

# **THE GLOBAL THREAT OF HIDDEN HUNGER**

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# NUMBERS OF INDIVIDUALS AFFECTED

Deficiency	Number affected
<b>IRON DEFICIENCY AT ALL AGES</b>	2 BILLION *
<b>CHRONIC UNDERNUTRITION</b>	1 BILLION *
<b>IODINE DEFICIENCY IN PREGNANCY</b>	200 MILLION **
<b>VITAMIN A DEFICIENCY IN YOUNG CHILDREN</b>	200 MILLION *
<b>PROTEIN – ENERGY MALNUTRITION IN YOUNG CHILDREN</b>	167 MILLION *
<b>FOLIC ACID DEFICIENCY ALL AGE</b>	UNKNOWN

\* Source WHO

\*\* Estimated proportion of women of child-bearing age of WHO total

# HIDDEN NUTRITIONAL DEFICIENCIES THAT CAN PERMANENTLY DAMAGE FUNCTION

DEFICIENCY	HOW DIAGNOSED	LAY RECOGNITION
IRON DEFICIENCY AT ALL AGES	PLASMA HEMOGLOBIN OR HEMATOCRIT	NO
ALL AGES- CHRONIC UNDERNUTRITION	LOW BODY MASS INDEX (BMI)	NO
IODINE DEFICIENCY IN PREGNANCY	URINARY IODINE OR THYROID HORMONE	NO
VITAMIN A DEFICIENCY IN YOUNG CHILDREN	SERUM VITAMIN A, RELATIVE DOSE RESPONSE, ETC.	NO
PROTEIN- ENERGY MALNUTRITION IN CHILDREN	LOW WEIGHT OR HEIGHT FOR AGE	NO
FOLIC ACID DEFICIENCY ALL AGES	SERUM FOLIC ACID LEVEL	NO

# CONSEQUENCES OF DEFICIENCIES

DEFICIENCY	FUNCTIONAL CONSEQUENCES
ALL AGES CHRONIC UNDERNUTRITION	INCREASED MORBIDITY AND MORTALITY FROM INFECTIONS
IN ADULTS	DECREASED WORK CAPACITY AND
PROTEIN-ENERGY MALNUTRITION IN YOUNG CHILDREN *	GREATER ABSENTEEISM LASTING COGNITIVE AND PHYSICAL DAMAGE
IODINE DEFICIENCY IN PREGNANCY	COGNITIVE DAMAGE TO INFANT
VITAMIN A DEFICIENCY IN YOUNG CHILDREN**	INCREASED MORTALITY
FOLIC ACID DEFICIENCY	IN PREGNANCY NEURAL TUBE DEFECTS IN ADULTS HIGHER HOMOCYSTEINE LEVELS IN BLOOD RESULTING IN INCREASED ATHEROGENESIS

# RANGE OF IRON STATUS IN HUMANS

	Iron Status			
	Normal Iron	Iron Depletion	Iron Deficiency	Anemia
Marrow Iron Stores	2 - 3+	0-Trace	0	0
Plasma Ferritin ( $\mu\text{g/L}$ )	$100 \pm 60$	$<20$	10	$<10$
Plasma Iron ( $\mu\text{g/L}$ )	$115 \pm 50$	$<115$	$<60$	$<40$

# RANGE OF IRON STATUS IN HUMANS

	Iron Status			
	Normal Iron	Iron Depletion	Iron Deficiency	Anemia
<b>Transferrin Saturation (%)</b>	None	None	<15	<10
<b>Metabolic Manifestation</b>	None	None	Impaired Cognition Compromised Immune Function Impaired Skeletal Muscle function	Impaired cognition Compromised Immune Function Reduce Skeletal Muscle function
<b>Clinical Manifestation</b>	None	None	Fatigue Weakness	Fatigue Weakness Increased

# BODY IRON

- **Hemoglobin** **73 %**
- **Storage (Ferritin, etc)** **12 %**
- **Other** **15 %**  
**(Most in Critical Enzymes)**

# NUMBER OF IRON DEFICIENT PERSONS (WHO)

WHO REGION	ANEMIC OR IRON DEFICIENT (millions)	PREVALENCE OF ANAEMIA IN PREGNANCY (%)
AFRICA	206	52
AMERICA	94	60
EUROPE	27	18
E. MEDITERRANEAN	149	50
SOUTHEAST ASIA	616	74
WESTERN PACIFIC	1058	40
DEVELOPED		18
DEVELOPING		56
TOTAL	2150	51

# **CONSEQUENCES OF IRON DEFICIENCY AND IRON DEFICIENCY ANEMIA**

- **IN PREGNANCY:**

- **POOR PREGNANCY OUTCOMES**
- **LOWER NEONATAL IRON STORES**

- **IN INFANCY AND PRESCHOOL YEARS:**

- **IMPAIRED IMMUNITY**
- **INCREASED MORBIDITY**
- **SLOWER GROWTH**
- **LASTING IMPAIRMENT OF COGNITION**

# **CONSEQUENCES OF IRON DEFICIENCY AND IRON DEFICIENCY ANEMIA**

- **IN ADULTS :**

- **WEAKNESS/TIREDNESS**
- **REDUCED PHYSICAL CAPACITY**
- **LOWERED RESISTANCE TO INFECTIONS**
- **REVERSIBLY REDUCED COGNITION**
- **WITH SEVERE ANEMIA, INABILITY TO MAINTAIN BODY TEMPERATURE UPON EXPOSURE TO COLD**

**WHY HAS THE PREVENTION  
OF IRON DEFICIENCY LAGGED  
SO FAR BEHIND THAT OF  
IODINE AND VITAMIN A?**

# **MISCONCEPTIONS THAT HAVE IMPEDED THE IMPLEMENTATION OF PROGRAMS FOR PREVENTING IRON DEFICIENCY**

- **THE MYTH THAT IRON DEFICIENCY IS MORE DIFFICULT TO PREVENT THAN IODINE AND VITAMIN A DEFICIENCIES**
- **INTERVENTIONS HAVE LARGELY BEEN LIMITED TO SUPPLEMENTATION ONLY DURING PREGNANCY AND HAVE FOCUSED ONLY ON ANEMIA**
- **CONCERN THAT IRON DEFICIENCY IS ONLY ONE OF A NUMBER OF NUTRITIONAL AND OTHER CAUSES OF ANEMIA**
- **HISTORICAL LEADERSHIP CHOICES**

# CONFUSION BETWEEN THERAPEUTIC AND PREVENTIVE APPROACH

- CURRENT WHO RECOMMENDATION IS “60 mg OF IRON ONE OR MORE TIMES DAILY FOR FOUR TO SIX WEEKS ONCE OR TWICE A YEAR FOR POPULATIONS WITH ANEMIA PREVALENCE RATES THAT EXCEED 40%’ THIS IS TREATMENT NOT PREVENTION!!

# **WHY THE WHO SUPPLEMENTATION RECOMMENDATION NEEDS REVISION**

- 1. ANEMIA RETURNS WITHIN 2 TO 3 MONTHS**
- 2. THERAPEUTIC DOSE ADOPTED FOR PREVENTION WITHOUT PROPER DISCUSSION AND IS TOO HIGH**
- 3. DAILY DOSES GIVE UNACCEPTABLE LEVELS OF FERRITIN ETC.**
- 4. FIGURE OF 40% FOR THRESHOLD OF PREVENTION WITHOUT SCREENING - NO SCIENTIFIC REASON FOR NOT ADOPTING THE 10% FIGURE USED FOR ENDEMIC GOITER**

# **SPECIFIC MISCONCEPTIONS THAT HAVE IMPEDED THE IMPLEMENTATION OF PROGRAMS FOR PREVENTING IRON DEFICIENCY**

- **THAT SUPPLEMENTATION CAN INCREASE THE SEVERITY OF INFECTIONS**
- **THAT IRON SHOULD NOT BE GIVEN WHERE MALARIA IS ENDEMIC**
- **THAT THALASSEMIAS AND OTHER HEMOGLOBINOPATHIES ARE CONTRA-INDICATIONS TO IRON SUPPLEMENTATION**
- **THAT SCREENING IS REQUIRED BEFORE SUPPLEMENTATION BECAUSE OF THE PREVALENCE OF HEMOCHROMATOSIS**
- **THAT IRON FORTIFICATION AND SUPPLEMENTATION COULD INCREASE THE RISK OF HEART DISEASE AND CANCER**

# HAEMOCHROMATOSIS

## HOMOZYGOTES

**NORTHERN EUROPE EXTRACTION: 0.1-0.5%**

**FINLAND: 0.5%**

**ALGERIA, ETHIOPIA, SENEGAL: 0%**

**20% NEVER DO DEVELOP SYMPTOMS**

# IRON, CANCER AND HEART DISEASE?

- **“THERE IS NO VALID EVIDENCE FOR A ROLE OF IRON INTAKE, WHETHER BY DIET OR OTHER ROUTES, IN THE ETIOLOGY OF HUMAN CANCER OR HEART DISEASE”**
- U.S. National Academy of Sciences 1998

# **INCREASING IRON AND FOLIC ACID INTAKES**

- **IRON/FOLATE FORTIFICATION OF CEREAL FLOURS**
- **WEEKLY IRON/FOLATE SUPPLEMENTATION IN POPULATIONS WITH HIGH ANEMIA PREVALENCE OF CHILDREN AND ADOLESCENTS AND OF WOMEN OF CHILD-BEARING AGE**
- **IRON/FOLATE SUPPLEMENTATION DURING PREGNANCY AS PART OF ROUTINE PRENATAL CARE IN THE HEALTH SYSTEM**

# **RISK WITH DAILY IRON SUPPLEMENT**

**VITERI et al. - DAILY BUT NOT WEEKLY IRON SUPPLEMENTATION CAN PRODUCE TEMPORARY IRON OVERLOAD AND OXIDATIVE STRESS AS MANIFESTED BY:**

**RATS:**

**HIGH ETHANE BREATH RATES**

**MITOCHONDRIAL DISFUNCTION**

**YOUNG WOMEN**

**ELEVATED SERUM FERRITIN**

**ELEVATED TRANSFERRIN SATURATION**

**INCREASED ETHANE BREATH RATES**

# **INCREASING IRON AND FOLIC ACID INTAKES**

- **OTHER IRON DELIVERY APPROACHES**
  - **TABLE SHAKER WITH FORTIFICANT MIX**
  - **FORTIFIED COOKIES AND BISCUITS FOR CHILDREN**
  - **COOKING WITH IRON POTS**
- **IMPROVED DIET**
  - **INCREASE IN HEME IRON FROM MEAT**
  - **MORE IRON-RICH LEAVES AND VEGETABLES**
  - **VITAMIN C AS AN ENHANCER OF IRON ABSORPTION**
  - **VITAMIN A AS AN ENHANCER OF IRON STATUS**
  - **VARIETIES OF VEGETABLES WITH INCREASED AVAILABLE IRON**
- **DOUBLE FORTIFICATION OF SALT WITH IRON AND IODINE**

# **ADDITIONAL PUBLIC HEALTH APPROACHES TO IMPROVED IRON STATUS**

- **PROMOTION OF EXCLUSIVE BREAST FEEDING FOR FOUR TO SIX MONTHS; THEN COMPLEMENTARY FEEDING THAT INCLUDES FORTIFIED CEREAL OR IRON SUPPLEMENTS UNTIL AT LEAST 18 MONTHS**
- **DELAYED UMBILICAL CORD LIGATION**
- **WHERE HOOKWORM AND SCHISTOSOMIASIS ARE A SIGNIFICANT CAUSE OF BLOOD LOSS THEY SHOULD BE TREATED**
- **MAKE READILY AVAILABLE AND PROMOTE METHODS FOR CHILD SPACING**

# MULTIPLE NUTRIENT SUPPLEMENTATION

## MULTIPLE SUPPLEMENTATION FORMULA - BASIC NUTRIENTS

UNICEF/WHO/UNU 1999

**Vitamin A**

**Thiamin**

**Vitamin E**

**Riboflavin**

**Vitamin D**

**Niacin**

**Vitamin B12**

**Folic Acid**

**Iron**

**Zinc**

# MULTIPLE SUPPLEMENTATION

## PROPOSED FORMULA

<b>Vit A</b>	<b>800 ug</b>	<b>Thiamin</b>	<b>14 mg</b>
<b>Vit C</b>	<b>70 mg</b>	<b>Riboflavin</b>	<b>14 mg</b>
<b>Vit D</b>	<b>200 IU</b>	<b>Niacin</b>	<b>18 mg</b>
<b>Vit E</b>	<b>10 mg</b>	<b>Pyridoxine</b>	<b>1.9 mg</b>
<b>Vit B12</b>	<b>2.6 mg</b>	<b>Folic Acid</b>	<b>400 ug</b>
<b>Iron</b>	<b>30 mg</b>	<b>Zinc</b>	<b>15 mg</b>
<b>Copper</b>	<b>2 ug</b>	<b>Selenium</b>	<b>65 ug</b>
<b>Iodine</b>	<b>150 ug</b>		

[UNICEF/WHO/UNU 1999]

# **MULTIPLE SUPPLEMENTATION**

## **UNICEF SCHEDULE FOR SUPPLEMENTS**

### **WEEKLY**

**ADOLESCENTS**

**NON PREGNANT/NON LACTATING  
WOMEN**

### **DAILY**

**PREGNANT WOMEN**

**LACTATING WOMEN - TO 3 MONTHS  
POST PARTUM**

# **GROUPS WITH SPECIAL NEEDS**

**INFANTS - IRON TO SUPPLEMENT  
BREAST MILK**

**TERM - 4 - 6 MONTHS**

**LOW BIRTH WEIGHT: 2-4 MONTHS**

**PREGNANT WOMEN**

# **MULTIPLE NUTRIENT FORTIFICATION**

**FOR MARGARINE, COOKING OIL AND  
LOW FAT MILKS**

**VITAMINS A & D**

**CONSIDER OTHER VEHICLES**

# **WHY MULTIPLE NUTRIENT FORTIFICATION?**

- **IT EITHER ELIMINATES OR LOWERS THE FREQUENCY AND SEVERITY OF THE DEFICIENCIES OF THE NUTRIENTS ADDED**
- **IT CAN ACHIEVE NEAR UNIVERSAL COVERAGE**
- **IT IS HIGHLY COST EFFECTIVE**

# MULTIPLE CEREAL FORTIFICATION - VENEZUELA

- **FORTIFICATION OF WHEAT FLOUR B1, B2, NIACIN AND FERROUS GLUCONATE AND PRECOKED MAIZE FLOUR THE SAME PLUS VITAMIN A IN 1990 AFTER A NATIONAL SURVEY**
- **PREVALENCE RATES OF 19% ANEMIA AND 37% IRON DEFICIENCY REDUCED TO 10% AND 19% IN TWO YEARS**

# **GENETIC APPROACHES TO IMPROVED MICRONUTRIENT STATUS**

## **QUALITY PROTEIN MAIZE (QPM)**

**INCREASED LYSINE AND TRYPTOPHAN  
CONTENT GIVES IT A PROTEIN QUALITY  
EQUIVALENT TO MILK (Conventional breeding)**

## **GOLDEN RICE**

**INTRODUCTION OF GENES THAT  
GIVE IT BETA CAROTENE AND A  
YELLOWISH COLOR (Transgenic)**

# MULTIPLE FORTIFICATION

**CAN AMINO ACID FORTIFICATION  
SIGNIFICANTLY IMPROVE THE PROTEIN  
VALUE OF DIETS?**

- **WHEAT WITH LYSINE IMPROVED FAMILY PROTEIN S AND IMMUNE STATUS IN PAKISTAN AND CHINA BUT IS RELATIVELY COSTLY**
- **THEREFORE, GENETICALLY IMPROVED CEREAL VARIETIES WOULD BE PRACTICAL**

# GENETIC IMPROVEMENT OF CEREALS

## EXAMPLES

- **QUALITY PROTEIN  
MAIZE (QPM) -  
PROTEIN QUALITY**
- **GOLDEN RICE -  
VITAMIN A ACTIVITY**

# THE LIFE CYCLE APPROACH

**MOST PERSONS BORN WITH THE POTENTIAL FOR A LONG AND HEALTHY LIFE BUT FROM THE MOMENT OF CONCEPTION ONWARD THIS CAN BE IMPAIRED BY NUTRITIONAL AND OTHER ENVIRONMENTAL FACTORS.**

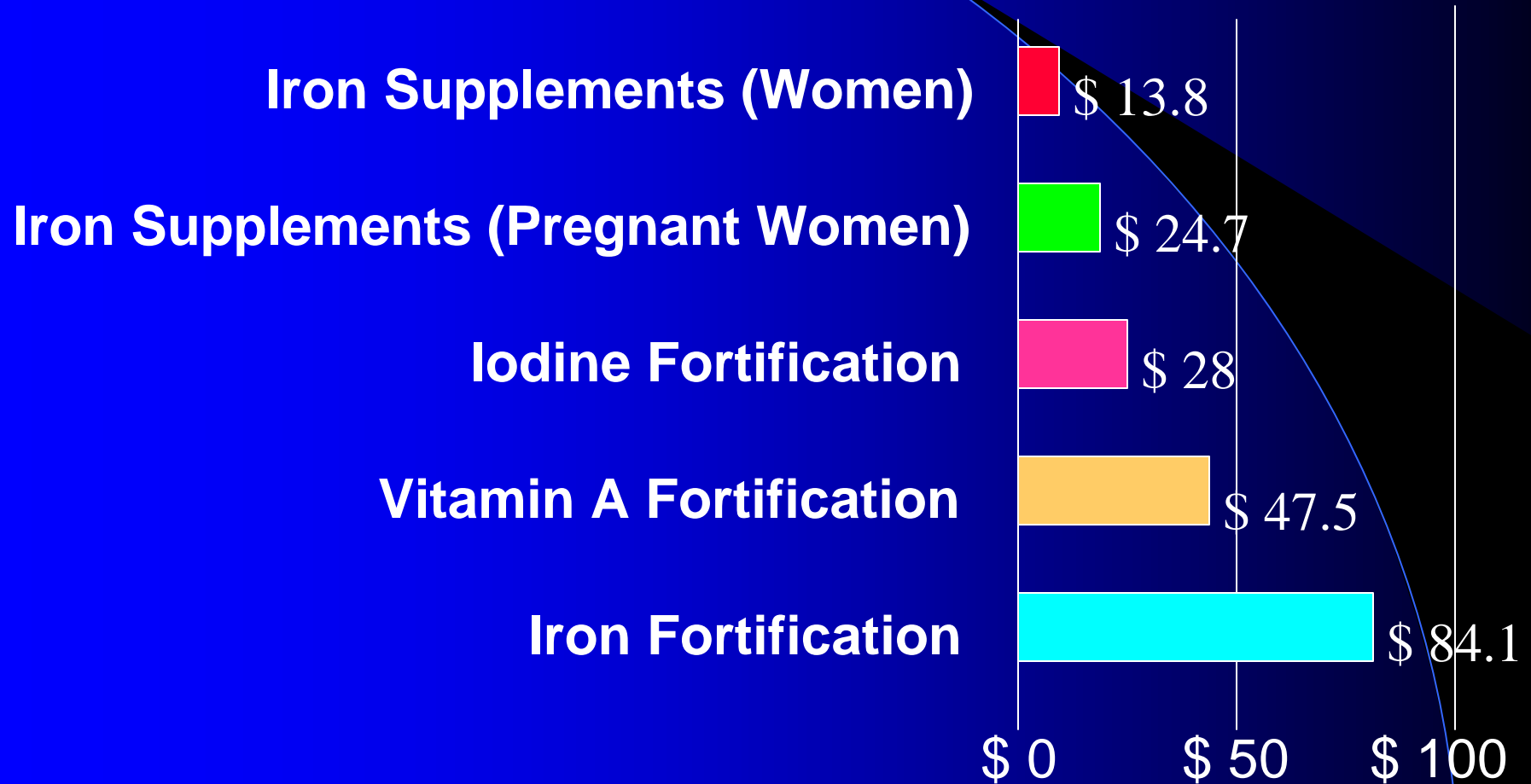
**THE LIFE CYCLE APPROACH CALLS FOR MINIMIZING ADVERSE NUTRITIONAL AND OTHER ADVERSE ENVIRONMENTAL FACTORS AT ALL AGES.**

# **ECONOMICALLY QUANTIFIABLE COSTS OF IRON DEFICIENCY**

- **LOWER FUTURE PRODUCTIVITY OF CHILDREN**
- **LESS EFFECTIVE EDUCATIONAL SYSTEM**
- **LOWER PRODUCTIVITY OF ADULTS**
- **COST OF MATERNAL COMPLICATIONS AND DEATHS**
- **DECREASED IMMUNITY AND INCREASED MORBIDITY**
- **SUSCEPTIBILITY TO HEAVY METAL TOXICITY**

# RELATIVE EFFECTIVENESS OF MICRONUTRIENT INTERVENTIONS

Productivity Gained per Program US \$



*Adapted from Levin, World Bank, 1991*

# A HUMAN RIGHTS APPROACH

## RECOGNIZE:

- **THAT HUNGER AND MALNUTRITION ARE A VIOLATION OF HUMAN RIGHTS**

- **THAT GOVERNMENTS HAVE A MORAL OBLIGATION AS WELL AS ECONOMIC AND SOCIAL REASONS TO STOP THE CONSTANT PHYSICAL AND MENTAL IMPAIRMENT OF FUTURE GENERATIONS**

# A HUMAN RIGHTS APPROACH

## EMPHASIZE:

- THAT INTERNATIONAL HUMAN RIGHTS AGREEMENTS GENERATE A LEGAL OBLIGATION FOR GOVERNMENTS TO TAKE ACTIVE STEPS TO CONTROL IRON DEFICIENCY IN THEIR POPULATIONS

# **A CALL TO ACTION - 1**

- **NATIONAL GOVERNMENTS HAVE AN ECONOMIC, SOCIAL AND MORAL OBLIGATION TO IMPLEMENT THE EFFECTIVE AND AFFORDABLE MEASURES NOW AVAILABLE FOR PREVENTION OF MICRONUTRIENT DEFICIENCIES**

## **A CALL TO ACTION - 2**

**➤ INTERNATIONAL AND BILATERAL AGENCIES NEED TO CHANGE THEIR ATTITUDES TOWARD THE PREVENTION OF IRON DEFICIENCY AMONG THE TWO BILLION PERSONS AFFECTED BY GIVING IT THE HIGHEST OF THEIR PRIORITIES AND RESOURCE ALLOTMENTS FOR THE PREVENTION OF NUTRITIONAL DISORDERS**

# **A CALL TO ACTION - 3**

- **PIECEMEAL AND PILOT EFFORTS ONLY ARE NO LONGER ACCEPTABLE; THE APPROACHES MUST BE MULTIPLE WITH FORTIFICATION OF CEREAL FLOUR, SUPPLEMENTATION OF VULNERABLE GROUPS, PREVENTION OR TREATMENT OF PARASITIC DISEASES WORSENING IRON STATUS, EDUCATION AND PROMOTION,**

## **A CALL TO ACTION - 4**

**PREVENTIVE PROGRAMS WITH FORITFICATION OF CEREAL FLOURS, IRON SUPPLMENTATION OF ADOLSCENT GIRLS AND WOMEN OF CHILDBEARING AGE, PREGNANT WOMEN, SCHOOL CHILDREN AND THOSE IN THE VULNERABLE PERIOD 6 TO 12 MONTHS OF AGE IN DEVELOPING COUNTRIES SHOULD BE PLANNED TO CONTINUE INDEFINITELY**

# **MAJOR CONCLUSIONS AND RECOMMENDATIONS**

- 1. INTERNATIONAL AND BILATERAL AGENCIES AND GOVERNMENTS SHOULD EMBARK IMMEDIATELY ON LONG-TERM MULTIPLE INTERVENTIONS FOR THE PREVENTION OF IRON DEFICIENCY**
- 2. HIGHEST PRIORITY SHOULD BE GIVEN TO THE FORTIFICATION OF STAPLE FOODS**
- 3. WEEKLY PREVENTIVE IRON SUPPLEMENTATION IS RECOMMENDED FOR SCHOOL CHILDREN AND NON-PREGNANT WOMEN OF CHILDBEARING AGE**

# **MAJOR CONCLUSIONS AND RECOMMENDATIONS**

- 4. AS LONG AS WOMEN CONTINUE TO ENTER PREGNANCY ANEMIC, DAILY IRON-FOLIC ACID SUPPLEMENTATION SHOULD BE PROVIDED TO ALL PREGNANT WOMEN**
- 5. PARASITES CONTRIBUTING TO BLOOD LOSS SHOULD BE TREATED, CHILD SPACING PROMOTED, AND DIETARY IMPROVEMENT ENCOURAGED**

**DIVIDER BETWEEN HIDDEN  
HUNGER LECTURE AND  
MULTIPLE FORTIFICATION  
LECTURE**

# THE LIFE CYCLE APPROACH

**MOST PERSONS BORN WITH THE POTENTIAL FOR A LONG AND HEALTHY LIFE BUT FROM THE MOMENT OF CONCEPTION ONWARD THIS CAN BE IMPAIRED BY NUTRITIONAL AND OTHER ENVIRONMENTAL FACTORS.**

**THE LIFE CYCLE APPROACH CALLS FOR MINIMIZING ADVERSE NUTRITIONAL AND OTHER ADVERSE ENVIRONMENTAL FACTORS AT ALL AGES.**

# THE LIFE CYCLE APPROACH

**IN PREGNANCY**

**I**

**UNDERNUTRITION, CHRONIC INFECTION LEAD TO  
LOW BIRTH WEIGHT**

**IODINE DEFICIENCY RESULTS IN IMPAIRED  
COGNITION IN INFANCY AND LATER LIFE**

**ANEMIA, LOW BIRTHWEIGHT LEAD TO LOW  
FETAL IRON STORES**

# THE LIFE CYCLE APPROACH

**LOW BIRTH WEIGHT ASSOCIATED WITH  
ADULT ONSET ; (Barker et al.)**

**HYPERTENSION**

**TYPE-2 DIABETES**

**ESSENTIAL HYPERTENSION**

**CORONARY HEART DISEASE**

**AUTOIMMUNE THYROID DISEASE ETC.**

**WEIGHT AT ONE YEAR SHOWS SOME OF THESE SAME  
RELATIONSHIPS**

# THE LIFE CYCLE APPROACH

## **WEANING PERIOD**

**PROTEIN-ENERGY MALNUTITION 6 - 24 MONTHS  
RESULTS IN STUNTING, POORER LEARNING  
AND LATER REDUCED PHYSICAL CAPACITY  
OF ADULTS (Martorell et al. Chavez et al.)**

**IRON DEFICIENCY ANEMIA RESULTS IN A  
PERMANENTLY REDUCED COGNITIVE  
CAPACITY**

## **SCHOOL AGE**

**MARGINAL UNDERNUTRITION LEADS TO  
REDUCED SCHOOL ATTENDANCE AND  
PERFORMANCE**

# THE LIFE CYCLE APPROACH

## **ADOLESCENTS**

**ANEMIA IN ADOLESCENT GIRLS DIRECT AND LASTING  
EFFECTS**

**LOW CALCIUM INTAKES SET STAGE FOR ADULT  
OSTEOPOROSIS**

**IN SOME POPULATIONS ADOLESCENT OBESITY  
CONTINUES IN ADULTS**

# THE LIFE CYCLE APPROACH

**ADULTS - NUTRITIONAL FACTORS CONTRIBUTING TO:**

**HYPERTENSION**

**OBESITY**

**HIGH SALT DIET**

**HIGH SATURATED FAT INTAKE**

**ATHEROSCLEROSIS**

**OBESITY**

**HIGH FAT DIET ESPECIALLY SATURATED FAT**

**LOW FOLIC ACID, VITAMIN B12, PYRIDOXINE**

**CAUSING ELEVATED BLOOD HOMOCYSTEIN**

**CANCERS**

**30 TO 50% OF HUMAN CANCERS DIET RELATED**

# THE LIFE CYCLE APPROACH

**ELDERLY**

**LOW CALCIUM DIET CONTRIBUTES TO OSTEOPOROSIS**

**MICRONUTRIENT DEFICIENCIES REDUCE MENTAL  
ALERTNESS**

**UNDERNUTRITION CONTRIBUTES TO FRAILNESS**