Potential Impacts of Increasing Supply of Specific Fruits and Vegetables on Nutrient Adequacy

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Aligning the Food System to Meet Dietary Needs: Fruits and Vegetables June 2, 2017 Food Sec. DOI 10.1007/s12571-015-0452-y

ORIGINAL PAPER

Improving nutrition security through agriculture: an analytical framework based on national food balance sheets to estimate nutritional adequacy of food supplies

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Food Security 2015

Describes analytical framework for assessing:

- the micronutrient adequacy of national food supplies
- the potential for increased crop production to address micronutrient gaps

Food balance sheets Food composition tables 1. Calculate Daily per capita availability Micronutrient content of foods micronutrient of commodity foods Source: USDA Standard Reference availability Source: FAO **FAO**STAT USDA United States Department of Agriculture Country Indicators Compare Data Definitions and Standards FAQ A Data Agricultural Research Service National Nutrient Database for Standard Reference Release 28 Food Balance Sheets NDL Home Food Search Nutrients List Ground Beef Calculator DOWNLOAD DATA VISUALIZE DATA METADATA REPORT Select Source Enter one or more terms COUNTRIES REGIONS SPECIAL GROUPS **\$**... ELEMENTS ~ Standard Reference broccoli, raw Q Filter results e.g. afghanistan Q Filter results e.g. total population - both sexes () Armenia QAdvanced search Import Quantity ^ ~ Australia Stock Variation Austria Export Quantity 6 foods found Click on a food name to view details Azerbaijan Domestic supply quantity Bahamas O Feed NDB No. Description 🕑 Bangladesh Seed Operhades SR 11090 Broccoli, raw Clear All Clear All Select All Select All Bangladesh \times Domestic supply quantity × Broccoli raab, raw SR 11096 11739 Broccoli, leaves, raw ITEMS ITEMS AGGREGATED YEARS 11741 Broccoli, stalks, raw Q Filter results e.g. 2013 Q Filter results e.g. population Population 2013 ^ ^ 11994 Broccoli, chinese, raw Wheat and products 02012 Rice (Milled Equivalent) 02011 11740 Broccoli, flower clusters, raw

1. Calculate micronutrient availability Food balance sheets Daily per capita availability of commodity foods Source: FAO

Food composition tables

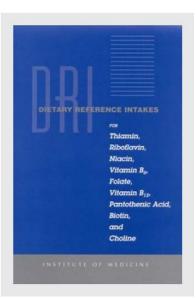
Micronutrient content of foods Source: USDA Standard Reference

2. Calculate mean population micronutrient requirements

Population data

of individuals in age and sex groups Source: UN Department of Economic and Social Affairs Nutrient adequacy Estimated average requirements (EAR) Source: IOM, IZiNCG

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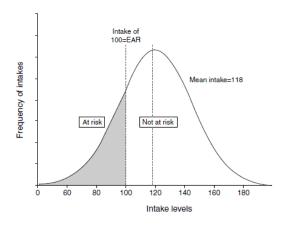
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EAR cut-point method

Source: IOM

Nutrient adequacy Estimated average requirements (EAR) Source: IOM, IZiNCG

3. Estimate % of population with adequate micronutrient intakes



IOM (2000) Dietary Reference Intakes. Applications in Dietary Assessment.

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4. Calculate micronutrient gap

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Micronutrient availability

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Target nutrient availability to achieve 80% prevalence of adequate intakes

Method to assess crop amount to meet gap

1. Compile list of nutrient-dense crops

Food composition data Micronutrient content of foods

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2. Calculate amount of crop and land needed to meet gap for each food

Crop amount Convert daily per capita amount needed to annual amount for entire population <u>% of crop land</u> Land needed to grow crop amount/total crop land in country *Source: FAO*

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<u>Crop amount</u> Convert daily per capita amount needed to annual amount for entire population <u>% of crop land</u> Land needed to grow crop amount/total crop land in country *Source: FAO*

3. Calculate crop mix to meet multiple nutrient gaps

Linear programming using Microsoft Excel Solver

- Minimize land
- Meet nutrient gaps
- Portion size limits

Results: Micronutrient adequacy - Bangladesh

Nutrient	Population	Availability	Prevalence	Target	Gap
	adjusted	per	of	availability per	
	mean EAR	capita/day	adequate	capita/day	
			intakes	(80%	
		\sim		adequacy)	
Vitamin A (mcg RAE)	485	121	<1%	696	- 575

Results: Micronutrient adequacy - Bangladesh

Nutrient	Population adjusted mean EAR	Availability per capita/day	Prevalence of adequate intakes	Target availability per capita/day (80% adequacy)	Gap
Vitamin A (mcg RAE)	485	121	<1%	696	- 575
Vitamin C (mg)	54	31	8%	75	- 44
Riboflavin (mg)	0.87	0.68	18%	1.16	- 0.48
Niacin (mg)	9.9	13.6	86%	-	-
Vitamin B-6 (mg)	0.96	3.98	99%	-	-
Folate (mcg DFE)	280	132	<1%	374	- 242
Calcium (mg)	839	256	<1%	1122	- 866
Zinc (mg)	9.0	8.7	44%	11.4	- 2.7

Amounts of <u>single</u> crops and land needed to meet <u>Vitamin A</u> gap - Bangladesh

Nutrient	Gap	Сгор	Nutrient content per serving	Portion size (edible)	Daily portions per capita to meet the gap	% of crop land
Vitamin A	575 mcg	Carrots	319 mcg	1 carrot	1.5	2.6
Vitamin A	575 mcg	Mustard greens	433 mcg	½ cup	1.3	4.0
Vitamin A	575 mcg	Spinach	472 mcg	½ cup	1.2	13.6
Vitamin A	575 mcg	Pumpkin	360 mcg	½ cup	1.6	14.9

<u>Single</u> crops that meet gap for <u>each</u> nutrient with the <u>smallest</u> amount of land - Bangladesh

Nutrient	Gap	Сгор	Nutrient content per serving	Portion size (edible)	Daily portions per capita to meet the gap	% of crop land
Vitamin A	575 mcg	Carrots	319 mcg	1 carrot	1.5	2.6
Vitamin C	44 mg	Guava	125 mg	1 fruit	0.4	1.7
Riboflavin	0.48 mg	Spinach	0.22 mg	½ cup	2.2	24.8
Folate	242 mcg	Broccoli	84 mcg	½ cup	2.9	15.6
Calcium	866 mg	Okra	31 mg	½ cup	14.1	55.7
Zinc	2.7 mg	Okra	0.4 mg	½ cup	7.9	31.1

<u>Crops</u> to meet gap for <u>multiple nutrients</u>, with minimal land use and portion limits - Bangladesh

Constrain to achieve 80% adequacy for vitamins A and C, 50% for folate (no constraints for riboflavin, calcium and zinc)

	portions	grams	Vitamin A (mcg)	Vitamin C (mg)	Ribo (mg)	Folate (mcg)	Calcium (mg)	Zinc (mg)	% land
Broccoli	0.25	20	15	13	0.02	21	8	0.1	1.4
Carrots	0.50	23	196	0.8	0.01	3	7	0.1	0.9
Guava	0.15	8	3	19	0	4	2	0	0.7
Lentils	0.28	27	0	0	0.02	49	5	0.3	4.3
Mustard greens	0.25	18	108	4	0.01	2	21	0	0.7
Mustard spinach	0.05	4	18	3	0	3	7	0	0.6
Spinach	0.50	45	236	4	0.11	66	61	0.3	5.6
TOTAL	1.97	145	575	44	0.18	148	110	0.9	14.2
% adequacy	-	-	80%	80%	48%	50%	<1%	59%	-

Micronutrient adequacy - Cameroon

Nutrient	Prevalence of adequate intakes	Gap
Vitamin A (mcg RAE)	52%	- 190
Vitamin C (mg)	99%	-
Riboflavin (mg)	87%	-
Niacin (mg)	97%	-
Vitamin B-6 (mg)	99%	-
Folate (mcg DFE)	91%	-
Calcium (mg)	<1%	- 733
Zinc (mg)	62%	- 1.5

<u>Crops</u> to meet gap for <u>multiple nutrients</u>, with minimal land use and portion limits - Cameroon

Constrain to achieve 80% adequacy for vitamins A and C (no constraint for calcium)

	portions	grams	Vitamin A (mcg)	Vitamin C (mg)	Ribo (mg)	Folate (mcg)	Calcium (mg)	Zinc (mg)	% land
Barley	0.25	12	0	0	0.03	2	4	0.3	2.2
Broccoli	0.50	39	30	25	0.05	42	16	0.2	0.5
Cashew nuts	0.50	14	0	0	0.01	4	5	0.8	4.0
Collard greens	0.12	11	42	2	0.01	2	16	<0.1	0.2
Spinach	0.25	23	118	2	0.05	33	31	0.2	0.4
TOTAL	1.62	98	190	30	0.15	82	71	1.5	7.3
% adequacy	-	-	80%	99%	91%	95%	<1%	80%) -

Summary

- Fruit and vegetable availability is a contributor to some nutrient gaps (vitamins A, C, and folate)
- Per capita availability of fruits and vegetables (non-starchy) was <u>122 g/d</u> in Bangladesh and <u>385g/d</u> in Cameroon
 - WHO recommendation at least <u>400 g/d¹</u>
 - Analysis by Seigel et al. (PLOS ONE 2014) estimated low income countries supply 42% of need
- Seasonality of fruits and vegetables was not directly addressed in these analyses, but processing could extend the period of consumption

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