

*NAMS-NFI Symposium*  
**Micronutrient Deficiencies**

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# A Promise to Keep

*‘Today, while speaking about the achievements of our Government, I wish to make one more promise. We have done much, but I realize that there is more to do. The problem of malnutrition is a curse that we must remove.’*

Dr. Manmohan Singh  
15 August, 2008  
Independence Day Address

## **MDG : *Arcadia or Dystopia?***

More than 12 years have passed since world leaders established goals and targets to free humanity from extreme poverty, hunger, illiteracy and disease.

# MDG 1 - *Eradicate extreme poverty and hunger*

**Target :** Prevalence of underweight children under-five years of age

*The percentage of underweight children has declined from 25% in 1990 to 16% in 2010.*

*In India, it is 42.5% (Planning Commission, February, 2012)*

*Stunting in children U5 has decreased globally from 40% to 27% over the same period.*

*In India, it is 44.9% (Planning Commission, February, 2012)*

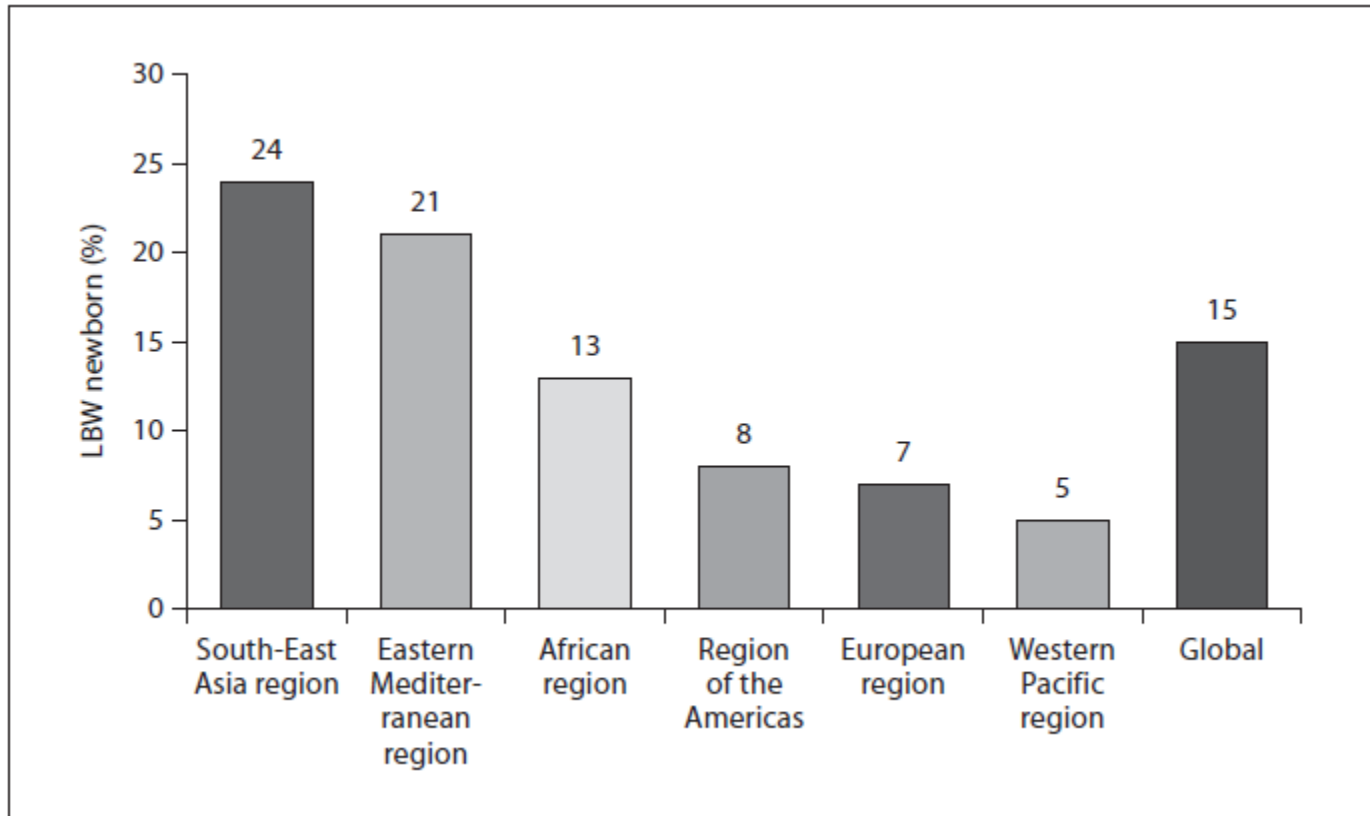
# Nutrition challenges in Children :

## *Indian Factfile*

- Every fifth child in the world lives in India
- 22% babies are born with low birth weight
- 50 out of 1000 live births do not complete their first year of life
- 42.5% of children 0-5 years are underweight
- 79% children (6-35 months) are anaemic

*Working Group on Nutrition, 2012*

# LBW (%) newborns by WHO region (2005-2010)



WHO, 2012

# Eleventh and Twelfth Plan targets

S. No.	Eleventh Plan Monitorable Target	Baseline Level	Recent Status
1	Reducing Maternal Mortality Ratio (MMR) to 100 per 100000 live births.	254 (SRS, 2004–06)	212 (SRS, 2007–09)
2	Reducing Infant Mortality Rate (IMR) to 28 per 1000 live births.	57 (SRS, 2006)	44 (SRS, 2011)
3	Reducing Total Fertility Rate (TFR) to 2.1.	2.8 (SRS, 2006)	2.5 (SRS, 2010)
4	Reducing malnutrition among children of age group 0–3 to half its level.	40.4 (NFHS, 2005–06)	No recent data available
5	Reducing anaemia among women and girls by 50%.	55.3 (NFHS, 2005–06)	No recent data available
6	Raising the sex ratio for age group 0–6 to 935	927 (Census, 2001)	914 (census, 2011)

Recent Status			Target for Twelfth Plan			U3 Mn
IMR	MMR	Anaemia	IMR	MMR	Anaemia	
44	212	55.3	25	100	28	20

MDG : IMR 27; MMR 109; U3 Mn 26

*Twelfth Five Year Plan  
(2012–2017)  
Health*

# Malnutrition & Nutrition Security

***Malnutrition*** refers to nutritional deficiencies as measured by *wasting, stunting, underweight, micronutrient deficiencies and/or anaemia*. ***Nutrition security*** is broadly defined as physical, economic and social access to, and utilization of, an appropriate, balanced diet based on age, gender, physiological status, and activity levels.



# Economic cost of Malnutrition

Productivity losses related to poor nutrition are estimated to be more than 10 percent of lifetime earnings for individuals and 2-3 percent of GDP to the nation. Malnutrition and micronutrient malnutrition were estimated to have reduced the country's GDP between 3-9 percent in 1996. Cost of treating malnutrition is 27 times more than the investment required for its prevention.

## *Nutrition Security for All*

‘The vision for 12<sup>th</sup> Five Year Plan on Nutrition would be to ensure “*Nutrition Security for All*” – especially the more vulnerable infants and young children, adolescent girls and women, across the life cycle, fulfilling their rights to nutrition, health and human development- to their full potential.’

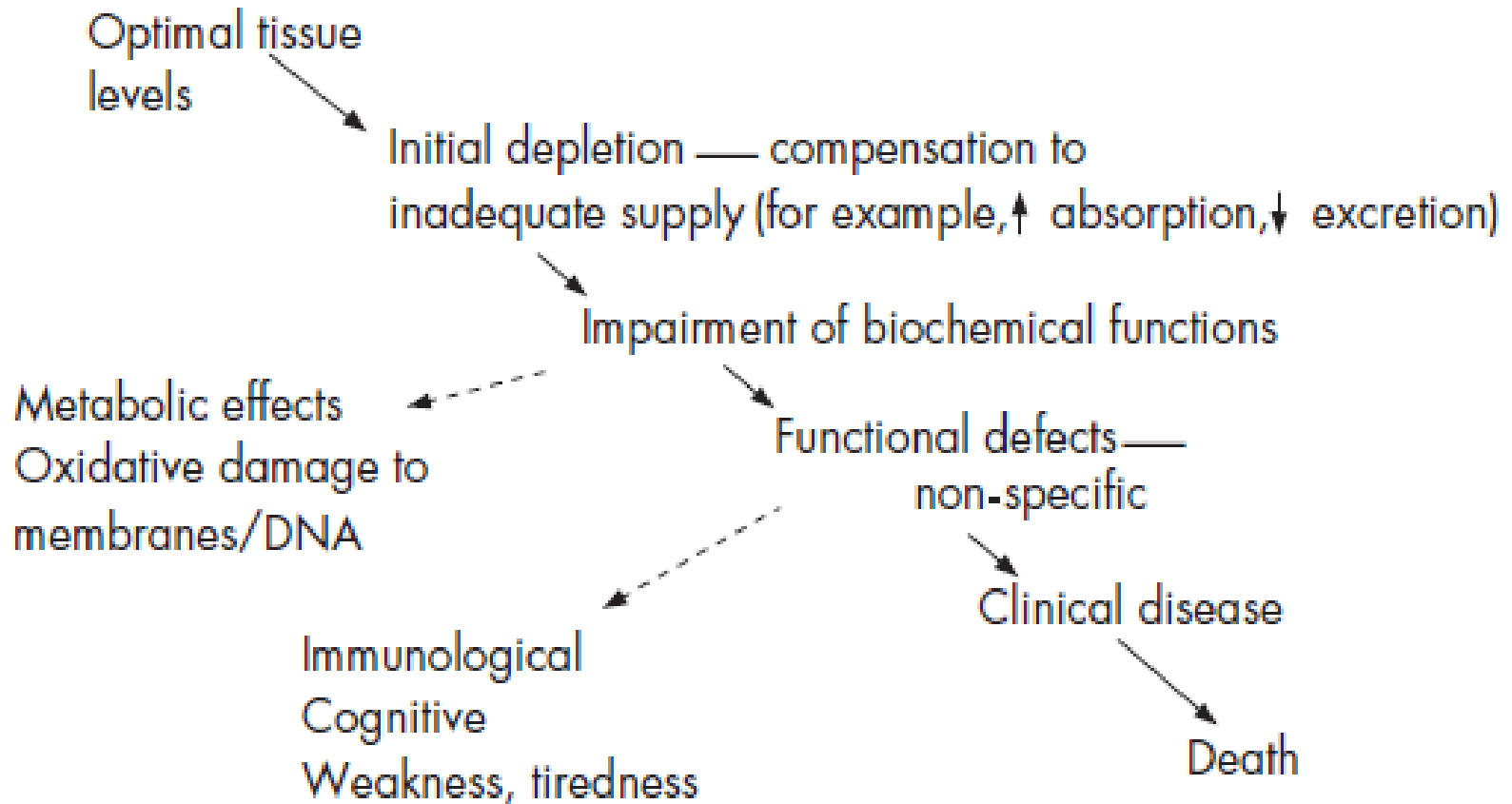
*Working Group on Nutrition, 2012*

## *A Solemn Promise*

Maternal and child malnutrition in a country with abundant foodgrains is a shame that we must overcome.... Food security is as much a basic human right as the right to education or the right to health care. The National Food Security Bill is a promise of the UPA Government

*P. Chidambaram, Budget Speech  
February 28, 2013*

# Micronutrient deficiency in health and disease



# Addressing Undernutrition : *key interventions through life cycle*

Growth retardation originates early in life and proportion of underweight children rises rapidly for the first 20 months, with wasting and stunting setting in as early as the first month. Undernutrition can be reduced through delivery of simple yet essential interventions at key stages of the life cycle –***for the mother***, at adolescence, before pregnancy, during pregnancy, during lactation, and ***for the child in utero***, in infancy and during early childhood.

# Prevalence of the three major micronutrient deficiencies by WHO region

<i>WHO region</i>	Anemia <sup>a</sup> (total population)		Insufficient iodine intake <sup>b</sup> (total population)		Vitamin A deficiency <sup>c</sup> (preschool children)	
	n (millions)	% of total	n (millions)	% of total	n (millions)	% of total
Africa	244	46	260	43	53	49
Americas	141	19	75	10	16	20
South-East Asia	779	57	624	40	127	69
Europe	84	10	436	57	no data available	
Eastern Mediterranean	184	45	229	54	16	22
Western Pacific	598	38	365	24	42	27
Total	2,030	37	1,989	35	254	42

*a : WHO, 2001*

*b : WHO, 2004*

*c : WHO, 1995*

# Global deaths and DALYs in children <5 years attributed to micronutrient deficiencies

	Deaths	% of deaths in children <5 years	Disease burden (1,000 DALYs)	% of DALYs in children <5 years
Vitamin A deficiency	667,771	6.5	22,668	5.3
Zinc deficiency	453,207	4.4	16,342	3.8
Iron deficiency	20,854	0.2	2,156	0.5
Iodine deficiency	3,619	0.03	2,614	0.6

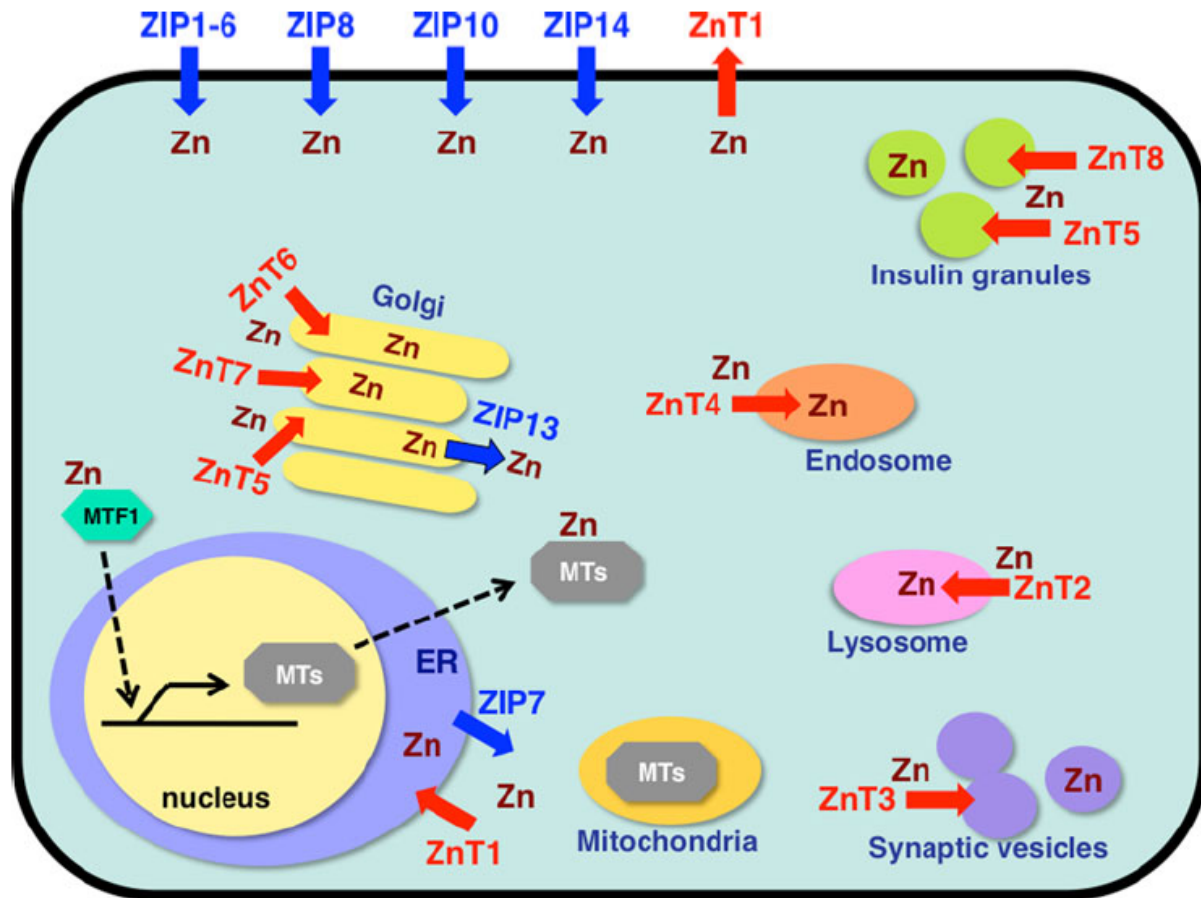
*Lancet 2008;371:243-260*

# Zinc deficiency in humans

Deficiency of zinc in humans is quite prevalent and may affect over two billion subjects in the developing world. The manifestations of a moderate deficiency of zinc include growth retardation and male hypogonadism in adolescents, rough skin, poor appetite, mental lethargy, delayed wound healing, cell-mediated immune dysfunctions, and abnormal neurosensory changes.



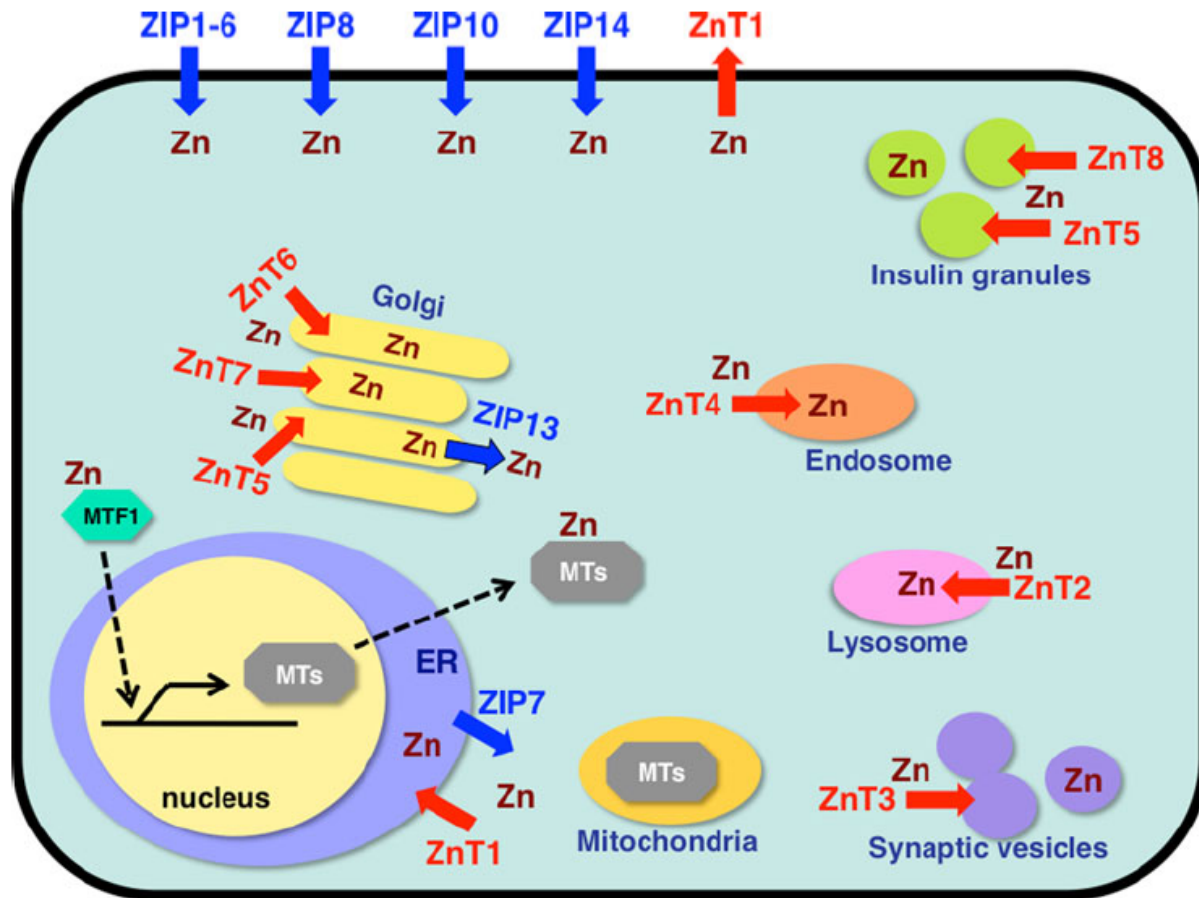
# Subcellular localization of zinc transporters and metallothioneins



# Zinc signaling in health and disease

Zinc is widely required in cellular functions and Zn homeostasis is regulated through Zn transporters, permeable channels, and metallothioneins. Zn acts as an intracellular signaling molecule, capable of communicating between cells, converting extracellular stimuli to intracellular signals, and controlling intracellular events.

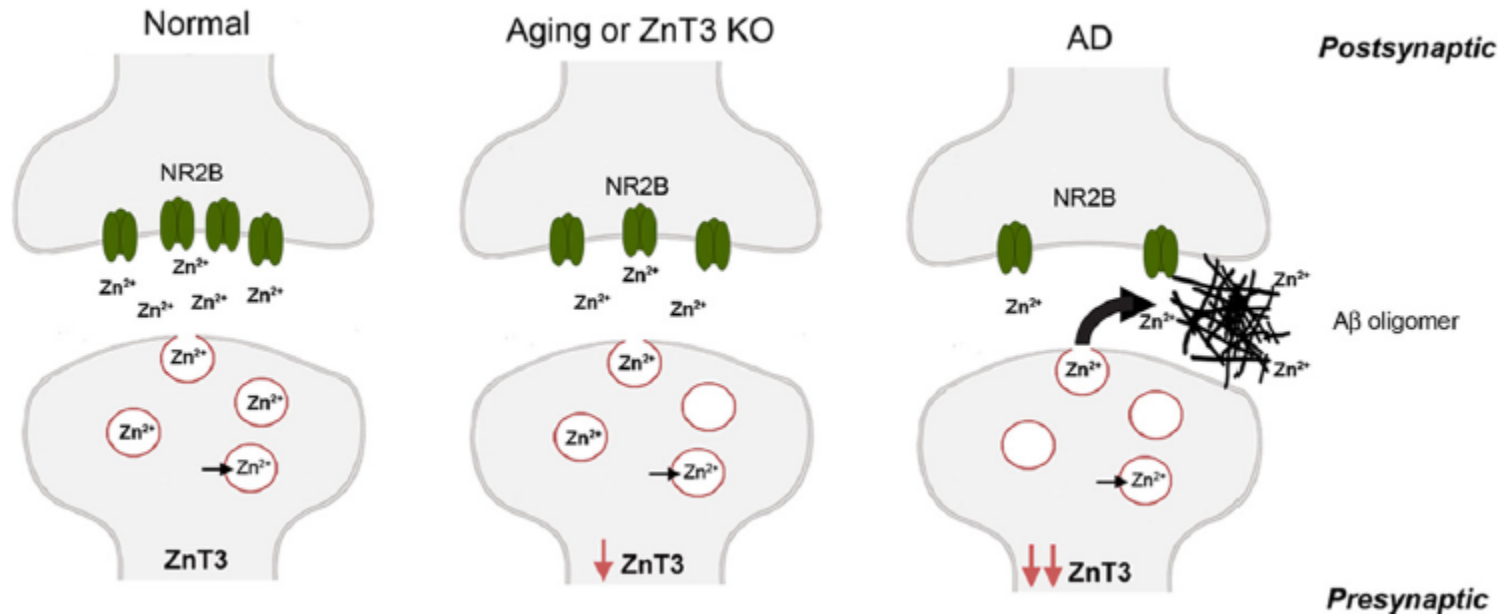
# Subcellular localization of zinc transporters and metallothioneins



# Zinc as Neuronal Messenger

The zinc transporter-3 gene was originally cloned and characterized in 1996 and is primarily localized to glutamatergic synapses present in the hippocampus and neocortex, regions that mediate higher cognition and memory. ZnT3 is major synaptic vesicular Zn<sup>2+</sup> transporter which plays a key role in learning and memory via its function as a neuronal messenger and a modulator of synaptic transmission and plasticity.

# ZnT3 decline in synaptic zinc in aging, ZnT3KO and Alzheimer's disease



*J Neurosci (2010);30:1631-1636*

# Speech of Sh. P. Chidambaram

## *Budget 2013-2014*

Eminent agricultural scientists have suggested that we start a pilot programme on Nutri-Farms for introducing new crop varieties that are rich in micro-nutrients such as iron-rich bajra, protein-rich maize and zinc-rich wheat.



# Zn suppresses Th17 cell development

