UNDER 5-YEAR-OLD CHILD'S GROWTH AND NUTRITION

A poor start of life can lead to poor health and inadequate learning. Childhood development is a growth process of perceptual, motor, cognitive, language, socio-economical and self-regulation skills. Health, nutrition, responsive caregiving, security and safety, and early learning are domains on nurturing care for children to reach their developmental potential.

Picture: Family - Family of four - 00 - Nigeria, USAID/SPRING-UNICEF IYCF Image Bank

NUTRITION RELATED CHILD MORTALITY

Child mortality rates

In Sub-Saharan Africa mortality rate of new-borns is 38 percent. Children have the highest risk of dying in their first months, after the first month but before age 1 and before turning 5 years. In sub-Saharan Africa about 1 new-borns from 36 dies in their first month and 1 child in 13 dies before child´s fifth birthday. Each year undernutrition, fatal growth restriction, stunting, wasting and micronutrient deficiencies and suboptimum breastfeeding underlie nearly 3,1 million deaths of children younger than five years worldwide. Suboptimum breastfeeding and fatal growth restriction together are responsible over 1,3 million deaths of all deaths among children under age five years. Stunting is a commonly used indicator of chronic undernutrition and it increases rapidly after age six months, by 24-month 50 percent of children in low-and-middle income countries are stunted. Widely used measure of child mortality is the under -five mortality rate.

A staggering 43 percent on children under five years of age living in low- and middle-income countries are at risk of suboptimal development due to poverty and stunting. Stunting prevalence is highest in the poorest population and in rural areas. Mortality rates among young children are the best single indicator of child health in low- and middle-income countries. They are also used as indicators of general social and economic development.

Country, regional and global estimates of mortality among children under age 5 and children aged 5–14 & Estimates of mortality among children under age 5 and children aged 5–14 by Sustainable Development Goal region.

(Hug, Sharrow & You, 2017, 30)

Country, regional and global estimates of mortality among children under age 5 and children aged 5–14

	Under-five mortality rate (U5MR) with 90 per cent uncertainty interval (deaths per 1,000 live births)									Number of under-five deaths with 90 per cent uncertainty interval (thousands)					
	1990			2016			Annual rate of reduction (ARR) (per cent) 1990-2016			1990			2016		
Country	U5MR	Lower bound	Upper bound	U5MR	Lower bound	Upper bound	ARR	Lower bound	Upper bound	Underfive deaths	Lower bound	Upper bound	Underfive deaths	Lower bound	Upper bound
United Republic of Tanzania	179	169	189	57	46	71	4.4	3.6	5.2	192	181	203	117	96	146

Estimates of mortality among children under age 5 and children aged 5–14 by Sustainable Development Goal region

	Under-five mortality rate (U5MR) with 90 per cent uncertainty interval (deaths per 1,000 live births)									Number of under-five deaths with 90 per cent uncertainty interval (thousands)					
	1990			2016			Annual rate of reduction (ARR) (per cent) 1990-2016			1990			2016		
Country	U5MR	Lower bound	Upper bound	U5MR	Lower bound	Upper bound	ARR	Lower bound	Upper bound	Underfive deaths	Lower bound	Upper bound	Underfive deaths	Lower bound	Upper bound
Sub-Saharan Africa	183	179	187	79	73	89	3,2	2,8	3,5	3,787	3,714	3,869	2,777	2,570	3,113

Country, regional and global estimates of mortality among children under age 5 and children aged 5–14 & Estimates of mortality among children under age 5 and children aged 5–14 by Sustainable Development Goal region.

(Hug, Sharrow & You, 2017)

Country, regional and global estimates of mortality among children under age 5 and children aged 5–14

	Number of under-five deaths with 90 per cent uncertainty interval (thousands)				Infant mortality rate (deaths per 1,000 live births)		Number of infant deaths (thousands)		Neonatal mortality rate (deaths per 1,000 live births)		Number of neonatal deaths (thousands)		Probability of dying among children aged 5–14 (deaths per 1,000 children aged 5)		Number of deaths among children aged 5–14 1990 2016 (thousands)	
Country	Male 1990	Female 1990	Male 2016	Female 2016	1990	2016	1990	2016	1990	2016	1990	2016	1990	2016	1990	2016
United Republic of Tanzania	185	172	60	53	108	40	118	84	41	22	47	46	31	12	23	20
Estimates of mortality among children under age 5 and children aged 5–14 by Sustainable Development Goal region																
Sub-Saharan Africa	192	173	84	73	109	54	2,301	1,910	46	28	1,008	1,003	42	19	604	513

UNDERNURTITION

Undernutrition associates with morbidity and mortality

Stunting, wasting, and underweight are associated with death from diarrhea, pneumonia, measles, and other infectious diseases, also malaria has complex interplay between undernutrition and infection. Association between micronutrient deficiencies and mortality is established. Vitamin A deficiency increases the risk of severe diarrhea and diarrhea mortality. Other micronutrient deficiencies, such as zinc, is associated with increased risk of morbidity and mortality.

Undernutrition´s impact for growth and child´s development

Undernutrition has important consequences for physical and cognitive growth and development. Malnutrition leads to early physical growth failure, delayed motor, cognitive and behavioural development, it diminished immunity and increased morbidity and mortality. Those children who survived malnutrition in early childhood have disadvantages compared with those who have had adequate nutrition and a healthy environment in life.

Undernutrition is associated with shorter adult height, less schooling, and reduced economic productivity and low offspring birth weight. Undernutrition in childhood is also associated with increased risk of developing metabolic syndrome and cardiovascular disease, systolic hypertension, obesity, insulin resistance, and diabetes in adulthood. Malnutrition in childhood includes diminished intellectual performance, low work capacity, and increased risk of delivery complications.

How to improve nutrition surveillance and nutrition?

Health workers should be trained on anthropometric measurements, on growth monitoring and promotion, and the WHO Child Growth Standards. Nutrition surveillance has improved in nutrition services by strengthening health workers skills and ensuring the availability of equipment. Also counselling on infant and young child feeding and management of severe acute malnutrition is important.

Picture: Sick Baby Health Care - Malnourished baby 6-24 mo - 00 - Niger, USAID/SPRING-UNICEF IYCF Image Bank

CHILD GROWTH AND ANTHROPOMETRIC MEASUREMENTS

Childs growth is a critical indicator of child health and WHO identifies growth assessment as the beast single measure to define child´s nutritional status and health. Failure to grow at an appropriate rate may be associated with primary growth disorder, or due of general failure, infections or poor feeding practise.

Measurements of growth, body dimensions and body composition are easy, rapid and non-invasively performed. It is important that measurements are performed consistently, using appropriate equipment and made by trained staff.

Height

During the first year of life infant grows more rapidly than in any other period of his or her life. During the first months an infant can grow 2,5 cm in a month and 2 years old child has approximately gained half the adult height, meaning that 50% of growth has occurred in the first two years. In childhood starts slowly growth around age 2 to 3 years, and it continues until puberty. By age eight most children have gained three quarters of their final height.

Measuring height before Child can stand

Height is traditionally measured lying down until age 2 to 3 years. This measurement needs to have two persons, one hold head and other straighten the knees and hold feet flat against footboard while measurement is taken. Standing height measurement is recommended from 2 years of age. It is commonly used as soon as child can stand.

Picture: Sick Baby Health Care - Sick baby being measured at clinic 9-12 mo - 01A - Non-country specific, USAID/SPRING-UNICEF IYCF Image Bank

Measuring height after Child can stand

Measurement is performed without shoes and the head is held so that child looks forward with heels and back in contact with an upright wall. Repeated height measurement should be taken at the time of day. Growth is not a continuous process, it has growth spurts and stops and seasonal variations in growth. In the first 6 months child grows around 14 cm, and by the age of 2 years growth rate is 9 cm per year.

Percentage of final height achieved:

Age (years)	Boys (%)	Girls (%)
2	50	52
3	55	58
4	58	62
5	62	66
6	66	69
7	69	73
8	73	77
9	76	80
10	78	83
11	81	87
12	84	92
13	88	97
14	92	98
15	97	100
16	99	100
17	100	100

(Holden & MacDonald 2000, 163)

Measuring weight

Infants under 2 years of age are usually measured naked, and then after in light clothing only, nappies and shoes are removed. Infant scales are graduated to 10 g, and toddlers to 100 g. Weight gain is a poor guide to estimate child's health, because it says nothing about nutritional status.

Picture: Sick Baby Health Care - Sick baby being weighed at clinic 9-12 mo - 02B - Non-country specific, USAID/SPRING-UNICEF IYCF Image Bank

Measuring skinfold thickness

Skinfold thickness gives an indication of subcutaneous fat and hence of nutritional status. Measurement is made by pinching the skin between two fingers and measuring the skinfold thickness by using skinfold callipers. A trained person can reach an accuracy of 1,0 to 1,5 mm. Standard sites for skinfold measurement are triceps and subscapular areas.

Picture: University of Cambridge/MRC Epidemiology Unit / Take Part / Typical Visit / Paediatric measures for babies and children/Subscapular

Measuring mid-upper arm circumference, MUAC

Mid-arm circumference (mid-upper arm circumference, MUAC) is an easy measurement to perform, and error is less than 0,5 cm. Measurement is taken at the midpoint of the upper arm. Despite bone, muscle, fat and skin, the mid-arm circumference gives a good reflection of nutritional status. It can be used in all age groups to estimate under- and overweight.

Picture: Baby Health Care - Measuring a child's arm 12-24 mo - 00 - Non-country specific, USAID/SPRING-UNICEF IYCF Image Bank

Measuring head circumference

Head circumference can be most accurate and repeatable measurement. The maximum head circumference is taken from the midpoint of the forehead to the occipital prominence. Measurement should be made to the nearest millimetre and it is routinely measured up until the age of 2 years. The head circumference and mid-arm circumference are easily performed and reproducible measurements in, and are independent from age and sex, and can be used to recognise both over- and under-nutrition.

Picture: University of Cambridge/MRC Epidemiology Unit / Take Part / Typical Visit / Paediatric measures for babies and children/Head circumference

CRITERIA FOR SEVERE ACUTE MALNUTRITION (SAM)

WHO and UNICEF recommend the use of a cut-off for weight-for-height of below -3 standard deviations (SD) of the WHO standards to identify infants and children as having severe acute malnutrition (SAM). Children below this cut-off have a highly elevated risk of death compared to those who are above, and they have a higher weight gain when receiving a therapeutic diet and faster recovery compared to other diets. Children with a MUAC less than 115 mm have a highly elevated risk of death.

Weight-for -length -standard deviations (SD)

The new WHO growth standards confirm that the effect of ethnic differences on the growth of infants and young children in populations is small. WHO has defined severe malnutrition in children as a weight-for-height is below -3 SD and/or the presence of oedema. After the WHO released child growth standards, analysis showed that children with a weight-for-height below -3 SD have a 9 times higher risk of death than children with a weight-for-height above -1 SD.

Using the new WHO standards increases 2–4 times the number of infants and children falling below -3 SD compared to using the former reference. Weight-for-height below -3 SD is a highly specific criterion to identify severely acutely malnourished infants and children. Children with weight-for-height above -2 SD and below -1 SD, have a lower mortality risk than children under -3 SD. Child with a weight-for-height above -1 SD have an even lower risk of death. Children admitted at -3 SD weight-for-height, a decrease to -2 SD and -1 SD corresponds on 9% and 19% weight gain. For children with oedema, the same criterion should be used with the weight after oedema has disappeared.

Mid-upper arm circumference -standard (MUAC)

Using MUAC as diagnostic criteria showed that the risk of dying is in-creased under 115 mm. The risk of death in these cut-offs requires the implementation of intensive nutritional and medical support. WHO standards for MUAC-for-age, the recommended MUAC cut-off of 110 mm as an independent diagnostic criterion for severe acute malnutrition was necessary. A higher cut-off of 115 mm is recommended as it will identify more infants and children with severe acute malnutrition.

Using a 3-colour tape:

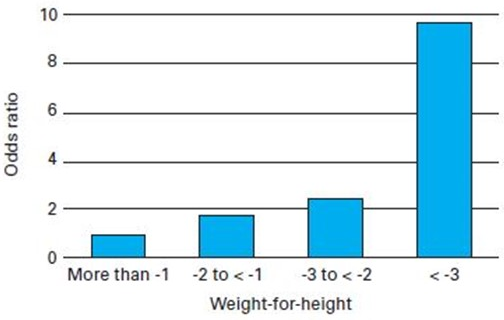
- Red (≤115mm) means Severe Malnutrition: The child should be immediately referred for treatment.
- Yellow (115 – 125mm) means Moderate Malnutrition and risk of Severe Malnutrition: the child should be immediately referred for supplementation and is at risk of severe acute malnutrition.
- Green (≥125mm) means no risk of Malnutrition: the child is well nourished.

Criteria for severe acute malnutrition (SAM).

Diagnostic criteria for SAM in children aged 6–60 months		
Indicator	**Measure**	**Cut-off**
Severe wasting (2)	Weight-for-height (1)	< -3 SD (standard deviations)
Severe wasting (2)	MUAC (mid-upper arm circumference)	< 115 mm
Bilateral oedema (3)	Clinical sign	
1 Based on WHO Standards (www.who.int/childgrowth/standards) 2,3 Independent indicators of SAM that require urgent action		

(A Joint Statement by the World Health Organization and the United Nations Children's Fund)

Odds ratio for mortality by weight-for-height.



(A Joint Statement by the World Health Organization and the United Nations Children's Fund)

NUTRITION´S IMPACT TO CHILD´S MENTAL DEVELOPMENT

The conditions that affect the health and growth of children in the first 1,000 days can also affect mental development. These elements include pregnancy nutritional status of the mother, child´s birth weight and linear growth of the infant, and child birth conditions, mother´s mental health and environmental conditions. Short length- or height-for-age is one of the strongest risk factors for poor mental development.

Good nutrition is essential for children to achieve their full developmental potential. Deficiencies of essential vitamins and minerals have effects on child survival and development. Deficiencies of vitamin A and zinc adversely affect child health and survival. Deficiencies of iodine and iron can together with stunting limit the ability of children to realize their developmental potential.

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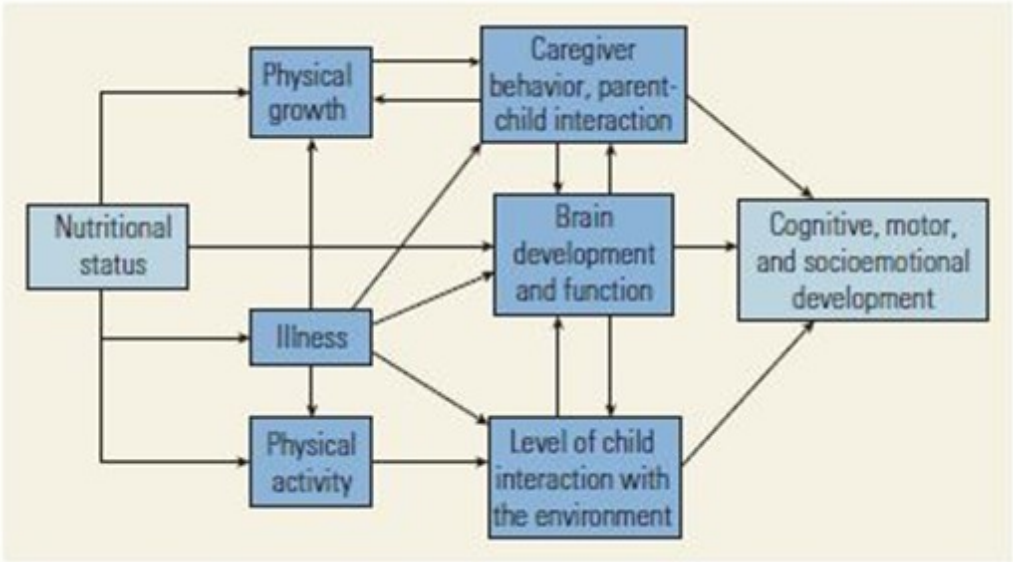
It is not clear why length and height are so strongly related to cognitive and language development, it may be that linear growth nutrition processes are related to brain and behavioural development. One conclusion is that nutrients support the structure and activity of brain for mental development, other conclusion offers that nutrition enhances health and engagement with the environment and so promotes mental development.

Illustrating Pathways from Nutritional Status to Mental Development:

(Aboud & Yousafzai 2016)



Effect of micronutrient's in Child´s development

Short length- or height-for-age is one of the strongest risk factors for poor mental development. It is not clear why length and height are so strongly related to cognitive and language development, it may be that linear growth nutrition processes are related to brain and behavioural development. One conclusion is that nutrients support the structure and activity of brain for mental development, other conclusion offers that nutrition enhances health and engagement with the environment and so promotes mental development.

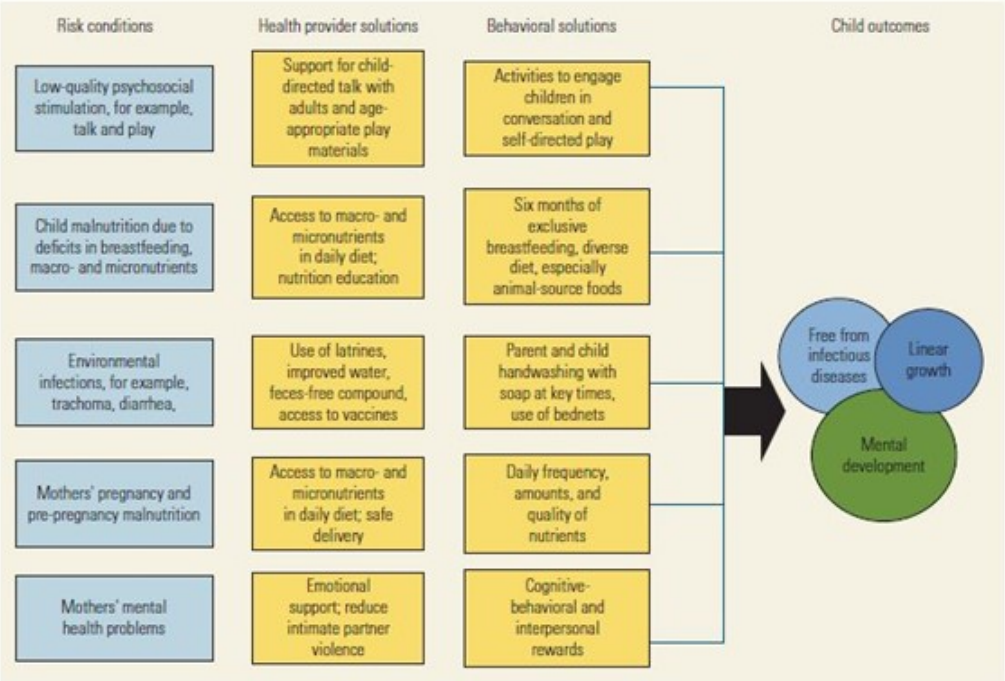
Mental development

Developmental potential is the ability to think, learn, remember, relate, and articulate ideas appropriate to age and level of maturity, and an estimated 39 percent of the world's children under age five years do not attain this potential. Early disadvantageous conditions from conception through the first 24 months of life can impair brain´s normal development. Failure is often progressive and is noticed not until school begins. Impairment can lead to gradual deletion of unused brain synapses. The lack of synapses use may be due to the absence of stimulation in the family environment or lack of available energy for brain activity.

Children who do not have good vocabulary in the early years will have difficulties to learn how to read and children who do not learn strategies to solve simple problems in the first 24 months will have difficulties to understand math concepts. A second reason for take care of early mental development is that individuals are healthier and more productive if their mental skills have full-grown. More educated adults are healthier and wealthier than less educated adults and educated mothers have healthier children, they are more likely to recognize symptoms of illness, they follow medical advice and feed their children nutritious foods.

The conditions that affect the health and growth of children in the first 1,000 days can also affect mental development. These elements include:

1. Pregnancy nutritional status of the mother.
2. Child´s birth weight and linear growth of the infant.
3. Child birth conditions.
4. Mother´s mental health
5. Environmental conditions.



Conditions That Put Children at Risk of Poor Mental Development, and Solutions En-tailing Health Provider Support and Parental Behaviour Changes:

(Aboud & Yousafzai 2016)

NEW-BORN, INFANT AND CHILD NUTRITION

Picture: Counseling - Breastfeeding counseling - 01B - Non-country specific, USAID/ SPRING-UNICEF IYCF Image Bank

Mother´s influence on child´s nutrition

Child´s nutrition status starts before birth. Maternal nutritional status and maternal stunting and underweight lead to small for gestational age and prematurity. Fatal growth restriction is an important contributor to stunting and wasting in children. Optimal infant and young child feeding means that mothers receive optimal antenatal care, are empowered to initiate breastfeed within one hour of birth, continue breast feeding for the first six months and keep on breast feeding for two years or more.

Counselling and educational interventions increased early breastfeed by 43 percent at day one, by 30 percent until age one month, and by 90 percent from age one month to age five months. Significant reductions with mothers who do not breastfeed, reduction at day one is 32 percent, 30 percent until one month, and 18 percent for one month to five months. Combined individual and group counselling is more efficient than individual or group counselling alone.

Breastfeeding (BF)

Breastfeeding within 24 hours of birth is associated with a 44–45 percent reduction in all-cause and infection-related neonatal mortality. Interventions to promote breastfeeding are a key component of expanding its use. All babies are they well or sick, preterm or term, new-born or toddler benefit from being breastfeed.

Breastmilk changes to suit baby´s needs. It changes from colostrum (a form of milk few days after birth) to mature milk and it changes during feeding. Mature milk also changes from day to day and between feeding. At the beginning of feeding breast milk´s lactose content is high and has low fat, and at the ending of feeding milk has four to five times fatter and provides more calories and is more satisfying. It is important that baby gets high lactose and high fat parts of the milk. Therefore, mothers should allow baby to empty first breast before nursing the second breast. Babies who are breastfeed receive great protection against disease in long ang short term. Breastfeeding is also beneficial to mother, because it reduces risk of breast and ovarian cancer, and osteoporosis.

Evidence show that breastfed babies have better mental development and children who have been breastfed longer had higher verbal intelligence at age six years. Breast milk´s important nutrient fatty acids have relation to mental development in high-income-countries. Long-chain polyunsaturated fatty acids support mental development and supplementation with a milk lipid, ganglioside, has positive effects on early mental development. Mental development benefits of fatty acids in colostrum.

Picture: Breastfeeding - Exclusive breastfeeding 0-6 mo - 01B - Non-country specific, USAID/SPRING-UNICEF IYCF Image Bank

Colostrum

Colostrum (a form of milk few days after birth) is produced for the first 3–4 days after baby is born. It is valuable fluid, highly concentrated nutrition to the new-born. Fat and lactose content is less than it is in breastmilk, but it contains higher concentration of fat-soluble vitamins such as vitamin A and E. Colostrum has a vital part in protecting infant from infections. The anti-infective properties of lactoferrin, immunoglobulins and lysosomes are in colostrum in very high concentrations.

Colostrum has a mild laxative effect and helps to clear meconium from the gut. It also prevents bilirubin´s reabsorption. Colostrum´s typical yellow colour is caused by the fact that it has a ten times greater amount of concentrated carotene than breastmilk has. In some cultures, mothers refuse to give yellow-coloured colostrum to new-born. Mothers believe that milk is dirty or spoiled or has been too long in breast. Health-workers must explain and educate mother of the benefits of giving colostrum.

Picture: Breastfeeding - Early initiation of breastfeeding 0-24 mo - 01 - Nigeria, USAID/SPRING-UNICEF IYCF Image Bank

Breastmilk

Breastfeeding provides immunologic, psychological, social, economic, and environmental benefits. The WHO recommends early breastfeeding for infants until age six months to achieve optimum growth. Early breastfeeding reduces the risk of hospitalization for lower respiratory tract infections in the first year by 72 percent.

Any kind of breastfeeding compared with commercial infant formula feeding can reduce the incidence of otitis media by 23 percent, and early breastfeed for more than three months reduces the risk of otitis media by 50 percent. Breastfeeding is associated with a 64 percent reduction in the incidence of nonspecific gastrointestinal tract infections and this effect lasts for two months after breastfeed ending.

Breastfeeding is beneficial for preterm infants because it gives a 58 percent reduction in the incidence of necrotizing enterocolitis. Early breast-feed gives a protective effect for three to four months against the incidence of clinical asthma, atopic dermatitis and eczema. Breastfeed improves nutrition status directly or by reducing infections and morbidity. Promoting early breastfeed is important in preventing both stunting and overweight among children.

Human milk

Human milk contains carbohydrates, fats, protein and vitamins. Lactose is the main carbohydrate and provides 37 percent of baby´s need of energy. Lactose is easily broken into glucose and provides energy to brain and central nervous system. Lactose also helps calcium and iron to absorb and have an impact on enteropathy organism. Breastmilk contains enzyme amylases which helps carbohydrate to digest. Breast milk has plenty of long chain fatty acids.

Fat variations changes during every feed with lowest content in the foremilk and highest in the hindmilk. Fats quantity varies at different time of the day. Of all mammalian milk, mature breast milk has the lowest content of protein, therefore it is easily digested. Breastfed child is protected from the infections his or her mother has been exposed and has become or is becoming immune.

Vitamins quantity varies in breast milk, it contains both fat-soluble and water-soluble vitamins. Vitamin-K is an exception and breastmilk almost always meet the need of on infant, if breastfeed is regular. Because vitamin K is essential to the blood clotting mechanism and the K-vitamin quantity of breastmilk is uncertain, almost all babies should be given prophylactic to prevent haemolytic disease.

Nutrient		Colostrum milk	Transitional milk	Mature milk
Energy	Kcal	56	67	69
	KJ	236	281	289
Protein	g	2,0	1,5	1,3
Fat	g	2,6	3,7	4,1
Carbohydrate	g	6,6	6,9	7,2
Sodium	mg	47	30	15
Calcium	mg	28	25	34
Iron	mg	0,07	0,07	0,07
Retinol	µg	155	85	58
Vitamin C	mg	7	6	4

Composition of human milk

(Holden & MacDonald 2000)

Use of Infant formulae

The WHO and UNISEF International code of marketing of breast milk substitutes, promotes breastfeeding and ensures infant formulae is correctly used. Promoted principals are following: Milk formulae should not be advertised to the public and free samples are not given to the public, and health personnel is not allowed promote milk formulae, there should not be pictures of babies in bottle´s label and all information on milk formulae must include reference to superior nature breastfeeding.

Health workers should ensure that parents know how to make, sterilize and storage infant formulae, teach the proper preparation and use of infant formulae. Formulae should be mixed exactly according the manufactures instructions. When powder is not boiled, and content of minerals and nitrates are saved.

Picture: HIV - Preparing infant formula 0-24 mo - 01 - Tanzania, USAID/SPRING-UNICEF IYCF Image Bank

Complementary feeding (CF)

Complementary feeding for infants refers introduction of safe and nutritional foods in addition to breastfeeding. Clean and nutrient-dense additional foods introduced at age six months and typically provided until age 24 months. Appropriate complementary feeding can significantly reduce stunting during the first two years of life.

The quality of the food received is often inadequate, failing to provide sufficient protein, fat, or micro-nutrients for optimal growth and development. Children may not receive complementary foods at the right age, not being fed frequently enough during the day or food´s quality maybe is being poor. Inadequacy and insufficiency of complementary foods, poor feeding practices, and high rates of infections have unfavourable impacts on health and growth among children. Sufficient quantities of adequate, safe, and appropriate complementary feeding after age six months are essential to meet nutritional requirements when breast milk alone is no longer sufficient.

Complementary feeding interventions are most efficient in reducing malnutrition and promoting adequate growth and development. Complementary feeding should be timely, adequate, appropriate, and given in sufficient quantity. For improving complementary feeding, it is important to provide nutritional counselling for mothers to promote healthy feeding practices. Providing complementary foods offer extra energy, micronutrient fortification and increasing the nutrient density of complementary foods.

Counselling caregivers on the best use of available foods and feeding practices, also provision of micronutrient and food supplements if needed. It is essential to improve maternal knowledge of feeding practices by education and prepare culturally acceptable complementary foods that can lead to increased dietary intake and growth of infants. In health system it is important to secure optimal complementary feeding practices by maternal counselling. Educational messages should be clear and include the promotion of nutrient-rich animal products or protein-rich plant food sources. Among food-insecure populations financial constraints may limit the possibility of adequate amounts of animal products in children's diets.

Special therapeutic foods

Children with severe acute malnutrition are treated with special therapeutic foods, usually with Ready-to-Use-Therapeutic Foods or F75 and F100 milk-based diets. Infants and children 6–60 months of age with a weight-for-height above -3 SD also benefit from these therapeutic diets, and the children who are above -3 SD but are below -3 SD are most likely to benefit from therapeutic feeding.

After 6 months of age

After six months of age child´s food is supplemented by nutritionally adequate, nutrient-dense, safe and age-appropriate feeding of solid, semisolid, and soft foods. Early ending of breast feed and early introduction and poor-quality complimentary feeding dominates.

Follow-on formulae are designed for older infants over age 6 months. They are based on cow´s milk and it contains less protein, calcium and phosphorous than cow´s milk, but more than infant formulae. Follow-on formula should not replace breast milk or standard instant formula, if milk´s volume is adequate (over 400 ml/day). Cow´s milk has low iron, vitamin C and D percentage, and it is not recommended as the main drink before age 1 year, but it can be used in preparation of solid food.

Guidelines on the average number and volume on feeds at different ages

Approximate age	Approximate volume per feed	Number of feeds per day
1–2 weeks	50–70 ml	7–8
2–6 weeks	75–100 ml	6–7
2 months	110–180 ml	5–6
3 months	170–220 ml	5
6 months	220–240 ml	4

(Holden & MacDonald 2000, 35)

Infant and young child feeding

A major component of infant and young child feeding is to provision of breast milk and appropriate, nutrient-dense complementary food. WHO has published IYCF (Infant and Young Child Feeding) simple and practical indicators of appropriate feeding practises for children 6-23 months. It is a core of eight indicators, three for breast feeding (BF) and five for complementary feeding (CF). It includes measures of dietary diversity, feeding frequency and consumption of food with iron as well as appropriate BF practises.

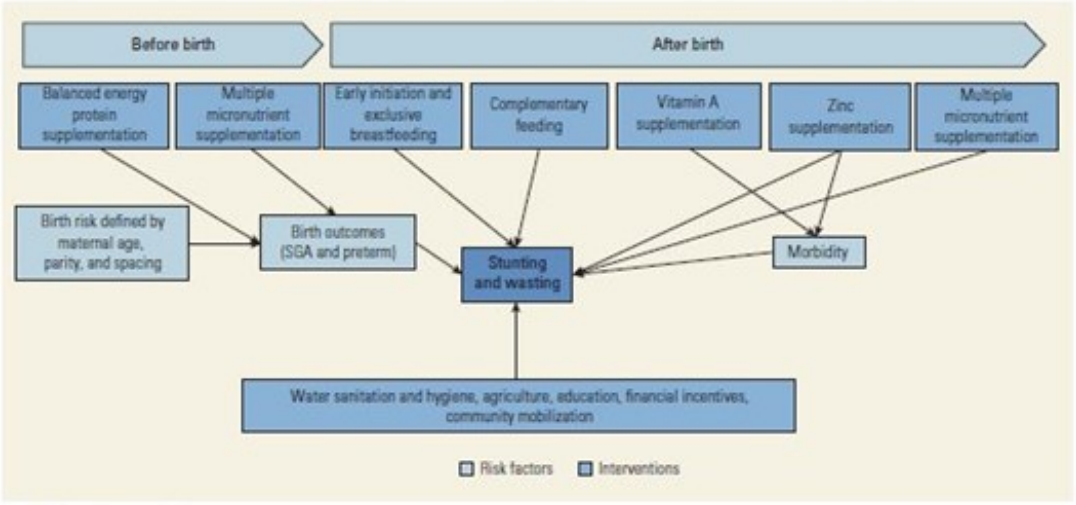
World Health Organization's Infant and Young Child Feeding Core Indicators

World Health Organization's Infant and Young Child Feeding Core Indicators	
Breastfeeding indicators	
Early initiation of breastfeeding	Proportion of children born in the past 24 months who were breastfed within one hour of birth
Exclusive breastfeeding under age six months	Proportion of infants from birth to age five months who were exclusively breastfed during the previous day
Continued breastfeeding at age one year	Proportion of children ages 12–15 months who were fed any breast milk during the previous day
Complementary feeding indicators	
Introduction of solid, semisolid, or soft foods	Proportion of infants ages six months to eight months who received solid, semisolid, or soft foods during the previous day
Minimum dietary diversity	Proportion of children ages 6–23 months who received foods from four or more food groups during the previous day
Minimum meal frequency	Proportion of breastfed and non-breastfed children ages 6–23 months who received solid, semisolid, or soft foods (including milk feeds for non-breastfed children) the minimum number of times or more during the previous day
Minimum acceptable diet	Proportion of children ages 6–23 months who had at least the minimum dietary diversity and minimum meal frequency (apart from breast milk) during the previous day
Consumption of iron-rich or iron-fortified foods	Proportion of children ages 6–23 months who received iron-rich food or iron-fortified food specially designed for infants and young children, or fortified in the home, during the previous day

(Das ect. 2016)

Risk factors and the nutrition-specific interventions for childhood stunting and wasting: Malnutrition Risk Factors and Nutrition-Specific Interventions:

(Das ect. 2016)



NUTRIENT

Nutrient intake for neonate, young and pre-school aged children

Appropriate nutrition is essential for optimal development and growth of an Infant and it also influences adulthood health. Neonate is almost immediately depended on energy for growth, metabolism and activity. Infants grow in different rates so adequate daily weight gain varies between 10 to 12 g/kg per day.

Infants are vulnerable to under- or inappropriate nutrition for five reasons.

1. Poor fat and protein stores, secondly, they grow and develop rabidly and nutrient and energy requirements are high.
2. Neuronal development, brain grows rapidly the first two years of life.
3. Body system is immature and inadequate feeding can result in problems with digestion, poor absorption, impaired excretion or infection.
4. Poor growth is a contribution to develop adult diseases such as coronary artery diseases, hypertension and diabetes.

Picture: Food - Food storage - 00 - Ethiopia, USAID/SPRING-UNICEF IYCF Image Bank

Fat and carbohydrate

40% to 50% of the energy of breast and formula milk is fat and carbohydrate. Nutrient intake of protein for children aged 1 to 3 years is 14,5 g per day, and children aged 4 to 6 years it is 19,7 g per day. Amount is easily achieved by drinking 300 ml of cow´s milk, eating two portions of meat, yoghurt, eggs or fish. Aspect of cardiovascular disease recommends that children age 5 years or older should not consume more than 35% of calories from fat. This does not apply to children under age of 2 years.

Between years 2 to 5 it is recommended to reduce fat intake from 50% to 35%. 50% of energy should be supplied by carbohydrate, 39% of it comes from starch and milk sugars (e.g. fruits, vegetables) and no more than 11% should come from non-milk sugars (e.g. table sugar and honey). High carbohydrate intake from starch and sugar is appropriate for children under 2 years of age. From age 2 years, gradual increase of energy from starchy food and decrease in energy from fats.

Unitarization of energy in infancy

Energy use	kcal/kg per day
Resting metabolic rate	48–55
Growth	25–40
Activity	10–15
Thermogenic effect of food	5–10
Losses	5
Total	93–120

(Holden & MacDonald 2000, 34)

Estimated average requirements for energy in infancy

Age in months	Energy requirement kcal/kg per day
1	115
3	100
6	95
9	95
12	95

(Holden & MacDonald 2000, 34)

Protein

Protein is necessary for body proteins, enzymes and hormones, and it is crucial for linear growth and infant should receive 7,5 to 12 % of their energy from protein.

Reference nutrient intake for protein in infancy

Age in months	Protein g/kg per day
0–3	2,2
4–6	1,6
7–9	1,6
10–12	1,5

(Holden & MacDonald 2000, 34)

Vitamins and micronutrients

Children are often deficient in many minerals, such as iron, zinc and vitamins. They are critical for health and growth, and they effect on mental development. Multiple micronutrients work together to improve health, they are necessary for linear growth and they are found in the brain. Programs which emphasizing dietary diversity and animal-source foods are most effective. In food-insecure countries short-term supplementation can lead to permanent fortification and lead to better mental development.

In the first six months, exclusive breastfeeding provides sufficient nutrients to support healthy growth and immunity. Breastfed infants under 6 months do not need vitamin supplementation if mother has had adequate vitamin status. From 6 months infant should be given A, D and C vitamin drops. Formula milk fed infant do not need vitamin supplements if follow-on milk amount is more than 500 ml per day.

Vitamin A

The WHO estimates, 190 million preschool children have vitamin A deficiencies. Estimated 5.17 million preschool-age children have night blindness and 90 million have subclinical vitamin A deficiencies. Vitamin A deficiency is the most common nutritional cause of blindness. Vitamin A controls cell differentiation and turnover and it is essential to growth and retinas normal function (eyesight).

Low vitamin A status is associated with increased diarrhea and measles, and disease development and mortality rate. Vitamin A deficiency affects immunity, can cause loss of appetite, retard growth, drying and even death. Beta-carotene is an antioxidant and precursor of vitamin A. It is recommended that all children under 5 years are given vitamins A, D and C, except breastfed babies under 6 months of age and bottle-fed infants who consume 500 ml of infant formula per day.

Vitamin B

Vitamin B6 and B12 statuses are also inadequate in many low-and-middle-income countries. Vitamin B deficiency is rare among breastfeed infants.

Vitamin C

C vitamin is an important nutrient for young child, it is an antioxidant, aids wound to heel and assists absorption of iron. Between age 1 to 5 years vitamin C should be given in form of drops, unless adequate amounts of vitamins are taken from a diet. Breastfeed children and children fed with normal infant formula seem not have shortage of vitamin or vitamin C.

Vitamin D

Vitamin D has an important role in bones by enhancing calcium and phosphorus absorption in bones and teeth. Children between age 1 to 3 years are vulnerable to run out of vitamin D, because bones need much calcium. There are only few dietary sources of vitamin D and main source is sun´s UV radiation in the skin. It is recommended for all children between age 1 to 5 years old to take vitamin D in form of drops. After 3 years of age Afro-children usually have satisfactory status of vitamin D and have no need to D vitamin requirement. Adequate volumes of normal infant formula do not develop rickets, because infants receive enough vitamin D from formula.

Picture: Food - Grains and starches - 00M - Non-country specific, USAID/SPRING-UNICEF IYCF Image Bank

Iron

Approximately 1.5 percent of children have anemia or severe anemia. In Sub-Saharan Africa 20 percent of children younger than age five years have iron deficiency anemia and have the highest prevalence of severe iron deficiency anemia. Occasional iron supplementation in children under two years of age reduced the risk of anemia by 49 percent and iron deficiency by 76 percent. Both an iron-deficient diet and hookworm disease are responsible for low levels of hemoglobin. Malaria-endemic areas have an in-creased risk of admission to hospital and serious illnesses to have iron supplementation, therefore the WHO recommends routine prophylactic iron supplements for prevention and treatment.

Infants are born with adequate stores of iron and it lasts for four months, therefore dietary source is not important for children under 4 months old. Young children have high iron requirements for tissue growth and to build iron stores, and iron deficiency anemia is common in young children, therefore preschool aged children need to achieve appropriate amount of iron from the diet.

Anemic children show socially isolating behaviours, such as wariness and sleepiness. There is only a small gain of effect in iron supplementation in children on mental, motor development and intelligence scores. Iron therapy is not alone adequate to raise child´s mental development, they also need stimulation in home environment.

Iodine

Iodine deficiency is associated with poor school achievement, but its effect on the mental development of children younger than age 24 months is less known. Estimated 40 percent of the Sub-Saharan African population are iodine deficient. Mental development scores of children with inadequate iodine levels at birth were half a standard less than those with healthy levels.

Zink

Zinc deficiency is associated with growth failure and increased risk of morbidity and mortality as a result diarrheal and respiratory illness. Zink supplementation promotes linear growth, a dose of 10 milligrams per day for 24 weeks led to gains growth of 0.37 centimetres. Therapeutic zinc given to children with diarrhea reduces severity and the duration of illness.

Calcium

From infant formula milk absorption of calcium is relatively poor. Calcium absorption from breastmilk is 66 %, infant formula milk only 40 %. Calcium intakes for children from 1 to 4 years are less than in the first year of life, be-tween year 1 to 10 years, daily calcium need rises from 70 to 150 mg per day, and only 35% of dietary calcium is absorbed.

Reference nutrient intake for vitamins and minerals

Nutrient	0–3 months	4–6 months	7–12 months
Vitamin A µg	350	350	350
Vitamin D µg	9	9	7
Vitamin C mg	25	25	25
Calcium mg	525	525	525
Iron mg	1,7	4,3	7,8

(Holden & MacDonald 2000, 35)

Water

70–75 % of the weight of new-born and infant is water. Feeding with breast or formula milk should cover the healthy amount on fluids needed. In the first 4 months infants consume 150 to 200 ml/kg per day. After other foods are introduced to diet quantity of fluids tend to fall. Infants should not be given more than 1200 ml of feed in 24 hours.

Maintenance water requirements

Use	ml/kg per day
Insensible (lungs and skin)	20
Urine	60–75
Stool	5
Growth	1–3
Total	86–103

(Holden & MacDonald 2000, 35)

Picture: Objects - Water bottle - 01 - Sierra Leone, USAID/SPRING-UNICEF IYCF Image Bank

NUTRITIONAL INTERVENTIONS

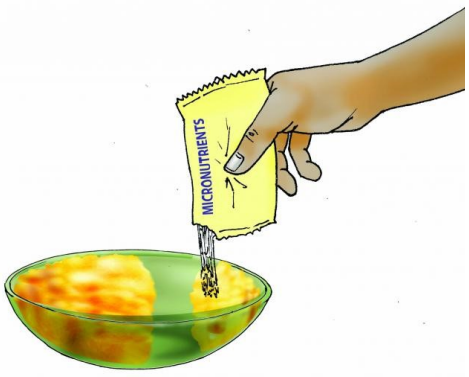
Infant formulae

Infant formulae are design to match closely the nutritional composition of breast milk, but there are differences. Human milk has more nutrients than infant formula has, for example calcium and iron. Vitamins D and K are considered inappropriate for infant formulae. Immunological, hormonal and enzymes are not used in infant formulae. Full-term normal infant digest formula well. Infants with poor gastrointestinal function may have problems with casein-based formulae. Low birth-weight infants have better nitrogen and fat absorption with whey-based formulae.

Micronutrient supplementation

In many low-and-middle income countries are approaches needed to estimate and ad-dress multiple micronutrient supplementation. These approaches include strengthening education, dietary modification, food provision, agricultural interventions either alone or in combination.

Multiple micronutrient fortification in children shows an increase in hemoglobin levels and reduce anemia and iron deficiency in children younger than age two years. Multiple micronutrient food fortification also increased vitamin A serum levels. Multiple micronutrient powders are powdered vitamins and minerals that can be added to prepared foods. They are designed to provide the recommended daily nutrient intake of two or more vitamins and minerals.



Picture: Complementary Feeding - Adding micronutrient powder to complementary foods - 03B - Non-country specific, USAID/SPRING-UNICEF IYCF Image

Nutrition interventions

Nutrition-specific interventions reduces fatal growth restriction and small for gestational age births and improves nutrition among children younger than age five years. Interventions include peri-conceptional folic acid supplementation or fortification, maternal balanced protein energy, iron-folate supplementation, multiple micronutrient supplementation, calcium supplementation for pre-eclampsia, breastfeed promotion, suitable complementary feeding, zinc and vitamin A supplementation and management of malnutrition in children. If these identified interventions could be scaled up to 90 percent coverage would it reduce deaths among children younger than age five years by nearly 15 percent and stunting by 20 percent and severe wasting by 61 percent.

Child Interventions

(Das ym. 2016)

INTERVENTION	ESTIMATES
Child interventions	
Breastfeeding	• Exclusive breastfeeding rates increased by 43 percent at four to six weeks, with 89 percent and 20 percent significant increases in LMICs and HICs, respectively. Exclusive breastfeeding improved at age six months by137 percent, with a sixfold increase in LMICs.
Complementary and supplementary feeding	• Statistically significant difference of effect for length during the intervention in children
Iron supplementation	• Anemia (RR: 0.51; 95 percent CI: 0.37–0.72) • Iron deficiency (RR: 0.24; 95 percent CI: 0.06–0.91), hemoglobin (MD: 5.20 g/l; 95 percent CI: 2.51–7.88), ferritin (MD: 14.17 mcg/l; 95 percent CI: 3.53–24.81)
Vitamin A supplementation	• All-cause mortality reduced by 24 percent (RR: 0.76; 95 percent CI: 0.69–0.83) • Diarrhea-related mortality reduced by 28 percent (RR: 0.72; 95 percent CI: 0.57–0.91) • Incidence of diarrhea reduced by 15 percent (RR: 0.85; 95 percent CI: 0.82–0.87) • Incidence of measles reduced by 50 percent (RR = 0.50; 95 percent CI 0.37–0.67) • Nonsignificant impacts on measles and ARI-related mortality
Zinc supplementation	• Height improved by 0.37 centimeters (SD 0.25) in children supplemented for 24 weeks • Diarrhea reduced by 13 percent • Pneumonia reduced by 19 percent • Nonsignificant impacts on mortality
Disease prevention and management	
WASH interventions	• Diarrhea reduced by 48 percent (RR: 0.52; 95 percent CI: 0.34–0.65) with handwashing with soap, 17 percent with improved water quality, and 36 percent with excreta disposal
Deworming	• Prophylactic single and multiple dose deworming had a nonsignificant effect on hemoglobin and weight gain. • Treating children with proven infection showed that single dose of deworming drugs increases weight (0.58 kg; 95 percent CI: 0.40–0.76) and hemoglobin (0.37 g/dl; 95 percent CI: 0.1–0.64).
Malaria prevention and treatment	• Antimalarial to prevent malaria in pregnant women reduced antenatal parasitemia (RR: 0.53; 95 percent CI: 0.33–0.86) • Birth weight increased (MD: 126.7 g; 95 percent CI: 88.64–164.75) • LBW and severe antenatal anemia reduced by 43 percent and 38 percent, respectively • ITNs in pregnancy reduced LBW by 23 percent (RR: 0.77; 95 percent CI: 0.61–0.98) and reduced fatal loss (first to fourth pregnancies) by 33 percent (RR: 0.67; 95 percent CI: 0.47–0.97) • Nonsignificant impacts on anemia and clinical malaria
Note: ARI = acute respiratory infection; CI = confidence interval; g = grams; g/dL = grams per decilitre; g/l = grams per litre; HIC = high-income country; ITNs = insecticide treated bednets; kg = kilogram; LBW = low birth weight; LMICs = low- and middle-income countries; mcg/l = micrograms per litre; MD = mean difference; RR = relative risk; SD = standard deviation; SGA = small for gestational age; WASH = water, sanitation, and hygiene.	

WEANING AND FEEDING CHILDREN UNDER 5

Weaning

Weaning is a process when infants diet is expanding to include foods and drinks. Weaning starts with semi-solid foods in 4–6 months and process continues up to 1 year´s age, when child should manage with similar food as the rest of family. Weaning replaces energy and protein received from milk, it adds micronutrients, develop chewing and make´s diet similar as family´s food.

After age six months, diversity of diet is positively related to linear growth. Improving dietary diversity, especially with animal-source foods, is a critical message in nutrition education interventions. Nutrition education about foods to feed and number of meals for mothers of children ages 6–24 months, led child to gains in length. Micronutrients such as iron and iodine are important for mental development in the first F24 months.

At the age of 4 to 5 months

Food should be thin, smooth and semi-solid. Suitable foods are pureed fruits, vegetables, mashed potatoes, custard, natural yoghurt and baby rice. After infant accept eating from a spoon, different tastes and textures can be introduced. Breast and formula-milk can be added to the food to improve energy and nutrient density. Salt should not be used, and sugar should be avoided. Weaning starts by offering one or two teaspoons of pureed food, to ease hunger milk is given first. Quality, quantity and frequency are increased gradually up to three times in day. The breast milk or infant formulae should still be the main source of nutrition because intake of solid is small.

Example of a weaning plan (0–6 months)

Age	Solids/drinks to introduce	6.00 am	10.00 am	2.00 pm	6.00 pm	10.00 pm
4 months	1–2 teaspoons of pureed baby food	✓	✓ ●	✓	✓	✓
4,5 months	3–4 teaspoons of pureed baby food	✓	✓ ●	✓	✓ ●	✓
5 months	6 teaspoons of pureed baby food	✓	✓ ●	✓ ●	✓ ●	✓
		8.00 am	12.00 am	5.00 pm	9.00 pm	
5,5 months	3–4 tablespoons on pureed baby foods	✓ ●	✓ ●	✓ ●	✓	
6 months	1–2 tablespoons of smashed baby food	✓ ●	✓ ●	✓ ●	✓	
✓ = infant feed (breast or formula milk ● = solid food						

(Holden & MacDonald 2000, 41)

Picture: Complementary feeding - Complementary Feeding 6-9 months - 04A - Non-country specific, USAID/SPRING-UNICEF IYCF Image
Picture: Complementary feeding - Complementary feeding 12-24mo 12-24 mo - 08 - Non-country specific, USAID/SPRING-UNICEF IYCF Image

At the age of 6 to 9 months

Food should be minced or smashed, and baby can also have finger food. Suitable foods are pureed meat, soft cooked fish, wholemeal cereal and porridge, scrambled well-cooked egg, raw soft fruits, soft carrot, slice of soft bread, food can have stronger flavour and mildly spiced. Solid foods can be offered three times a day. Provided volume of milk is 55% and solid food 45%. Child should be encouraged to use mug for drinking.

At the age of 10 to 12 months

Food should be minced or chopped and child is encouraged to self-feed. At the of 1 year, infant should be eating same food as the rest of the family, get three main meals and milk should supply 40–45% of energy intake. Home-made weaning food have advantages which are adjust to the taste of adult food, food is cheap and easy to prepare. Drawback of home-made food is nutrition quality, they can be low in energy, iron and zinc. Commercial weaning foods are easy to use, manufacturers have strict regulations of safety, composition and added vitamins and minerals. They are however ex-pensive and wastage can be high.

Child age 1 to 4 feeding

For pre-school children, food and mealtimes help to create good eating habits, supports communication skills and language, sets dietary model for later life and gives useful way for learning and play. Pre-school children have high nutrient requirements as they are still growing and developing rapidly and they are physically active. They should be offered small snacks between meals as well as meals at regular times. Young children need energy for basic metabolic functions, for keeping warm, for activity and for growth.

Nutrient intake of protein for children aged 1 to 3 years is 14,5 g per day, and children aged 4 to 6 years it is 19,7 g per day. Amount is easily achieved by drinking 300 ml of cow´s milk, eating two portions of meat, yoghurt, eggs or fish. Aspect of cardiovascular disease recommends that children age 5 years or older should not consume more than 35% of calories from fat. This does not apply to children under age of 2 years. Between years 2 to 5 it is recommended to reduce fat intake from 50% to 35%. 50% of energy should be supplied by carbohydrate, 39% of it comes from starch and milk sugars (e.g. fruits, vegetables) and no more than 11% should come from non-milk sugars (e.g. table sugar and honey).

High carbohydrate intake from starch and sugar is appropriate for children under 2 years of age. From age 2 years, gradual increase of energy from starchy food and decrease in energy from fats. Calcium intakes for children from 1 to 4 years are less than in the first year of life, between year 1 to 10 years, daily calcium need rises from 70 to 150 mg per day, and only 35% of dietary calcium is absorbed.

Requirements for pre-school aged children.

Age (years)	Daily energy requirements (kcal)	
	Boys	Girls
1 to 3	1230	1165
4	1715	1545
	Calcium requirements mg/day	
1 to 3	350	
4	450	
	Iron requirements mg/day	
1 to 3	6,9 mg	
4	6,1 mg	
	Vitamin C requirements mg/day	
1 to 3	30 mg	
4	30 mg	
	Vitamin D requirements µg/day	
1 to 3	7	
4	0	

(Holden & MacDonald 2000, 50–51)

Picture: Family - Adolescent nutrition - 00A - Nigeria, USAID/SPRING-UNICEF IYCF Image

Pre-school-aged child feeding

Diet for pre-school age children is a variation of foods from all food groups. However, toddler´s diet is notoriously and variation is narrow and based on a limited range of foods. Toddlers should have two to three serving with milk per day. There should be minimum 300 ml of cow´s milk, but no more than 600–700 ml. Toddler should have daily two servings including beef, lamp, pork, fish, eggs, baked beans or lentils. Meat and meat products provide one quarter of all protein intake and red meat is good source of iron. On four serving in day, toddler should be offered bread, potatoes, pasta or rice.

Toddler´s should have fruits and vegetables on four or more servings daily. Suitable fruits and vegetables are for example pears, bananas, orange, raisins, cooked carrot, cauliflower, cucumber etc. Partially cooked vegetables are better for young children and hard fruit and vegetables should be given to children after 3 years of age. It is recommended to establish regular eating and child should have plenty of time to eat and encouraged self-feeding.

School-aged child feeding

Thea health of school aged children is generally good, but children from poor conditions are likely to have inadequate intake of nutrition and weak growth. High quality diet is needed to gain adequate intakes of nutrients, particularly calcium and iron. Girls and boys have different need of nutrient when they grow older, but at young age their needs are the same.

EPILOQUE

Early childhood is a critical time when the benefits of early interventions are amplified and the risk of negative effects can be reduced. Families need support to provide nurturing care for children and provision of services, including health and nutrition. Stable environment that promotes children´s health and nutrition protects children from threats, gives opportunity to early learning and has life-long benefits.

The volume of reproductive, maternal, new-porn and child health is based on the link between interventions at each stage. Interventions need to deliver integrated, and be preventive and therapeutic interventions for mother and children. One of the recognised factor to decline child mortality is maternal education. Women with secondary or higher education has strong association to reduce child mortality.

Strategies to protect, promote and support early breast feeding are needed at health system. The health systems strategies include baby-friendly and initiative hospital personnel, the education of health staff about breast-milk substitutes and building a capacity for health-workers to provide breast feed counselling.

Counseling - Community Video - 10 - Nigeria, USAID/SPRING-UNICEF IYCF Image

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PICTURES: USAID/SPRING-UNICEF IYCF Digital Image Bank (iycf.spring-nutrition.org)

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