Original Article

Estimating dietary micronutrient supply and the prevalence of inadequate intakes from national Food Balance Sheets in the South Asia region

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Micronutrient deficiencies continue to be a major public health concern worldwide with many South Asian countries suffering a significant proportion of the global burden. A lack of nationally representative data on micronutrient deficiencies hampers sustained action to address the problem. Using data on the national food supply produced by the Food and Agriculture Organisation of the United Nations, and international food composition tables, the present study estimated the prevalence of inadequacy of seven micronutrients (vitamin A, thiamine, riboflavin, folate, vitamin B-12, zinc and calcium) in seven South Asian countries - Bangladesh, India, Iran, Maldives, Nepal, Pakistan and Sri Lanka. The estimated average requirement cut-point method was employed to determine the likelihood of inadequate micronutrient intakes. We report multiple micronutrient inadequacies in the food supply in the region, especially in the low and lower-middle income countries. Of the seven micronutrients investigated, calcium had the highest risk levels of inadequacy. Folate, riboflavin, vitamin B-12 and zinc were also deemed to be at high risk of inadequacy, although results differed markedly between countries. Various strategies to combat micronutrient deficiencies are currently underway in these countries. In order to facilitate the implementation of these efforts, the collection of nationally representative nutritional assessment survey data are urgently required to ascertain the true burden of micronutrient malnutrition.

Key Words: South-Asia, food, micronutrients, inadequacy, intake

INTRODUCTION

Micronutrient deficiencies continues to be a major public health problem with far reaching social, economic and health consequences.[1,2] Worldwide, the largest number of people suffering from micronutrient deficiencies live in lower income South Asian countries.[3] Deficiencies of iron, vitamin A, zinc and iodine have been widely documented; however, folate, vitamin B-12, calcium and other micronutrients deficiencies are increasingly being recognized in many disadvantaged groups.[4-6]

Micronutrient deficiencies often coexist and contribute to high rates of morbidity and mortality, particularly among young children and low-income women. In Bangladesh, Bhutan, India, Nepal, and Pakistan anaemia prevalence in children under five years of age ranges from 47% to 81%, for vitamin A deficiency the range is between 13% and 62%.[7] Pregnant women in South Asia have high rates of iron deficiency resulting in anaemia; estimates for Bhutan, Nepal, and Bangladesh range from 63% to 74%[8] increasing as high as 85% in India[9] and 91% in Pakistan.[10] Data on the prevalence of zinc deficiency in South Asia based on low plasma zinc concentrations are more limited. Among Indian preschoolers and adolescent girls the estimates are 44% and 50%, respectively,[11,12] whereas in Pakistan, based on the 2011 national nutrition survey, the prevalence was 42% for non-pregnant women and 48% for pregnant women.[13]

One of the major underlying causes of micronutrient deficiencies is inadequate dietary intake. While accepted strategies like supplementation, fortification and dietary diversification prevent and mitigate micronutrient malnutrition,[4,14,15] the success of these programmes require reliable survey data to document the extent and severity of nutrient inadequacies. Nationally representative data collected appropriately at the individual level, by 24-hour recalls or food records, allow for the evaluation of usual nutrient intakes at the population level,[16] yet few less developed countries conduct such food consumption surveys as they are time-consuming and expensive.

For the past several decades, the FAO has published Food Balance Sheets (FBS) detailing the national supply of 95 major food commodities for human consumption

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per annum, in over 180 countries and territories. These FBS are used by the FAO as a primary indicator of global food security,[17] and can provide a potential source of information on the ability of a national food supply to ensure an adequate supply of nutrients to its population. Previous research has utilised the FBS to identify likely micronutrient deficiencies in the Western Pacific Region for fortification planning,[18] to estimate the global prevalence of inadequate zinc intakes,[19,20] to assess the risk of magnesium deficiency in Africa,[21] and more recently to determine dietary mineral supplies in Africa.[22]

In this paper, we sought to determine country-specific estimates of the prevalence of inadequate supply of seven micronutrients: vitamin A, thiamine, riboflavin, folate, vitamin B-12, calcium and zinc, in 7 low- to upper middle-income South Asian countries-Bangladesh, India, Iran, Maldives, Nepal, Pakistan and Sri Lanka.

METHODS

National FBS for: Bangladesh, India, Iran, Maldives, Nepal, Pakistan and Sri Lanka were obtained from the FAO Statistics Division database for the period of 2009; food balance sheets for Afghanistan and Bhutan were unavailable.[23] According to the World Bank; Bangladesh and Nepal are classified as low income; India, Pakistan and Sri Lanka are lower middle-income while Iran and Maldives are upper-middle income South Asian countries.[24] The FBS provide the overall available food supply (kg capita^{-1}year^{-1}) during a given period based on the total quantity of foodstuffs produced in a country, added to the total quantity imported. Only the food available for human consumption is represented in the national FBS, not the actual amount of food consumed. Losses due to storage, cooking and household waste, and quantities fed to pets are also not taken into account.[17] The following specific steps were taken to estimate the prevalence of inadequate micronutrient supplies on a country-specific basis.

i. Calculation of the average daily per capita supply and energy availability of the major food commodities;
ii. Calculation of the vitamin A, thiamine, riboflavin, folate, vitamin B-12, calcium and zinc content of the daily available food supply;
iii. Calculation of the estimated average daily per capita dietary requirement for vitamin A, thiamine, riboflavin, folate, vitamin B-12, calcium and zinc, based on the age and sex distribution of the national population;
iv. Estimation of the prevalence of inadequate intakes in the national population using the Estimated Average Requirement (EAR) cut-point method.

A more detailed explanation of each of these steps is set forth below.

Calculation of the average daily per capita supply and energy availability of major food commodities on a country-specific basis

The FAO groups each food item into one of 95 major food commodities by compiling similar foods into one group (i.e. chicken, turkey and duck are placed into the commodity 'Poultry'), or in the case of processed foods, reverting the food back to the original food commodity (i.e. wheat flour is reported as wheat, and yoghurt as milk). The FBS expresses the availability of each food commodity both in terms of quantity (kg capita^{-1}year^{-1}) and energy (kcal capita^{-1}day^{-1}).[17] In our analysis, the kcal capita^{-1}day^{-1} data were used as this value accounts for inedible elements of the commodity.

Calculation of the vitamin A, thiamine, riboflavin, vitamin B-12, calcium and zinc content of each food commodity

The micronutrient content per capita of each major food commodity was estimated using the World Food System International Mini-list for the following six micronutrients: vitamin A, thiamine, riboflavin, folate, vitamin B-12 and calcium. The International Mini-list draws on data from food composition tables in six countries, compiling foods of similar nutrient content into a single entry. During construction of the database emphasis was placed on identifying the most frequently consumed foods, common methods of preparation and extraction rate of cereals. Where suitable food composition data were not found in the International Mini-list (e.g. prunes, cottonseed oil and grapefruit), the United States Department of Agriculture (USDA) nutrient database for standard reference, release 25, was used.[25] Zinc and phytate values for each food commodity were obtained from the recently developed composite database of Wessells, Singh and Brown.[19]

While the FAO provides details on which individual foods are incorporated into each commodity group, the overall proportion these foods contribute to the commodity are not listed. For this analysis, all individual foods were assumed to contribute equal weight, and the micronutrient content of the food commodities were calculated as the mean of these individual food items. Once the composite nutrient values were calculated for each commodity, the nutrient content of the available food supply capita^{-1} day^{-1} was determined.

For the purpose of this paper, all major food commodities were also classified into one of six food groups — animal products (including dairy products), cereals, fruits and vegetables, legumes, roots and tubers and other foods — allowing for estimates to be made of the contribution of these higher level food groups to the overall supply of the seven micronutrients.

Calculation of the estimated average daily per capita dietary requirement for seven micronutrients, based on age and sex distribution of the national population

For six micronutrients-vitamin A, thiamine, riboflavin, vitamin B-12, folate and calcium-the country-specific requirements were determined based on the Recommended Nutrient Intakes (RNIs) proposed by the WHO/FAO 2004.[26] Standard conversion factors published by the WHO/FAO 2006,[27] were applied to convert the RNI to the EAR (Supplementary table 1). In addition, calcium requirements were adjusted based on the WHO/FAO figures for populations with low consumption of animal protein (20-40 g day) given the correlation between animal protein intake and urinary calcium excretion.[28] This was done for all countries with the exception of Maldives, where the supply of animal-based protein was in excess of 80 g $capita^{-1}$ day^{-1}. Standard conversion factors do not apply to infants, and as such the EAR for those between 6-12 months of age could not be calculated. As a result the population adjusted EAR was based on the requirements of those over 1 year of age.

For zinc, the EARs proposed by the International Zinc Consultative Group (IZiNCG) and based on the average phytate to zinc molar ratio of the food supply were used. In each of the seven countries the phytate to zinc molar ratio exceeded 18, ranging from 19 in Maldives to 26 in Nepal. A value over 18 is indicative of low bioavailability of zinc and thus the higher dietary requirement values were used in the present study.[29]

Next, country specific EARs were calculated for each nutrient based on the age and sex distribution of the population, and number of yearly births. These data were obtained from the United Nations World Population Prospects 2012 revision, published by the United Nations Department of Economic and Social Affairs for the year 2010.[30] Infants were not included in the population weighted EARs. The number of pregnant women observed at any point during the year was calculated by dividing the number of yearly births by 12 and then multiplying this by the duration of pregnancy, assuming a gestational period of 9-months. This calculation is similar to that employed by Horton and colleagues in a report on the cost of scaling up nutrition.[31] The number of pregnant women was subsequently subtracted from those aged 15-49 years and not pregnant. Lactation was assumed to continue for 2 years post-partum, however, it is recognized that this is likely an overestimate, as it does not account for premature mortality and early cessation of breastfeeding (Supplementary table 2).

Estimation of the prevalence of inadequate supply in the national population using the EAR cut-point method

The risk of inadequate intakes was estimated using the EAR cut-point method, described by the IOM,[32] with those at risk assumed to be the proportion of the population with a per capita nutrient supply below the weighted country-specific EAR.[16] This method assumes that the intakes and requirements of the nutrient are independent, the distribution of intakes in the population are more variable than the distribution of requirements, and the distribution of requirements in the group is symmetrical around the EAR. For the purpose of the analysis, a coefficient of variation (CV) of 25% was used to account for inter-individual variation in dietary intake due to differences such as household economic and gender inequities, which may affect access and availability of certain foods.[20-22]

RESULTS

The estimated daily per capita availability of energy and seven micronutrients in the food supply of seven countries in the South Asian region are provided in Table 1. Iran had the highest average daily per capita amount of energy in the food supply, which was approximately 760 kcal higher than India, which had the lowest energy supply. Similarly, Iran has the highest daily per capita supply for three of the seven micronutrients — vitamin A, folate and riboflavin - followed by the Maldives, which has the highest supply of thiamine and vitamin B-12. Pakistan had the highest daily per capita supply for calcium, while Nepal had the highest supply of zinc. The lowest daily per capita supply of four of the seven micronutrients was found in Bangladesh-vitamin A, riboflavin, folate and calcium-India had the lowest supply of vitamin B-12 and zinc, while Pakistan had the lowest supply of thiamine.

Table 1 also summarizes the likelihood of inadequate supply of dietary micronutrients as estimated by the percentage of individuals within the country who fall below the age and sex specific EAR. For all micronutrients the country with the lowest supply also had the highest prevalence of inadequacy. There were notable differences in the risk of inadequacy of certain micronutrients between countries, such as vitamin A, which was 78% for the population in Bangladesh, compared to around 1% in Iran and Maldives. Calcium had the highest risk of inadequacies of all the micronutrients studied, with Pakistan as the only country with a risk for calcium inadequacy below 40%. The risk of inadequacy for folate was also high (over 15%) for all countries. Moreover, the prevalence of risk for inadequate zinc intake was high, being in excess of 25% for all but one of the countries analysed, this being Nepal.

Table 2 shows the contribution of the higher-level food groups to the total micronutrient supply. The importance of fruits and vegetables for the supply of vitamin A varied markedly from 70% in the Maldives to only 14% in Pakistan, with animal sources also making a significant contribution to vitamin A in all countries. Sweet potato, which is part of the food group 'roots and tubers’, was an important source of dietary vitamin A in Bangladesh and Sri Lanka, providing 21.4% and 14.2% of the total vitamin A supply in these countries respectively. In all other countries, sweet potato provided less than 6% of the total vitamin A supply (data not shown).

Animal products were an important contributor to the calcium supply in all countries. On further disaggregation of this food group the importance of the commodity ‘milk excluding butter’ is apparent. The availability of this commodity in Pakistan was 301 kcal $capita^{-1}day^{-1}$ providing in excess of 70% of the total calcium supply, while in Bangladesh the supply was only 30 kcal $capita^{-1}day^{-1}$ providing only 20% of the total calcium (data not shown). Lastly the food group cereals provided a significant proportion of the zinc supply in all countries, only in the Maldives did the group cereals provide less than 45% of the total zinc supply.

DISCUSSION

The present analyses suggest a high prevalence of potential nutrient inadequacies in the food supply in a number of countries in the South Asia region. The prevalence of inadequacies was greatest among the low- and lower-middle income countries with Bangladesh, India and Sri Lanka ranking among the top three countries with the highest potential for inadequate intakes of vitamin A, riboflavin, vitamin B-12 and calcium. A number of countries in the region have biochemical and/or clinical indicators that support reports of nutrient

Table 1. Estimated daily per capita supply of energy and six micronutrients in the food supply of seven countries in the South Asian Region and country-specific prevalence of risk of inadequate intakes in those over 1 year of age using the EAR cut-point method

Country	Total population over 1 year of age	Energy supply	Vitamin A				Thiamine			
			EAR	Supply	Risk of inadequacy		EAR	Supply	Risk of inadequacy	
	Millions	(kcal capita-1day-1)	(mg capita-1day-1)		% below EAR	Millions	(mg capita-1day-1)		% below EAR	Millions
Bangladesh	147	2479	402	332	76.9	117	0.89	1.27	11.6	17.2
India	1176	2316	402	490	23.8	80.0	0.90	1.22	14.8	173
Iran	73.8	3080	402	1149	0.46	0.34	0.91	1.57	4.3	3.38
Maldives	0.32	2630	403	885	1.46	0.01	0.90	1.83	2.1	0.01
Nepal	26.0	2436	401	697	4.50	1.17	0.88	1.48	5.3	1.38
Pakistan	167	2417	404	673	5.52	9.26	0.89	1.07	24.8	41.6
Sri Lanka	20.3	2418	401	501	21.2	4.31	0.90	1.26	13.0	2.64

	Riboflavin				Vitamin B-12				Folate			
	EAR	Supply	Risk of inadequacy		EAR	Supply	Risk of inadequacy		EAR	Supply	Risk of inadequacy	
	(mg capita-1day-1)		% below EAR	Millions	(mg capita-1day-1)		% below EAR	Millions	(mg capita-1day-1)		% below EAR	Millions
Bangladesh	0.93	0.46	100	147	1.83	1.58	73.5	108	297	191	98.7	145
India	0.94	0.82	70.8	831	1.84	1.16	99.1	1164	298	299	49.6	583
Iran	0.95	1.48	7.49	5.45	1.87	4.73	0.8	0.57	303	355	27.9	20.3
Maldives	0.94	1.37	10.5	0.03	1.84	6.65	0.2	0.001	299	297	51.3	0.16
Nepal	0.91	1.00	36.8	9.58	1.80	2.36	17.1	4.45	293	335	30.7	7.98
Pakistan	0.93	1.27	14.1	23.7	1.81	3.72	12.0	3.37	295	233	85.4	143
Sri Lanka	0.94	0.61	98.5	20.0	1.86	1.97	41.2	8.36	301	295	53.5	10.9

	Calcium				Zinc			
	EAR	Supply	Risk of inadequacy		EAR	Supply	Risk of inadequacy	
	(mg capita-1day-1)		% below EAR	Millions	(mg capita-1day-1)		% below EAR	Millions
Bangladesh	643	328	100	147	9.5	10.9	29.8	43.9
India	641	504	86.3	1014	9.6	9.80	46.0	540
Iran	641	597	61.6	44.9	9.8	11.5	27.7	20.2
Maldives	918	803	71.6	0.23	9.5	10.6	33.8	0.11
Nepal	642	608	58.6	15.3	9.0	12.0	15.7	4.09
Pakistan	642	829	18.4	30.9	9.3	10.0	39.4	66.1
Sri Lanka	639	401	99.1	20.1	9.6	10.4	38.3	7.78

Table 2. Percentage contribution of different food groups to the supply of seven micronutrients in seven South Asian countries

Country	Food group	Micronutrient						
		Vitamin A	B-1	B-2	B-9	B-12	Calcium	Zinc
Bangladesh	Animal Products	36	8	37	5	99	26	8
	Cereals	2	67	16	32	0	35	63
	Fruits and Vegetables	32	6	12	16	0	9	9
	Other foods	1	1	3	6	1	20	2
	Pulses and Beans	8	15	30	38	0	9	18
	Roots and Tubers	21	3	2	3	0	1	1
India	Animal Products	38	10	39	4	99	47	10
	Cereals	1	52	21	21	0	18	53
	Fruits and Vegetables	50	14	18	21	0	13	12
	Other foods	0	2	1	4	1	12	3
	Pulses and Beans	5	19	20	48	0	9	21
	Roots and Tubers	6	3	1	2	0	1	1
Iran	Animal Products	53	16	51	11	100	46	30
	Cereals	0	48	20	29	0	15	53
	Fruits and Vegetables	45	26	25	38	0	26	9
	Other foods	0	0	0	1	0	8	2
	Pulses and Beans	1	6	4	18	0	3	6
	Roots and Tubers	0	3	1	2	0	1	1
Maldives	Animal Products	27	49	63	15	100	56	33
	Cereals	0	26	8	18	0	7	36
	Fruits and Vegetables	70	20	24	48	0	19	17
	Other foods	2	2	2	6	0	16	10
	Pulses and Beans	0	2	2	12	0	1	3
	Roots and Tubers	2	1	0	2	0	1	1
Nepal	Animal Products	41	7	33	4	97	31	10
	Cereals	4	64	36	29	0	26	66
	Fruits and Vegetables	52	12	16	24	0	15	9
	Other foods	1	4	5	13	3	23	4
	Pulses and Beans	1	8	8	25	0	4	9
	Roots and Tubers	0	5	1	4	0	2	1
Pakistan	Animal Products	83	25	72	15	100	77	29
	Cereals	1	52	18	32	0	9	46
	Fruits and Vegetables	14	9	3	15	0	5	11
	Other foods	1	1	1	3	0	7	2
	Pulses and Beans	2	11	6	34	0	3	11
	Roots and Tubers	0	2	0	1	0	0	1
Sri Lanka	Animal Products	30	14	44	5	99	37	9
	Cereals	0	46	12	17	0	19	45
	Fruits and Vegetables	34	12	16	18	0	11	17
	Other foods	19	8	6	11	1	22	11
	Pulses and Beans	3	16	21	47	0	10	17
	Roots and Tubers	14	3	1	2	0	2	1

inadequacies, namely for vitamin A, zinc and iron.[33,34] A limited amount of biochemical/clinical indicator data exists for folate, thiamine, vitamin B6, and B12,[5,35-37] however, biochemical/clinical data for riboflavin and calcium in the region are scarce.

It should be noted that the data on vitamin A supply per capita generated in this analysis using the International Mini-list food composition database was based on retinol equivalents calculated using the conversion factors given in FAO/WHO 1998[38] and not on retinol activity equivalents based on the new bioconversion factors for dietary provitamin A carotenoids[39] now recommended by the FAO/WHO. If the latter had been used, the vitamin A activity for the provitamin A carotenoids would have been half of that obtained using the older FAO/WHO conversion factors, and thus the risk of vitamin A deficiencies would increase further in all countries. An additional limitation of the FBS are that they do not separate vegetables and fruits into many discrete categories, rather they group these foods together under the commodity groups ‘other fruits’ and ‘other vegetables’. There are a number of vitamin A rich foods included in the ‘other vegetables’ and ‘other fruit’ categories, which may indeed have low availability within these countries. Given that fruits and vegetables provide in excess of 30% of the vitamin A supply in all but one country (Pakistan) in this analysis, the inability to be more precise on the availability of specific foods is a limitation of our analysis. This could potentially lead to an under- or overestimation of the true level of vitamin A inadequacy.

The adequacy of zinc per capita in the food supply depends on both the amount of the nutrient and the bioavailability in the diet. Few South Asian countries have national data on the prevalence of zinc deficiency based on plasma zinc concentrations. Notable exceptions are Pakistan and India. In Pakistan the prevalence of low serum zinc among non-pregnant and pregnant women was reported to be 42% and 48%, respectively.[13] In India the prevalence in preschool child was shown to be 44% while it was reported to be as high as 50% in adolescent girls.[11,12] In this study we estimate the risk of inadequacy to be around 40% in Pakistan, and 46% in India. Our prevalence estimates of inadequate zinc intake range from 15.7% to 46.0% in the seven countries investigated. These estimates are based on our estimates of the phytate-to-zinc molar ratio of the dietary supply for each country generated from a recently compiled database and IZiNCG EARs. Recently, using data over a five-year period from 2003-2007 Wessells and colleagues estimated the prevalence of zinc inadequacy in six South Asian countries (Afghanistan, Bangladesh, Bhutan, India, Nepal and Pakistan), to be 45.1%.[19] For a number of countries the estimates in our paper are lower than those obtained in this previous analysis. Assumptions about the consumption of whole wheat, and the extraction rates of flour significantly impact estimations about a country's zinc supply. The issue is heightened when cereals make a large proportion of the total zinc supply, as is the case with the countries in our analysis. In this present work, we have assumed that all wheat is consumed as flour, with an equal distribution of whole wheat and white flour. This may not be a true reflection of extraction rates and consumption patterns in these countries. More detailed information on national extraction rates and end uses of wheat would be beneficial. Differences in these assumptions, as well as variability in the food supply, are likely to explain the discrepancies between our results and previously published estimates.

Our study has some strengths and weaknesses. The value of our data lie in the ability of the FAO FBS to identify countries estimated to be at high risk of micronutrient inadequacies relative to other countries. However, such prevalence estimates should not be considered absolute values, as the quantity of available food reaching the consumer at the retail level does not necessarily reflect the amount of food consumed. Moreover, because the FBS do not provide information on the actual distribution of the supply of food among different population groups, we assumed a CV of 25% within a specific life-stage group and consistent with earlier studies,[19,21,22] although we recognize that the CV will vary by population sub-group and micronutrient. Finally, our estimates of the nutrient content of commodities in the FBS used the same international nutrient database for all seven countries. Hence, we did not account for any differences in the availability of within country fortified food products, or in the case of the commodities, differences in the proportion individual foods contribute to the total commodity supply in different countries. However, it should be noted that in 2009, very few countries in the South Asian region had implemented national food fortification programs.

Conclusions

While it should be cautioned that food or nutrient availability are not the same as food or nutrient consumption, FBS data offer a key source of information for identifying likely shortfalls or surplus in a country's energy and nutrient intake. Countries, international agencies, donors and researchers can use this information as a key advocacy tool for improved food and nutrition policy-making. To this end, our work has identified probable micronutrient inadequacies in the available food supply on a per capita basis in a number of South Asian developing countries with Bangladesh, India and Sri Lanka ranking the highest for risk of multiple micronutrient inadequacies. While these data are in line with the overall burden of undernutrition in the region,[40] national level nutrition assessment surveys are needed to obtain measurements of household or individual food insecurity and consumption patterns among different population groups. This will yield more accurate information on those at greatest risk of deficiency and provide insight on potential nutrition strategies specific to the situation of the country.

AUTHOR DISCLOSURES

LA Houghton and RS Gibson declare they have no conflict of interest. HE Mark works as a consultant for Sight and Life, a humanitarian nutrition think tank supported by DSM. DSM is a global vitamin producer and has been a global partner of the United Nations World Food Programme since 2007. E Monterrosa and K Kraemer are employed by Sight and Life, who also funded this research.

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Supplementary table 1. Age and sex specific EARs for 6 micronutrients based on WHO 2004 recommended nutrient intakes and WHO/FAO 2006 EAR conversion factors[26,27]

	Children			Men			Women					
	1-3 years	4-6 years	7-9 years	10-18 years	19-65 years	65+ years	10-18 years	19-50 years	51-65 years	65+ years	Pregnancy	Lactation
Vitamin A (μg/day)	286	321	357	429	429	429	429	357	357	429	571	607
Thiamine (mg/day)	0.4	0.5	0.7	1.0	1.0	1.0	0.9	0.9	0.9	0.9	1.2	1.3
Riboflavin (mg/day)	0.4	0.5	0.7	1.1	1.1	1.1	0.9	0.9	0.9	0.9	1.2	1.3
Folate (μg/day)	120	160	240	320	320	320	320	320	320	320	480	400
B-12 (μg/day)	0.7	1.0	1.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.2	2.3
Calcium (mg/day)[†]	417	458	583	833	625	667	833	625	667	667	667	625
Calcium (mg/day)[‡]	417	500	583	1083	1083	1083	1083	833	1083	1083	833	833

[†]Based on a diet with 20-40 g of animal protein consumed per day.
[‡]Based on a diet with more than 40 g animal protein consumption per day.
The age and sex specific EARs for zinc employed in this study can be found in Wessells, Singh, Brown.[19]

Supplementary table 2. Age and sex distribution of the national populations in the year 2010 based on UN population statistics. Presented as the percentage contribution of each age and sex group to the total population.[30]

	Infants	Children			Men			Women					
	0-12 months	1-3 years	4-6 years	7-9 years	10-18 years	19-65 years	65+ years	10-18 years	19-50 years	51-65 years	65+ years	Pregnancy	Lactation
Bangladesh	3	8	5	5	10	28	2	9	18	4	2	2	4
India	3	8	5	5	9	30	2	8	16	5	3	2	4
Iran	2	7	4	4	8	32	3	8	21	5	3	1	4
Maldives	3	8	5	5	10	28	3	10	18	4	2	2	4
Nepal	3	9	6	6	10	23	2	10	15	5	3	2	5
Pakistan	3	9	6	6	11	26	2	10	14	4	2	2	5
Sri Lanka	2	7	4	4	7	30	4	7	18	8	4	1	4

Original Article

Estimating dietary micronutrient supply and the prevalence of inadequate intakes from national Food Balance Sheets in the South Asia region

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估计南亚地区膳食微量营养素的供给和国家食品平衡表摄入量不足的流行率

微量营养素缺乏依然是全球范围内重要的公共卫生问题，在南亚国家微量营养素缺乏造成的全球负担占很大比例。在微量营养素缺乏的国家，由于代表性数据的匮缺，阻碍了解决该问题的持续行动。目前的研究使用根据联合国粮农组织和国际食物成分表得出的国家食品供应的数据，在 7 个南亚国家—孟加拉国，印度，伊朗、马尔代夫、尼泊尔、巴基斯坦和斯里兰卡，估计 7 种微量营养素不足的流行率（维生素 A、硫胺素、核黄素、叶酸、维生素 B-12、锌、钙）。估计平均需求切入点法测定微量营养素摄入不足的可能性。我们报告了食物供给中多种微量营养素的不足，特别是在低收入和中等收入国家。虽然不同国家的结果有显著差异，但在调查的 7 种微量营养素中，钙不足风险水平最高，叶酸、核黄素、维生素 B-12 和锌也被视为高风险不足。这些国家正在采取不同的策略抵制微量营养素的缺乏。为了便于这些工作的实施，迫切需要收集全国代表性的营养评估调查数据，确定微量营养素缺乏的真正负担。

关键词：南亚、食物、微量营养素、缺乏、吸收