(flatten rice), *khori*, *lawa* and *muri* (puffed rice), bread, bakery products, *suji* (semolina), *maida*(refined wheat flour), jowar products, *besan*(chickpea flour), other gram products, cold and hot beverages, outside cooked meal including snacks, prepared sweets, namkeen, chips, pickles, sauce, jams, jelly, ice cream, biscuits, chocolates have been included in the category of processed food along with meals consumed outside of home. These types of food, normally high in sugar, salt, saturated fat and processed flour and are considered unhealthy and often linked to obesity/overweight and NCDs (18) (2) (19) (20) (21) (22) (23).

Processed food accounts for around one tenth of the total caloric intake in both rural and urban India (Table2 and Fig. 5). The highest income group in the urban sector consumes more than one fourth (26%) of their total daily calories in the form of processed food (Fig.5). Across regions, proportion of processed food in the total calorie intake is highest for South Indian diets and lowest for North Eastern diets in India (Table 2).

Spices like ginger, garlic, coriander powder (*dhania*) and turmeric constitute 1-2% of total caloric consumption in rural and urban India.

Discussion

Diets in India are found unhealthy across different income levels and both rural and urban areas. All types of households eat less fruits and vegetables and more processed foods than the recommended levels. The deficit in fruits consumption is more acute for low-income households while better-off households eat more processed foods.

Whole grains account for 70% of the total calorie consumption among the poorest households and 41% among the richest ones in rural areas. High subsidies on rice and wheat through the public distribution system and active management of the markets to keep market prices of cereals at low levels are possible reasons for higher consumption of whole grains.

Healthy diet is not just a function of affordability as is evident in this analysis. For the highest income group in urban areas, calories from whole grains (28%), dairy foods (12%), palm oil (7%) and processed food (26%) form almost two-thirds of the total 3068 kcal/day caloric

intake. Whereas, Vegetables (2%), fruits (4%), animal source proteins (meat, fish and eggs) (2%), legumes (5%), unsaturated fat (3%) form a smaller part of the diet in comparison the reference diet. The situation for highest fractile of MPCE in rural areas is similar (Table 2). This points towards lack of availability, accessibility and acceptability as potential causes for poor diet quality even in higher income groups.

Legumes are the main source of non-cereal plant protein in Indian diets. However, their consumption is low. The production of pulses has grown slower than the population, resulting in a slow decline in their per capita availability and consumption over the last five decades. Milk and other dairy products are the most common sources of animal protein in India. Majority of Indians now identify themselves as non-vegetarian (24). NFHS 4 data supports this and indicates that only approximately 20-30% population is vegetarian having never had fish, chicken or meat and eggs (25). Yet most Indians consume non-vegetarian food only occasionally. Meat production is projected to continue its fast growth at 3.1% per year to 2023, with poultry dominating meat production. Per capita fish consumption is also expected to grow at 0.9% p.a. to reach 6.8 kg in 2023 (26). This indicates that though the consumption of animal products is rising in India with rising incomes and urbanization, it still is significantly below the world average.

Consumption of edible oil and other added fats is increasing rapidly for households at all income levels. Rising imports of cheap palm oil have contributed to the sharp rise in their consumption over the years—both in-home cooking and in the form of processed foods. Before 1992 edible oil was in the negative list and imports were disallowed. With liberalization Palm oil is the largest food import in India (17) (27) and more than half of domestic consumption of oil comprises imports.

Indian diets are unhealthy also because healthier calories are more expensive and their inflation are rising faster than the cereals and edible oils (28) (29).

Our comparison of Indian diets with EAT-LANCET recommendations has some limitations. First, NSS and other consumption expenditure surveys tend to underestimate total calorie consumption, especially, calories consumed from meals taken outside and processed foods (30). These differences are bigger for richer households. Moreover, gender and age-related differences in consumption of food within the Indian households are cannot be assessed through NSS data. Women eat a poorer diet than the men in their families (31) (32). However, we only have household-level consumption data and intra household distribution is unaccounted for. The important intra-household differences in diet qualities are ignored. Lastly, the latest available NSSO-CES is already 8 years old and pre-dates the implementation of the National Food Security Act (NFSA)-2013 that led to a significant increase in the public distribution of highly subsidized rice and wheat potentially affecting dietary patterns of the poorest two-thirds of Indian households. Therefore, recent changes in the dietary pattern and behaviour cannot be analysed. Notwithstanding the limitations due to age of data, the comparison of Indian diets with the EAT Lancet reference diets still provides important insights.

The pattern of consumption in India is consistent with the global consumption. Across the world the consumption of almost all healthy foods and nutrients is deficient and the intake of unhealthy foods exceeded the optimal level. Overall, dietary risks were responsible for 22% of all deaths and of all DALYs amongst adults. (33). Diets low in fruits, vegetables and whole grains but high in salt and fat which constitute dietary risk, are also India's leading risk factors responsible for disease burden (23).

Mitigating this risk requires taking a food systems approach to improving diets. Policy interventions that are cognizant of the variability of Indian diets are needed to bring about this transformation. Discourse on nutrition should involve discussion on production, processing, marketing, retail practices and consumer awareness and the food environment. Extension of this approach to the social welfare policies and programmes that aim to reach the vulnerable sections of the society is also critical.

Conclusion

The EAT-Lancet reference diet is described as a healthy and sustainable diet. Based on the analysis of consumption data, it is evident that Indian diets across urban-rural divide, regions and income levels deviate from this reference diet and are far from the high quality, healthy and sustainable diet required for better nutrition, health and environment outcomes. This is in line with the persistently high levels of undernutrition including micronutrient deficiencies and rising levels of overweight and obesity in India.

The variation in the dietary patterns across India underlines the need for context-specific intervention. It calls for public health and nutrition policies addressing malnutrition but additionally needs agriculture, trade and consumer awareness policies that can address broader context affecting the accessibility, acceptability and affordability of healthier dietary options. Bringing about the much-needed transformation of the Indian food system is certainly needed for both reasons of human health as well as environmental sustainability.

Abbreviations

NSS-CES: National Sample Survey-Consumer Expenditure Survey; NFHS: National Family Health Survey; DALY: Disability-Adjusted Life Year; NCDs; Non-communicable diseases; WHO: World Health Organization; MPCE: Monthly per capita expenditure; RDA: Recommended Dietary Allowances RDAs; ICMR: Indian Council of Medical Research

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and material

The Household Consumption of Various Goods and Services in India 2011-12, NSS 68th round data that support the findings of this study is available publicly from Ministry of Statistics and Program Implementation at http://mospi.nic.in/sites/default/files/publication_reports/Report_no558_rou68_30june14.pdf

As the analysis is based on publicly available data, ethics approval or consent to participate are not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MS conceived the study. AK DR MS, analysed data, interpreted results and wrote the manuscript. All authors read and approved the final manuscript.

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Figures

Figure 1

Caloric intake* deficit of vegetables, fruits, legumes and animal source proteins (chicken, other poultry, eggs, lamb, beef, pork and fish) as compared to the reference diet. Darker colour depicts higher calorie difference between actual consumption and reference diet.
*Difference between actual consumption and the daily per capita calorie intake suggested by the EAT-Lancet reference. State level caloric intake calculated using population weights for rural and urban populations. Values for Telangana same as that for Andhra Pradesh.

Figure 2

Caloric intake from various animal-based protein sources Values in kcal

Figure 3

Difference of Vegetables and Fruits caloric intake between the proposed EAT-Lancet reference diet and sectors, MPCE fractile and regions in India Values in kcal

Figure 4

Caloric intake difference for added fats between sector, MPCE fractile classes and regions in India and proposed EAT-Lancet reference diet. Values in kcal

Figure 5

Proportion of daily per capita caloric intake from processed food by sectors, MPCE fractile classes and regions in India Values in kcal