

Role of Science in Shaping Future Micronutrient Policies and Programs

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Health Problems among the Undernourished

Nutritional Deficiencies

- **PEM**
- **Micronutrient deficiencies:**
 - Vitamin A, zinc, iron, iodine, folate, others
- **Behavioral Causes:**
 - Breast & compl feeding; home diet; low SES, hygiene, and education; markets; global economics



Child and Maternal Health Problems

- **Infant or Child**
 - Infection
 - Poor growth
 - Impaired mental, motor & behavioral development
 - Mortality
- **Mother**
 - Short stature
 - Infection/sepsis
 - Obstetric problems
 - Anemia
 - Mortality

Chronic disease, disability, mortality

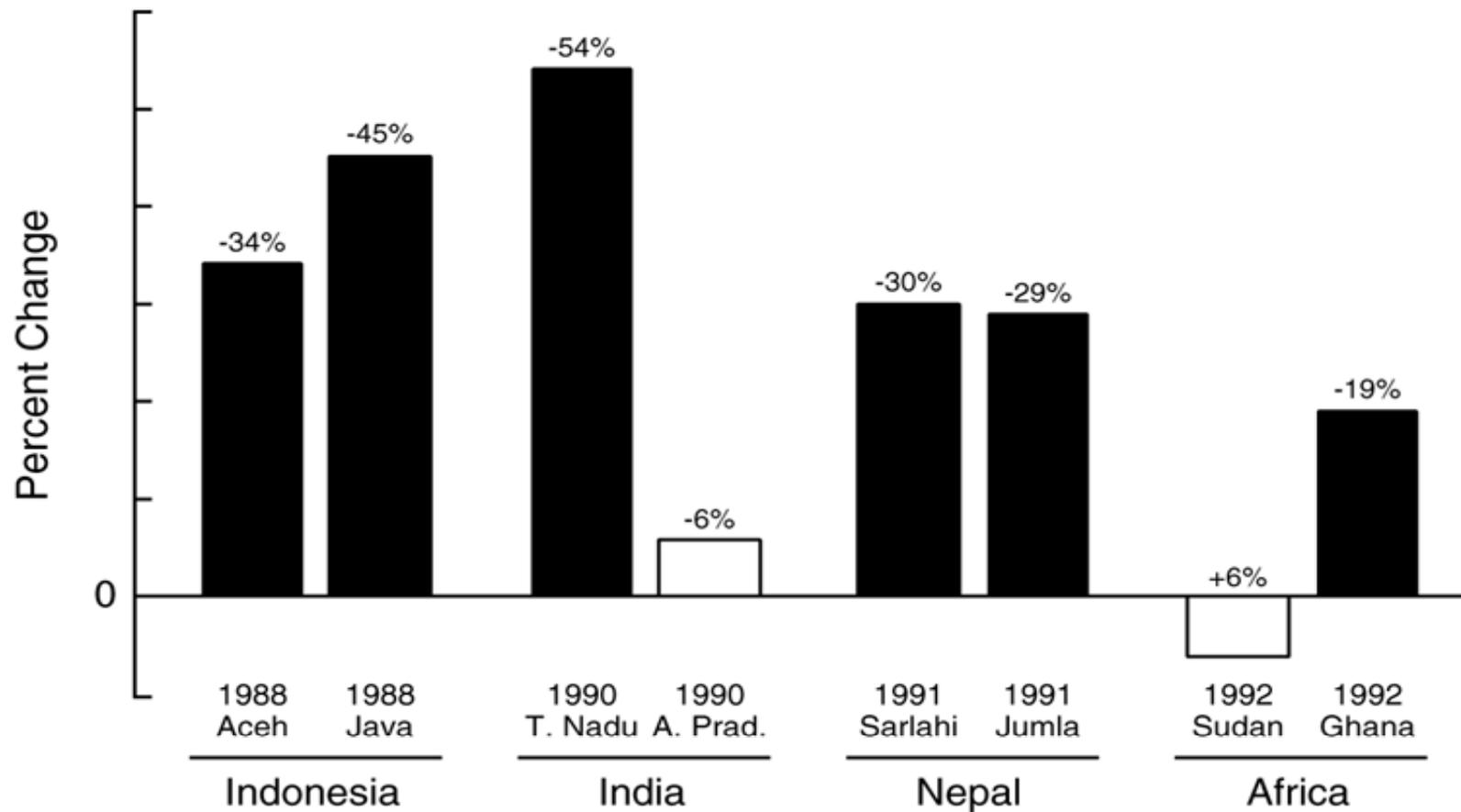
Essential Nutrient Facts

- Micronutrients must be provided by diet, always
- Perform millions of vital functions
- Deficiencies decrease stores & health deteriorates
- Public health importance depends on prevalence, severity and health consequences
- Roles of science: quantifying deficiency and consequences, assessing public health impact, offering plausible mechanisms, monitoring trends and evaluating approaches to prevention

Success Stories Guided by Science: Pillars of Public Health

- Iodization of salt to prevent IDD
- Flouride to reduce dental cavities
- Vitamin A to prevent blindness and mortality (VADD)
- Zinc as adjunct to ORS for diarrhea
- Iron to prevent (iron-deficiency) anemia
- Folic acid fortification to prevent NTDs

A Decade of Research on Vitamin A & Child Mortality



Sommer & West, 1996

NVAS and Infant Mortality

In W Java, Indonesia: **Vitamin A (50,000 IU) at birth reduced mortality 64%**

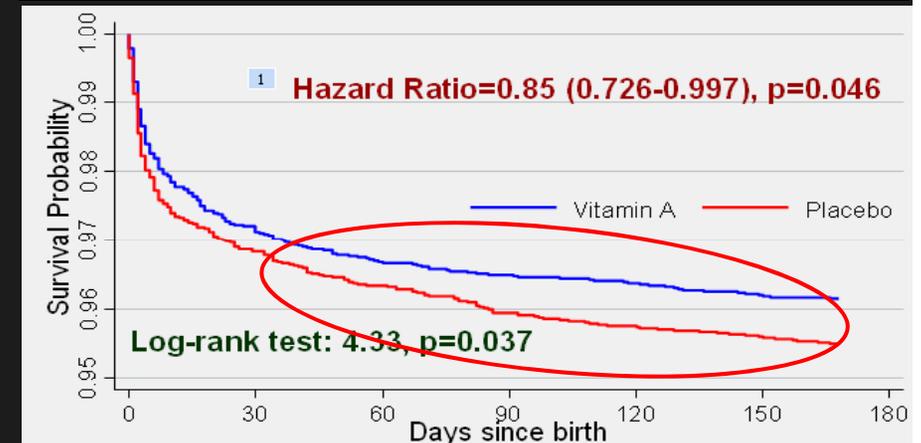
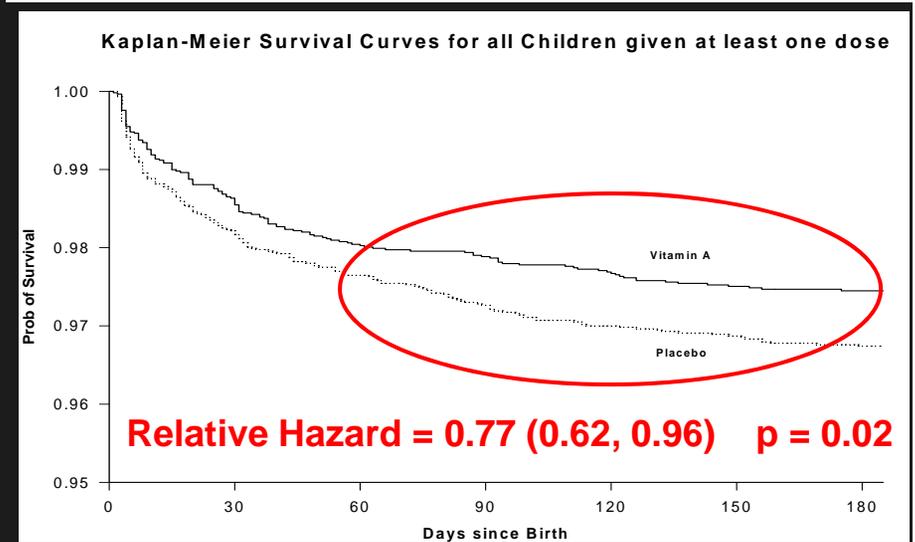
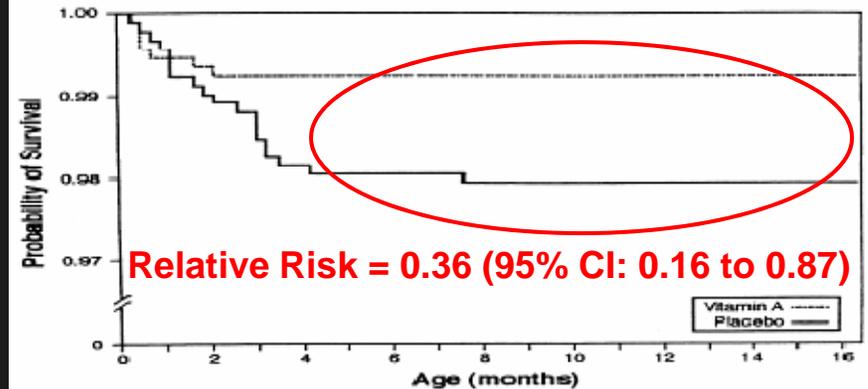
Humphrey et al J Pediatr 1996;128:489

South India: **VA (~50,000 IU) at birth reduced infant mortality by 23%**

Rahmathullah et al BMJ 2003;327:254

NW Bangladesh: **VA (50,000 IU) at birth reduced infant mortality by 15%**

Klemm et al MF Meeting 2007



A Decade of Trials on Zinc in Treating Diarrhea, Preventing Other Infections

Diarrhea Incidence

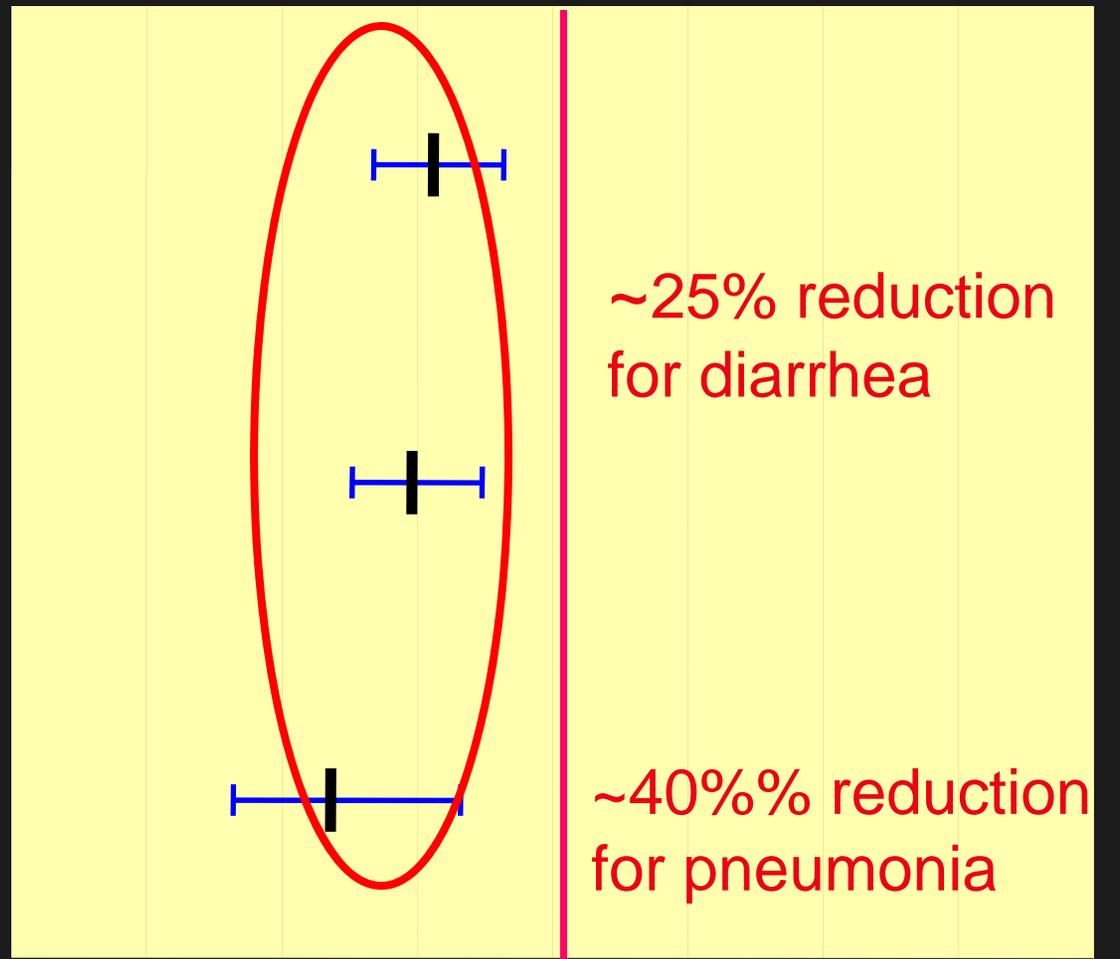
9 countries

Diarrheal Prevalence

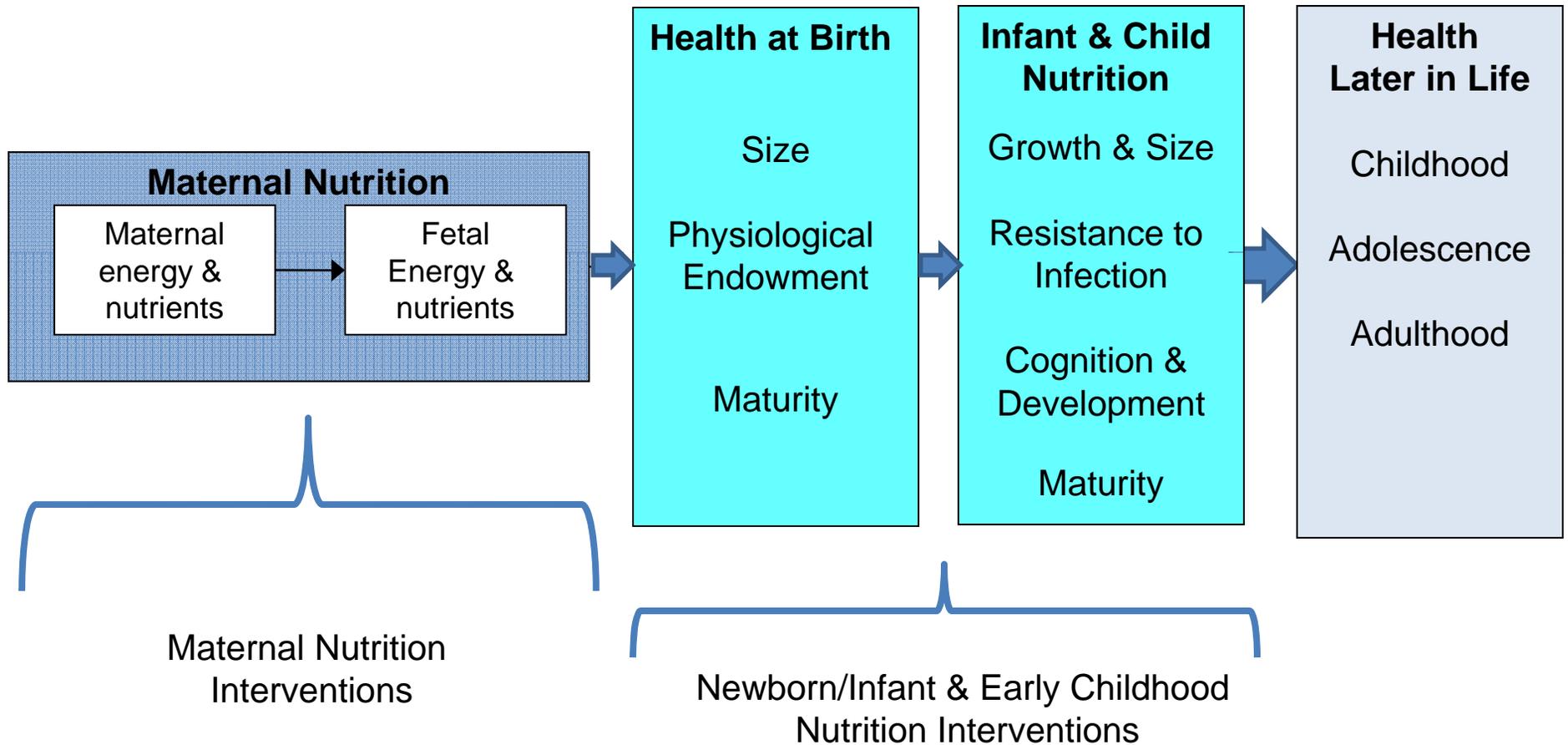
9 countries

Pneumonia Incidence

4 countries



Early Life Micronutrient Nutrition: Influence on Lifelong Health



Antenatal Folic Acid Supplementation Reduced Microalbuminuria in Offspring 6-8 Yrs of Age

Maternal supplement group	<i>n</i>	Microalbuminuria, <i>n</i> (%)	OR (95% CI)
Control	653	40 (6.1)	
Folic acid	595	21 (3.5)	0.56* (0.33, 0.93)
Folic acid+iron	609	29 (4.8)	0.77 (0.49, 1.22)
Folic acid+iron+zinc	621	21 (3.4)	0.53* (0.32, 0.89)
Multiple micronutrient	675	30 (4.4)	0.70 (0.44, 1.11)

¹ Microalbuminuria = urinary microalbumin:creatinine ratio ≥ 3.4 mg/mmol. * $P < 0.05$. OR and 95% CI were calculated using a GEE logistic regression model controlling for the child age at follow-up.

Lessons Being Learned

Context Matters

- Populations vary by nutrition and health outcomes, health services, cultures, other resources
- Once studies pass design, power, conduct and analysis criteria, local factors may explain differences in results

Double blind, cluster randomised trial of low dose supplementation with vitamin A or β carotene on mortality related to pregnancy in Nepal

Keith P West Jr, Joanne Katz, Subarna K Khattri, Steven C LeClerq, Elizabeth K Pradhan, Sharada R Shrestha, Paul B Connor, Sanu M Dali, Parul Christian, Ram P Pokhrel, Alfred Sommer on behalf of the NNIPS-2 Study Group *BMJ* 1999;318:570

MMR 700, VAD ~20%, XN ~15%, high wasting, no AN care, effects on children
44% reduction in maternal mortality

Effect of vitamin A supplementation in women of reproductive age on maternal survival in Ghana (ObaapaVitA): a cluster-randomised, placebo-controlled trial

Betty R Kirkwood, Lisa Hurt, Seeba Amenga-Etego, Charlotte Tawiah, Charles Zandoh, Samuel Danso, Chris Hurt, Karen Edmond, Zelee HZ, Guus ten Asbroek, Justin Fenty, Seth Owusu-Agyei, Oona Campbell, Paul Arthur, *for the ObaapaVitA Trial Team† *Lancet* 2010

MMR ~350, VAD ~15%, XN nil, generally better nutritional status
No reduction in maternal mortality

Effects of Vitamin A or Beta Carotene Supplementation on Pregnancy-Related Mortality and Infant Mortality in Rural Bangladesh

A Cluster Randomized Trial West KP Jr, Christian P, Labrique et al *JAMA* 2011

MMR 230, VAD ~8%, XN ~9%, PEM, diet and care better than in Nepal
No reduction in maternal mortality

Lessons Being Learned

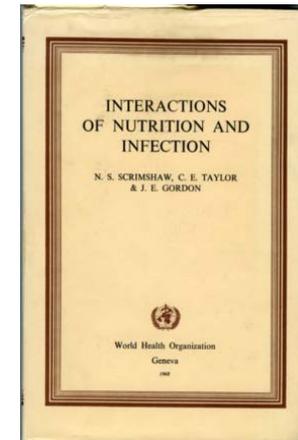
- Nutrition is complex: simplify but not too much
- Meta-analysis requires comparable risk profiles
- Extend and blend vs confirm or negate
- Infection: a cause, not a confounder
- Mechanisms count, expand biology, lead to new thinking/approaches, but won't drive policy
- Surveys establish prevalence, epidemiological studies raise risk factors, trials reveal impact of solutions
- RCTs drive reactions, further research and ... eventually evidence-based programs

Future Directions

- Look beyond survival...improve cognition & function, reduce infection, prevent inflammation, oxidative stress & chronic disease
- Look before birth... to achieve healthy growth
- Look beyond size ... Examine roles of maternal micronutrient intakes on “functional growth and development” of offspring
 - including preventing birth defects
- Look beyond health outcomes ... to change feeding and dietary practices and intakes within resources and seasons



Future Directions



- Discern interactions between infection and nutrition
- Roles of “antinutritionals” (eg, mycotoxins, arsenic, smog) in affecting inflammation, status and health
- Look beyond dietary content ... to hygiene in food processing, home, contaminants and water
- Design and evaluate adequate, balanced nutrient delivery: from food, fortificants, supplements
- Reveal ‘Hidden Hunger’ in all of its breadth, depth and consequence

Future Directions: Assessment

- New “point of population” (PoP) platforms to rapidly assess multiple micronutrient deficiencies to
 - Know what they are, who has them, when and how severely,
 - Act in real time to prevent - specifically
 - Discern population deficiency thresholds for expecting certain health impacts
 - Monitor and evaluate programs addressing broader array of deficiencies



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Thank You!

