
بسم الله الرحمن الرحيم
١٤٣٨

Age-appropriate Developmental Requirements in Children, Importance of 1000 days, Child Growth Monitoring, Responsive Caregiving, Recognizing Danger Signs and Taking Timely Actions

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Learning outcomes

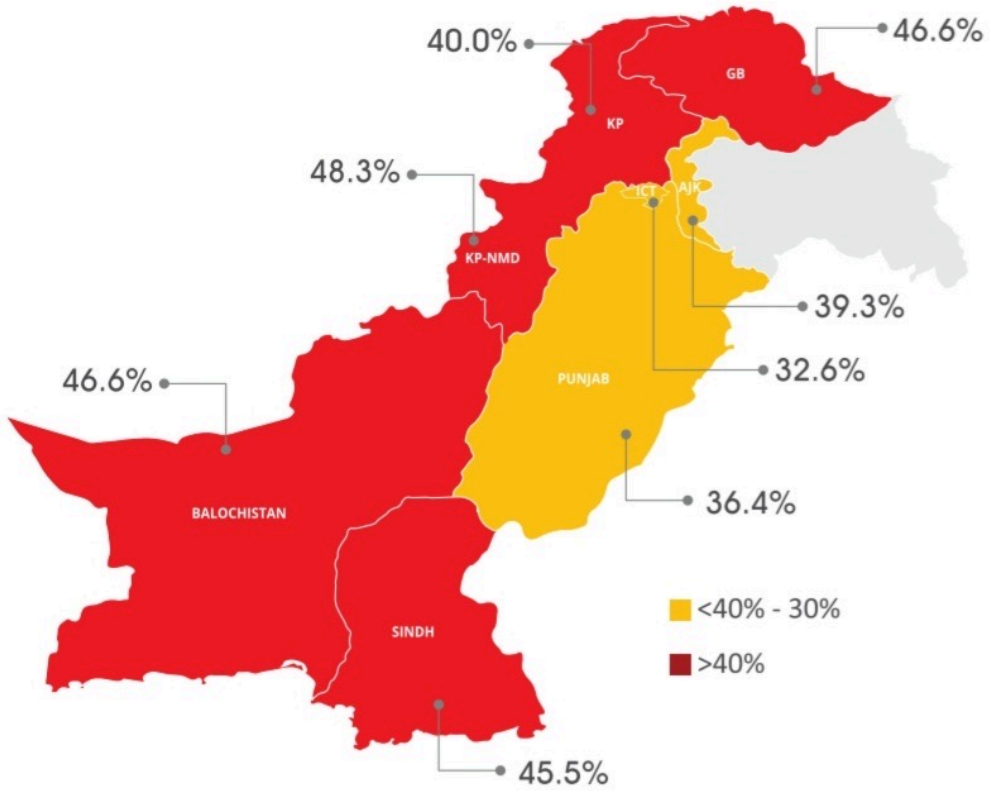
- Brain development stages and role of nutrition
- Role of Breast milk in brain development
- Micronutrients and brain development
- Complementary feeding
- Responsive Caregiving
- Growth monitoring

Disclaimer

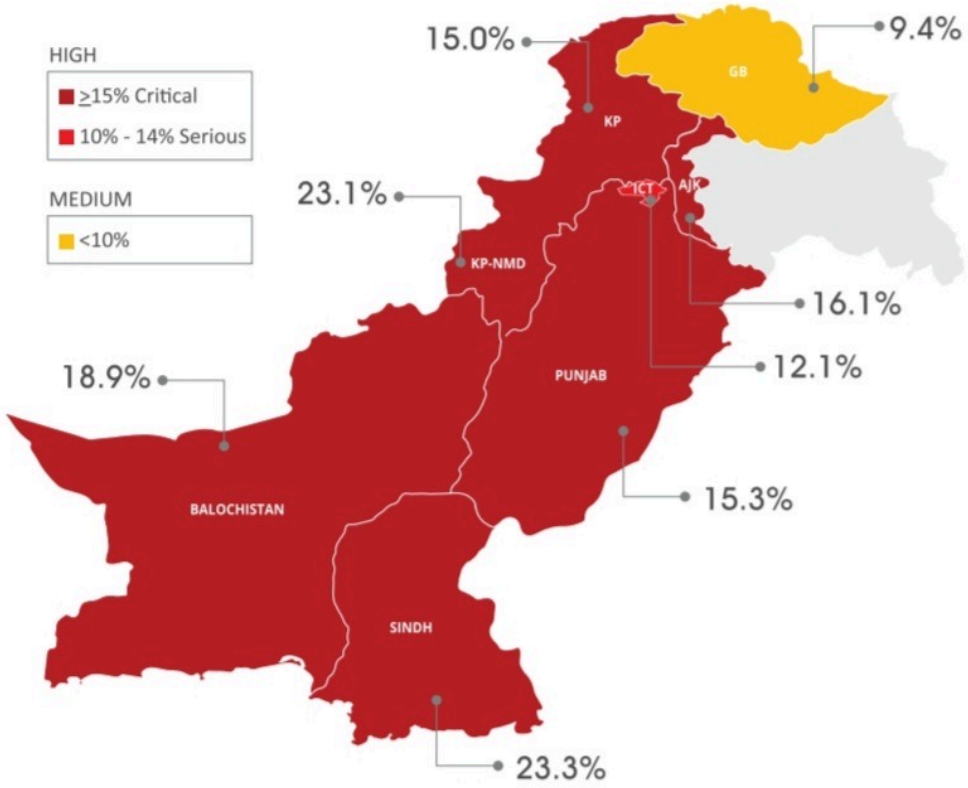
No conflict of Interest

Magnitude of the Problem

Prevalence of Stunting by Province/Region



Prevalence of Wasting by Province/Region



Brain growth Timelines & Influence on Childhood Development

- Myelination: Spurts at 32 weeks gestation and active through the first 2 years
- Monoamine neurotransmitter systems develops in pre-natal life: involved in mediating reward, affect, and mood
- The hippocampus has rapid growth at 32 weeks gestation, through the first 18 months: involved in recognition and spatial memory
- Prefrontal cortex has growth spurt in the first 6 postnatal months: manages attention and multi-tasking
- **Factors affecting early brain development:** Avoiding toxic stress and inflammation, optimal nutrition, environmental factors as strong social support and secure attachment
- Timing of the nutrient deficiency & the brain region's requirement for that nutrient at that time

Critical periods of vulnerability for the developing nervous system: evidence from humans and animal models.*Rice D, Barone S Jr Environ Health Perspect. 2000 Jun; 108 Suppl 3():511-33.*[PubMed] [Ref list]

Nutrient supplementation and neurodevelopment: timing is the key.*Cusick SE, Georgieff MK Arch Pediatr Adolesc Med. 2012 May; 166(5):481-2.*[PubMed] [Ref list]

Brain Development: Role of Nutrition “First 1000 Days”

Neurologic Process	Cell Type	Function	Nutrient Example	At Risk During Late Gestation and 0–3 yrs
ANATOMY	Neurons & Oligodendrocytes	• Division (Neurogenesis) • Migration • Differentiation (Neurite outgrowth; synaptogenesis) • Myelination	• Protein, Carbohydrates, LC-PUFA • Iron, Copper, Zinc, Iodine, Selenium • Vitamin A & D Vitamin B6, Vitamin B12 Vitamin C	Global, Hippocampus, Striatum, Cortex, Retina

Brain Development: Role of Nutrition “First 1000 Days”

Neurologic Process	Cell Type	Function	Nutrient Example	At Risk During Late Gestation and 0–3 yrs
Chemistry	Neuron Astrocyte	• Neurotransmitter Concentration • Receptor, reuptake	• Protein • Iron, Iodine, Copper, Zinc, Selenium, Choline • Vitamin B6, Vitamin D	Global, Hippocampus, Nucleus, Accumbens, VTA, Cortex, Cerebellum
Physiology & Metabolism	Neuron Oligodendrocyte	• Electrical Efficiency	• Glucose, Protein, Iron, Iodine, Zinc, Choline, Copper	Global

IRON & Brain Development

Iron has as a key role in brain development:

- Important for normal anatomic development of the fetal brain myelination
- Development and function of the dopamine, serotonin, and norepinephrine systems
- Kids whose mothers received iron/folic acid supplementation during pregnancy scored better on multiple tests of intellectual, executive, and motor function compared with placebo controls
- Mis-timed or excessive iron may lead to worsening of neurodevelopmental outcomes, as recently shown in a single 10-year follow-up study

Prenatal micronutrient supplementation and intellectual and motor function in early school-aged children in Nepal.*Christian P, Murray-Kolb LE, Khatry SK, Katz J, Schaefer BA, Cole PM, Leclerq SC, Tielsch JM JAMA. 2010 Dec 22; 304(24):271623.*[PubMed] [Ref list]

Iron-fortified vs low-iron infant formula: developmental outcome at 10 years.*Lozoff B, Castillo M, Clark KM, Smith JB Arch Pediatr Adolesc Med. 2012 Mar; 166(3):208-15.* [PubMed] [Ref list]

Iron Supplementation: 6-23 Months WHO Guidelines

Daily iron supplementation is recommended as a public health intervention in infants and young children aged 6–23 months, living in settings where anaemia is highly prevalent,[2] for preventing iron deficiency and anaemia (*strong recommendation, moderate quality of evidence*).

Table A. Suggested scheme for daily iron supplementation in infants and young children aged 6–23 months

TARGET GROUP	**Infants and young children (6–23 months of age)**
SUPPLEMENT COMPOSITION	10–12.5 mg elemental iron[a]
SUPPLEMENT FORM	Drops/syrups
FREQUENCY	Daily
DURATION	Three consecutive months in a year
SETTINGS	Where the prevalence of anaemia in infants and young children is 40% or higher[b]

[a] 10–12.5 mg of elemental iron equals 50–62.5 mg of ferrous sulfate heptahydrate, 30–37.5 mg of ferrous fumarate or 83.3–104.2 mg of ferrous gluconate.

Zinc; Iodine, Essential Fatty Acids and Brain Development

- **Zinc** is necessary for normal neurogenesis and migration, myelination, synaptogenesis, regulation of neurotransmitter release in GABA-ergic neuron and ERK1/2 signaling particularly in the fetal cortex, hippocampus, cerebellum and the autonomic nervous system.
- Behaviorally, early life zinc deficiency results in poorer learning, attention, memory and mood
- **Iodine's** vital role in brain development is thyroid hormone synthesis.
- The developing fetal brain is most susceptible to iodine deficiency during the first trimester, when fetal T3 production depends entirely upon supply of maternal T4.
- Severe iodine deficiency can result in cretinism, marked by deficits in hearing, speech, and gait and IQ of approximately 30
- Essential Fatty Acids: (Docosahexaenoic acid, Omega-3) are vital for cell membrane synthesis; the brain, retina and other neural tissues are particularly rich in long-chain polyunsaturated fatty acids (LC-PUFA)

Zinc deficiency and neurodevelopment: the case of neurons.*Adamo AM, Oteiza PI Biofactors. 2010 Mar-Apr; 36(2):117-24.* [PubMed] [Ref list]

Developmental zinc deficiency and behavior.*Golub MS, Keen CL, Gershwin ME, Hendrickx AGJ Nutr. 1995 Aug; 125(8 Suppl):2263S-2271S.* [PubMed] [Ref list]

Iodine deficiency in pregnancy: the effect on neurodevelopment in the child.*Skeaff SA Nutrients. 2011 Feb; 3(2):265-73.*[PubMed] [Ref list]

Breast Milk & Brain Development

Rapid brain development: Brain mass doubles its volume by the end of 1st year

Breast Milk is Ideal: with *Automatic Composition Change* as per baby's requirements and a dose response relationship between early breast milk intake and later IQ

- *Poly unsaturated fatty acids* Omega 3 DHA (docosahexaenoic acid) highly concentrated in brain: helps modulating inflammatory response, regulate gene expression and influence cell membranes in highly functional areas, brain & retina
- Predominant breastfeeding in 1st- 28 days of life was associated with a greater deep nuclear gray matter volume at term equivalent age and *better IQ, academic achievement, working memory, and motor function* at 7 years of age *in very preterm infants*.
- Helps in *white matter development*

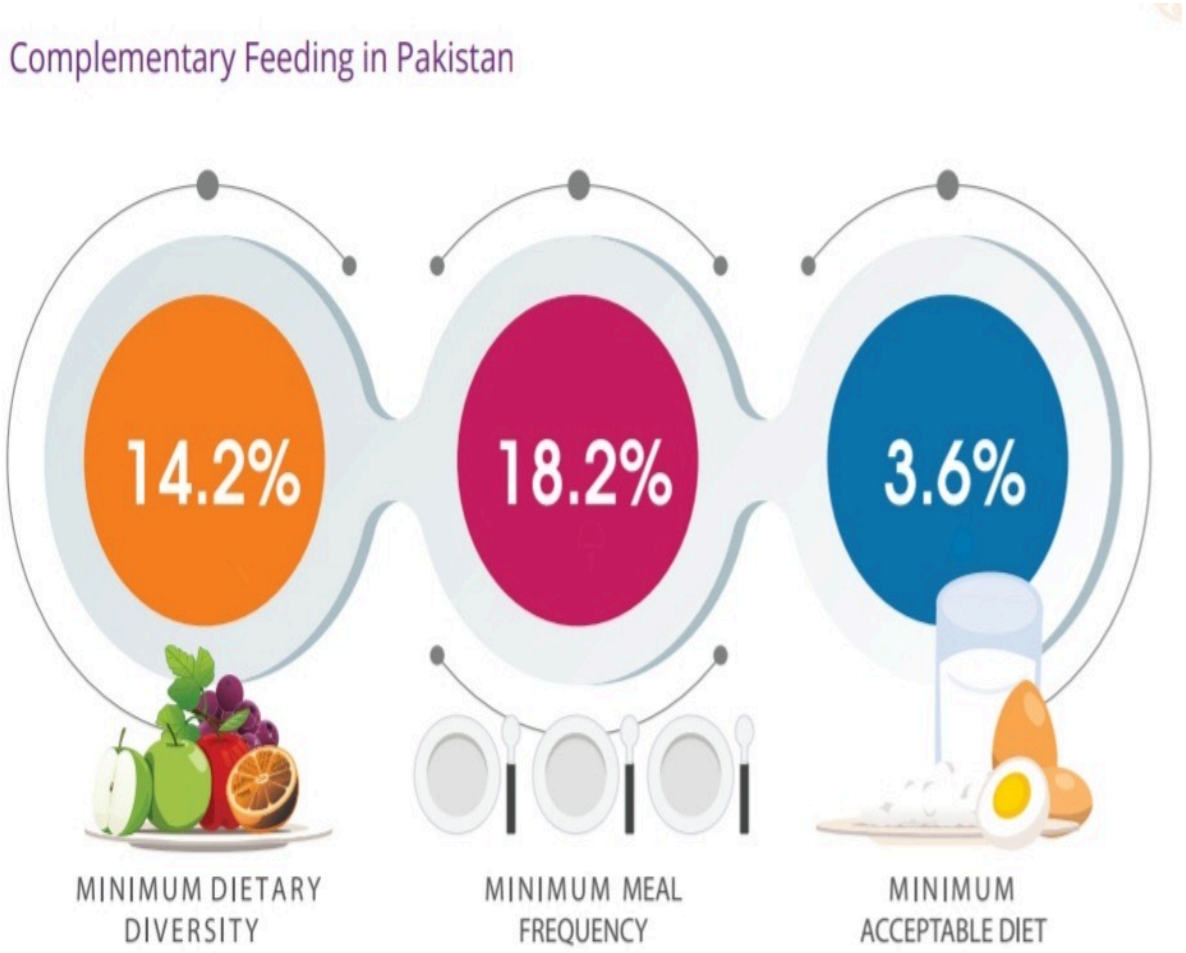
Maternal Nutrition: Breast milk is relatively deficient in iron (Fe) and zinc (Zn), but they are efficiently absorbed. Vit B1, B6, B12, D & DHA(Docosahexaenoic acid) levels in Breast milk depend on maternal nutrition.

Ital J Pediatr. 2021; 47: 109; Published online 2021 May 8. doi: 10.1186/s13052-021-01061-0, Macronutrient Balance and micronutrient amount through growth and development; Giovani Savarino et al

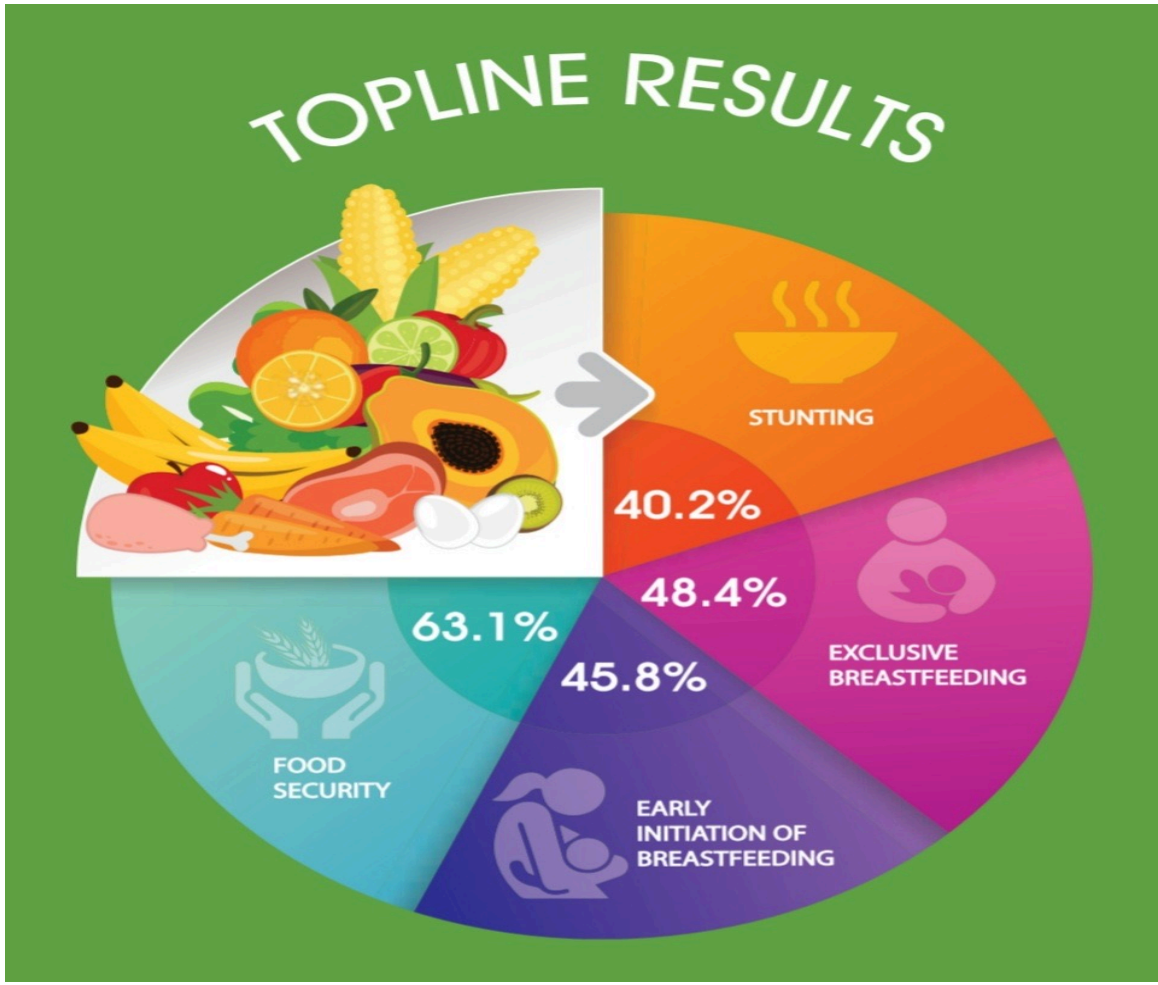
Volume 177, October 2016, Pages 133-139.e1Breast Milk Feeding, Brain Development, and Neurocognitive Outcomes: A 7-Year Longitudinal Study in Infants Born at Less Than 30 Weeks' Gestation

Magnitude: Cause & Effect of Problem

CAUSE



EFFECT

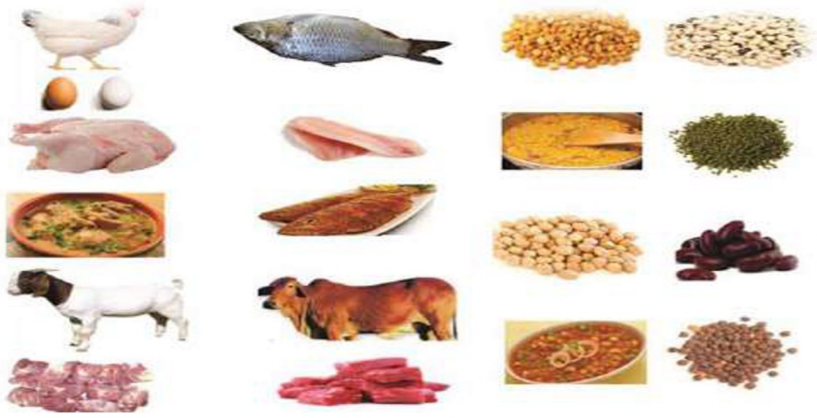


Complementary Feeding: Minimal Acceptable Diet: Food Diversity

GRAINS

VEGETABLES

FRUITS



PROTEINS

DAIRY

OIL & FAT

Food Diversity:

Responsive Caregiving: Is it optimal ?

Responsive caregiving:

- The ability of the caregiver to notice, understand, and respond to the child's signals in a timely and appropriate manner.
- Refers to parents and caregivers supporting the learning of babies by sitting close to babies during play
- Offering verbal and non-verbal gestures to communicate, support & assurance, as the baby explores and plays.
- Responsive caregiving is essential for ensuring children's health, nutrition, safety and security.
- It is negatively influenced by: Poor maternal physical and especially mental and emotional health
- Screen dependency and too much of screen time, is also turning as a barrier to responsive care giving

WHO Guidelines on Improving early childhood development 2018

WHO Recommendation for Early Childhood Development

1 RESPONSIVE CAREGIVING

All infants and children should receive responsive care during the first 3 years of life; parents and other caregivers should be supported to provide responsive care.

Strength of recommendation: Strong
Quality of evidence: Moderate (for responsive care)

2 PROMOTE EARLY LEARNING

All infants and children should have early learning activities with their parents and other caregivers during the first 3 years of life; parents and other caregivers should be supported to engage in early learning with their infants and children.

Strength of recommendation: Strong
Quality of evidence: Moderate (for early learning)

3 INTEGRATE CAREGIVING AND NUTRITION INTERVENTIONS

Support for responsive care and early learning should be included as part of interventions for optimal nutrition of infants and young children.

Strength of recommendation: Strong
Quality of evidence: Moderate

4 SUPPORT MATERNAL MENTAL HEALTH

Psychosocial interventions to support maternal mental health should be integrated into early childhood health and development services.

Strength of recommendation: Strong
Quality of evidence: Moderate

World Health Organization

Monitoring of Growth & Development: Identifying Waning Signs

Vital intervention for ECD; Regular monitoring of growth & development:

- Well baby clinics
- Breast feeding Clinics, promotion & support
- Anthropometry; weight, length/height, OFC
- Developmental mile stones (motor, cognitive, social)
- Vaccination status
- Identifying micro/macronutrient deficiencies
- Nutritional counselling
- Promoting positive parenting
- Responsive Caregiving

QUESTIONS

THANK YOU

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