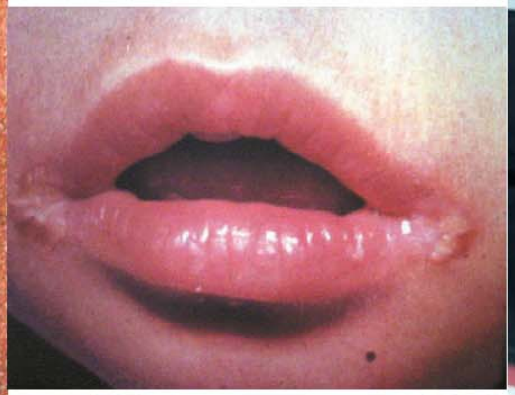
Adequate and Quality Nutrients are Essential for Optimal Human Health

Both Excess and Deficiency can Lead to Sub-Optimal Health





Truly a Hungry and Starving Nation or Misdirected Stigma?

India ranks 3rd from bottom of the world on malnourished kids

Hunger Index puts India worse than sub-Saharan Africa

SONU JAIN
NEW DELHI, OCTOBER 13

YET another report confirms India's losing battle against hunger. In the Global Hunger Index, India ranks 117th for the prevalence of underweight children. Only Bangladesh and Nepal are worse-off.

Overall, India is ranked 96th out of 119 countries covered by the index, which doesn't paint a rosy picture per se. But India comes off far worse in its record for malnutrition in children, as measured by found underweight in India, according to the latest figures is 47.5 per cent, which makes it worse than conflict-plagued, drought-stricken Sub-Saharan Africa, where the figure is some 30 per cent on average. India's figure is also worse than that of individual Sub-Saharan countries.

These findings are from a report released globally today by the Washington-based International Food Policy Institute (IFPRI).

The Global Hunger Index combines three indicators: child malnutrition, child mor-

Chapter 3: Addressing the Challenge of Hidden Hunger

Download Report

> "The 'hidden hunger' due to micronutrient deficiency does not produce hunger as we know it. You might not feel it in the belly, but it strikes at the core of your health and vitality."
>
> —Kul C. Gautam, former deputy executive director of UNICEF

Hidden hunger, also known as micronutrient deficiencies, afflicts more than 2 billion individuals, or one in three people, globally (FAO 2013). Its effects can be devastating, leading to mental impairment, poor health, low productivity, and even death. Its adverse effects on child health and survival are particularly acute, especially within the first 1,000 days of a child's life, from conception to the age of two, resulting in serious physical and cognitive consequences. Even mild to moderate deficiencies can affect a person's well-being and development. In addition to affecting human health, hidden hunger can curtail socioeconomic development, particularly in low- and middle-income countries.

A Different Kind of Hunger

Hidden hunger is a form of undernutrition that occurs when intake and absorption of vitamins and

Quantifying, Projecting, and Addressing India's Hidden Hunger

Hannah Ritchie[1], David S. Reay[1] and Peter Higgins[2]*

[1] School of GeoSciences, University of Edinburgh, Edinburgh, United Kingdom, [2] Moray House School of Education, University of Edinburgh, Edinburgh, United Kingdom

It is estimated that more than two billion people suffer from 'hidden hunger' (micronutrient malnutrition) globally, with nearly half living in India. Despite being highlighted as one the most cost-effective investments for human development, progress on addressing micronutrient deficiencies (MiND) has been slowing. The severe social, health, and economic costs of MiND in India should make it a top priority for domestic governance and international donors alike. This study, for the first time, maps food system pathways from crop production through to household-level food availability, for a range of key vitamins, minerals, and amino acids. Results suggest widespread (>80% total Indian

“The Hidden-Hunger Trap”: An Indian Perspective

Prof. H.P.S. Sachdev

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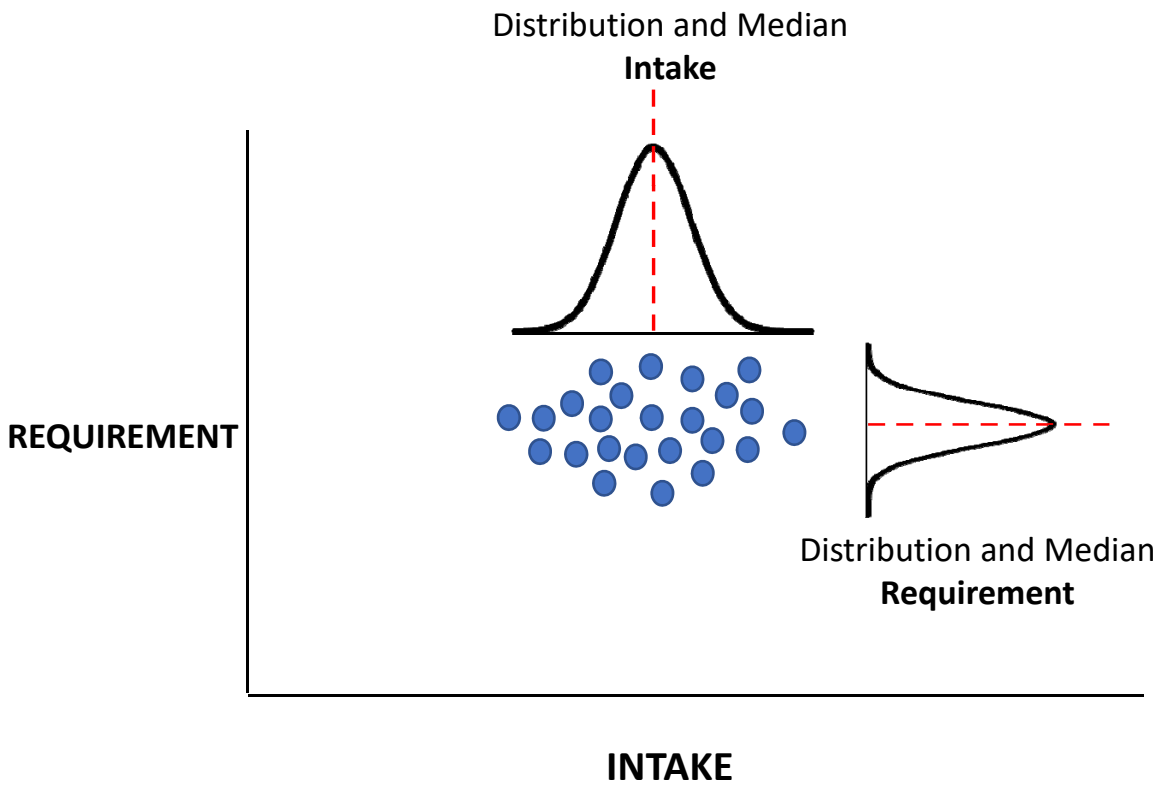
Presentation Format

- Measuring “Hidden-Hunger”
  - Principles & Indian norms
  - Appropriate measures ?
  - “One-size-fits-all” cut-off ?
- Functional benefits
- “Invisible” harms
- Practice & policy implications

Measuring risk of nutrient deficiency in populations

A plot of *minimum* intakes vs requirements in a normal population

Normal healthy population



Distributions overlap in normalcy: nutrient intakes of 50% population are to the ***left*** of the median requirement

Courtesy: A.V. Kurpad

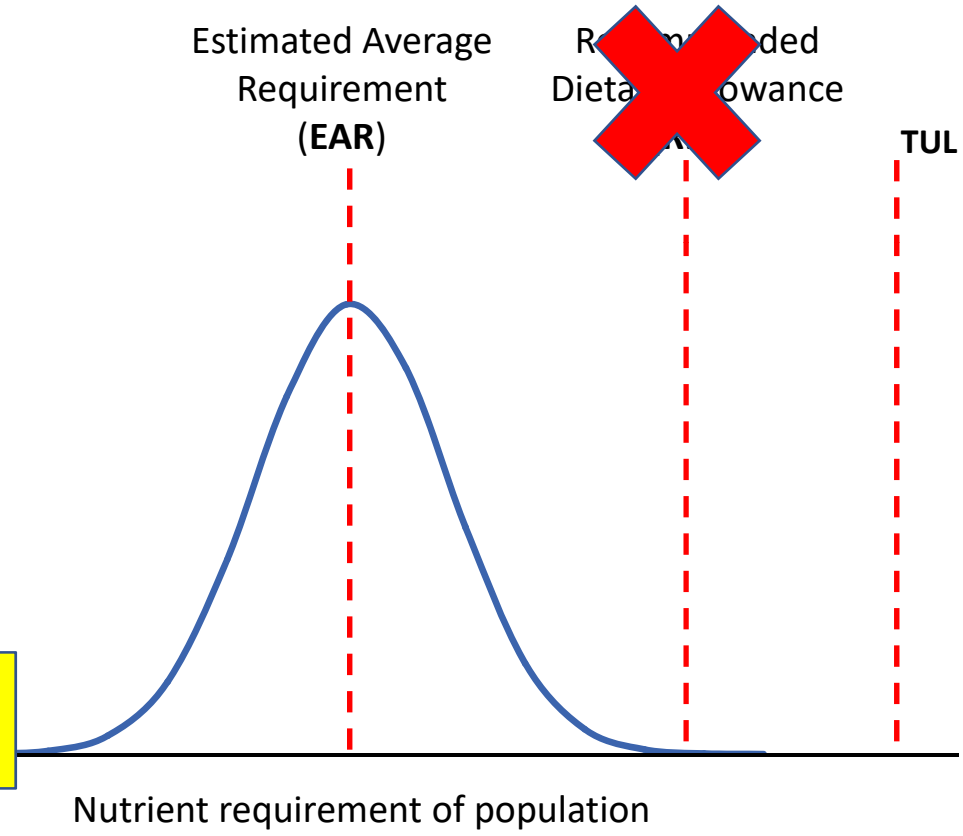
The Nutrient Requirement Values

We need a **single** population nutrient requirement value for each age/gender

EAR: population requirement

RDA: Can 'over-nourish' populations

TUL: Tolerable Upper Limit of intake: **Toxic Framework & Clinical**



Courtesy: A.V. Kurpad

NIN-ICMR Indian Requirements 2020 have EAR

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Crude Methods and Non-Representative Samples Extrapolated

- Dated: ~Decade or more
- NNMB: Underprivileged mostly
- No robust quantification of national dietary intakes
- Biomarkers on filter paper (serum retinol ~20-30% lower)

FAO Food Balance Sheet (2011) Estimates Crude & Grossly Amplifying Interpretation!!

	Iron (mgpppd)	Calcium (mgpppd)	Zinc (mgpppd)	Vitamin A (µgpppd)	Vitamin B_6 (mgpppd)	Vitamin B_{12} (µgpppd)	Folate (mgpppd)
Estimated Average Requirement (EAR)	14	639	9.6	402	1.0	1.8	298
Average Intake (2011)	15	463	12	308	1.7	1.4	245
Risk of deficiency, % of population (number of people)	41% (509m)	94% (1167m)	25% (316m)	89% (1112m)	6% (73m)	89% (1112m)	81% (1007m)

>50%; 25-50%; 5-25%

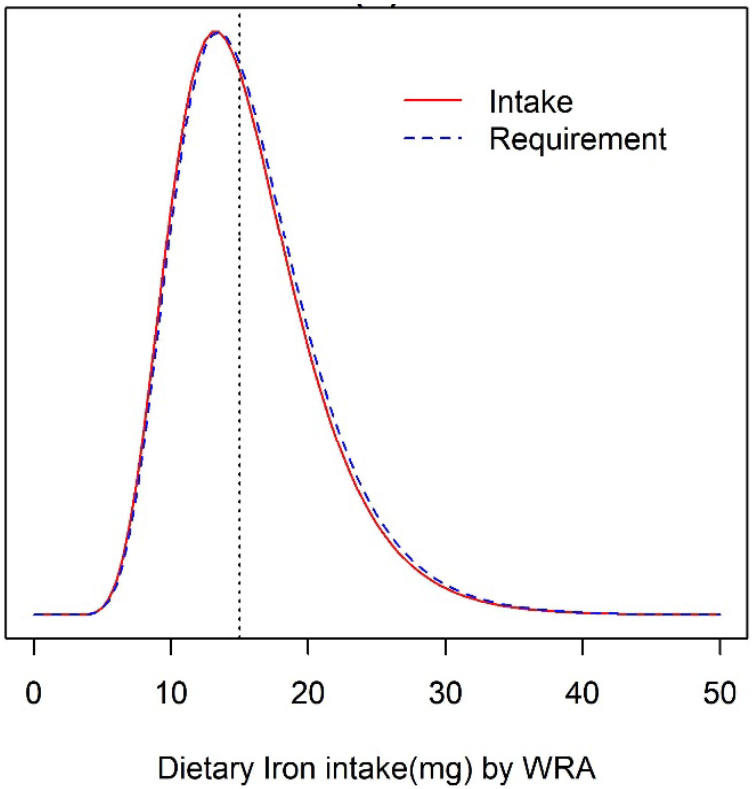
Pathway analysis from crop production to supply at individual level: export, Import, stock variation, resown produce, animal feed, other non food uses

Presumes Equitable Distribution of Food

Ritchie H, *et al.* Frontiers Sustain Food Syst. 2018;2:11

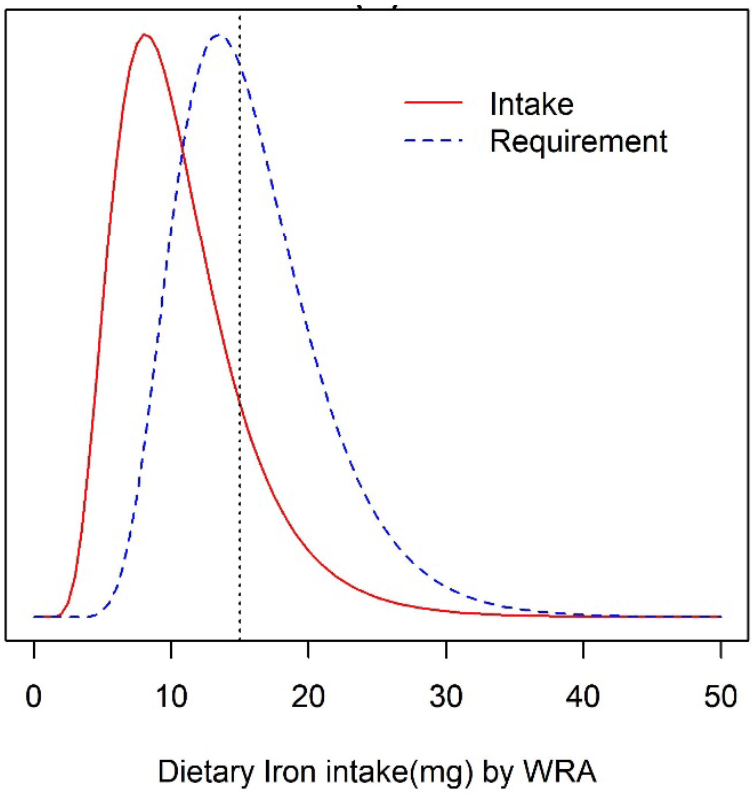
WRA Risk of Iron Deficiency by NSSO: Quantify Distribution Shift OR Apply Correction (-50%)

✖ 50% OR 0% ✔



Top SES Gap=0 mg

↔ ✖ 79% OR 29% ✔



Bottom SES Gap=5 mg

Courtesy: A.V. Kurpad

Capillary vs Venous Blood Hb: NFHS vs CNNS

Sample	Capillary blood g/dL	Venous Blood g/dL	Difference g/dL
All	11.4 ± 1.6	12.3 ± 1.7	0.9 (~7.5%)

Venous-Anaemia (Hb<12 g/dL)	Capillary Anaemia (Hb<12 g/dL)
35%	59%

Scatter of difference

Neufeld L, .Kurpad AV…. Ann NY Acad Sci 2019;1450:172

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Comparison of Indian vs WHO cut-offs

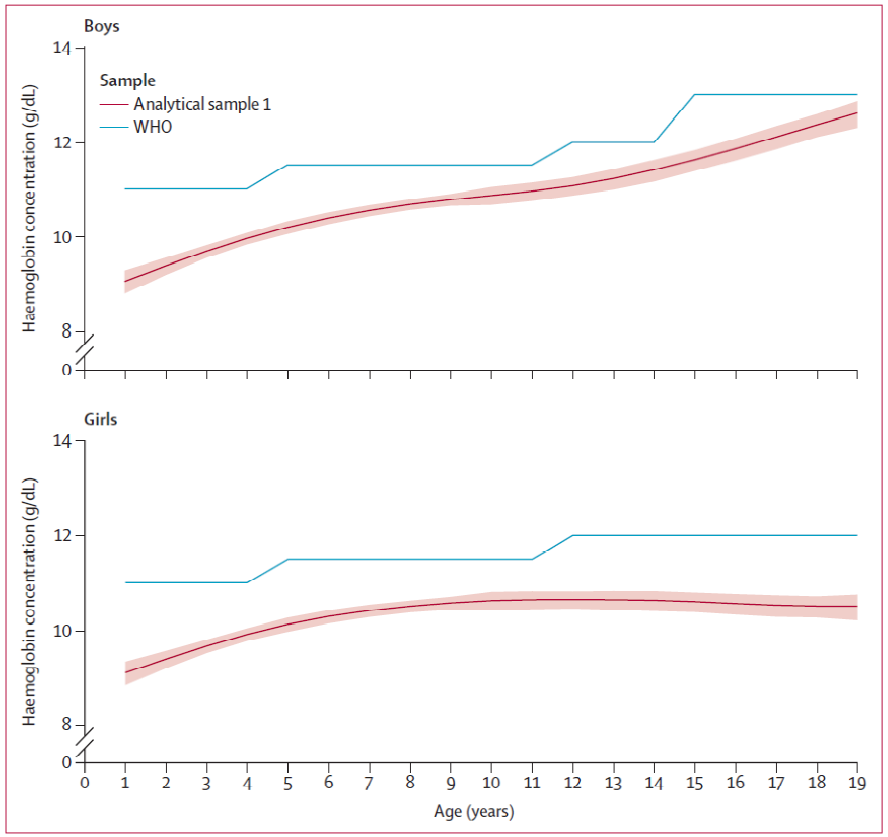
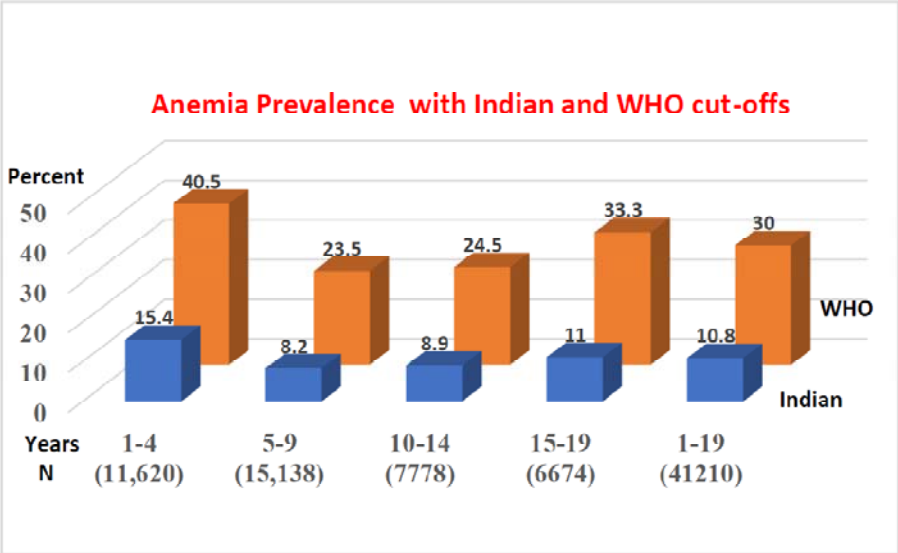


Figure 3: Age-specific and sex-specific study cutoffs and WHO anaemia cutoffs in children and adolescents



Haemoglobin thresholds to define anaemia in a national sample of healthy children and adolescents aged 1–19 years in India: a population-based study

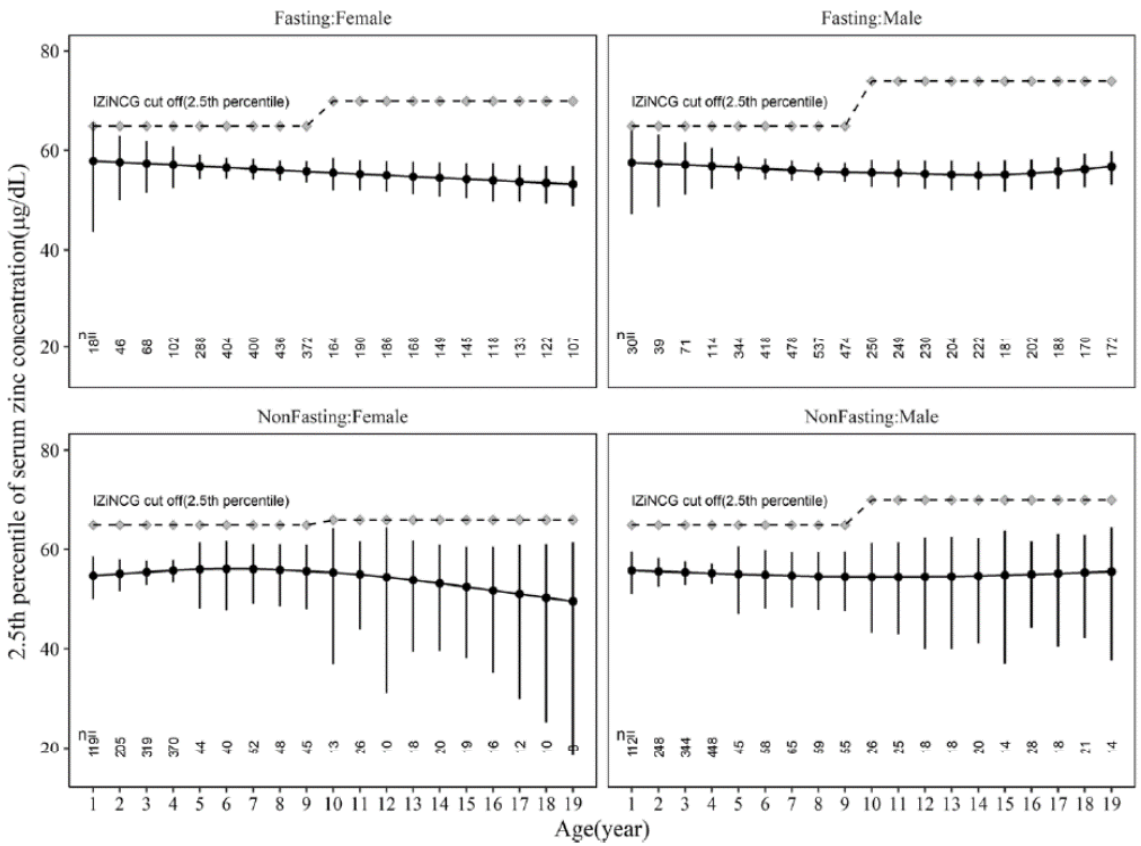
Harshpal Singh Sachdev, Akash Porwal, Rajib Acharya, Sana Ashraf, Sowmya Ramesh, Nizamuddin Khan, Umesh Kapil, Anura V Kurpad, Avina Sarna

Summary

Background WHO's haemoglobin cutoffs to define anemia were based on five studies of predominantly White adult populations, done over 50 years ago. Therefore, a general re-examination of the existing haemoglobin cutoffs is warranted for global application, in representative healthy populations of children and adults. Such data are scarce in low-income and middle-income countries; however, a 2019, large-scale, nationally representative survey of children and adolescents aged 0–19 years in India (Comprehensive National Nutrition Survey [CNNS]) offered an opportunity for this re-examination. Using this survey, we aimed to assess the age-specific and sex-specific percentiles of

Lancet Glob Health 2021; 9: e822–31
Published Online April 16, 2021
https://doi.org/10.1016/S2214-109X(21)00097-2

CNNS Healthy Subjects Serum Zinc Thresholds (2.5th Cen)



- 10-18 µg/dl lower than IZiNCG cut-offs
- Deficiency prevalence 2.7 (<10 yr) to 5.5 (>10 yr) lower
- No State public health problem (>20%) vs 9-27 States

Pullakhandam R,…Sachdev HS. Eur J Clin Nutr 2022

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Intervention Benefit: Biomarker Elevation Alone?

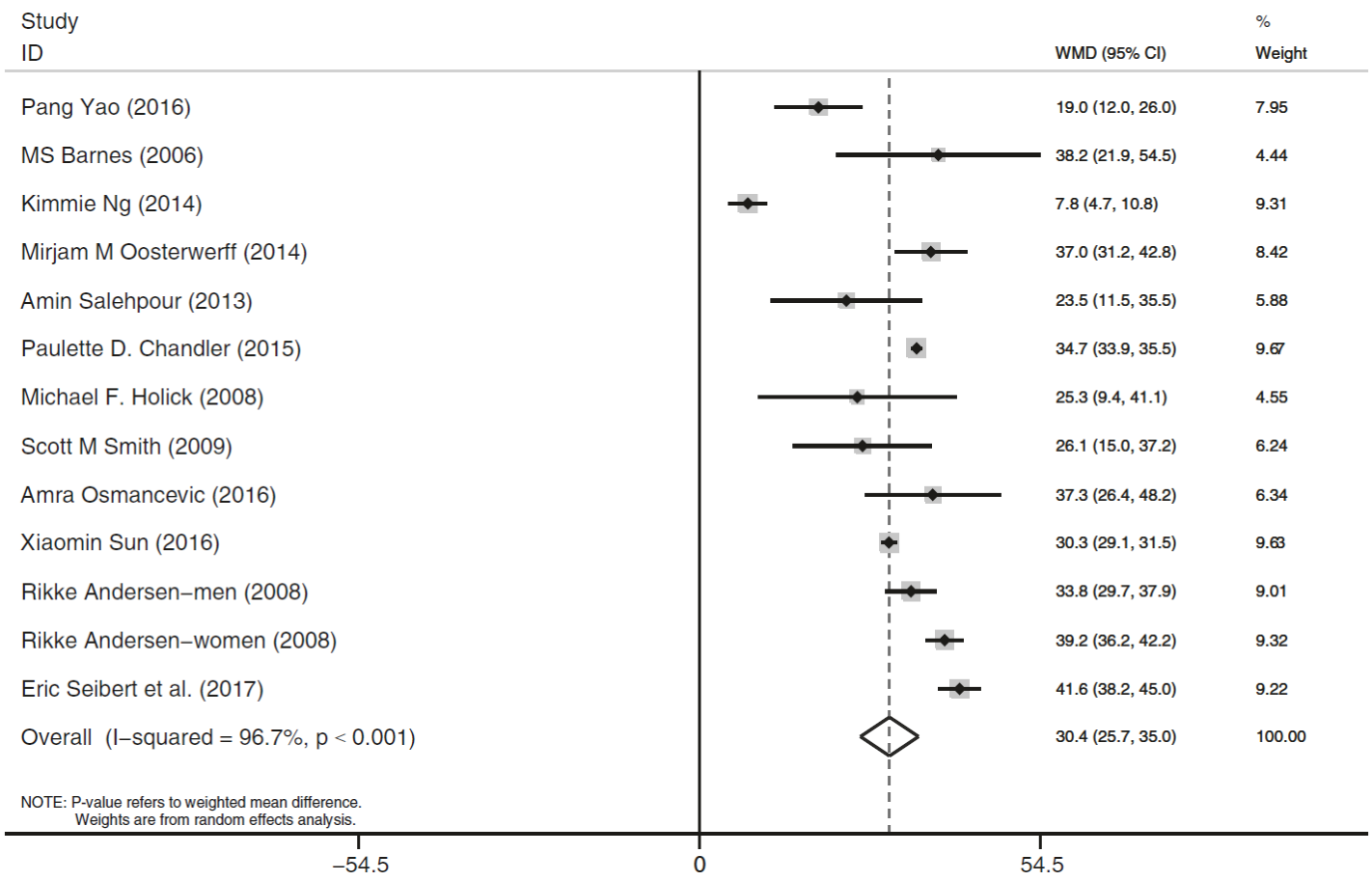

Fig. 2 Low dose (< 1500 IU) vs. placebo in adult subjects with baseline 25(OH)D concentration < 50 nmol/L

Vit. D supplement & serum 25(OH)D. Mo et al. Eur J Clin Nutr 2019;73:816

Biomarkers or Functional Benefits ?

WHO recommendation on antenatal vitamin D supplements

Oral vitamin D supplementation is not recommended for all pregnant women to improve maternal and perinatal outcomes. *(Not recommended)*

Box 1. ANC nutritional interventions outcomes of interest

Maternal outcomes	Fetal/neonatal outcomes
Infections	Neonatal infections
Anaemia	Small for gestational age
Pre-eclampsia/eclampsia ±	Low birthweight
Gestational diabetes mellitus	Preterm birth
Mode of delivery	Congenital anomalies
Excessive weight gain	Macrosomia/large for gestational age
Side effects	Fetal/neonatal mortality
Maternal mortality	
Maternal satisfaction	

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Iodine Fortification and Hypothyroidism

Increased Incidence Rate of Hypothyroidism After Iodine Fortification in Denmark: A 20-Year Prospective Population-Based Study

Mads Petersen,[1] Nils Knudsen,[2] Allan Carlé,[1] Stig Andersen,[3] Torben Jørgensen,[4,5,6] Hans Perrild,[2] Lars Ovesen,[7] Lone Banke Rasmussen,[2] Betina Heinsbæk Thuesen,[4] and Inge Bülow Pedersen[1]

Thyroid, VOL. 28, NO. 6 | Iodine and Endemic Goiter

normal

Excessive Iodine Intake and Subclinical Hypothyroidism in Children and Adolescents Aged 6–19 Years: Results of the Sixth Korean National Health and Nutrition Examination Survey, 2013–2015

Min Jae Kang, Il Tae Hwang, and Hye Rim Chung

Published Online: 1 Jun 2018 | https://doi.org/10.1089/thy.2017.0507

European Journal of Endocrinology (2011) **164** 943–950 ISSN 0804-4643

CLINICAL STUDY

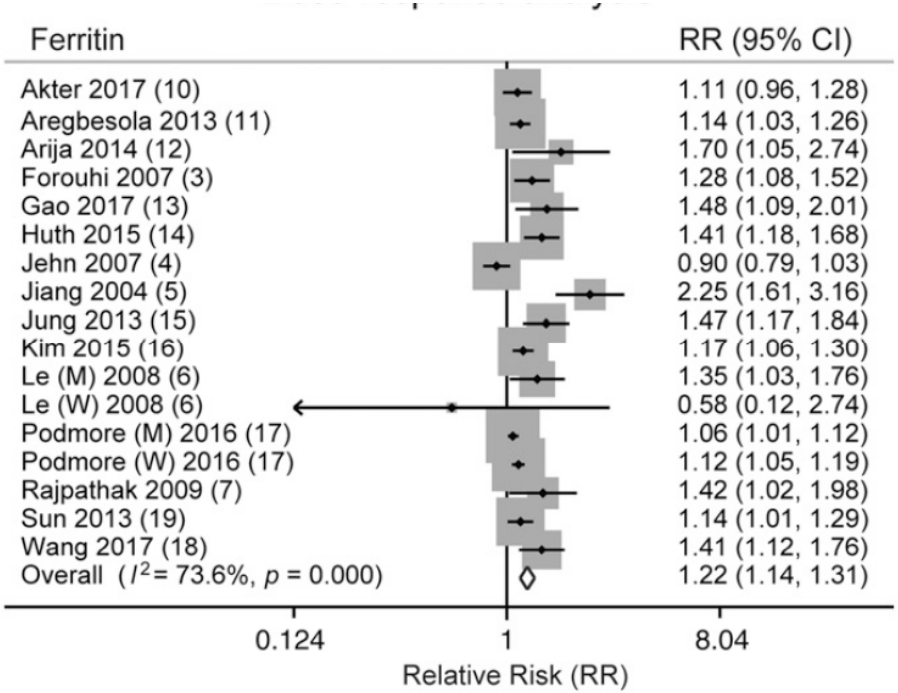
More than adequate iodine intake may increase subclinical hypothyroidism and autoimmune thyroiditis: a cross-sectional study based on two Chinese communities with different iodine intake levels

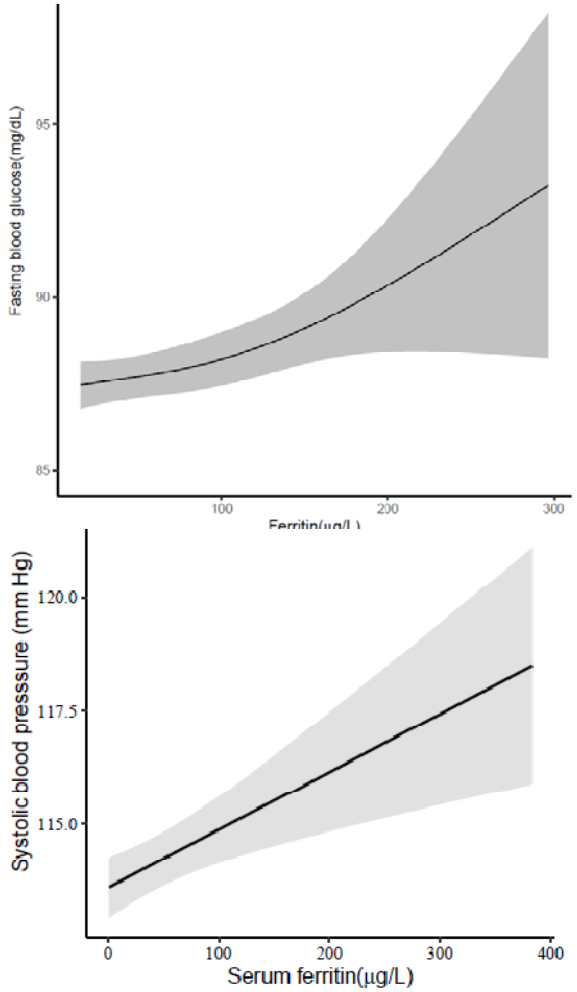
Xiaochun Teng[1], Zhongyan Shan[1], Yanyan Chen[2], Yaxin Lai[1], Jiashu Yu[2], Ling Shan[2], Xue Bai[2], Yuanbin Li[2], Ningna Li[2], Zhidan Li[2], Sen Wang[2], Qian Xing[2], Haibo Xue[2], Lin Zhu[2], Xin Hou[2], Chenling Fan[2] and Weiping Teng[2]

[1]*Department of Endocrinology and Metabolism and* [2]*Liaoning Key Laboratory of Endocrine Diseases, Institute of Endocrinology, The First Affiliated Hospital, China Medical University, No 155 Nanjing Bei Street, Heping District, Shenyang, People's Republic of China*

(Correspondence should be addressed to W Teng: Email: twpendocrine@yahoo.com.cn; X Teng: Email: tengxiaochun@126.com)

Iron Excess and NCD Risk





Ferritin & diabetes in prospective data
J Clin Endocrinol Metab. 2019;104:4539

Increased risk of hypertension, dyslipidemia, GDM & PET
RCT evidence emerging

CNNS. Adolescents Ghosh S, et al. 3 Dec, 2021.
https://www.researchsquare.com/article/rs-1136688/v1

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Key findings

- The prevalence of vitamin A deficiency was 18% among pre-school children, 22% among school-age children and 16% among adolescents
- Vitamin D deficiency was found among 14% of pre-school children, 18% of school-age children and 24% of adolescents
- Nearly one-fifth of pre-school children (19%), 17% of school-age children and 32% of adolescents had zinc deficiency
- The prevalence of vitamin B12 deficiency was 14% among pre-school children, 17% among school-age children and 31% among adolescents
- Nearly one-quarter (23%) of pre-school children, 28% of school aged children and 37% of adolescents had folate deficiency
- Adequate iodine status (median urinary iodine concentration ≥100 µg/L and ≤ 300 µg/L) was observed in all three age groups - 213 µg/L among

Natural diverse diets suffice for meeting requirements: Linear Programming Analysis

Diets 6-12 mo assuming 200 ml breast milk intake

Wheat diet

Food Name	Food Group	Quantity (gm)	Cost (Rs)
Amaranth leaves (red)	Green leafy vegetables	13	0.34
Banana	Fruits	30	0.42
Red gram dhal	Pulse	22	1.85
Oil	Oil	26	2.11
Bottle Gourd	Other vegetables	5	0.07
Salt	Salt	5	0.09
Sugar	Sugar	14	0.259
Tapioca	Roots and tubers	5	0.11
Wheat flour atta	Cereals	43	1.63
Optimal cost (in Rs)			**6.87**

Nutrient	EAR	% of EAR
Energy (kcal)	681	>100
Protein (g)	12	>100
Fat (g)	35	>100
Iron (mg)	4	>100
Zinc (mg)	2	>100
Iodine (µg)	150	>100
Vitamin A RAE (µg)	279	>100
Vit B6 (mg)	19	>100
Folate (µg)	73	>100

Rice diet

Food Name	Food Group	Quantity (gm)	Cost (Rs)
Amaranth leaves (red)	Green leafy vegetables	18	0.47
Banana	Fruits	5	0.07
Red gram dhal	Pulse	30	2.52
Oil	Oil	23	1.86
Pumpkin (Orange)	Other vegetables	5	0.055
Salt	Salt	5	0.09
Rice	Cereals	60	2.76
Optimal cost (in Rs)			**7.83**

Nutrient	EAR	% of EAR
Energy (kcal)	680	>100
Protein (g)	14	>100
Fat (g)	31	>100
Iron (mg)	4	>100
Zinc (mg)	2	100
Iodine (µg)	150	>100
Vitamin A RAE (µg)	527	>100
Vit B6 (mg)	37	>100
Folate (µg)	86	>100

St. John's Research Institute, Bengaluru (Thomas, Kurpad, Sachdev, *et al.*)

Concluding Thoughts

Micronutrient Deficiencies Do Exist

Ignores
Hidden-Harms

Magnified
“Hidden-Hunger”


THANK
YOU