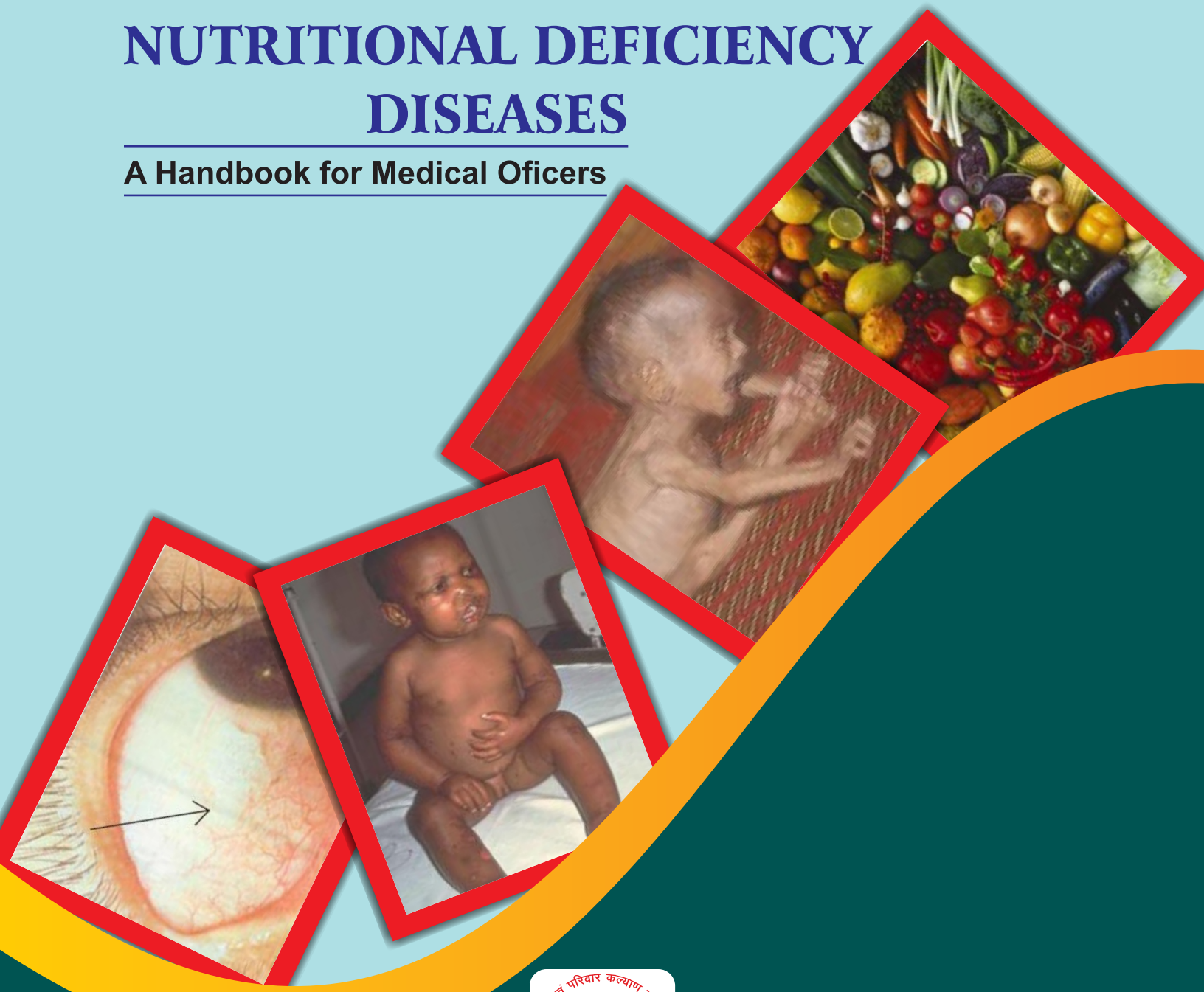
NUTRITIONAL DEFICIENCY DISEASES

A Handbook for Medical Oficers



DEPARTMENT OF MEDICAL HEALTH AND FAMILY WELFARE,
GOVERNMENT OF UTTAR PRADESH

NUTRITIONAL DEFICIENCY DISEASES

– A HANDBOOK FOR MEDICAL OFFICERS

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Dr. Ramashankar Rath
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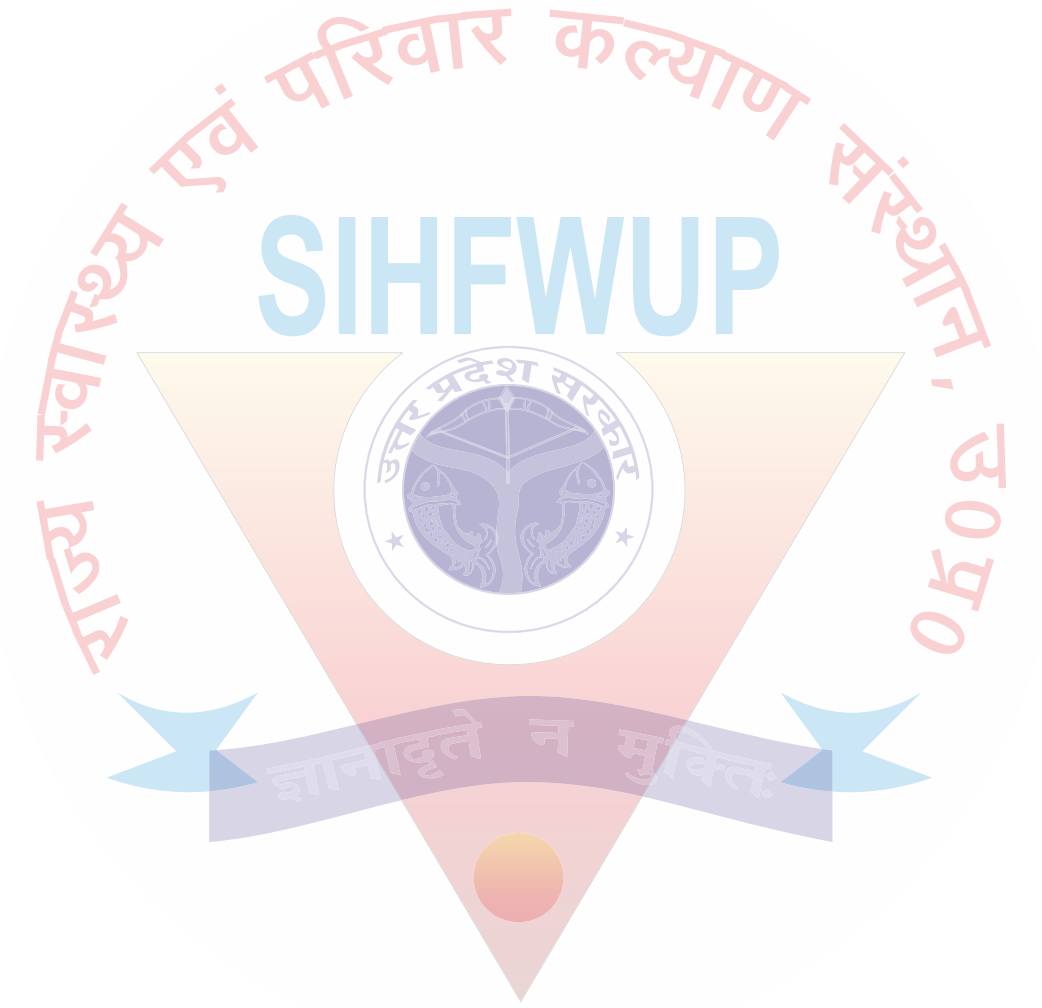
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MESSAGE

Shri Brajesh Pathak

Hon'ble Deputy Chief Minister
Hon'ble Minister of
Medical Health and Family Welfare
Department
Government of Uttar Pradesh

Nutrition is a critical part of health and development. Better nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases (such as diabetes and cardiovascular disease), and longevity. People with adequate nutrition are more productive and can create opportunities to gradually break the cycles of poverty and hunger.

Nutritional diseases cause nutrients deficiencies or excesses, eating disorders, obesity, chronic diseases like cardiovascular diseases, hypertension, diabetes mellitus, cancer, inherited metabolic disorders, developmental abnormalities, food intolerances and allergies. The anthropometric measurement will help in improve the nutritionaldeficiencies of the population. Therefore, it is desirable that state develops tailored made Continuing Medical Education (CME) modules to caret the medical needs specific to its inhabitants.

Considering the above stated facts, CME on nutritional deficiencies disease is a minimum standard practice to be offered during course of life. Through this, Medical Officers in Provincial Health & Medical Services in Uttar Pradesh, will be exposed to much needed training, thus ensuring that preventing macro- and micronutrient deficiency is crucial and this could be achieved through supplementation and food-based approaches.

I wish the team of State Institute of Health & Family Welfare, Uttar Pradesh and subject matter experts to continue developing such module on CME for the benefit of Medical Officers in Provincial Health & Medical Services in Uttar Pradesh that ultimately benefit their patients too.

(Brajesh Pathak)


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MESSAGE

Shri Mayankeshwar Sharan Singh

Hon'ble State Minister
Medical Health and Family Welfare
Department
Government of Uttar Pradesh

Nutrition is the source of energy that is required to carry out all the processes of human body. A balanced diet is a combination of both macro- and micronutrients. “Nutritional inadequacy” involves an intake of nutrients that is lower than the estimated average requirement, whereas “nutritional deficiency” consists of severely reduced levels of one or more nutrients, making the body unable to normally perform its functions and thus leading to an increased risk of several diseases like cancer, diabetes, and heart disease.

Nutritional biomarkers – like serum or plasma levels of nutrients such as folate, vitamin C, B vitamins, vitamin D, selenium, copper, zinc – could be used for the evaluation of nutrient intake and dietary exposure. Macronutrients deficiencies could cause kwashiorkor, marasmus, ketosis, growth retardation, wound healing, and increased infection susceptibility, whereas micronutrient – like iron, folate, zinc, iodine, and vitamin A – deficiencies lead to intellectual impairment, poor growth, perinatal complications, degenerative diseases associated with aging and higher morbidity and mortality.

In order to further strengthen the nutrition, it helps in establishing a range of dietary based preventive health care services, Continuing Medical Education (CME) on nutritional deficiencies disease, for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh is one of the good intervention in states growth.

I am happy that the team at State Institute of Health & Family Welfare, Uttar Pradesh along with the experts from the field, have come up with such an intensified and detailed CME for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh.

I wish team at SIHFW success in their endeavors of aiding an improved health service through such CME onnutritional deficiencies disease.

(Mayankeshwar Sharan Singh)


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MESSAGE

Dr. Deepa Tyagi

Director General (Training)
Medical, Health & Family Welfare
Government of Uttar Pradesh

Nutrition is an indispensable part of human life, which is inevitable for leading a healthy life. Nutrients are usually categorized into macronutrients and micronutrients. Macronutrients are those nutrients, which body needs in large amounts including Fats, Proteins, and Carbohydrates. Micronutrients are needed in smaller amounts, which include several vitamins and minerals. The quantity of micronutrients-vitamins and minerals required in a balance diet are very low yet they have a profound impact on the physical and mental growth of the child.

In countries with the limited health-care budget, we have to work holistically and also finding evidence-based solutions to the cases in course of life. The nutrition training and food-basedapproach contribute to improve the health of the nation.

Continuing Medical Education (CME) on nutritional deficiencies disease is an effort in improving the minimum standard of nutrition care to all who are need and to alleviate the micro and macronutrients status of population.

Considering the above stated facts, this module on Continuing Medical Education (CME) on nutritional deficiencies disease, for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh, State Institute of Health & Family Welfare, Uttar Pradesh with the help of Subject Matter Experts has provided a comprehensive, coherent and insightful module for Medical Officers to deal with nutritional deficiencies.

I wish the team of State Institute of Health & Family Welfare, Uttar Pradesh and subject matter experts for such a commendable job.

(Dr. Deepa Tyagi)


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FOREWARD

Shri Partha Sarthi Sen Sharma

Principal Secretary
Department of
Medical Health and Family Welfare
Government of Uttar Pradesh

Good nutrition is the starting point for the foundation of a sustainable future. The first 1000 days represent a window of opportunity from conception through the first 2 years after birth. This period is a vulnerable period where poor nutrition can have short and long-term consequences for health and functioning.

Malnutrition remains a core public health issue, contributing to over 50% of child deaths in developing nations. Despite the wealth of evidence confirming the effects of nutrition interventions, there is a huge gap in the implementation and scale-up of nutrition programmes in the country.

Experts recommended evidence-based nutrition interventions including exclusive breastfeeding, appropriate complementary feeding, proper hygiene and micronutrient supplementation among other interventions. In countries with the limited health-care budget, we have to work holistically and also finding evidence-based solutions to the cases in course of life. The nutrition training and food-based approach contribute to improve the health of the nation.

Considering the above stated facts, this module on Continuing Medical Education (CME) on nutritional deficiencies disease, for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh, State Institute of Health & Family Welfare, Uttar Pradesh with the help of Subject Matter Experts has provided a comprehensive, coherent and insightful module for Medical Officers to deal with nutritional deficiencies.

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(Partha Sarthi Sen Sharma)


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MESSAGE

Dr. Brijesh Rathor

Director General
Family Welfare, Uttar Pradesh

The progressive development of clinical and public health nutrition has long relied on dietary clinical trials (DCTs), investigating the causal relationship between diet and multiple risk factors of non-communicable and chronic diseases. DCTs are also hallmarks for establishing dietary requirements and promoting overall nutritional health among the population.

Despite their critical importance in translation into public health strategies and practices, DCTs have several limitations and challenges for study design, implementation and finding interpretation. The complex nature of nutrition interventions, collinearity between diet components, multi-target effects of the interventions, diverse dietary behaviors, and food culture are the most challenging issues. Furthermore, baseline exposure and dietary status, appropriate control groups, blinding, randomization, and poor adherence undermine the effectiveness of DCTs in translation into practices.

Disruptive factors will be minimized if researchers are committed to following good clinical practice (GCP) standards available for common designs of clinical trials. Planning DCTs, however, needs careful considerations for hypothesis generation, study design development, the definition of primary and secondary outcome measures, and target population.

Continuing Medical Education (CME) on nutritional deficiencies disease for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh, State Institute of Health & Family Welfare, Uttar Pradesh with the help of Subject Matter Experts has provided a comprehensive, coherent and insightful module for Medical Officers to deal with nutritional deficiencies.

I wish the team of State Institute of Health & Family Welfare, Uttar Pradesh and subject matter experts for such a commendable job.

(Dr. Brijesh Rathor)


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MESSAGE

Dr. Shailesh Kumar Srivastava

Director General (Training),
Medical and Family Welfare,
Uttar Pradesh

Malnutrition is the world's most serious health problem and the single biggest contributor to child deaths. One third of the developing world's population suffers micronutrient deficiencies that can lead to blindness, mental retardation and early death.

The early years of life are a period of very rapid growth and development. In this critical phase, food preferences are formed which carry over into childhood and beyond and foundations are laid for a healthy adult life. Excess energy, imbalances in macronutrient quality, and nutritional deficiencies may form inappropriate nutritional signals, leading to metabolic disturbances and affecting the obesity risk.

Considering the above stated facts, this module on Continuing Medical Education (CME) on nutritional deficiencies disease, for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh, State Institute of Health & Family Welfare, Uttar Pradesh with the help of Subject Matter Experts has provided a comprehensive, coherent and insightful module for Medical Officers to deal with nutritional deficiencies.

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ACKNOWLEDGEMENT

Dr. Rajaganapathy R.
Director
State institute of
Health & Family Welfare
Government of Uttar Pradesh

Malnutrition, in its various guises, represents the greatest modifiable threat to global health and survival. This is especially so among children in the poorest nations of the world, where malnutrition and infections act hand in hand to create a self-reinforcing downward cycle of tissue depletion and lowered resistance to disease.

Many of the solutions are already known and require political will, economic advancement, and operational research to achieve a resolution. In the interim, efforts should be made in combating micronutrient deficiencies that lead to so-called “hidden hunger,” since these are potentially amenable to short-term resolution.

However, there remain a host of unsolved scientific questions that critically inhibit the development of such interventions that could potentially bring immediate health benefits and save millions of lives.

Continuing Medical Education (CME) on nutritional deficiencies disease is an effort in the right direction where Medical Officers in Provincial Health & Medical Services in Uttar Pradesh, will be equipped with comprehensive, coherent material and insightful intervention.

I acknowledge the efforts by Faculties at State Institute of Health & Family Welfare, Uttar Pradesh with that of Dr. Anil Koparkar, AIIMS-Gorakhpur, and his team, who as Subject Matter Experts have provided an excellent module for Medical Officers to deal with nutritional deficiencies.

I wish the team of State Institute of Health & Family Welfare, Uttar Pradesh and subject matter experts for such a commendable job.

(Dr. Rajaganapathy. R)


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A. Introduction

a. Overview of Public Health Nutrition and Nutritional Deficiencies

Nutrition plays an important role in maintaining our health. There are various nutrients in the food we eat. Adequate amounts of different nutrients in appropriate proportions are required for a healthy body. When diet is not balanced and is inadequate in terms of calories, proteins, fat, micronutrients and minerals; malnutrition affects our body.(1)

A balanced diet is a combination of both macro- and micronutrients.

"Nutritional inadequacy" involves an intake of nutrients that is lower than the estimated average requirement, whereas **"nutritional deficiency"** consists of severely reduced levels of one or more nutrients, making the body unable to normally perform its functions and thus leading to an increased risk of several diseases like cancer, diabetes, and heart disease.(2)

Malnutrition: Malnutrition, in all its forms, includes undernutrition (wasting, stunting, underweight), inadequate vitamins or minerals, overweight, obesity, and resulting diet-related noncommunicable diseases.(3)

Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients. The term malnutrition addresses 3 broad groups of conditions:

1. **Undernutrition**

   Undernutrition denotes insufficient intake of energy and nutrients to meet an individual's needs to maintain good health. (4) This includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age);
2. **Micronutrient-related malnutrition**, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and
3. **Overweight, obesity and diet-related noncommunicable diseases** (such as heart disease, stroke, diabetes and some cancers).(3)

Though we are living in the era of transition from undernutrition to overnutrition(5), still undernutrition is posing major challenge in large part of the world. In this handbook, we will mainly focus on undernutrition or nutritional deficiency.

There are 4 broad sub-forms of undernutrition: wasting, stunting, underweight, and deficiencies in vitamins and minerals. Undernutrition makes children in particular much more vulnerable to disease and death.(3)

- Low weight-for-height is known as **wasting.** It usually indicates recent and severe weight loss. It can be due because a person has not had enough food to eat and/or they have had an infectious disease, such as diarrhoea, which has caused them to lose weight. A young child who is moderately or severely wasted has an increased risk of death, but treatment is possible.
- Low height-for-age is known as **stunting**. It is the result of chronic or recurrent undernutrition, usually associated with poor socioeconomic conditions, poor maternal health and nutrition, frequent illness, and/or inappropriate infant and young child feeding and care in early life. Stunting holds children back from reaching their physical and cognitive potential.
- Children with low weight-for-age are known as **underweight.** A child who is underweight may be stunted, wasted, or both.
- Iodine, vitamin A, and iron are the most important in global public health terms; their deficiency represents a major threat to the health and development of populations worldwide, particularly children and pregnant women in low-income countries.

Vitamins and minerals often referred to as micronutrient. Micronutrients enable the body to produce enzymes, hormones, and other substances that are essential for proper growth and development

b. Current scenario: Global to local

Global scenario(3)**:**

- In 2020, 149 million children under 5 were estimated to be stunted (too short for age), 45 million were estimated to be wasted (too thin for height), and 38.9 million were overweight or obese in the world.
- Around 45% of deaths among children under 5 years of age are linked to undernutrition. These mostly occur in low- and middle-income countries. At the same time, in these same countries, rates of childhood overweight and obesity are rising.
- The developmental, economic, social, and medical impacts of the global burden of malnutrition are serious and lasting, for individuals and their families, for communities and for countries.

Scenario in India:

India contributes a third of the global burden of undernutrition.(6)

According to National Family Health Survey (NFHS)-5, following are findings about nutritional deficiencies – (7)

Table 1: Nutritional Deficiencies in India as per NFHS -5

Parameter	Urban	Rural	Total	NFHS 4
Underweight (BMI <18.5)				
Women	13.2	21.2	18.7	22.9
Men	13.0	17.8	16.2	20.2
Undernutrition in children under 5 years				
Children under 5 years who are **stunted** (height-for-age) (%)	30.1	37.3	35.5	38.4
Children under 5 years who are **wasted** (weight-for-height) (%)	18.5	19.5	19.3	21.0
Children under 5 years who are **severely wasted** (weight-for-height) (%)	7.6	7.7	7.7	7.5
Children under 5 years who are **underweight** (weight-for-age) (%)	27.3	33.8	32.1	35.8

Anaemia in children				
Children age 6-59 months who are **anaemic** (<11.0 g/dl)	64.2	68.3	67.1	58.6
Anaemia in adult				
Non-pregnant women age 15-49 years who are anaemic (<12.0 g/dl) (%)	54.1	58.7	57.2	53.2
Pregnant women age 15-49 years who are anaemic (<11.0 g/dl)(%)	45.7	54.3	52.2	50.4
All women age 15-49 years who are anaemic (%)	53.8	58.5	57.0	53.1
All women age 15-19 years who are anaemic (%)	56.5	60.2	59.1	54.1
Men age 15-49 years who are anaemic (<13.0 g/dl) (%)	20.4	27.4	25.0	22.7
Men age 15-19 years who are anaemic (<13.0 g/dl) (%)	25.0	33.9	31.1	29.2

It is very clear from table 1 that nutritional deficiency is very common in India. And situation worsens in rural area and in women. We have very small improvement from NFHS 4 to NFHS 5 in case of macronutrient deficiency but has deteriorated in case of Anamia in all categories. High prevalence of anaemia in children age 6-59 months, women age 15-`19 years, pregnant women are of great concern.

Half of preschool children in India suffer from moderate and severe grades of protein-calorie malnutrition. Over 50% women suffer from iron deficiency anaemia (IDA). Many have mild vitamin A deficiency. B-complex vitamins deficiencies particularly of riboflavin, folic acid and vitamin B12 are also common. (1)

Scenario in Uttar Pradesh:

According to National Family Health Survey (NFHS)-5, following are findings about nutritional deficiencies (8) –

Table 2: Nutritional Deficiencies in Uttar Pradesh as per NFHS -5

Parameter	Urban	Rural	Total	NFHS 4
Underweight (BMI <18.5)				
Women	13.6	20.8	19.0	25.3
Men	13.4	19.5	17.9	25.9
Undernutrition in children under 5 years				
Children under 5 years who are **stunted** (height-for-age) (%)	33.0	41.3	39.7	46.3
Children under 5 years who are **wasted** (weight-for-height) (%)	18.7	17.0	17.3	17.9
Children under 5 years who are **severely wasted** (weight-for-height) (%)	8.2	7.1	7.3	6.0
Children under 5 years who are **underweight** (weight-for-age) (%)	28.2	33.1	32.1	39.5
Anaemia in children				
Children age 6-59 months who are **anaemic** (<11.0 g/dl)	65.3	66.7	66.4	63.2
Anaemia in adult				
Non-pregnant women age 15-49 years who are anaemic (<12.0 g/dl) (%)	50.5	50.7	50.6	52.5
Pregnant women age 15-49 years who are anaemic (<11.0 g/dl)(%)	37.1	47.9	45.9	51.0
All women age 15-49 years who are anaemic (%)	50.1	50.5	50.4	52.4
All women age 15-19 years who are anaemic (%)	53.4	52.8	52.9	53.7
Men age 15-49 years who are anaemic (<13.0 g/dl) (%)	18.0	22.7	21.5	23.7
Men age 15-19 years who are anaemic (<13.0 g/dl) (%)	22.5	29.9	28.2	31.5

Scenario in Uttar Pradesh is also as poor as scenario at National level. Considering huge population burden in Uttar Pradesh, there is always huge impact of scenario in Uttar Pradesh on scenario of India. Considering rural dominance in Uttar Pradesh, challenges are still high. Table 2

c. Risks factors, linkages for causation and Public health consequences of undernutrition

- **Every country in the world is affected by one or more forms of malnutrition**. Combating malnutrition in all its forms is one of the greatest global health challenges.
- **Women, infants, children, and adolescents are at higher risk of malnutrition.** Optimizing nutrition early in life—including the 1000 days from conception to a child's second birthday—ensures the best possible start in life, with long-term benefits.
- **Poverty amplifies the risk of, and risks from, malnutrition**. People who are poor are more likely to be affected by different forms of malnutrition. Also, malnutrition increases health care costs, reduces productivity, and slows economic growth, which can perpetuate a cycle of poverty and ill-health. (3)

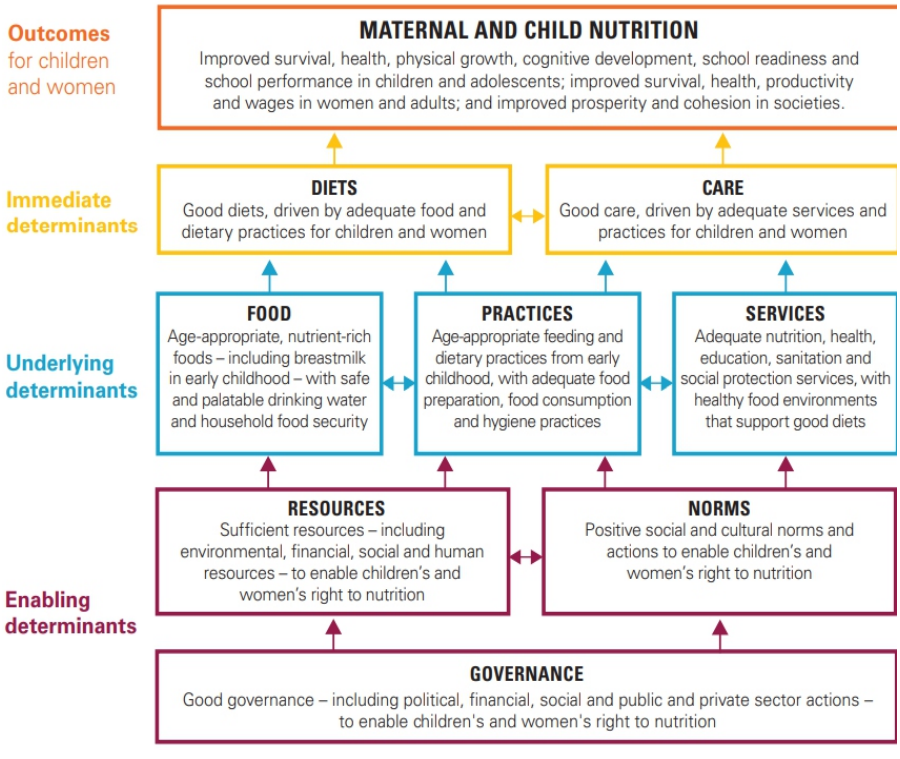


Fig 1: UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition

Hidden Hunger: - Micronutrient Deficiencies (MND)s are only one form of undernutrition. Other forms of undernutrition are more readily visible and, for this reason, MNDs are often referred to as hidden hunger.

At the most basic level, MNDs, like all forms of

undernutrition, occur due to insufficient intake or sufficient in- takes combined with impaired absorption due to infection, disease, or inflammation. For infants, MNDs may result from maternal MND in utero or rapid postnatal growth. The antecedents to these immediate causes for undernutrition are complex and can be fully appreciated by examining the 2013 UNICEF Conceptual Framework for the Determinants of Undernutrition (Fig 1)(9). The underlying causes that contribute to the immediate causes include food insecurity, inadequate care or feeding practices, and an unhealthy environment with inadequate access to health services. Nutritional status is greatly impacted by infection. Infection is the leading cause of child mortality. Acute respiratory infection and diarrhea are the most common causes of infant mortality, and MNDs contribute greatly to the immune response. Undernutrition is the leading cause of immunodeficiency worldwide.

have the highest burden of MNDs; however, MNDs exist even in certain population groups in higher-income countries. (3) These causes can also be classified as follows (9) –

The **outcomes** resulting from improved nutrition for children and women manifest in the short and long term and include:	• **In childhood and adolescence** – Improved survival, health, physical growth, cognitive development, school readiness and school performance. • **In adulthood and for societies** – Improved survival, health, productivity and wages in adults, and improved prosperity and social cohesion for societies.
The **immediate determinants** of maternal and child nutrition are diets and care, which influence each other.	• **Diets:** Good diets are driven by adequate foods and and adequate feeding and dietary practices to support good nutrition for children and women. • **Care:** Good care is driven by adequate services and adequate services to support good nutrition for children and women.
The **underlying determinants** are the food, practices and services available to children and women in their households, communities and environments to enable good nutrition.	• **Food,** which comprises age-appropriate, nutrient-rich foods – including breastmilk and complementary foods for children in the first two years of life – with safe and palatable drinking water and household food security all year round for all children and women. • **Practices,** which comprises age-appropriate feeding and dietary practices – including breastfeeding, responsive complementary feeding and stimulation in early childhood – with adequate food preparation, food consumption and hygiene practices for all children and women. • **Services,** which comprises adequate nutrition, health, sanitation, education and social protection services, with healthy food environments and healthy living environments that prevent disease and promote adequate diets and physical activity for all children and women.
The **enabling determinants** are the political, financial, social, cultural and environmental conditions that enable good nutrition for children and women. In the 2020 Conceptual Framework, the enabling determinants are organized into three categories:	• **Governance:** Good governance refers to the political, financial, social and public and private sector actions to enable children's and women's right to nutrition. • **Resources:** Sufficient resources refer to the environmental, financial, social and human resources needed to enable children's and women's right to nutrition. • **Norms:** Positive norms refer to the gender, cultural and social norms and actions needed to enable children's and women's right to nutrition.

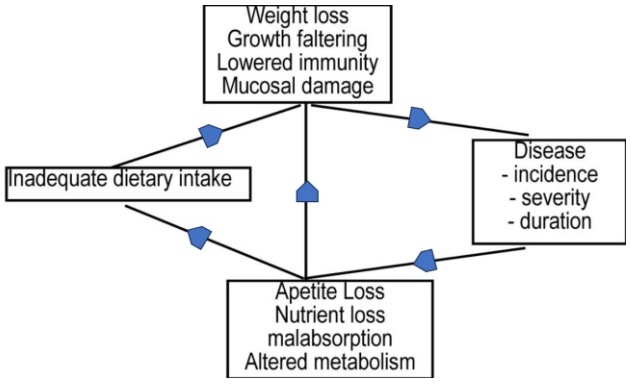


Fig 2: Undernutrition - infection vicious cycle.

- Infection-undernutrition-infection cycle: Undernutrition and infection are partners and supports each other. This can lead to very serious and vicious cycle which if we don't break the cycle will lead to make child deficient in many nutrient

and will keep falling sick very frequently. (Fig 2) (11)

Fig 3: Infant and young child feeding practices across wealth quintiles, and urban and rural areas

- Inadequate access to food in infant and young children: inadequacy in excess to food in infant and young children was found different in different wealth quintiles and also in urban and rural area. (Fig3) (12)

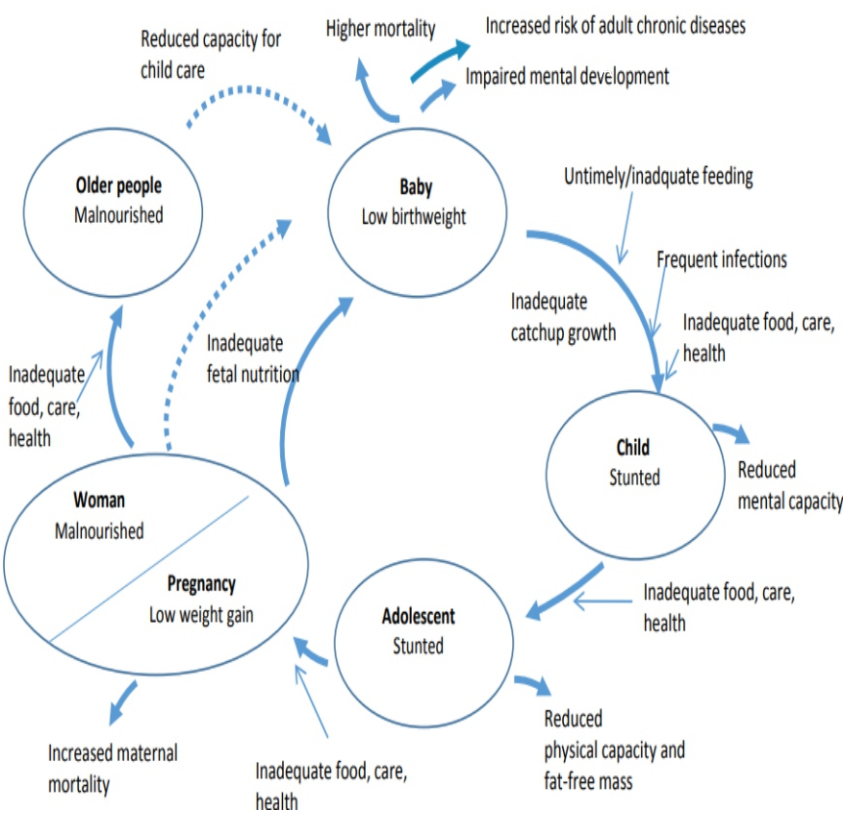


Fig 4: Nutritional deficiency throughout the lifecycle

Nutritional deficiency throughout the lifecycle

The United Nation's Millennium Development Goals include eradicating extreme poverty and hunger as their priority goal. Like poverty, under-nutrition and MNDs often occur as part of an intergenerational cycle (fig 4). During pregnancy and lactation, there are increased macro- and

micronutrient requirements. Pregnant mothers without optimal nutritional intakes have children with suboptimal nutrition- al status including impaired physical and mental development, setting the infant on a deleterious course of stunting, increased likelihood for infection, and developmental delays. In time, these children themselves enter their reproductive years at a nutritional disadvantage and the cycle continues. Furthermore, adults with nutritional disadvantages often have a lower work capacity due to the early developmental delays mediated through a lack of education. Thus, both malnutrition and poverty often track together and operate synergistically.

So, we understood that all causative factors do not lead to undernutrition or nutrient deficiencies in isolation, but many of these are interlinked while causing nutrient deficiencies. Few interlinks also affects beyond generation. Following are few examples. Try to understand multifactorial links and think where we can intervene.

- Fig 4 & 5 (11) depict how once nutritional deficiency sets in individual or in the family can lead to many other consequences which can lead to continuation of nutritional deficiency even beyond the generation. Many socio-economic factors keep on playing role to continue this cycle.

Micronutrient deficiencies have consequences throughout an individual's life span and are perpetuated across the generations. Around the world, pregnant women and children under 5 years of age are at the highest risk of MNDs.

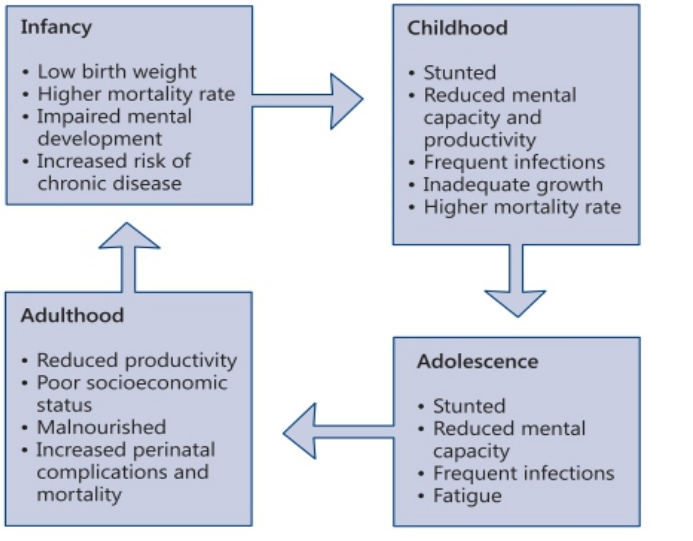


Fig 5:Various health and social issues in Intergenerational cycle in nutrient deficiencies.(13)

Iron, iodine, folate, vitamin A, and zinc deficiencies are the most widespread MNDs and are common contributors towards poor growth, intellectual impairment, perinatal complications, and increased risk of morbidity and mortality. Of greatest concern is the fact that the

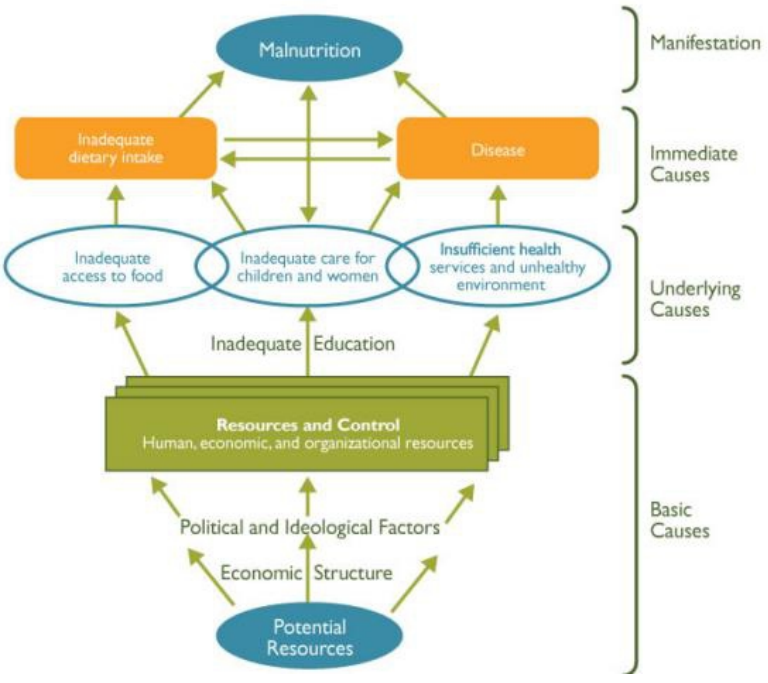
cycle of MNDs perpetuates across the generations, with far- reaching consequences on the future population. (13)

What to do…??

To break this cycle a health worker should be able to understand the factors which are contributing and opportunities to overcome these factors and break the cycle. (Fig 6) The process can take long time to see the effect and the recovery may not be complete in single generation. But breaking the cycle we'll have very good long term effect such as avoiding disadvantages of having malnutrition in next generation. We will discuss various ways to break this cycle at various levels in subsequent chapters.

Causes of undernutrition are multiple, interlinked and multi linked. The medical officer fighting with the problem of under nutrition should always remember that the various factors related to under nutrition are interlinked. The coexistence of few factors can work synergistically to complicate the existence of under nutrition in the family. One has to be very cautious to understand these linkages without solving of which they under nutrition underlying in the family will not be corrected for a long time. Figure 6 shows framework of such linkages of various causes of undernutrition e.g. immediate, underlying and basic causes. (12)

Fig 6:Framework on various linkages on causes



The causes of malnutrition are at different levels. The immediate causes are inadequate dietary intake and disease.

Inadequate dietary intake and diseases are caused by food insecurity, inadequate care for women and children, insufficient health services, and unsanitary environments.

These underlying issues are caused by conflict, inadequate education, poverty, gender inequality, inadequate infrastructure, and other basic issues.

Nutritional Deficiencies and financial development

Nutritional status and economic growth goes hand in hand at individual/family level to the country level. The country who has good policy on nutrition and if it is implemented well that can lead to it's economical growth in long term by decreasing poverty and increased productivity.

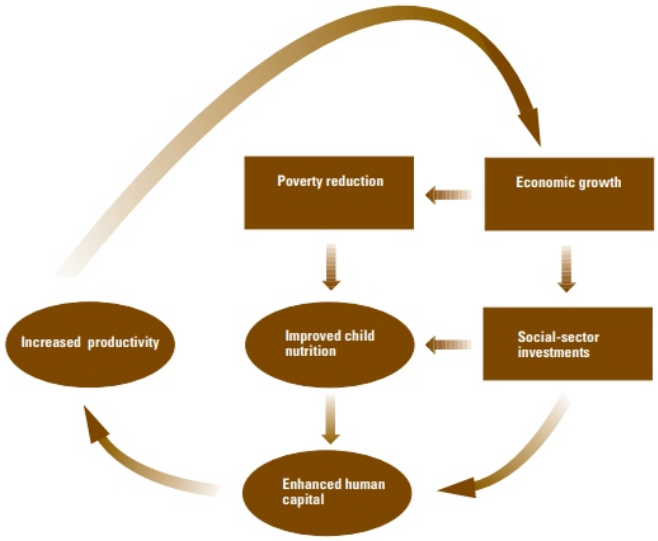


Fig 7:Child nutrition and Financial growth

Good early nutrition is most likely to result where there is economic growth, especially equitable growth; when social services become affordable and accessible; and when adequate investment is made in human resources, including the empowerment of women. Good nutrition, in turn, contributes to greater productivity and thus to economic growth. (11)

Summary:

Till now we have learned that nutrient deficiencies are very important public health problem and have huge burden all over the world especially in low and middle income countries like India. India bears large portion of nutrient deficiency of the world. There are many social economic and cultural factors contributing nutritional deficiency in the family. There are many interlinked factors which influence nutritional status of individuals in their family not only in one generation but can lead to affect children in next generation and so on.

There are many vicious cycles which leads to nutritional deficiency in children and so in adults. Health personnel should understand various factors in such vicious cycles and learn how to break this vicious cycle with various interventions, regular follow up and clinical vigilance. In further chapters we will learn how different types of nutritional deficiencies manifest, how to identify and manage them at individual and community level.

B. Macro-Nutrient deficiency

1. Protein-Energy Undernutrition

Magnitude of Problem:

Protein calorie undernutrition is one of the common health related problems in many of the Low Middle-Income Countries (LMIC). The problem is quite common in children aged less than 5 years. According to World Health Organization (WHO) globally in 2020, 149 million children under 5 were estimated to be stunted, 45 million were estimated to be wasted. In India according to National Health and Family Survey-5 (NFHS-5) conducted in 2019-2021, the prevalence of stunting was 35.5%, and wasting was 19.3%. Although the prevalence decreased from the previous survey, the decline was very less.

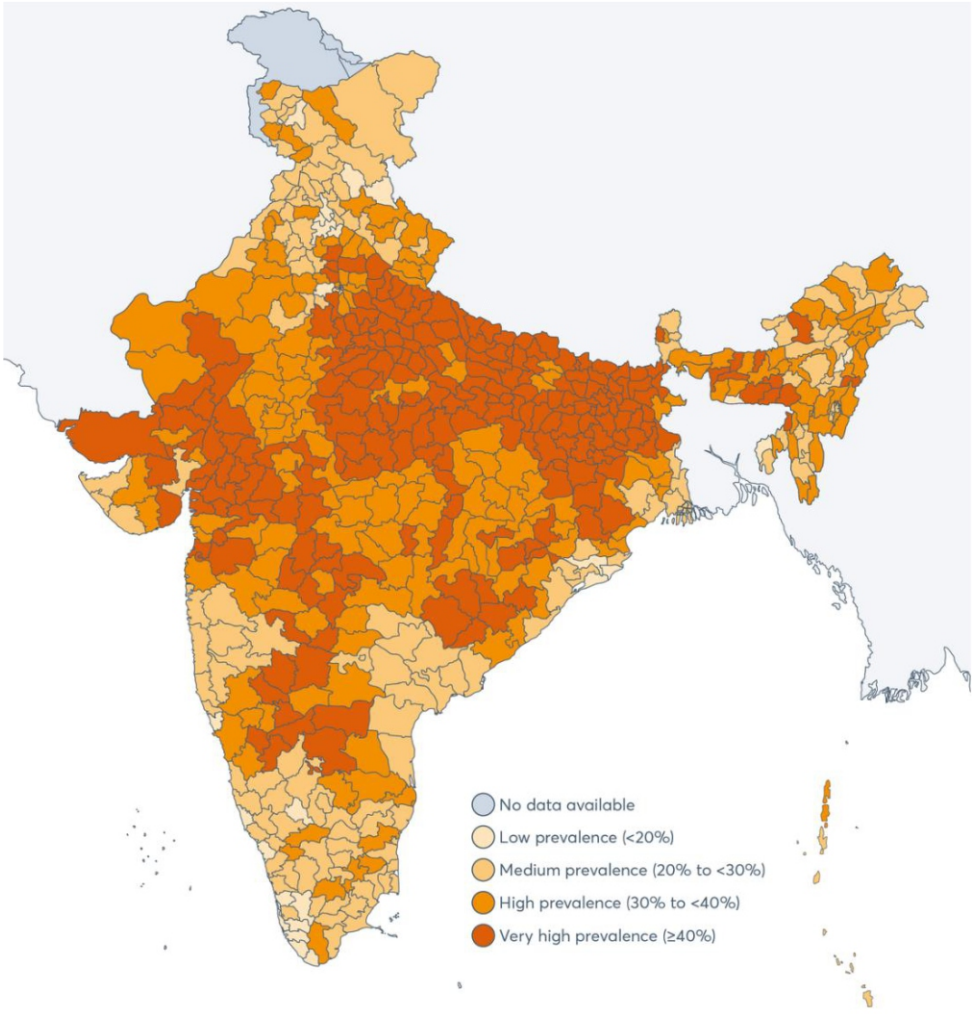


Figure-8: Burden of undernutrition (Stunting) in India

Prevalence of stunting is found to be higher (39.7%), and wasting is lower (17.3%) in the state of Uttar Pradesh than in India.

Causes:

Undernutrition in children, specifically in under-fives, is due to following causes:

1. Poor nutritional reserve in early life due to maternal under nutrition: Maternal malnutrition in the pregnancy and pre-pregnancy period due to poor knowledge regarding the long-term implications, local food faddisms, misconceptions, and lack of knowledge regarding the food.
2. Low birth weight: Many children born with weight less than 2500 gram are likely to continue to remain stunted, without proper care and nutrition in the later life.
3. Delayed start of complementary feeding: Many times, cultural practices related to breast feeding and delayed initiation of complementary feeding is one of key reasons of malnutrition in children after 6 months of age.
4. Poor nutritional quality of complementary food: Lack of awareness of the quality of the complementary food may lead to poor acceptance of complementary food among children. The too thick or too thin complementary food led to rejection of food by the children. If the food is too thin the acceptance will be there, but it will not meet the calorific requirement of the baby.
5. Repeated infection: Once the child falls into the category of undernutrition or infection this becomes a vicious cycle of undernutrition and infection.

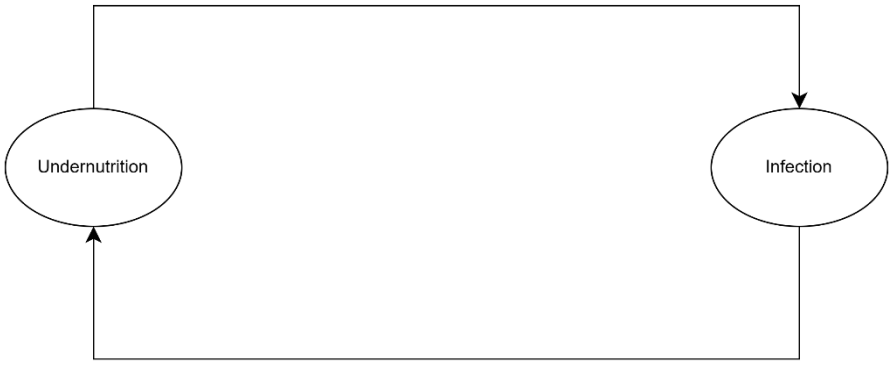


Figure-9: Malnutrition infection cycle

Identification of under nutrition:

Signs and Symptoms:

The patients with PEM may present with repeated infection history or poor growth as complained by the caretaker like mother. The presentation of the PEM case may vary according to the severity of the case.

PEM may be classified according to severity, clinical features and the energy or protein deficit. Severity classifications are based on body measurements (weight and height).

Table 3: Severity classifications based on body measurements

From Weight and Height	Stunting	Moderate	2-3 SD
		Severe	<3 SD
	Wasting	Moderate	2-3 SD
		Severe	<3 SD
From Upper Mid Arm Circumference		Red	<11.5 cm
		Yellow	11.5-12.5 cm
		Green	>12.5 cm

Stunting: A child having body height for age less than 2SD of the normal reference range may be called stunted. If the child lies in the range less than 2SD then the child may be called to be severely stunted.

Wasting: A child having weight for height less than 2SD of the calculated normal range for the age and sex of the child. If the child lies in the range less than 2SD then the child may be called to be severely wasted.

Mid Arm Circumference (MAC): This is known as an age independent anthropometric criteria for children between 1 and 5 years of age. MAC for 1–5 years old children should be more than 13.5 cm (about 5.31 in). Those with a MAC of less than 12.5 cm (about 4.92 in) are considered malnourished; those below 11.5 cm (about 4.53 in) are classified as having severe malnutrition and those between 12.5 cm (about 4.92 in) to 13.5 cm (about 5.31 in) are considered borderline. This is measured by using Shakir's tape which gives color coding of the measurement viz. red portion (below 12.5 cm), yellow (12.5–13.5 cm), green (more than 13.5 cm).

Few severe forms of Undernutrition -

Marasmus: Marasmus is defined as the presence of body weight 60% or less than the expected body weight without edema. The clinical features of the marasmus child (Fig 10) are severe emaciation, loss of subcutaneous fat leading to monkey face, severe muscle wasting, loose skin, fine brittle hair, impaired growth. However, the appetite is maintained and lethargic.[1]

Fig 10: Child with Marasmus (14)

This is due to their increased calorie requirements and increased susceptibility to infections. It results from the body's physiologic adaptation to starvation in response to severe deprivation of calories and other nutrients. Muscle wasting often starts in the axilla and groin, followed by thigh, buttocks, chest, abdomen, and finally the facial muscles. The skin is dry, wrinkled and loose because of the loss of subcutaneous fat. Affected children appear emaciated, irritable, weak, lethargic and have bradycardia, hypotension and hypothermia. The loss of buccal fat pads on the face gives the child an appearance of monkey or aged face in severe cases. These children are usually alert with strong appetite. (14)

Kwashiorkor: This is defined as having body weight 80% of the expected weight **with edema**. Peripheral pitting oedema that begins in dependent regions and proceeds cranially, Marked muscle atrophy, Abdominal distension (with/without dilated bowel loops and hepatomegaly), Round face (prominence of the cheeks, or "moon facies"), Thin, dry, peeling skin with confluent areas of scaling and hyperpigmentation, dry, full, hypopigmented hair that falls out or is easily plucked, growth retardation, psychic changes (anorexia, apathy), skin lesions/dermatitis (perineum, groin, limbs, ears, armpits) and subcutaneous fat retention with loose inner inguinal skin folds. [2]

Fig 11: Child with Kwashiorkor

[1] Titi-Lartey OA, Gupta V. Marasmus. [Updated 2023 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559224/

[2] Benjamin O, Lappin SL. Kwashiorkor. [Updated 2023 Jul 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507876/

The term Kwashiorkor originated from Ga language in Ghana, Africa which means “Disease associated with the birth of a second child”, or “the sickness the baby gets when the new baby comes.” Diet low in protein results in kwashiorkor. Generalised oedema, Distended abdomen and enlarged liver are typically seen. (Fig 11) Hair is usually dry, sparse, brittle, easily pluckable and depigmented, appears reddish yellow. With adequate protein intake, hair colour is restored and may result in alternating bands of pale and normal coloured hair also known as the flag sign. It signifies fluctuating periods of poor and good nutrition. Skin changes include shiny, varnished looking skin (64%), dark erythematous pigmented macules (48%), dryness (28%), residual hypopigmentation (18%), and hyper pigmentation and erythema. These children also have muscle wasting but tend to retain subcutaneous fat.(14)

Marasmic Kwashiorkor: When there is a mixed picture with features of both marasmus and kwashiorkor, then it is known as marasmic kwashiorkor. These children have concurrent gross wasting, oedema and frequently stunted. Mild hair and skin changes are often seen and they also have an enlarged palpable fatty liver.(14)

Anthropometry Methods:

Prevention of Under nutrition:

1. Breastfeeding promotion: Promotion of breast feeding among children aged 6 months (Exclusive BF) and more has been proved to have benefits related to child survival and prevention of under nutrition in certain settings.
2. Complementary feeding: initiation of complementary feeding at the age of 6 months has been found to be the most important cause of under nutrition. Many children develop under nutrition at this juncture of life. This under nutrition continues till 2 years of life due to faulty feeding practices among the care takers, specifically mothers.

   Initiation of complementary feeding at 6 months with the proper quantity and quality of food may help to prevent under nutrition. (Alive and Thrive figures)
3. Nutritional education
4. Deworming in children: Deworming of children specifically in the heavy workload areas have impact on the under nutrition.
5. Routine screening of the under-five in the public health facilities by the physician and during routine household visits by ASHA and ANM.

Management of Under nutrition

Identification of under nutrition in the community and hospital settings the cases can be managed in the community settings and hospital settings according to the type of the malnutrition, clinical presentation and complications.

The moderate under nutrition cases are managed in the community. The frontline workers like ASHA, ANM and Anganwadi workers.

Management of mild to moderate malnutrition:

Mild to moderate malnutrition is managed in home settings with proper counseling and follow-up of the cases. The cases must be identified by the frontline workers during the Village Health Nutrition Days (VHND).

Table- 4: Management of mild to moderate malnutrition according to age

Aged 6 -12 months	Aged 13-24 months	Aged > 24 months
Breast feeding to be continued	Breast feeding must be continued	
Give 3 servings* of complementary food per day if breastfed and 5 servings if not	Give 3 servings# of complementary food per day if breastfed and 5 servings if not	Give 3 servings of food and 2 servings of snacks
Feeding must be done by mother or immediate care giver	Feeding must be done by mother or immediate care giver	Feeding must be done by mother or immediate care giver
Hand hyegine must be maintained		

*- one serving= 1 cup

#- one serving= 1.5 cup

Management of Severe Acute Malnutrition:

The cases of SAM are identified by active or passive screening by the ASHA/ ANM/ Anganwadi worker during the community-based events like the VHND. These cases need to be referred to the health facility for physician consultation and ruling out complications. The complicated and those with poor appetite are managed at the health facility / Nutritional rehabilitation centers (NRC) under the guidance of the physician. The uncomplicated cases are referred to the community for further management under strict surveillance.

Appetite Test for SAM Children:

Appetite test to be conducted for all the identified children to rule out severe malnutrition. The test must be done by the AWW, in the presence of the household members. The test needs to be carried out in a quiet area with the THR available at the anganwadi. All the SAM children failing the test should be referred to the NRC and those who pass should be referred to the MO for further assessment. MO should assess the child for any complications. All children with complications must be referred to NRC for management. All the children without any complications should be referred for community-based management.

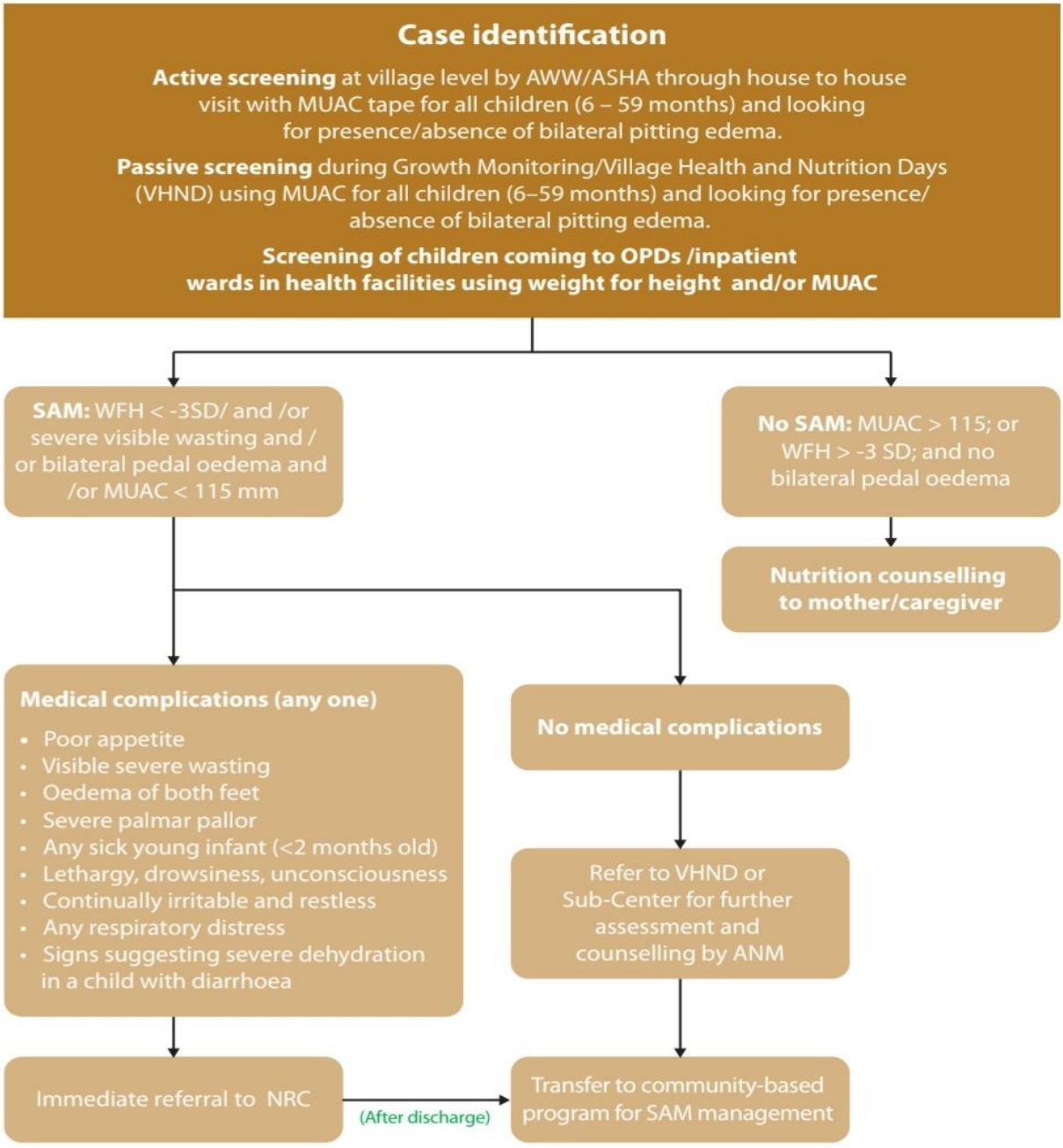


Figure-12: Management at the Medical Officer level for the referred children

Community based management:

Community based management is done for all uncomplicated under nutrition cases. All children with severe malnutrition manageable in the community should be followed strictly according to the guidelines. The community-based management has following steps:

1. Nutrition: Nutrition with appropriate calories, minerals and vitamins are the important part of management of undernourished children. All children will be provided nutrition according to the national food security act.
2. Nutritional counselling
3. Follow up:

   All children should be followed up in the community by the AWW and the trend must be reported in the Poshan tracker. Every SAM child must be followed up weekly in the first month followed by fortnightly. All MAM / SAM children presenting with growth flattering or health issues must be referred to the PHC/ CHC for further management. At the medical officer level the child must be screened for The MAM children must be followed up fortnightly.

   1. Severe Medical complications or anorexia
   2. Fever or hypothermia
   3. Severe pneumonia
   4. Diarrhea or showing signs of dehydration.
   5. Severe anemia
   6. Lethargic, unconscious, apathetic or with convulsions
   7. Appearance of edema
   8. Not eating for more than three days
   9. Weight loss for two consecutive weeks
   10. Failure to gain weight in two consecutive weeks.
   11. Non recovery after three months of Community based care

   The child must be followed up, two months after achieving normal weight or height. However the SAM child must be followed up till six years of age.

Special case of Infants under six months:

Infants under six months of age always screened for serious sickness or general danger signs. All the infants with general danger signs must be referred for further management after getting pre-referral

treatment. Those with no general danger signs must be assessed for other signs and symptoms and classified as severe risk of malnutrition or moderate or not at risk of malnutrition. Those with severe risk of malnutrition should be managed at NRC. Those with moderate risk should be managed in OPD based care or anganwadi based care. Those without risk should be managed by home based care.

Figure-13: Screening of children under six months

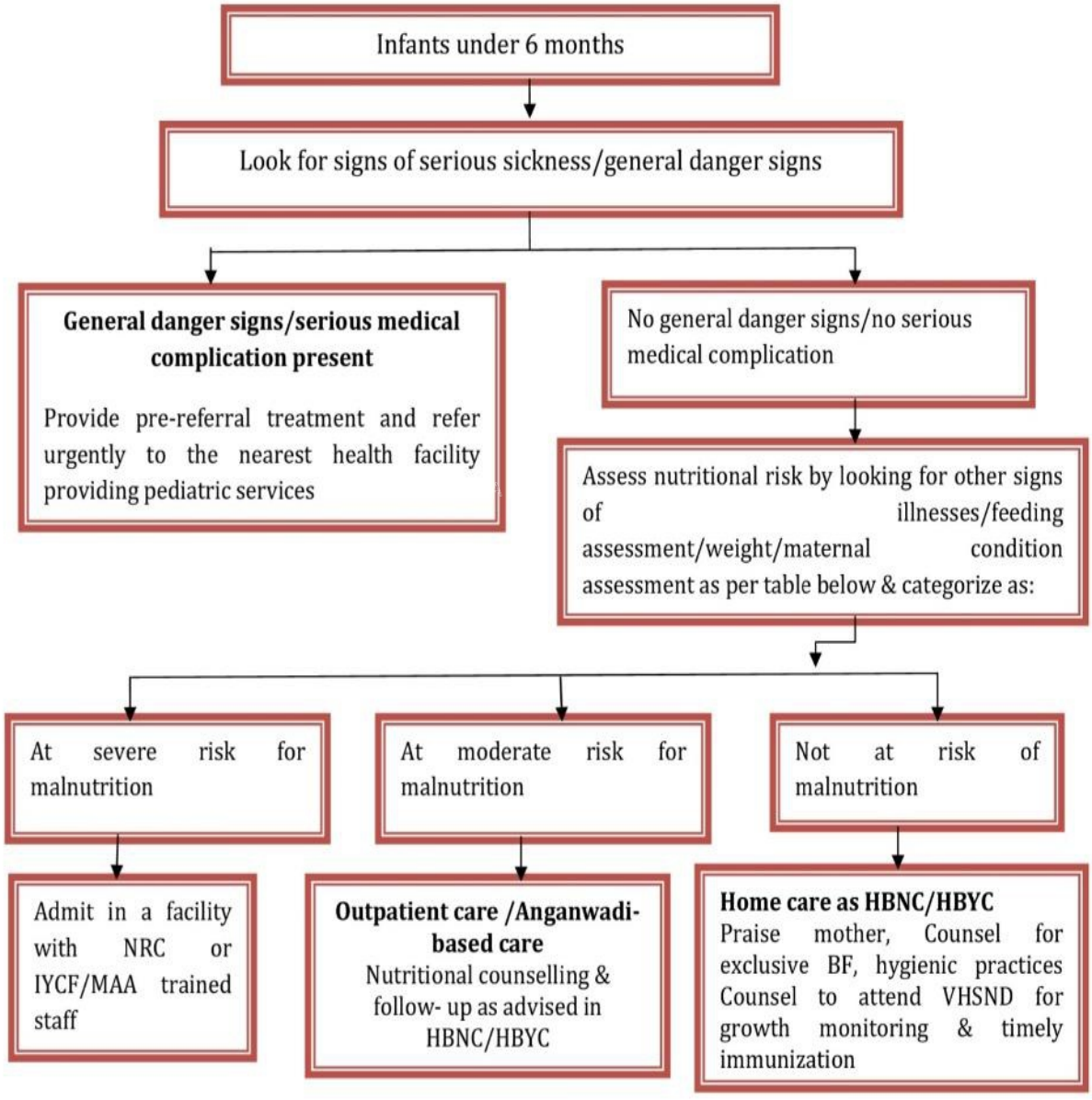


Table-5: Risk assessment of under 6-month children

High risk	Moderate risk	No risk
Not able to feed	Birth weight 1800 to 2500	Birth weight more than 2.5 kg and
IMNCI based danger signs	Moderate / severe malnutrition	Exclusively breastfed and
Birth weight less than 1800 gm during first month	No regained birth weight by day 14	WFA or WFH => 2SD
Weight loss between two consecutive visits after 2nd week of life after nutritional counselling	No weight gain between two consecutive visits even after nutritional counselling	Has gained >= 125 gm from last visit and
Sudden loss of weight more than 10% from previous week	Breast feeding problems	No maternal nutritional/ psychological issues
Sharp drop across growth curve line	No breastfeeding at all or mixed	
Congenital anomalies		

Hospital Based management:

Apart from all the points mentioned above, all the children who fall in the criteria of management in the hospital facility. The following table describes the admission criteria.

C. Vitamins and their deficiencies:

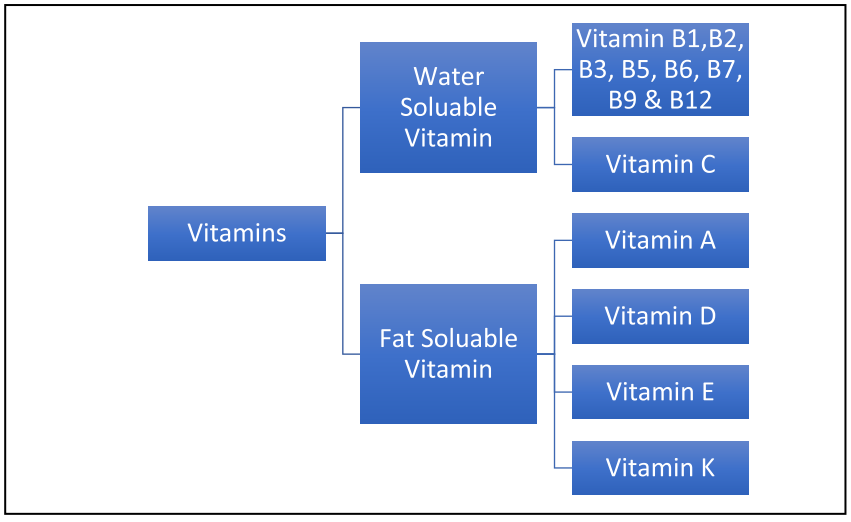
a. Introduction to vitamins

Fig 14: Vitamin rich foods

Vitamins are an essential, noncaloric, organic nutrient required by the body in tiny amounts. They must be present in our daily diet as they cannot be synthesized in the body. Vitamins are essential for numerous metabolism, body processes and maintenance of the structure of skin, bone, nerves, eye, brain, blood and mucous membrane. Vitamin deficiency due to malnutrition is particularly common in economically weaker section population.

They are either water soluble or fat-soluble. Vitamins A, D, E and K are fat-soluble, while vitamin C, and B-complex vitamins such as thiamine, riboflavin, niacin, pyridoxine, biotin, folic acid and cyanocobalamin are water soluble..

b. Classification of Vitamins, Fig 15:



Fat soluble vitamins can be easily stored in the body while water-soluble vitamins get easily excreted in urine. Vitamins B-complex and C are heat labile vitamins and are easily destroyed by high temperature, air or during drying, cooking and food processing.

Requirement of Vitamin Supplements

- Inadequate intake – Alcoholics, poor, elderly, dieters, poor diet
- Increased needs – Some physiological condition including pregnancy, lactation & infants, smokers, injury, trauma, recovery from surgery, infection, certain genetic disorders of metabolism
- Poor absorption – elderly, gastrointestinal disorders, surgeries like cholecystectomy, gastric bypass, cystic fibrosis, severe diarrhea, drug-induced vitamin deficiencies – e.g. long term antibiotic use, cholestyramine, mineral oil

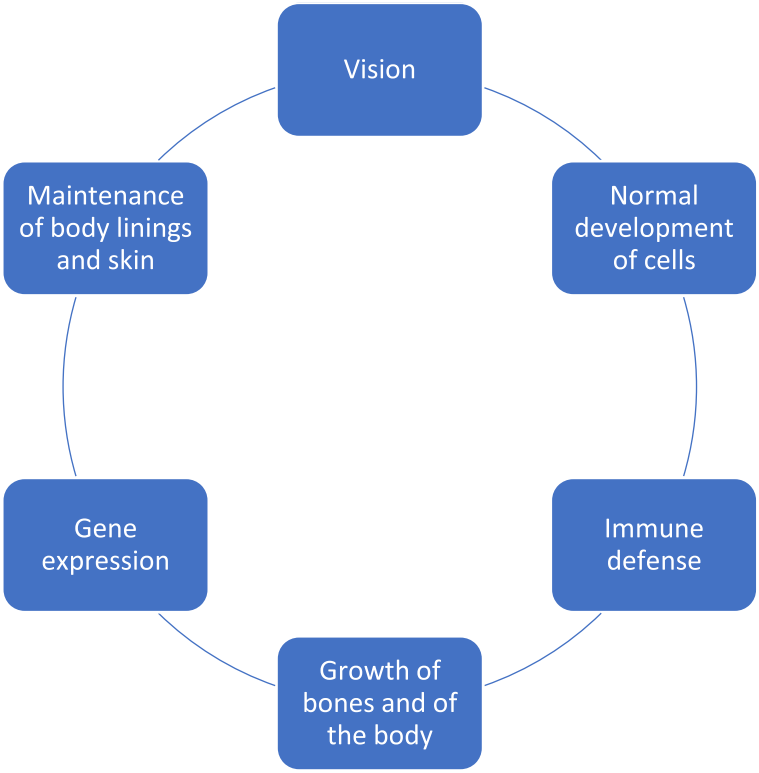
Fat Soluble Vitamin

- Found in fats and oils of foods
- Absorb like fats, first into the lymph then the blood
- Stored in liver and fatty tissues until needed
- Can reach toxic levels if too much is consumed
- Deficiencies can occur when people eat diets that are extraordinarily low in fat

c. Vitamin A

Vitamin A is a pale yellow primary alcohol from carotene. It include Retinol (alcoholic form), Retinal (aldehyde form) and Retinoic acid (acidic form). Beta-carotene is a plant derived precursor and Retinol is an active form stored in liver and it converted by cells into two other active forms Retinal and Retinoic acid.

Fig 16: Role of Vitamin A



RDA – 840 mcg (female) & 1000 mcg (male)

Sources

Potato, carrots, pumpkins, spinach, beef and eggs.

Vitamin A Deficiency

Clinical deficiency of vitamin A affects millions of children population worldwide, and subclinical deficiency is even more common. Retinol is the main circulating form of vitamin A in blood and plasma. Therefore, serum retinol is best used for the assessment of subclinical vitamin A deficiency in

a community or population. Blood concentrations of retinol in plasma or serum are used to assess subclinical vitamin A deficiency.

Xerophthalmia is the clinical spectrum of ocular manifestations of vitamin A deficiency;

1. Milder stages of night blindness and Bitot spots
2. Blinding stages of corneal xerosis, ulceration and necrosis (keratomalacia).

The various stages of xerophthalmia are regarded both as disorders and clinical indicators of vitamin A deficiency. Night blindness (in which it is difficult or impossible to see in relatively low light) is one of the clinical signs of vitamin A deficiency.

Keratinization due to vitamin A deficiency makes the tissues dry, hard and cracked which makes they are more susceptible to infection.

Serum retinol levels reflect vitamin A stores in liver when they are severely depleted or extremely high; however, between these extremes, plasma or serum retinol is homeostatically controlled and hence may not correlate well with vitamin A intake. Therefore, serum retinol is best used for the assessment of subclinical vitamin A deficiency in a population. Blood concentrations of retinol in plasma or serum are used to assess subclinical vitamin A deficiency.

- Subclinical vitamin A deficiency - <0.70 µmol/L
- Severe vitamin A deficiency - <0.35 µmol/L in children and adults

Consequences of Vitamin A deficiency

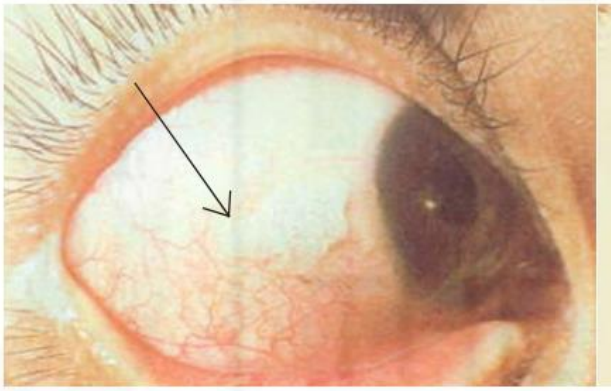


Fig 17:Bilot's spot

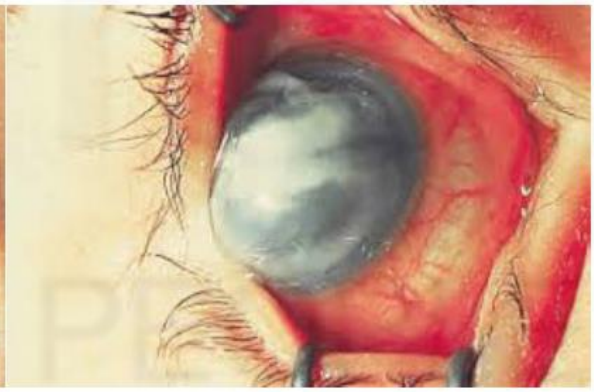


Fig 18: Bitot's Spot and kerato-malacia

Assessment of vitamin A deficiency –

- Population based clinical and biochemical survey
- Pre-school children (3 months – 6 years) who are at special risk
- The presence of any one of the criteria should be considered as evidence of xerophthalmia problem in the community.

Table 7: Cut-off values for public health significance

Indicator	Prevalence cut-off values [1]	public health significance
Serum or plasma retinol <0.70 µmol/L in preschool-age children	< 2%	No public health problem
	2-9%	Mild public health problem
	10-19%	Moderate public health problem
	≥ 20%	Severe public health problem
Night blindness (XN) in pregnant women	≥ 5%	Moderate public health problem

Table 8: Management of Vitamin A deficiency

Treatment and Prevention	
Vitamin A deficiency Treatment	• All of the early stages of xerophthalmia can be reversed by administration of massive dose of 2,00,000 IU or 110 mg of Retinol Palmitate oral on two successive days. • All children with corneal ulcers should receive vitamin A whether or not a deficiency is suspected.
Prevention	• Bi annual vitamin A supplementation for children 9-59 months • Half of the dose (1,00,000 IU) to children between 6 month to 1 year, preferably at 9 month

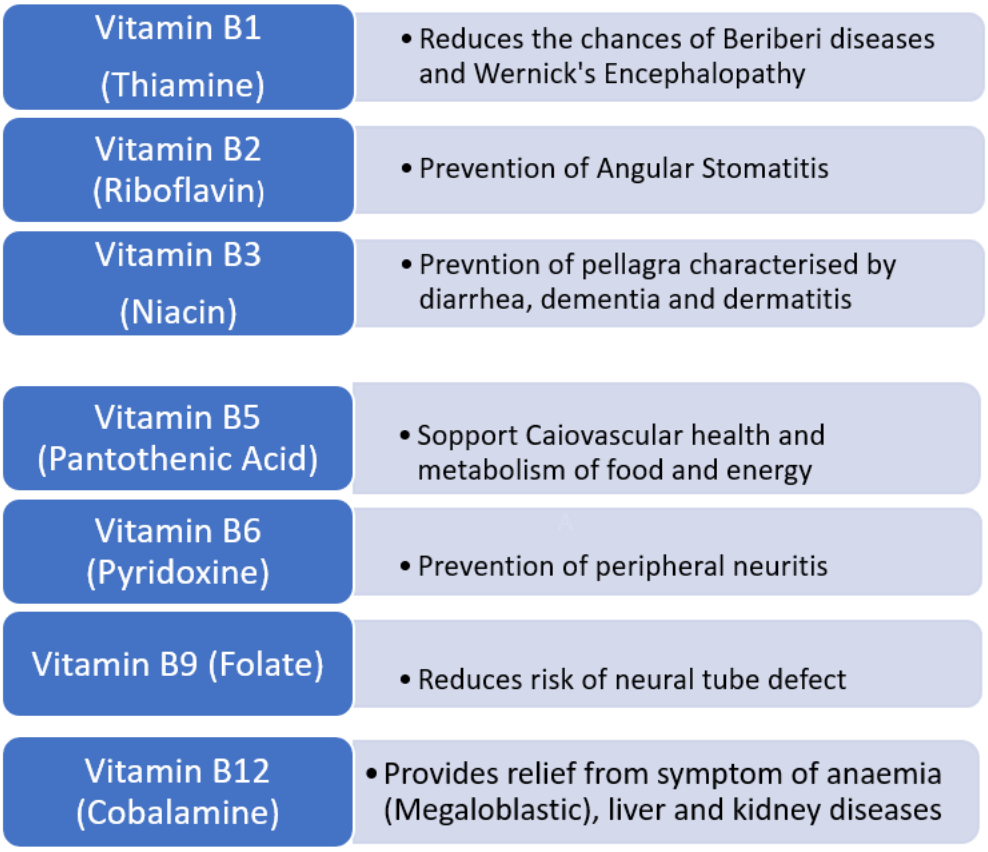
Control of Micronutrient Deficiencies or Vitamin and Mineral Deficiencies -

Micronutrients are Vitamins and Minerals that humans need to consume in tiny amounts for optimal health and development. Micronutrient deficiencies often coexist with protein energy malnutrition and have independent and interacting effects on health, growth and immunocompetence. Vitamin A Deficiency is public health problems which need to be addressed through a comprehensive approach that includes promoting optimal Feeding Practices, Dietary Diversification, Vitamin Supplementation, Food Fortification, Public Health Measures.

e. Vitamin B complex

Vitamin B are a group of 8 water-soluble vitamins. The body does not store them, so they need to be replaced daily. B vitamins are found in animal proteins, dairy products, leafy green vegetables, and beans. Overall, their function can generally be divided into catabolic metabolism, leading to energy production, and anabolic metabolism, resulting in bioactive molecules.

Fig19: Classification of Vitamin B



i. Vitamin B1

It is a colourless and crystalline substance. It is readily soluble in water and slightly in ethyl alcohol. Thiamine can be synthesized by plants and some microorganisms, but not usually by animals. Human being require thiamine from diet through small amount may be obtained from synthesis by intestinal bacteria. Our body can only store uo to 30 mg of thiamine in its tissues.

Thiamine is a co-enzyme required for glucose generation and neurotransmitter production. Storage exhaustion can start as early as two to three weeks.

Sources of Thiamine

Whole wheat floor, unpoliced rice, beans, Fresh fruits, corn, cashew nuts, potatoes, sweet potatoes, peas, wheat, milk, dates, black beans and yeast are the good source of thiamine.

Recommended daily allowance

- 1.8 mg/day (male) & 1.7 mg/day (female) [4]
- Requirement increases with increased carbohydrate intake, with some physiological situation pregnancy, lactation, smoking, alcoholism etc.

Deficiency of Thiamine

- First observed in East Asia, where rice provided
- people consumed.
    - Polished rice became widespread, and beriberi
- became epidemic.
- In developed countries today, alcohol abuse often leads to a severe form of thiamin deficiency, Wernicke-Korsakoff syndrome.
- Apathy, irritability, mental confusion, memory loss,
- jerky movement, staggering gait

Thiamine deficiency leads to neuronal loss, neuromuscular dysfunction, and oxidative stress, which is reflected in muscle weakness, areflexia, and progressive sensorimotor neuropathy (dry beri-beri).

Wernicke encephalopathy is characterized by a triad of encephalopathy, nystagmus, and ataxia. Damage in regions of high demand for thiamine (thalamus, mammillary bodies, basal forebrain, and cerebellum) results in anterograde and retrograde amnesia, confabulation, cognitive impairment, and memory deficits (Korsakoff syndrome).

Beri-beri are two types – dry and wet Beri-beri.

Dry Beri-beri –

- Predominantly nervous system involvement
- Various neurologic findings are symmetric impairment of sensory, motor and reflex function of extremities
- Mainly affect lower extremities, beginning with paresthesias in the toes, burning in feet

Wet Beri-beri –

- Predominantly involved cardiovascular system
- First effects are vasodilatation, tachycardia, wide pulse pressure, sweating, warm skin and lactic acidosis
- Later, heart failure develops, causing orthopnoea and pulmonary & pedal oedema.

ii. Vitamin B2

It is a component of the flavin coenzymes, FAD and FMN. It is mainly used in energy metabolism of sugars and lipids. Riboflavin is a yellow pigment and it is stable to heat & sensitive to light.

Source

- Rich sources are milk & its product, meat, eggs, liver and kidney, fish
- Bananas, grapes, mangoes, peas, pumpkin, mushrooms, popcorn etc.

RDA

- Men – 2.5 mg/day [4]
- Women – 2.4 mg/day

Deficiency

- Cheilosis – Fissure at the corners of the mouth or oral commissures.
- Glossitis - Glossitis typically causes tongue inflammation and can affect the tongue's texture and colour
- Dermatitis

iii. Vitamin B3

Niacin can be synthesized from amino acid tryptophan. Niacin contains a substituted pyridine ring and when NAD+ activated forms NAD+ and its phosphorylated derivative NADP+, which are coenzymes of many dehydrogenases. Niacin Participates in energy metabolism of every cell of body.

Source

- Meat, eggs, fish, milk products, guava, mushroom, peanuts, cereals, green peas, etc

RDA – 18 mg (male) & 14 mg (female) [4]

- Pellagra symptoms – 3 Ds
    1. Diarhhea
    2. Dementia
    3. Dermatitis

iv. Vitamin B5

It is also called coenzyme, pantothenic acid is a water-soluble vitamin that is found in all living cells within the body that forms an essential part of acyl groups in general, including the acetyl group derived from pyruvate.

RDA

Infants:

- 0–6 months, 1.7 mg [4]
- 7–12 months, 1.8 mg

Children:

- 1–3 years, 2 mg
- 4–8 years, 3 mg
- 9–13 years, 4 mg

Adults:

- Men and women 14 years and older, 5 mg
- Pregnant women, 6 mg
- Breastfeeding women, 7 mg

Sources

Meat, kidney, egg yolk, broccoli, peanuts, fish, chicken, milk, yoghurt, legumes, mushrooms, avocado, etc.

Deficiency of Vitamin B5

Pantothenic acid deficiency is commonly associated with malnourished and not acquiring enough calories daily. Deficiency may also occur in combination with deficiencies of other B vitamins.

Commonly deficient syndrome are fatigue, depression, irritability, insomnia, stomach pains, vomiting, burning feet, upper respiratory infections, muscle cramps etc.

v. Vitamin B6

Vit.B6 is also known as pyridoxine and it exists in three forms: Pyridoxine, Pyridoxal and Pyridoxamine and their corresponding phosphates. Pyridoxal phosphate participates in transamination, decarboxylation, racemisations and numerous modifications of amino acid sequence side chains.

Source

Bananas, Beans, Lentils, Walnuts, Chicken, Beef, Whole grain breads, Cereals, Soybeans, Liver, eggs, Dairy products etc.

RDA

2.4 mg/day (male) & 1.9 mg/day (female) [4]

Deficiency

Vitamin B6 deficiency lead to seborrheic dermatitis, microcytic anemia, dental decay, glossitis, epileptiform convulsions, peripheral neuropathy, depression, confusion, and weakened immune function.

Toxicity

Neurotoxicity and Photosensitivity

vi. Vitamin B7 - Biotin

Biotin is a vitamin and a coenzyme commonly associated with enzyme performing carboxylation reactions. Biotin is also known as “anti-egg white injury factor” or as H-factor. where the letter ‘H’ represents’ Haar und Haut’, this is a German terminology for "hair and skin", it is pivotal for a wide range of metabolic processes in the body including enzyme synthesis for several crucial metabolic pathways’ metabolism of fats and carbohydrates, as well as synthesis of amino acids which are necessary for protein synthesis.

Primarily, Biotin is a type of co-enzyme that is required for the synthesis of fatty acids which are molecules found in fats and oils; glucogenesis, i.e. synthesis of glucose from amino acids and fatty acids; and synthesis of leucine, a quintessential amino acid that the human body cannot generate on its own.

Source

Yeast, Rice, Soybeans, Peanut, Fish, Mushrooms, Bananas, Liver and Milk etc.

Deficiency

Fatty Liver and Kidney Diseases

vii. Vitamin B9 - Folate

The active form acid is tetrahydrofolate (THF). Coenzymes derived from the vitamin folic acid participates in the generation and utilization of single – carbon functional groups, methyl, methylene and formyl. Folate helps synthesize DNA and so is important for making new cells

RDA

300 mcg (male) & 240 mcg (female) [4]

Sources

Fish, poultry, meat and dairy products

Deficiency of Vitamin B9

Deficiency can occur when there is poor dietary habits as those of chronic alcoholics, impaired absorption or metabolism or increased demand in pregnancy etc.

- Deficiency of folate causes anemia, diminished immunity, and abnormal digestive function.
- Deficiencies are related to increased risk of cervical cancer (in women infected with HPV), breast cancer (in women who drink alcohol) and pancreatic cancer (in men who smoke).
- Adequate intakes of folate during pregnancy can reduce a woman's chances of having a child with a **neural tube defect (NTD)**.
- NTD arise in the first days or weeks of pregnancy, long before most women suspect they are pregnant
- Therefore, Indian health care providers are routinely using five milligram or more folic acid beginning at the first antenatal visit, in the hope to prevent NTDs. [6]

viii. Vitamin B12 – Cobalamin

The metal cobalt in vitamin B12 is coordinated with a tetrapyrole ring system, called a corin ring, which is similar to the porphyrin ring of heme compounds. B12 requiring reactions involve methyl group transfer and adenosyl cobalamin dependent isomerizations. Vitamin B12 and folate are closely related: each depends on the other for activation.

Vitamin B12 is an important micronutrient among all other vitamins as it has a considerable effect in various bodily functions. In India, over 650 million people have Vit B12 deficiency [7]. According to the WHO, scientific group report on nutritional anemia criteria for Vitamin B12 deficiency are as shown below [8].

- Vitamin B12's other functions then become compromised, and the results can be devastating: damaged nerves, creeping paralysis, and general muscle and nerve malfunctioning.
- Intrinsic factor is a compound made by the stomach needed for the absorption of B12.
- A few people have an inherited defect in the gene for intrinsic factor, which makes B12 absorption poor.
- Lack of intrinsic factor due to vitamin B12 deficiency is known as **pernicious anemia**.

Thus, a serum Vit B12 level of less than 200pg/mL is considered as deficiency. The prevalence of low vitamin B12 status increased with age from young adult (19–39 years of age) to older adults (>60 years of age) and was generally higher in women than in men (prevalence of 3.3% versus 2.4% with a serum B12 level of <148pmol per liter, respectively) [9].

Serum level (pg/ml)	Interpretation
200–960	Normal range
140–200	Diagnostically indeterminate
80–140	Suggestive of deficiency
Less than 80	Deficiency

Fig 20: Serum B12 levels and their interpretations

Vegetarian diet, dark complexion, below middle socio-economic class, and R.O processed water used for drinking purpose were found to be independently associated factors for vitamin B12 deficiency [10].

f. Vitamin C – Ascorbic acid

It is a water soluble vitamin. It is essential for the hydroxylation of proline and lysine in the formation of collagen. Collagen is a fibrous protein with myriad connective and supportive functions

Sources

Citrus fruits and juices, such as lemon, oranges and grapefruits etc.

RDA - 80 mg (Male), 65 mg (Female)

Deficiency of Vitamin C

Deficiency causes poor blood clotting and poor bone development

g. Vitamin E -Tocopherol

Vitamin E also called Tocopherol or fertility hormone. Vitamin E is required in the human diet but its deficiency is rare except in pregnancy and the new born, where it is associated with hemolytic anaemia. It exists in the diet as a mixture of eight closely related compounds called tocopherols. Vitamin E is an antioxidant. Oxidative damage occurs when highly unstable molecules known as free radicals, formed normally during cell metabolism, run amok and disrupt cellular structures.

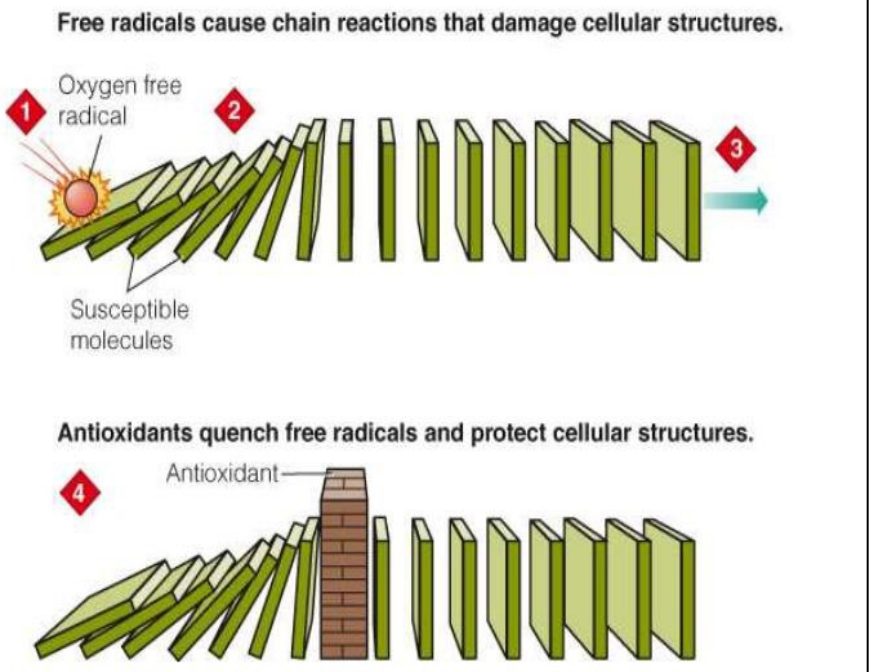


Fig 21: Vitamin E and its protection from free radicals

1. Chemical reaction
2. Destructive Chain reaction
3. Injury to lipids of cell membrane and cellular protein
4. Stop the chain reaction by changing the nature of free radical

Sources

Fortified cereals, leafy green vegetables, seeds, and nuts etc.

RDA

15 milligrams a day for adults

Vitamin E deficiency

- A classic vitamin E deficiency occurs in premature babies born before the transfer of the vitamin from mother to the infant, which takes place in the last weeks of pregnancy.

  - Infant's RBC lyse and infant becomes anemic

- Heart disease and cancer may arise in part through tissue oxidation and inflammation.
- People with low blood vitamin E concentrations die more often from these and other causes than do people with higher blood levels.
- No adverse effects arise from consuming foods that naturally provide vitamin E.
- Vitamin E supplements appear safe at lower doses.
- An increase in brain hemorrhages, a form of stroke, among smokers taking just 50 mg of vitamin E per day has also been noted.
- Supplements may also increase the effects of anticoagulant medication.

h. Vitamin K

Vitamin K is also called phylloquinone or anti-hemorragic vitamin or coagulation vitamin. Vitamin K is a complex unsaturated hydrocarbon found in two forms, vitamin K1(phylloquinone) and vitamin K2(Menaquinone).

Function of Vitamin K

Main function of vitamin K is to help synthesize proteins that help blood clot. Also necessary for the synthesis of key bone proteins. Vitamin K can be made by intestinal bacteria. Newborns are given a dose of vitamin K at birth

RDA

120 mcg (male) & 90 mcg (Female)

Sources

Dark green leafy vegetables, spinach, broccoli and in turnip or beet green

D. Minerals and their deficiencies

Let us now go through various minerals diseases such as iron, iodine and calcium and their deficiency which are important in diet.

a. Iron deficiency and Anemia

Human body contains about 4 gm of iron of which 3 gm are in the blood, with haemoglobin and rest 1 gm. is in stored form. Iron is essential for synthesis of haemoglobin. It is found in other myoglobin and certain other enzymes. There are two forms of iron: Haem is from animal sources such as liver, fish, meat, poultry etc. and non haem is from vegetable sources such as ragi, jiggery, dried fruits etc.

The commonest manifestation of iron deficiency is anaemia, the single most common nutrient deficiency all over the world. The most vulnerable are infants, children of school age group, adolescent girls and pregnant mothers. The impact is more profound in rural girls because of non-availability and nonintake of iron rich foods.

Anemia is defined as the condition where the number of red blood cells or the hemoglobin concentration is less than normal. Iron deficiency is one of the most common causes of anemia specifically in low middle income countries.

Magnitude of problem:

Prevalence of anemia has increased over the time from NFHS-4 to NFHS-5. Prevalence of anemia is higher among females than males due to obvious reasons. From 36 states and union territories in 7 states the prevalence of anemia is lower than 50%. Among all, 10 states, 19 states, 11 states have prevalence of anemia less than 50% among non-pregnant women, pregnant women and all women.

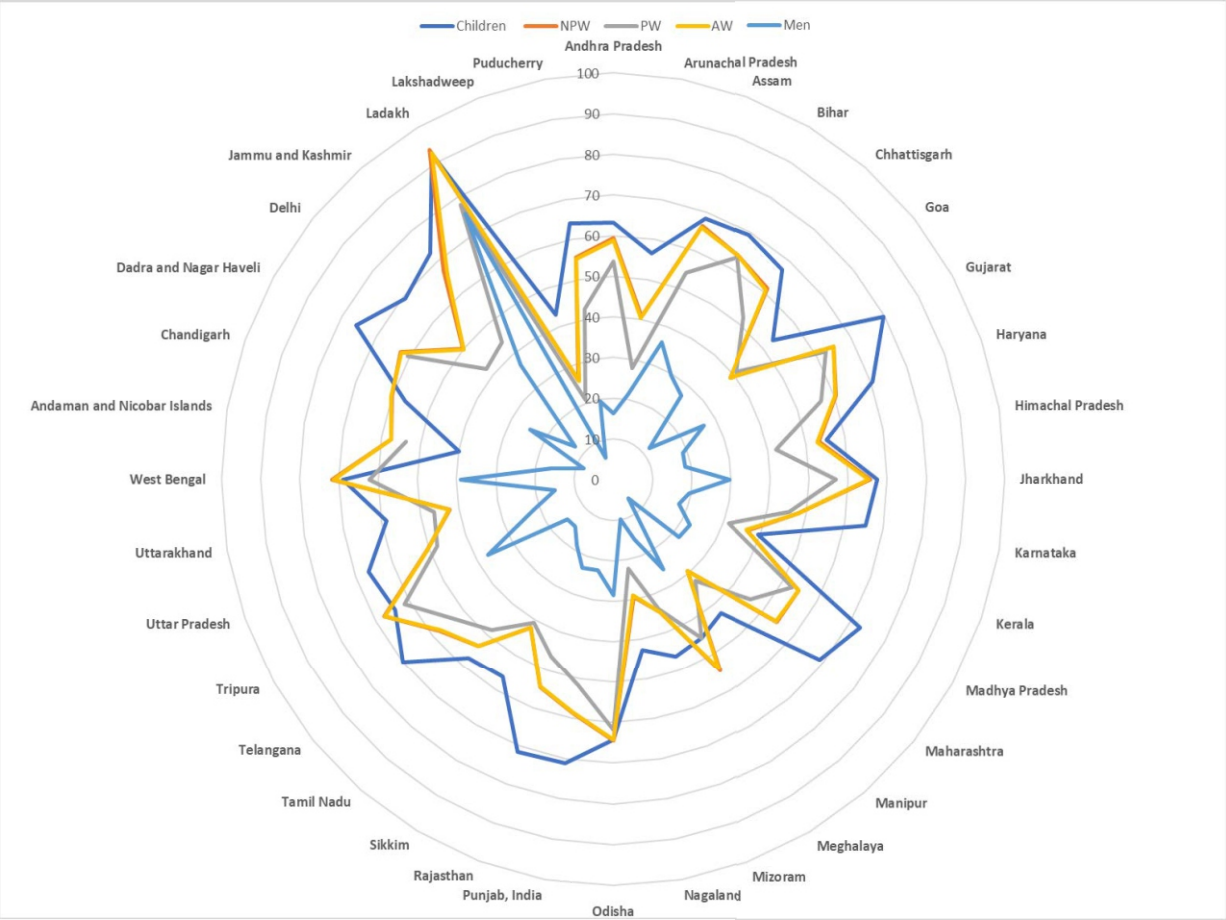


Figure 22-: prevalence of anemia in different subgroups

Causes:

Decreased production
• Nutrient Deficeincy
• Iron deficiency
• B12 deficiency
• Folic Acid Deficiency
• Haematopoietic cell defect
Increase loss or destruction
• Blood loss
• Haemolytic anemia

Table 9- Causes of Anemia

Prevalence of anemia mainly depends on various factors, but **iron deficiency is one of the most important reasons**. The other reasons can be poor nutrition, infections like malaria, heavy menstruation, pregnancy related problems and familial causes like haemoglobinopathies. Among females the blood loss during the menstrual cycle and multiple and frequent pregnancies are one of the important causes. Poor iron reserve is transmitted from mother to babies and leading to anemia in early life.

Symptoms of Anemia:

Common symptoms of anemia are non-specific like fatigue, reduced physical work capacity, shortness of breath, pale skin, mucus membrane, cold hands and feet.

Diagnosis and management:

Diagnosis of anemia is generally done based on the haemoglobin concentration in the blood. The cut-off varies according to age and sex. The cutoff for anemia in different age and sex are mentioned in the following table.

Table 10-: Classification of anemia according to hemoglobin concentration

Category	Anemia		
	Mild	Moderate	Severe
Children 6-59 months	10-10.9	7-9.9	<7
Children 5-11 years of age	11- 11.4	8- 10.9	<8
Children 12-14 years of age	11- 11.9	8-10.9	<8
Non pregnant women	11- 11.9	8-10.9	<8
Pregnant Women	10- 10.9	7- 9.9	<7
Men	11-12.9	8-10.9	<8

To manage and reduce anemia in the country government has planned for Anemia Mukt Bharat (AMB) strategy. The strategy targets the six age groups with six interventions involving six institutional mechanisms. This is called the 6x6x6 strategy.

Figure 23- 6x6x6 strategy

Strategy-1: Prophylactic Iron and Folic Acid Supplementation:

Prophylactic IFA is one of the key preventive interventions in key target age groups specifically in the children, adolescent girls and in women of reproductive age groups. The prophylactic IFA therapy prevents development of anemia. The following table mentions the various intervention groups and interventions.

Table 11- Prophylactic IFA supplementation

Category	Intervention	Who will provide
Children 6- 59 months	Biweekly 1ml of IFA syrup 1ml 1st week supervised (20 mg iron + 100 mcg folic acid)	ASHA
Children 5-9 years of age	One IFA tablet (Pink) weekly in the schools (45 mg iron + 400 mg Folic acid)	School Teacher
	One IFA tablet (pink) weekly during home visits in out of the school children (45 mg iron + 400 mg Folic acid)	ASHA
School going children 10- 19 years	One IFA (Blue) weekly (60 mg Iron + 500 mg Folic Acid)	School Teacher
Out of school children 10- 19 years	One IFA (Blue) weekly (60 mg Iron + 500 mg Folic Acid)	Anganwadi Centers
Women of reproductive age group	Weekly IFA tablet (Red) (60 mg Iron + 500 mg Folic Acid)	Anganwadi Centers
Pregnant women	Daily one tablet of IFA starting from 4th month for 180 days (60 mg Iron + 500 mg Folic Acid)	ASHA
Lactating women	Daily one tablet of IFA tablet for 180 days (60 mg Iron + 500 mg Folic Acid)	ASHA

Strategy-2: Deworming

Worm infestation is an important cause of anemia in low middle income countries. Targeting the infestation of worm is also important for aspect of anemia prevention. The following table describes the dose and regime of deworming.

Table 12- Dose and Regime of Deworming

Age group	**Dose and Regime**
Children 12-59 month	Biannual dose of 400 mg Albendazole (1/2 tablet to children aged 12-24 month and 1 tablet to children aged 24-59 month)
Children 5-9 years	Biannual dose of 400 mg Albendazole
School going adolescents 10-19 years of age *Out of School adolescents aged 10-19 years*	Biannual dose of 400 mg Albendazole
Women in reproductive age group	
Pregnant Women	One dose of 400 mg Albendazole after the first trimester preferably in the 2nd trimester

Strategy-3: Intensified Behavior Change Communication

Behavior Change Communication is an important aspect of the program. BCC mainly acts to facilitate the following:

1. Compliance to Iron and Folic Acid supplementation
2. Appropriate infant and young child feeding with age-appropriate feeding practices.
3. Food fortification
4. Promoting delayed cord clamping and early initiation of breast feeding

The various platforms to disseminate such messages will be VHSNC meetings, VHND days and meeting with school-teachers, panchayat leaders. The same must be communicated in the school level platforms like assemblies. The same messages must be ciculated during meetings in various occasions like National Nutrition Week, Deworming day, World Breast feeding week.

Strategy 4: Testing and treating Anemia

Testing of various target groups must be done periodically to diagnose the cases of anemia and manage them properly according to the protocol. The current proposed method is using the digital haemoglobinometer which is being provided by the government in all the centers.

As there are various age group where the anemia is common, their challenges are also different. Therefore we have to find and implement different approaches for different age groups according to their problem of anemia and different challenges to counter anemia in that particular group. Following are group wise approaches for anemia.

Table 13: Approach to Children 6-59 months for anaemia

Target group A	**Children 6–59 months**
Who will screen and place of screening	ANM: VHND/sub-centre/session site RSBK team: AWC/school Medical Officer: health facility
Periodicity	• RBSK/ANM: as per scheduled microplan • MO: opportunistic
If Haemoglobin is 7–10.9 g/dl (mild and moderate anemia)	
First level of treatment (at all levels of care)	3 mg of iron/kg/day for 2 months • For children 6–12 months (6–10.9 kg): 1 ml IFA syrup, once a day • For children 1–3 years (11–14.9 kg): 1.5 ml IFA syrup, once a day • For children 3–5 years (15–19.9 kg): 2 ml IFA syrup, once a day Line listing for all anemic children to be maintained by the ANM/ ASHA/ AWW
Follow-up	• Every month by ANM at VHND • Hb estimation after 2 months for completing 2 months of treatment to document Hb>= 11g/dl • Monitoring by ASHA for compliance of IFA syrup every 14 days for a period of 2 months If haemoglobin levels have improved to normal level, discontinue the treatment, but continue with the prophylactic IFA dose
If no improvement after first level of treatment	In case the child has not responded to the treatment of anemia with daily dose of iron for 2 months, refer the child to the FRU/DH medical officer/paediatrician/physician for further investigation
If Haemoglobin is <7 g/dl (severe anemia)	
Treatment	• Refer urgently to District Hospital/First Referral Unit • Management of severe anemia in children of 6–59 months is to be done by the medical officer at the First Referral Unit/ District Hospital based on investigation

Table 14: Approach to adolescents (10-19 years) in school for anaemia

Target group	**All school-going adolescents 10–19 years in government/ government-aided schools**
Who will screen and place of screening	In school premises by RSBK team
Periodicity	Annually
Mild and Moderate Anemia (Hb cut-off as per Table 1)	
First level of treatment (at all levels of care)	Two IFA tablets (each with 60 mg elemental iron and 500 mcg folic acid), once daily, for 3 months, orally after meals
Follow-up	• Line listing of all anemic cases to be maintained in the school register for Iron Folic Acid supplementation and given to the ANM/LHV/MPHW of designated area • Follow-up by ANM/LHV/MPHW of designated area, as feasible for the state • Parents to ensure follow-up of adolescent after 45 days to 90 days at the nearest sub-centre/ health facility • If haemoglobin levels have improved to normal level, discontinue the treatment, but continue with the prophylactic IFA dose
If no improvement after first level of treatment	If no improvement after three months of treatment (i.e., still in mild/moderate category), ANM/MO of nearest facility to refer adolescent to First Referral Unit (FRU)/District Hospital (DH)
If Haemoglobin is <8 g/dl (severe anemia)	
First dose of treatment	Management of severe anemia in adolescents 10–19 years is to be done by the medical officer at FRU/DH based on investigation and subsequent diagnosis

Table 15: Approach to pregnant women for anaemia

Target group	Pregnant women registered for antenatal care
Who will screen and place of screening	Health service provider at any ANC contact, including Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA)[5]
Periodicity	At every ANC contact
If Haemoglobin is 10–10.9 g/dl (mild anemia)	
First level of treatment (at all levels of care)	• Two tablets of Iron and Folic Acid tablet (60 mg elemental Iron and 500 mcg Folic Acid) daily, orally given by the health provider during the ANC contact • Parental iron (IV Iron Sucrose or Ferric Carboxy Maltose (FCM) may be considered as the first line of management in pregnant women who are detected to be anemic late in pregnancy or in whom compliance is likely to be low (high chance of lost to follow-up)
Follow-up	• Every 2 months for compliance of treatment by health provider during the contact • If haemoglobin levels have come up to normal level, discontinue the treatment and continue with the prophylactic IFA dose
If no improvement after first level of treatment	If no improvement in haemoglobin (<1 g/dl increase) after one month of treatment, refer to First Referral Unit (FRU)/District Hospital (DH) by health provider The case to be referred to FRU/DH for further investigations for cause of anemia and may be managed with IV Iron Sucrose/ FCM
If Haemoglobin is 7–9.9 g/dl (moderate anemia)	
First level of treatment (at all levels of care)	Two tablets of Iron and Folic Acid tablet (60 mg elemental Iron and 500 mcg Folic Acid) daily, orally given by the health provider during the ANC contact • Parental iron (IV Iron Sucrose or FCM) may be considered as the first line of management in pregnant women who are detected to be anemic late in pregnancy or in whom compliance is likely to be low (high chance of lost to follow-up)
Follow-up	• Every 2 months for compliance of treatment by health provider at regular ANC clinics/PMSMA/VHND platform. • The contact is to be utilized by the health provider to also conduct haemoglobin estimation of the anemic cases every month. If haemoglobin levels have come up to normal level, discontinue the treatment and continue with the prophylactic IFA dose.

If no improvement after first level of treatment	If no improvement in haemoglobin (<1 g/dl increase) after two month of treatment, refer to First Referral Unit (FRU)/District Hospital (DH) by health provider The case to be referred to FRU/DH for further investigations for cause of anemia and may be managed with IV Iron Sucrose/ FCM
If Haemoglobin is 5.0–6.9 g/dl (severe anemia)	
First level of treatment	Management of severe anemia in pregnant women will be done by the medical officer at PHC/CHC/FRU/DH The treatment will be done using IV Iron Sucrose/Ferric Carboxy Maltose (FCM) by the medical officer *Immediate hospitalization recommended in the third trimester of pregnancy at a health facility where round-the-clock specialist care is available
Follow-up after first level of treatment	After the first level of treatment, monthly or as prescribed by the medical officer
Treatment protocol if no improvement	As prescribed by the medical officer
Note	For severely anemic pregnant women with haemoglobin less than 5 g/dl, immediate hospitalization irrespective of period of gestation where round-the-clock specialist care is available. This is to be done till normal level of haemoglobin is achieved.

Strategy -5 Mandatoy provision of fortified foods in Government funded programs.

Government of India has mandated provision of fortified foods in all government funded programs like ICDS, and MDM schemes. The food provided in the government facility programs must be with fortified wheat, rice and double fortified salt.

Strategy-6: Intensified awareness, screening and treatment of non-nutritional causes of anemia in endemic pockets with special focus to malaria, haemoglobinopathies. And fluorosis.

b. Iodine Deficiency Disorders:

Iodine is one of the important compositions of thyroid hormone and helps metabolism in the body. Deficiency of iodine is linked to many diseases like physical and mental retardation, cretinism, repeated abortions, still birth and other problems. According to the survey conducted in almost 414 districts, 337 districts are endemic for iodine deficiency.

Magnitude of problem:

There is no nationalized survey in India to find the prevalence of iodine deficiency in India done recently. According to past surveys conducted 337 districts were found to be endemic for goiter i.e., prevalence more than 5% in the community.

Causes:

The most common cause is absence of iodine in the nutrient. Iodine is one of the common constituents of the minerals in the soil and completes its cycle as water. It generally reaches the human body through food. In the areas where the amount of iodine is less in the soil, people generally tend to suffer from iodine deficiency.

Clinical features and Diagnosis:

Iodine deficiency generally manifests as visible goiter which is the most obvious signs of iodine deficiency. Other clinical manifestations of iodine deficiency are described in table 16-.

Table 16- Manifestations of iodine deficiency in different age groups

Age category	Problems
Fetus	Miscarriage Still births Congenital anomalies Increased perinatal morbidity & mortality Endemic cretinism (Squint, Deaf-mutism, Motor spasticity)
Neonate	Neonatal goiter Neonatal hypothyroidism Endemic neurocognitive impairment
Child and Adolescent	Goiter Impaired mental function Retarded physical development
Adult	Goiter Impaired mental function Iodine induced hyperthyroidism

In the community assessment of iodine deficiency is generally done by three important methods:

1. Goiter rate (proportion of School age children have goiter)
2. Urine iodine concentration

Management:

Most cost-effective way of managing the goiter burden is salt iodization. Use of iodized salt mostly prevent the development of iodine deficiency. According to govt. of India Universal Salt Iodization is mandatory.

c. Calcium Deficiency

Calcium is one of the important micronutrients of the body. The majority of the calcium is found in free state bound to the plasma proteins in the blood followed by bone and muscles. It provides strength to the bones and the contraction of the muscles results from this.

Magnitude of the Problem:

Various studies in India have demonstrated the low consumption of dairy products among Indians. [3] But as mentioned in the Vitamin D deficiency there is no such country wide survey to assess the prevalence of Calcium deficiency in India.

Causes of Calcium Deficiency:

Calcium in the blood is mainly regulated by the Parathyroid hormone, Vitamin D and Calcitonin. While parathyroid hormone mainly pushes calcium to the blood, vitamin D helps to absorb calcium and pushes calcium to the bones. Calcitonin in the other hand also decreases calcium in the blood and pushes into the bones.

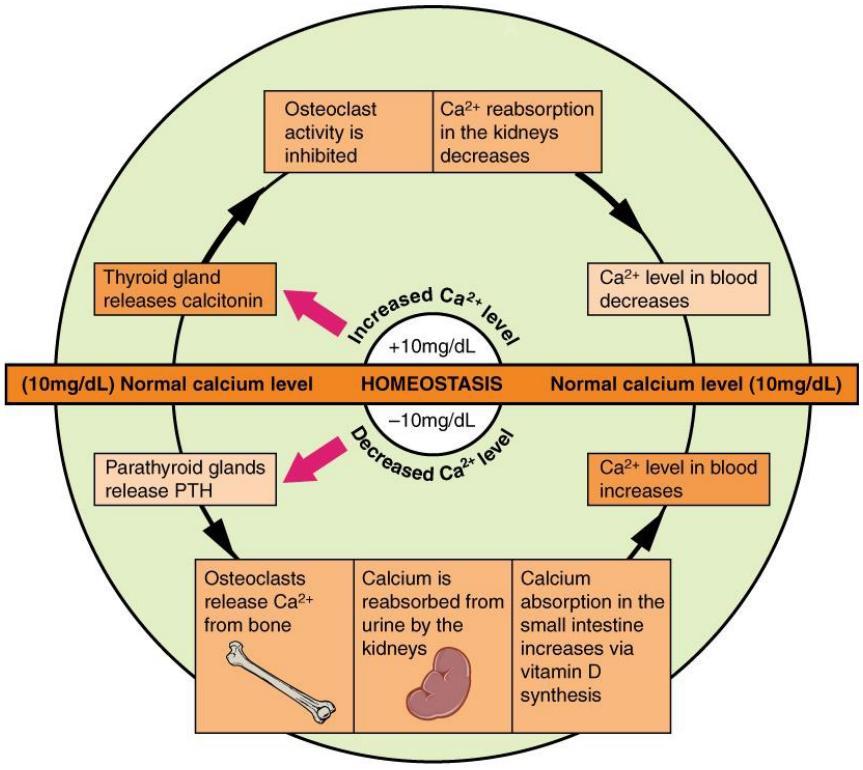


Figure 24-: Calcium Metabolism[4]

[3] Harinarayan CV, Akhila H, Shanthisree E. Modern India and Dietary Calcium Deficiency-Half a Century Nutrition Data-Retrospect-Introspect and the Road Ahead. Front Endocrinol (Lausanne). 2021 Apr 6;12:583654. doi: 10.3389/fendo.2021.583654.

Table 17 : Causes of calcium deficiency can be broadly classified to three categories:[5]

PTH deficiency	High PTH causes	Other
1. Post surgery 2. Autoimmune 3. Abnormal Parathyroid gland development 4. Parathyroid gland destruction	1. Vitamin D deficiency 2. Chronic Kidney Disease 3. Pseudo hypoparathyroidism	1. Pseudo hypocalcemia 2. Acidosis/ alkalosis 3. Acute Pancreatitis 4. Severe Sepsis 5. Hypo/ hypermagnesemia 6. Acute hyperphosphatemia 7. Drugs: Bisphosphonates, Donesumab 8. Massive blood transfusion 9. Pregnancy

Symptoms:

The clinical manifestations of hypocalcemia can be

1. Seizures: Usually present in very severe hypocalcemia. Sometimes hypocalcemia can present as a only as seizures.
2. Tetany: Is generally induced by a rapid decline in serum ionized calcium. Tetany is usually more dangerous and most commonly seen in the presence of respiratory alkalosis causing hypocalcemia.
3. Paresthesia: Can be perioral or in the extremities.
4. Psychiatric manifestations such as anxiety, depression, or emotional lability: can occasionally present in some cases of hypocalcemia.
5. Carpopedal spasm: This is also referred to as Trousseau's sign. It represents increased neuromuscular excitability which may be related to the gating function of calcium ions for ion channels at a cellular level (particularly in neurons). It manifests as a spasm of the hand characterized by adduction of the thumb, flexion of the

[4] https://courses.lumenlearning.com/suny-ap1/chapter/calcium-homeostasis-interactions-of-the-skeletal-system-and-other-organ-systems/

[5] Goyal A, Anastasopoulou C, Ngu M, et al. Hypocalcemia. [Updated 2022 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430912/

metacarpophalangeal joints, an extension of the interphalangeal joints, and flexion of the wrist when a sphygmomanometer is inflated above systolic blood pressure for three minutes.

6. Chvostek's sign: This is another manifestation of heightened neuromuscular excitability. Tapping of the facial nerve in front of the ear causes ipsilateral contraction of the facial muscles.
7. QTc prolongation: This can lead to Torsades de pointes that, although extremely rare, can be fatal.

Management:

If the symptoms are mild such as paresthesia, or in asymptomatic patients, oral calcium can be given. Calcium carbonate (40% elemental calcium) or calcium citrate (21% elemental calcium) are the most used calcium preparations. The goal is to administer 1500 to 2000 mg elemental calcium per day divided into 2 to 3 doses. Calcium carbonate needs an acidic medium to be absorbed, so this should be avoided in patients taking proton pump inhibitors (PPI). Vitamin D supplementation is often recommended with calcium to promote better absorption and because vitamin D deficiency is commonly encountered in most clinical scenarios leading to hypocalcemia.

Intravenous (IV) calcium is recommended for use in patients with severe symptoms, prolonged QTC intervals, or in asymptomatic patients who develop acute hypocalcemia in a short period. This can be given as calcium gluconate 1 to 2 g (equivalent to 90 to 180 mg elemental calcium) or 1 g of calcium chloride (equivalent to 270 mg elemental calcium) as a short infusion over 10 to 20 minutes. This should be followed by a continuous infusion if hypocalcemia persists. Calcium gluconate is generally preferred over calcium chloride as it is less likely to cause tissue necrosis if extravasation occurs. An alkaline solution like bicarbonate and phosphorus-containing solution needs to be avoided through the same IV to avoid precipitation of calcium salts.

Note: Please read section on Vitamin D deficiency along with Calcium deficiency.

E. While working in Government Health System

1. National Nutritional Programmes and Policy in India

a. Nutritional Programme in India

The government of India has initiated several large-scale nutritional programmes. These programmes aimed at overcoming specific deficiency diseases through various ministries to combat malnutrition.

Table 18: **Programmes Directed Against General Malnutrition and Specific Nutritional Deficiencies**

Programmes Directed Against General Malnutrition	**Programmes Directed Against Specific Nutritional Deficiencies**
Special Nutrition Programme	Vit. A Prophylaxis Programme
Balwadi Nutrition Programme	Prophylaxis against Nutritional Anaemia
Icds Programme	Control of Iodine Deficiency Disorders
Mid-Day Meal Programme	Zinc Supplementation Programme
Mid-Day Meal Scheme	

Programmes Directed Against Specific Nutritional Deficiencies-

1. **Vit. A prophylaxis programme-**

- National programme for the control of blindness.
- Launched in 1970 under the ministry of health and family welfare
- Initially it includes 6months to 6 years child but according to 2007 revised programme it includes children with age of 9 months to 5 years
- With total of 9 doses within 5 years
- First dose(1,00,000 IU)- At 9 months with measels-rubella immunization.
- 2,00,000 IU at 16 to 18 months with DPT booster followed by, 2,00,000 IU every 6 month upto the age of 5 year.

2. Prophylaxis against nutritional anaemia-

- Launched in 1972to prevent nutritional anaemia in mothers and children
- Currently the part of RCH programme and the target group include-

a) Children 6 month to 5 years.

Dose- 20mg elemental iron+100µgm folic acid (or 5 ml IFA syrup) for 100 days.

b) School children (6 to 10 years)

Dose- 30 mg elemental iron+ 250µgm folic acid for 100 days.

c) Adolescents (11 to 18 years- priority group girls)

Dose- 60 mg elemental iron+ 500µgm folic acid for 100 days.

d) Pregnant women- 1 tablet (60 mg elemental iron+ 500µgm folic acid) prophylactically.

if clinically anaemic, 2 such tablets daily for 100 days.

e) Nursing mothers and acceptors of family planning-

1 tablet (60 mg elemental iron+ 500µgm folic acid).

Strategy- promote consumption of iron and folate rich foods as well as food items that promotes iron absorption like citrous fruits. Also refer the section of Mineral deficiency-Anaemia in this manual.

3) Zinc supplementation programme-

- Zinc is used as an adjunct to ORS in the management of diarrhea in the children older than 3 months.
- Dose- 20 mg elemental Zn per day for 14 days
- Zn supplementation reduces the duration and severity of episode of acute diarrhea.
- Zn decreases the hospital admission rate by 15% to 20% and child mortality by 3% to 5%.
-

4) Control of iodine deficiency disorders-

- Initially the National goitre control programme was launched in 1962 for the conventional goitre belt only in Himalayan regions.
- Due to wide spread problem of goitre and iodine deficiencies disorders IDD control programmes are launched in 1986 with the fallowing objectives-

a) Replacement of all edible salt by Iodized salt.

b) Iodine surveillance programme.

c) Manpower training

d) Mass communication

Programme Directed Against General Malnutrition

1) Special nutrition programme-

* started in 1970.

* operational in urban slums, tribal areas and backward rural areas.

* beneficiary groups-

a) children below the age of 6 years.

b) pregnant and nursing mothers.

* In this programme, supplementary food supplies-

- About 300 kcal energy and 10 to 12 grams protein/child/day.

- About 500 kcal energy and 25 grams protein to the beneficiary mother upto 300 days in a year.

2) Balwadi nutrition programme-

*This programme was started in 1970.

*For the benefit of children in age group 3 to 6 years in rural areas.

*The programme is implemented through Balwadis which provide pre-primary education to these children.

*Food supplement provide 300 kcal and 10 gm protein to these children per day.

*Balwadis are being phased out because of ICDS.

3) Integrated child development services(ICDS) programme

* Launched in 2 oct 1975.

*ICDS is one of the world's largest childhood development programme.

* Aims at providing service to pre-school children in an integrated manner to ensure proper growth and development.

*** ICDS provides an integrated package of services-**

a) supplementary nutrition

b) Immunization

c) health check up

d) medical referral services

e) nutrition and health education for women

f) non-formal education for the children aged 3-6 year and pregnant and nursing mothers in rural, urban and tribal areas.

Table 19: Various beneficiaries and services under ICDS

Beneficiary	Services
Pregnant Women	Health check up Immunization against tetanus Supplementary nutrition – Take home ration Nutrition and health education
Nursing Mothers	Health check up Supplementary nutrition - Take home ration Nutrition and health education
Other Women(15-45 Years)	Nutrition and health education
Children < 3 Years	Supplementary nutrition - Take home ration Immunization Health check up Referral services
Children In Age Group 3 To 6 Years	Supplementary nutrition - Take home ration Immunization Health check up Referral services Non formal education
Adolescent Girls (11 To 18 Years)	Nutrition and health education

Table 20: Calorie and protein allowances under ICDS

	Catagories	Calories (K Cal) per day	Protein (g) per day	Rates (per day per beneficiary) (in Rupees)
1	Children (6-72 months)	500	12-15	8
2	Severely malnourished children (6- 72 months)	800	20-25	12
3	Pregnant women and Nursing mothers	600	18-20	9.50
4	Adolescent Girls (14-18 years)	600	18-20	9.50

- Heart of ICDS system- Anganwadi.
- Each anganwadi has 1 anganwadi worker and 1 helper
- 1 anganwadi centre per 400 to 800 population in rural and urban projects.
- 1 anganwadi centre per 300 to 800 population in tribal projects.
- 1 mini anganwadi centre per 150 population.

4) mid-day meal programme-

- Also called as school lunch programme.
- Operational since 1961.
- Objective is to attract more children for admission to schools and retain them so that literacy improvement of children could be brought about.
- The meal is supplement and not a substitute to home diet
- The meal should supply one third of the total energy requirement and half of the total protein.
- Being operationalised under the ministry of education
- According to national institute of nutrition hyderabad minimum 250 days are required to have the desired impact on children.

5) Mid-day meal scheme-

- National programme of nutritional support to primary education
- Launched in 1995.
- Main objective- Universalization of primary education by increasing enrolment, retention and attendance and simultaneously impacting on nutrition of students in primary classes
- The mid-day meal should supply one third of the total energy requirement and half of the total protein requirement.

***Principles for formulating mid-day meals-**

a) Meal should be a supplement only, not a substitute of home diet.

b) meal should provide one third calories and half protein

c) Meal cost should be low

d) Complicated cooking process should be avoided

e) Use locally available foods

f) Keep changing menu frequently.

Poshan 2.0 –

Poshan 2.0 seeks to address the challenging situation of malnutrition among children up to the age of 6 years, adolescent girls (14-18 years) and pregnant and lactating women.

Objectives –

- To contribute to human capital development of the country
- Address challenges of malnutrition
- Promote nutrition awareness and good eating habits for sustainable health and wellbeing
- Address nutrition related deficiencies through key strategies.

Other important initiatives related to nutrition

b. **National Nutrition Policy**:

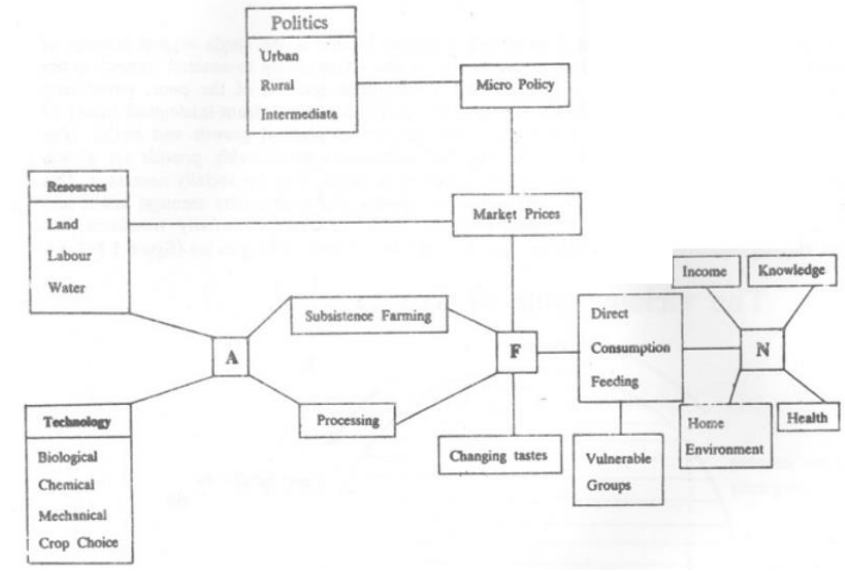


Fig 25: Agriculture-Food-Nutrition

National nutritional policy in India was made in 1993 by women in child department and ministry of human resource development. It was mainly focusing on the vicious cycle of

poverty-low intake of food and nutrients-leading to undernutrition-leading to impaired productivity-which leads ultimately to poverty again. Policy also mentions how agriculture, food and nutrition are linked and dependent on various other factors and with each other. (Fig 21) (15) Policy also says that it is both possible as well as necessary to devise policy interventions for influencing the working of the set off agriculture food and nutrition and thereby improving the nutritional status of the society. The nature of linkages determines the fate of such interventions. Fig shows the complex and multidimensional nature of the problem of nutrition various linkages oh these three subset which determines the nutritional status of society. (15)

- The policy also emphasized on intersectoral participation to overcome the problem of poor nutritional status. So, health professionals should understand their role including partnership with other sectors.
- Seasonal dimensions/diversity (flood-drought, high need of farm labour when rain is heavy, water borne diseases are high and food availability is low) of food production (leading to push families below poverty line) was also considered very important factor for our food production in India in nutritional policy. Therefore health professionals should understand the challenges faced by farmers.
- National nutrition policy also consider the effect of natural calamities, market distortion, disinformation, urbanization as a challenges for expected nutritional status in the country.

c. National Food Security Act (NFSA) and Its Implementation:

The National Food Security Act (NFSA), 2013 is a law that provides food and nutrition security to the people of India. It covers about two-thirds of the population, who can get subsidized food grains through the Targeted Public Distribution System (TPDS). The NFSA also provides nutritional support to pregnant women, lactating mothers, and children up to 14 years of age. It also has a grievance redressal mechanism and provisions for transparency and accountability.

d. PM POshan SHAkti Nirman (PM-POSHAN) and Child Nutrition:

The PM Poshan scheme is a program that provides free, nutritious cooked meals to children in government schools and other centres in India. It aims to improve the enrolment, attendance, retention, and health of the children. The PM Poshan scheme has improved completion rates of primary education, especially for girls, enhanced the attendance of children, has improved the nutritional status and micronutrient intake of children. The scheme has also had positive effects on the cognitive development, academic performance, and social behaviour of children.

e. Poshan Abhiyaan (National Nutrition Mission):

Poshan Abhiyaan is a program of the Government of India (GoI) to improve the nutrition of children, women, and adolescent girls. It converges various nutrition schemes and programs, using information and communication technology, providing incentives to states and districts, and promoting behaviour change communication and community mobilization. It has four key programme pillars: ICDS-CAS (Integrated Child Development Services-Common Application Software), which is a mobile application for data capture and analysis; ILA (Incremental Learning Approach), which is a training program for frontline workers; CAP (Convergence Action Plan), which is a framework for coordination and collaboration among stakeholders; and Jan Andolan, which is a social campaign for nutrition awareness. The challenges to Poshan Abhiyaan are similar to the challenges faced in implementing other programs like the PM Poshan scheme.

f. Maternal and Child Nutrition Initiatives:

Nutrition prevents malnutrition, supports fetal and infant growth, reduces chronic disease risk, and enhances cognitive and socio-emotional development. Women should eat well, take supplements, exercise, and rest before and during pregnancy and breastfeeding. Infants should be breastfed exclusively for six months and receive complementary foods afterwards. Women and children should have access to nutrition services.

The government runs three programs to improve maternal and child nutrition:

1. **Integrated Child Development Services (ICDS) Scheme**: Launched on 2nd October 1975, the ICDS scheme is the world's largest community-based programme. The scheme is targeted at children upto the age of 6 years, pregnant and lactating mothers and women 16–44 years of age. The scheme is aimed to improve the health, nutrition and education (KAP) of the target community.
2. **The India Newborn Action Plan (INAP):** It was launched in September 2014 with the aim of ending preventable newborn deaths and stillbirths by 2030. INAP has set the goals for neonatal mortality and stillbirths. The goal is to attain Single Digit Neonatal Mortality and Stillbirth Rates by 2030.
3. **Reproductive and Child Health (RCH) Programme**: It is a comprehensive sector wide flagship programme, under the umbrella of the GoI's NHM, to deliver the RCH targets for reduction of maternal and infant mortality and total fertility rates. The programme aims to reduce social and geographical disparities in access to and utilisation of quality reproductive, maternal, newborn, child and adolescent health services. Launched in April

2005 in partnership with the State governments, RCH is consistent with GoI's National Population Policy-2000, the National Health Policy-2001 and the Millennium Development Goals. Six key components of the RCH programme are Maternal Health, Child Health, Nutrition, Family Planning, Adolescent Health (AH) and PCPNDT.(16)

The programs need more monitoring, evaluation, budget, expenditure, convergence, and coordination to address the challenges of maternal and child nutrition.

2. Few Key players in nutrition programs & their roles

There are many important stakeholders in the field of war against undernutrition. E.g. ASHA, AWW and ANM, Medical Officer, CMO etc. Lets see role of some front line workers in the fight against nutritional deficiencies.

a. Accredited Social Health Activists (ASHA)(17)

a. Awareness about nutrition, determinants of health such as nutrition, basic sanitation & hygienic practices, healthy living and working conditions, information on existing health services and the need for timely utilization of health & family welfare services.
b. She counsels women on birth preparedness, importance of safe delivery, breastfeeding and complementary feeding, immunization, contraception and prevention of common infections including Reproductive Tract Infection/Sexually Transmitted Infection (RTIs/STIs) and care of the young child.
c. ASHA will mobilize the community and facilitate them in accessing health and health related services available at the village/sub-center/primary health centers, such as Immunization, Ante Natal Check-up (ANC), Post Natal Check-up (PNC), ICDS, sanitation and other services being provided by the government.
d. She will work with the Village Health & Sanitation Committee of the Gram Panchayat to develop a comprehensive village health plan.
e. She will arrange escort/accompany pregnant women & children requiring treatment/ admission to the nearest pre-identified health facility i.e. Primary Health Centre/ Community Health Centre/ First Referral Unit (PHC/CHC /FRU).
f. ASHA will provide primary medical care for minor ailments such as diarrhoea, fevers, and first aid for minor injuries. She will be a provider of Directly Observed Treatment Short-course (DOTS) under Revised National Tuberculosis Control Programme.
g. She will also act as a depot holder for essential provisions being made available to every habitation like Oral Rehydration Therapy (ORS), Iron Folic Acid Tablet (IFA),

chloroquine, Disposable Delivery Kits (DDK), Oral Pills & Condoms, etc. A Drug Kit will be provided to each ASHA. Contents of the kit will be based on the recommendations of the expert/technical advisory group set up by the Government of India.

h. She will inform about the births and deaths in her village and any unusual health problems/disease outbreaks in the community to the Sub-Centres/Primary Health Centre.

i. She will promote construction of household toilets under Total Sanitation Campaign.

All these roles of ASHA are directly or indirectly are related to affects nutritional status of the community. Her role as a provider can be enhanced subsequently. States can explore the possibility of graded training to her for providing newborn care and management of a range of common ailments particularly childhood illnesses. That means possibilities of contextualization of her role can be done as per the need of population. Medical officer working at PHC and CHC level should understand and apply availability of ASHA for upgrading nutritional status in their community.

b. Role of Anganwadi workers (AWWs) through Integrated Child Development Scheme (ICDS)

Anganwadis were established by the Indian government in 1975 as part of the ICDS program to combat child hunger and malnutrition. Currently India have about 14 Lakhs of AWC, 13 lakhs AWW giving services to more than 10 Crore beneficiaries. Whereas (18) Anganwadis are managed by Anganwadi workers (AWWs) who are the anchors of this program, chosen from the community and equipped with nearly four months of health care training.(19)

Package of Services under Anganwadi Services - The Anganwadi Services Scheme offers a package of six services, viz.

i) Supplementary Nutrition
ii) Pre-School Non-Formal Education
iii) Nutrition & Health Education
iv) Immunization
v) Health Check-Up and
vi) Referral Services

The last three services are related to health and are provided by Ministry/ Department of Health and Family Welfare through NRHM & Health System.

In the ICDS mission, the Anganwadi platform was designed to work as the preliminary village or habitation resource for health, nutrition, and early learning. AWWs, assisted by helpers, are supposed to look after contraceptive counselling, neonatal and postnatal care, nutrition supplementation, vaccination, non-formal pre-primary education for children 0 to 6 years, and nutrition and health education (NHED) for women between 15 and 49 years of age). NHED is a key element of the work of the Anganwadi worker, as it teaches women how to look after their own health, nutrition, and development needs as well as those of their children. (19)

Under the ICDS mission the core package of six services mentioned above could be continued but there will be few reforms in near future. (20)

Table 21: Various suggested interventions through ICDS

	Components	Interventions	Other associated service providers
1.	Early childhood care education and development (ECCED)	1. home based guidance for parents 2. early stimulation 3. early screening and referral optimal IYCF practices 4. monthly monitoring and promotion of child growth and developmental milestones 5. fixed monthly village ECCE days	Second AWW cum Child Care & nutrition Counsellor
2	supplementary nutrition	morning snacks hot cooked meal and take home Ration as per norm	Second AWW cum Child Care & nutrition Counsellor, AWH / SHGs
	care and nutrition counselling	1. infant and young child feeding (IYCF) promotion and counselling a. One to one counselling for optimal breastfeeding practices, complementary feeding b. counseling to ensure food intake c. home visit and follow up 2. Maternal care and counseling a. early registration of pregnancy b. three or more ANC c. institutional delivery d. PNC counseling on diet, rest and IFA Compliance e. monitoring weight gain f. examination for pallor, edema and any other danger signs g. home based counseling for essential newborn care h. counseling and lactational	Second AWW cum Child Care & nutrition Counsellor, AWH / ASHA, ANM Second AWW cum Child Care & nutrition Counsellor

		support i. counseling on spacing 3. Care nutrition health and hygiene education a. Monthly health and nutrition education session b. education on improved caring practices-feeding health and hygiene psychosocial support c. knowledge sharing for care during pregnancy lactation and adolescence d. promotion of local foods and family feeding e. Appropriate food demonstration f. celebration of nutrition week breastfeeding week, ICDS day etc 4. Community based care and management of underweight children a. 100% weighing of all eligible children and identification of underweight children b. referral to NRC for children requiring medical attention c. 12 day nutritional counseling and care session for moderately and severely underweight children d. 18 day home based care and follow up during home visit e. monitoring of weight gain after 12 days and 18 days 5. Immunization and micronutrient	Second AWW cum Child Care & nutrition Counsellor, supervisor Second AWW cum Child Care & nutrition Counsellor, Mothers' Group/PRIs / SHGs /MO

		supplementation a. Regular Fixed Monthly VHNDs b. Primary Immunization c. Boosters d. TT for Pregnant women e. Vitamin A supplementation (9 months —5 years) f. IFA supplementation (infants after 6 months of age) g. Deworming as per guidelines h. Counselling	ANM/MO/ ASHA/ AWWs5 as facilitator
		6. Health check-up 7. Referral services	ANM/ MO / ASHA /AWW as facilitator
	Community Mobilization, Awareness, Advocacy & IEC	1. Information disseminstion & awareness generation on entitlements, programmes behaviours and practices 2. Sharing of nutritiona! status of children at gram sabha meetings 3. Linkage with VHSNC 4. Voluntary Action Groups 5. Village contact drives	Second AWW/ supervisors / Dist. & Block Resource Centres / ICDS Management

The National Food Security Act 2013 (NFSA) claims to adopt a “life-cycle approach” to food and nutrition security in India, for, as Nevin S. Scrimshaw (1996) explained, nutrition starts in the womb and ends in the tomb. Although every life begins with an individual genetic potential, this potential can be compromised in utero if the mother suffers from malnutrition, infection, or other stress factors. Therefore, nourishment of a child begins even before its actual birth. The need for greater attention to young children is vital, as much of their nutritional and health prospects are sealed by the age of 2 to 3 years. (21–23)

c. **Role of Medical officer**

Reporting and understanding it –Basic step to fight against the issue

Common nutrition problems like Protein Energy Malnutrition, micronutrient deficiencies such as vitamin A deficiency , Iron Deficiency Anemia, Iodine Deficiency Disorders and vitamin B-complex deficiencies are the nutrition problems frequently encountered, particularly among the rural poor and urban slum communities. Medical officers have important key role to control these problems by providing timely intervention in the form of supplementation, vaccination, treatment and appropriate referral services.

3. Approaches of medical officers -

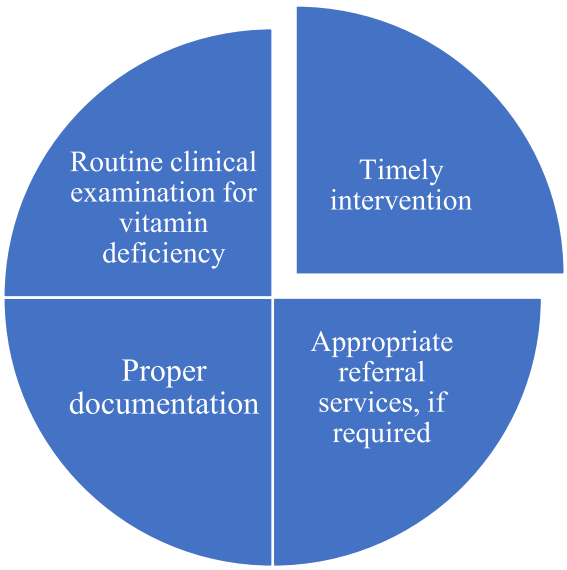


Fig 26:Good connect with Key stakeholders & intersectoral coordination

Intersectoral coordination is required for successful of any programme/activities. There are several support system to make a better system for awareness activities, supplies, to assure quality and health services etc.

E. While working in Government Health System

1. **Health Department** – History, Examination, Prevention and Management including referral
2. **Department of food and public distribution system** – For availability and accessibility of good quality food, Prevention of adulteration, Ensure uninterrupted supply
3. **ICDS** - For availability and accessibility of good quality take home ration
4. **Education department** - For availability and accessibility of good quality food of mid day meal food, along with food awareness activities among students
5. **Panchayat, Community Volunteers, Mass media** – Mass awareness, Beaviour change communication

4. Assessment of children with INMCI guidelines (24,25)**–**

In India, common illnesses in children under 3 years of age include fever (27%), acute respiratory infections (17%), diarrhoea (13%) and malnutrition (43%) – and often in combination. Infant Mortality Rate continues to be high.(24) Neonatal mortality contributes to 2/3rd of infant deaths and most of these deaths occur during the first week of life. Mortality rate in the second month of life is also higher than at later ages. Any health program that aims at reducing Infant Mortality Rate needs to address mortality in the first two months of life, particularly in the first week of life.

Many well-known prevention and treatment strategies have already proven effective for saving young lives. Childhood vaccinations have successfully reduced deaths due to measles. Oral rehydration therapy has contributed to a major reduction in diarrhoea deaths. Effective antibiotics have saved millions of children with pneumonia. Prompt treatment of malaria has allowed more children to recover and lead healthy lives. Even modest improvements in breastfeeding practices have reduced childhood deaths.

While each of these interventions has been successful, accumulating evidence suggests that an integrated approach is needed to manage sick children to achieve better outcomes. Child health programmes need to move beyond single diseases to addressing the overall health and well-being of the child. Because many children present with overlapping signs and symptoms of diseases, a single diagnosis can be difficult, and may not be feasible or appropriate. This is especially true for first-level health facilities where examinations involve few instruments, negligible laboratory tests, and no X-ray.

Therefore, An integrated approach is needed to manage sick children to achieve better outcomes.

Child health programmes need to move beyond tackling single diseases in order to address the overall health and well-being of the child.

THE PRINCIPLES OF INTEGRATED CARE

Depending on a child's age, various clinical signs and symptoms differ in their degrees of reliability and diagnostic value and importance. Therefore, the IMNCI guidelines recommend case **management procedures based on two age categories**:

- Young infants age up to 2 months
- Children age 2 months up to 5 years

The IMNCI guidelines are based on the following principles:

- All sick young infants up to 2 months of age7 must be assessed for “possible bacterial infection / jaundice”. Then they must be routinely assessed for the major symptom “diarrhoea”.
- All sick children age 2 months up to 5 years must be examined for “general danger signs” which indicate the need for immediate referral or admission to a hospital. They must then be routinely assessed for major symptoms: cough or difficult breathing, diarrhoea, fever and ear problems.
- All sick young infants and children 2 months up to 5 years must also be routinely assessed for nutritional and immunization status, feeding problems, and other potential problems.

Only a limited number of carefully selected clinical signs are used , based on evidence of their sensitivity and specificity to detect disease. These signs were selected considering the conditions and realities of first-level health facilities.

A combination of individual signs leads to an infant’s or a child’s classification(s) rather than a diagnosis. Classification(s) indicate the severity of condition(s). They call for specific actions based on whether the infant or child (a) should be urgently referred to a higher level of care, (b) requires specific treatments (such as antibiotics or antimalarial treatment), or (c) may be safely managed at home. The classifications are colour coded: “pink” suggests hospital referral or admission, “yellow” indicates initiation of specific treatment, and “green” calls for home management.

A. Regarding undernutrition in young infant (up to 2 months) -

1. **CHECK FOR FEEDING PROBLEM & MALNUTRITION**

ASK:	***LOOK, FEEL:***
• Is there any difficulty feeding? • Is the infant breastfed? If yes, how many times in 24 hours? • Does the infant usually receive any other foods or drinks? If yes, how often? • What do you use to feed the infant?	• Determine weight for age.

IF AN INFANT: **Has any difficulty feeding, or**
Is breastfeeding less than 8 times in 24 hours, or
Is taking any other foods or drinks, or
Is low weight for age,

AND

Has no indications to refer urgently to hospital:

ASSESS BREASTFEEDING:

• Has the infant breastfed in the previous hour?

If the infant has not fed in the previous hour, ask the mother to put her infant to the breast. Observe the breastfeed for 4 minutes.
(If the infant was fed during the last hour, ask the mother if she can wait and tell you when the infant is willing to feed again.)

• Is the infant able to attach?

no attachment at all *not well attached* *good attachment*

TO CHECK ATTACHMENT, LOOK FOR:

- *Chin touching breast*
- *Mouth wide open*
- *Lower lip turned outward*
- *More areola visible above than below the mouth*

(All of these signs should be present if the attachment is good)

• Is the infant suckling effectively (that is, slow deep sucks, sometimes pausing)?

not suckling at all *not suckling effectively* *suckling effectively*

Clear a blocked nose if it interferes with breastfeeding.

• Look for ulcers or white patches in the mouth (thrush).

• Does the mother have pain while breastfeeding?

If yes, look and feel for:
• Flat or inverted nipples, or sore nipples
• Engorged breasts or breast abscess

2. **Classify feeding as –**

Table 22: Classification of feeding

• Not able to feed or • No attachment at all or • Not suckling at all or • Very low weight for age.	**NOT ABLE TO FEED - POSSIBLE SERIOUS BACTERIAL INFECTION OR SEVERE MALNUTRITION**	➢ *Give first dose of intramuscular ampicillin and gentamicin.* ➢ *Treat to prevent low blood sugar.* ➢ *Warm the young infant by Skin to Skin contact if temperature less than 36.5°C (or feels cold to touch) while arranging referral.* ➢ *Advise mother how to keep the young infant warm on the way to the hospital.* ➢ *Refer URGENTLY to hospital#*
• Not well attached to breast or • Not suckling effectively or • Less than 8 breastfeeds in 24 hours or • Receives other foods or drinks or • Thrush (ulcers or white patches in mouth) or • Low weight for age or • Breast or nipple problems	**FEEDING PROBLEM OR LOW WEIGHT**	➢ If not well attached or not suckling effectively, teach correct positioning and attachment. ➢ If breastfeeding less than 8 times in 24 hours, advise to increase frequency of feeding. ➢ If receiving other foods or drinks, counsel mother about breastfeeding more, reducing other foods or drinks, and using a cup and spoon. • If not breastfeeding at all, advise mother about giving locally appropriate animal milk and teach the mother to feed with a cup and spoon. ➢ If thrush, teach the mother to treat thrush at home. ➢ If low weight for age, teach the mother how to keep the young infant with low weight warm at home. ➢ If breast or nipple problem, teach the mother to treat breast or nipple problems. ➢ Advise mother to give home care for the young infant. ➢ Advise mother when to return immediately. ➢ Follow-up any feeding problem or thrush in 2 days. ➢ Follow-up low weight for age in 14 days.
• Not low weight for age and no other signs of inadequate feeding.	**NO FEEDING PROBLEM**	➢ Advise mother to give home care for the young infant. ➢ Advise mother when to return immediately. ➢ Praise the mother for feeding the infant well.

3. TREAT THE YOUNG INFANT FOR FEEDING PROBLEMS

- ***Teach Correct Positioning and Attachment for Breastfeeding***

1. Show the mother how to hold her infant – **The position**

- with the infant's head and body straight

- facing her breast, with infant's nose opposite her nipple

- with infant's body close to her body

- supporting infant's whole body, not just neck and shoulders.

2. Show her how to help the infant to attach. She should: - **The attachment**

- touch her infant's lips with her nipple

- wait until her infant's mouth is opening wide

- move her infant quickly onto her breast, aiming the infant's lower lip well below the nipple.

3. **Look for signs of good attachment and effective suckling**. If the attachment or suckling is not good, try again.

4. If still not suckling effectively, ask the mother to express breast milk and feed with a cup and spoon in the clinic. To express breast milk:

· The mother should wash hands, sit comfortably and hold a cup or 'katori' under the nipple

· Place finger and thumb each side of areola and press inwards towards chest wall. Do not squeeze the nipple

· Press behind the nipple and areola between finger and thumb to empty milk from inside the areola; press and release repeatedly

· Repeat the process from all sides of areola to empty breast completely

· Express one breast for at least 3-5 minutes until flow stops; then express from the other side

5. If able to take with a cup and spoon advise mother to keep breastfeeding the young infant and at the end of each feed express breast milk and feed with a cup and spoon .

6. If not able to feed with a cup and spoon, refer to hospital.

- **Teach the mother to feed with a cup and spoon**

• Place the young infant in upright posture (feeding him in lying position can cause aspiration)

• Keep a soft cloth napkin or cotton on the neck and upper trunk to mop the spilled milk.

• Gently stimulate the young infant to wake him up

• Fill the spoon with milk, a little short of the brim

• Place the spoon on young infant's lips, near the corner of the mouth.

• Gradually allow a small amount of milk to drip into young infant's mouth making sure that he actively swallows it

• Repeat the process till the young infant stops accepting any more feed, or the desired amount has been fed

• If the young infant does not actively swallow the milk, do not insist on feeding; try again after some time

- **To Treat Thrush (ulcers or white patches in mouth)**

Tell the mother to do the treatment twice daily. The mother should:
• Wash hands.
• Wash mouth with clean soft cloth wrapped around the finger and wet with salt water.
• Paint the mouth with gentian violet 0.25%.

- **TREAT THE YOUNG INFANT FOR FEEDING PROBLEMS OR LOW WEIGHT**

1. Teach the mother to treat breast or nipple problems

• If the nipple is flat or inverted, evert the nipple several times with fingers before each feed and put the baby to the breast.

• If nipple is sore, apply breast milk for soothing effect and ensure correct positioning and attachment of the baby. If mother continues to have discomfort, feed expressed breast milk with katori and spoon.

• If breasts are engorged, let the baby continue to suck if possible. If the baby cannot suckle effectively, help the mother to express milk and then put the young infant to the breast. Putting a warm compress on the breast may help.

• If breast abscess, advise mother to feed from the other breast and refer to a surgeon. If the young infant wants more milk, feed undiluted animal milk with added sugar by cup and spoon.

2. **Teach the mother how to keep the young infant with low weight or low body temperature warm at home**

   Do not bathe young infant with low weight or low body temperature; instead sponge with lukewarm water to clean.

   • Provide Skin to Skin contact (Kangaroo mother care) as much as possible, day and night.

   • When Skin to Skin contact not possible:

   − Keep the room warm (>25oC) with a home heating device.

   − Clothe the baby in 3-4 layers; cover the head, hands and feet with cap, gloves and socks, respectively.

   − Let baby and mother lie together on a soft, thick bedding.

   − Cover the baby and the mother with additional quilt, blanket or shawl, especially in cold weather.

   FEEL THE FEET OF THE BABY PERIODICALLY– BABY'S FEET SHOULD BE ALWAYS WARM TO TOUCH

3. **Immunize Every Sick Young Infant, as Needed.**

B. Regarding undernutrition in child 2 months to 5 years –

1. **LOOK AND FEEL:**

- Look for visible severe wasting.
- Look for oedema of both feet.
- Determine weight for age.

3. Classify NUTRITIONAL STATUS as-

Table 23: Classification of Nutritional Status

• Visible severe wasting or • Oedema of both feet.	SEVERE MALNUTRITION	➢*Give single dose of Vitamin A.* ➢*Prevent low blood sugar.* ➢*Refer URGENTLY to hospital #* ➢*While referral is being organized, warm the child.* ➢*Keep the child warm on the way to hospital.*
• Very low weight for age.	VERY LOW WEIGHT	➢Assess and counsel for feeding ➢Advise mother when to return immediately ➢Follow-up in 30 days.
• Not very low weight for age and no other signs of malnutrition.	NOT VERY LOW WEIGHT	➢If child is less than 2 years old, assess the child's feeding and counsel the mother on feeding according to the FOOD box on the *COUNSEL THE MOTHER* chart. - If feeding problem, follow-up in 5 days. ➢Advise mother when to return immediately.

3. **Counsel the Mother About Feeding Problems**

If the child is not being fed as described in the above recommendations, counsel the mother accordingly.

- **If the mother reports difficulty with breastfeeding, assess breastfeeding. (See *YOUNG INFANT* chart.) As needed, show the mother correct positioning and attachment for breastfeeding.**
- **If the child is less than 6 months old and is taking other milk or foods:**
  - Build mother's confidence that she can produce all the breastmilk that the child needs.
  - Suggest giving more frequent, longer breastfeeds day or night, and gradually reducing other milk or foods.

  If other milk needs to be continued, counsel the mother to:
  - Breastfeed as much as possible, including at night.
  - Make sure that other milk is a locally appropriate dairy/animal milk .
  - Make sure other milk is correctly and hygienically prepared and given in adequate amounts.
  - Finish prepared milk within an hour.

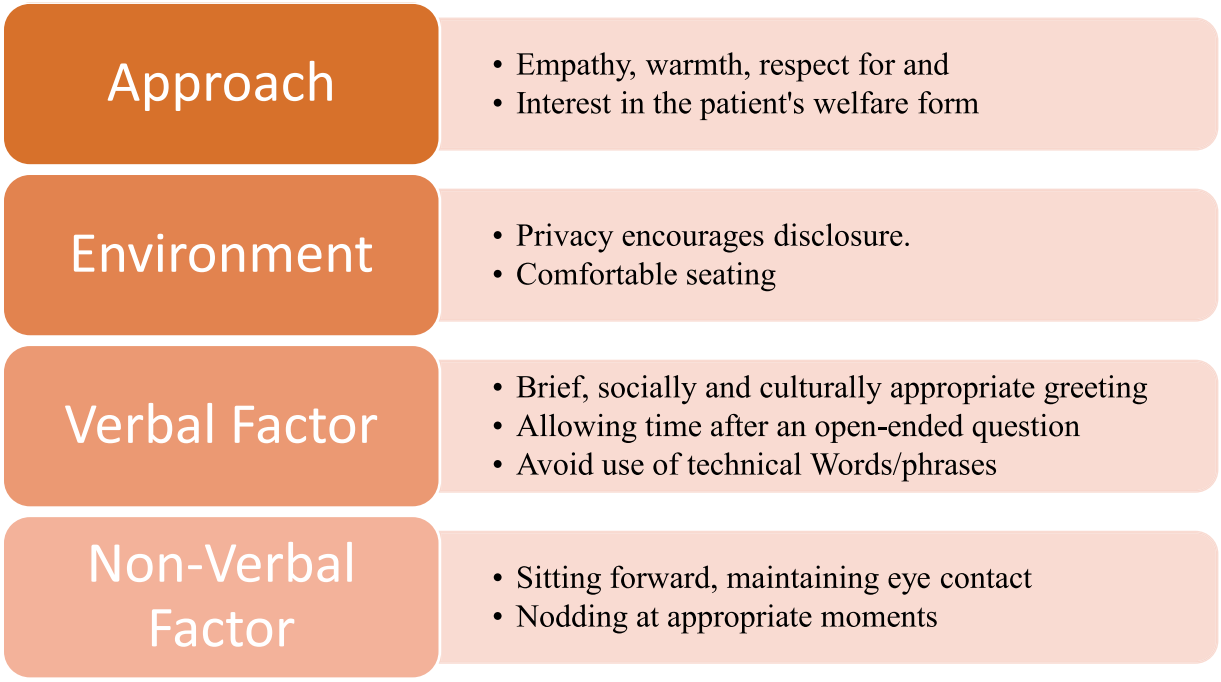
- **If the mother is using a bottle to feed the child:**
  - Recommend substituting a cup for bottle.
  - Show the mother how to feed the child with a cup.
- **If the child is not being fed actively, counsel the mother to:**
  - Sit with the child and encourage eating.
  - Give the child an adequate serving in a separate plate or bowl.
- **If the child is not feeding well during illness, counsel the mother to:**
  - Breastfeed more frequently and for longer if possible.
  - Use soft, varied, appetizing, favourite foods to encourage the child to eat as much as possible, and offer frequent small feedings.
  - Clear a blocked nose if it interferes with feeding.
  - Expect that appetite will improve as child gets better.
- **Follow-up any feeding problem in 5 days.**

Important : Medical officer should also look for all other possible socio-economical factors responsible for child's condition of undernutrition and deal accordingly.

5. Counselling is the key

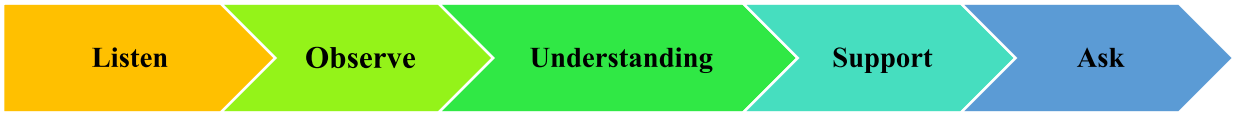
A good doctor-patient relationship is the cornerstone of good medical practice. Doctor-patient communication is an integral part of quality medical care and has an important influence on clinical outcome. Good communication skill shows about care providers competency and confidence.

Fig 27: Communication skills



A quality of communication is lead to improved diagnostic ability, Enhanced patients follow up and adherence to treatment.

Fig 28: 5-Steps of Communication



Doctors with poor communication skills often cite lack of time and the belief that such issues detract from the task of diagnosis and treatment. Personal fears also contribute to poor

Key Messages

- **You don't have to Eat Less……You just have to Eat Right**
- **Avoid junk food ……..Accept healthy life style**
- **Invest energy in eating a wide variety of fruits and vegetables in generous quantities, along with the recommended daily amounts of whole grains, lean meats, and milk products every day**

F. Assess yourself

we have learnt about the common nutritional deficiency diseases such as protein energy malnutrition, vitamin and mineral deficiencies, their causes, signs and symptoms, treatment and prevention. We have also learned about national nutrition policy and names of various programmes related to nutrition in India.

Nutrition assessment would help to identify deficiency dis-orders and enable you to advice appropriately as per the head.

1. For section B

1) Explain about Protein Energy Malnutrition?

.....

.....

2) List five causes of PEM.

.....

.....

3) …….percent of death among childhood occurs due to under nutrition, worldwide.

4) Write four signs and symptoms of Kwashiorkor.

.....

.....

5) Write four signs and symptoms of Marasmus.

.....

.....

6) What are the management and treatment guidelines for a child with severe PEM?

.....

.....

7) What are the strategies of prevention of PEM?

.....

.....

2. For Section C

1) Vitamin A deficiency causes ..... 2) Vitamin A deficiency can be prevented by .....

3) Skin ulceration or cracks atangles of mouth indicate ..... and is treated by giving .....

4) The features of B3 deficiency are

(a) ..... (b) ..... (c) .....

5) Vitamin C deficiency results in .....The common features are .....

6) Mention the cause of rickets .....

7) Give two preventive measures to prevent rickets.

.....

.....

3. For Section D

1) Write the management of child with haemoglobin of 8–12 gm%.

.....

.....

2) How can you prevent goiter in areas where food and water are deficient in Iodine?

.....

3) What are the manifestations of calcium deficiency in children?

.....

.....

4) Write two preventive measures of calcium deficiency.

.....

.....

4. For section E

1) Name five nutrition programmes in India.

.....

.....

2) How long the Exclusive breastfeeding shall be given to child.

.....

.....

3) ICDS services are meant for whom.

.....

.....

Annexure-1: Anthropometry measurements

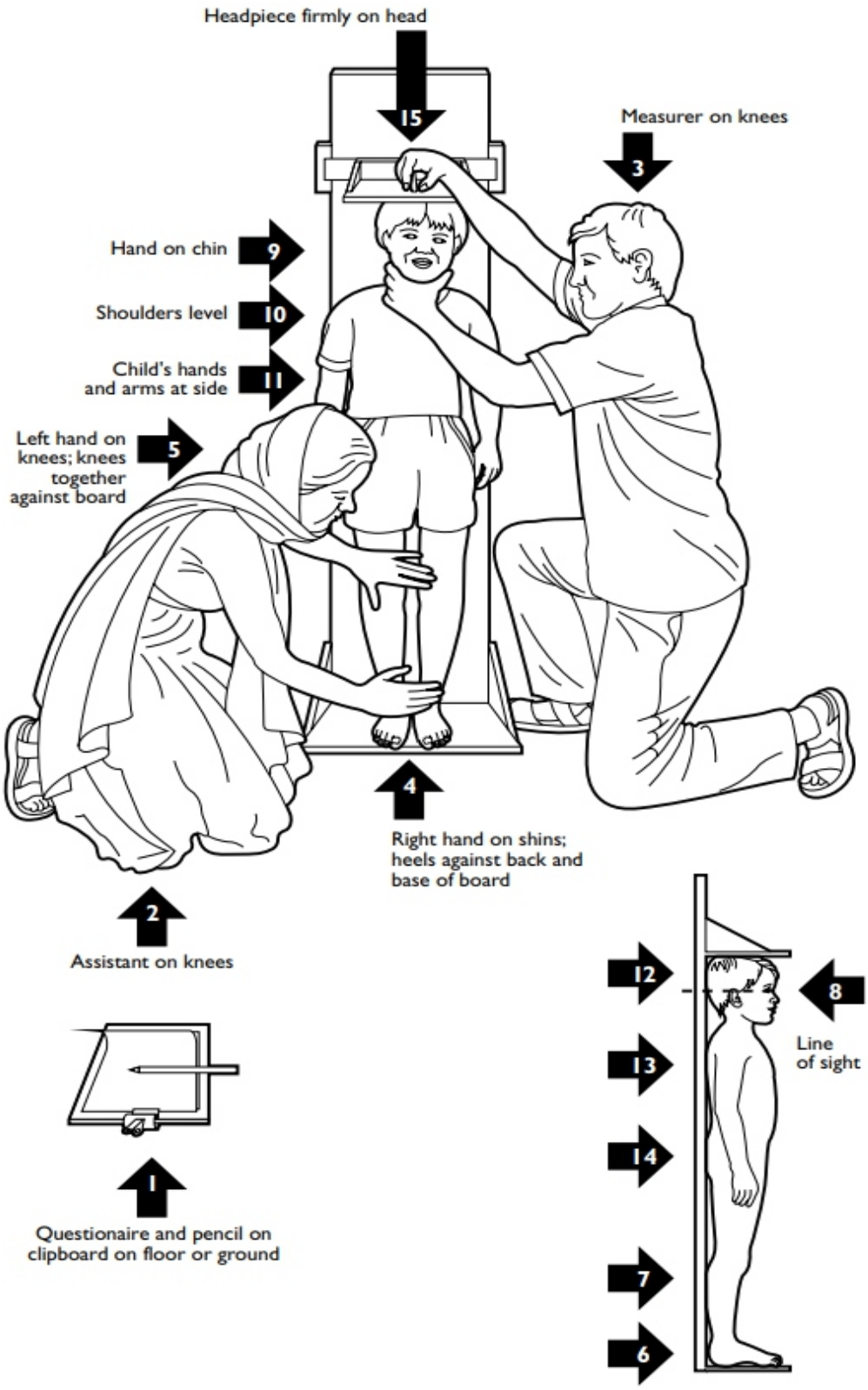


Fig 29: Taking height in standing position

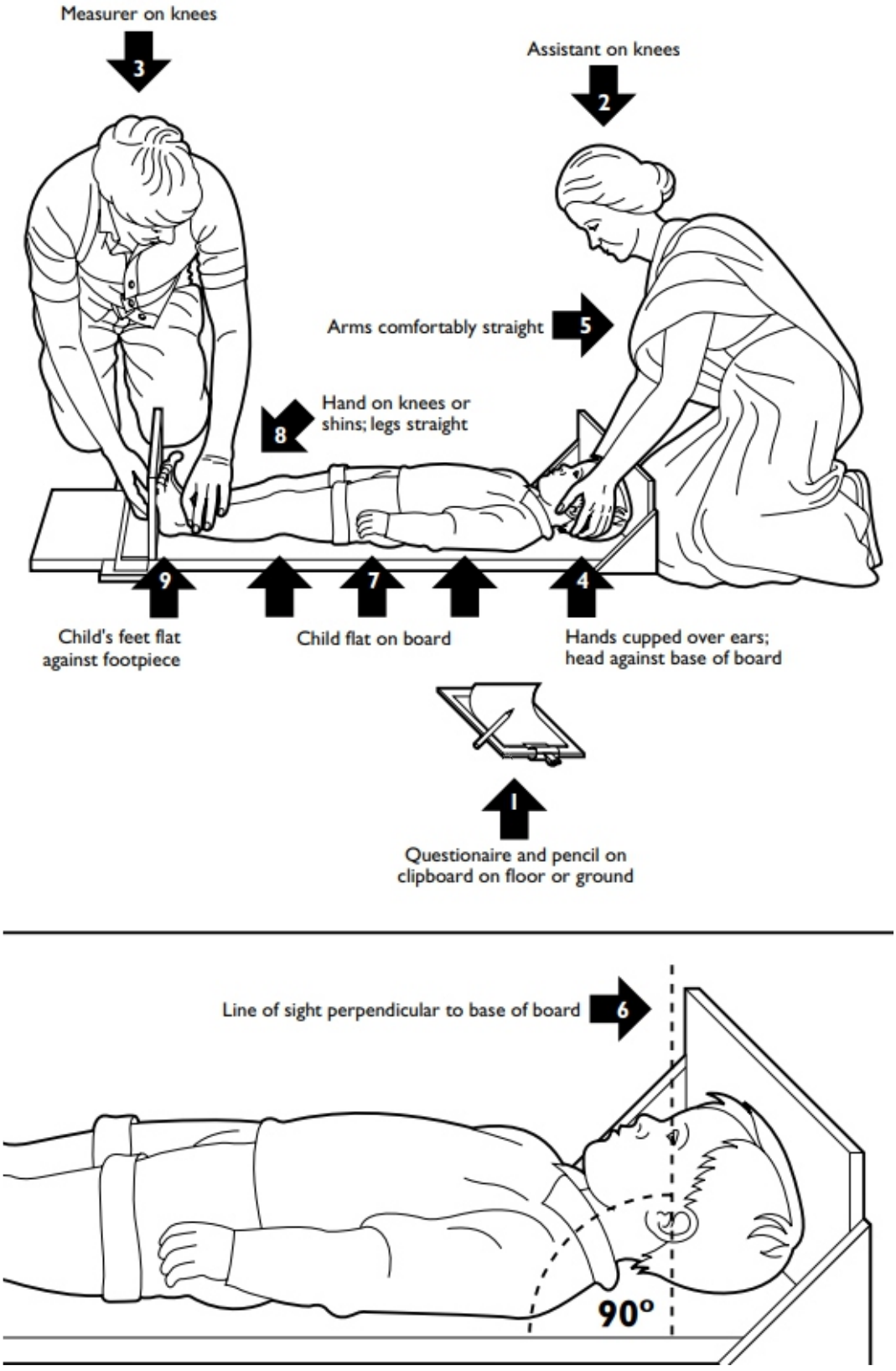


Fig 30: Taking length in lying down/supine position

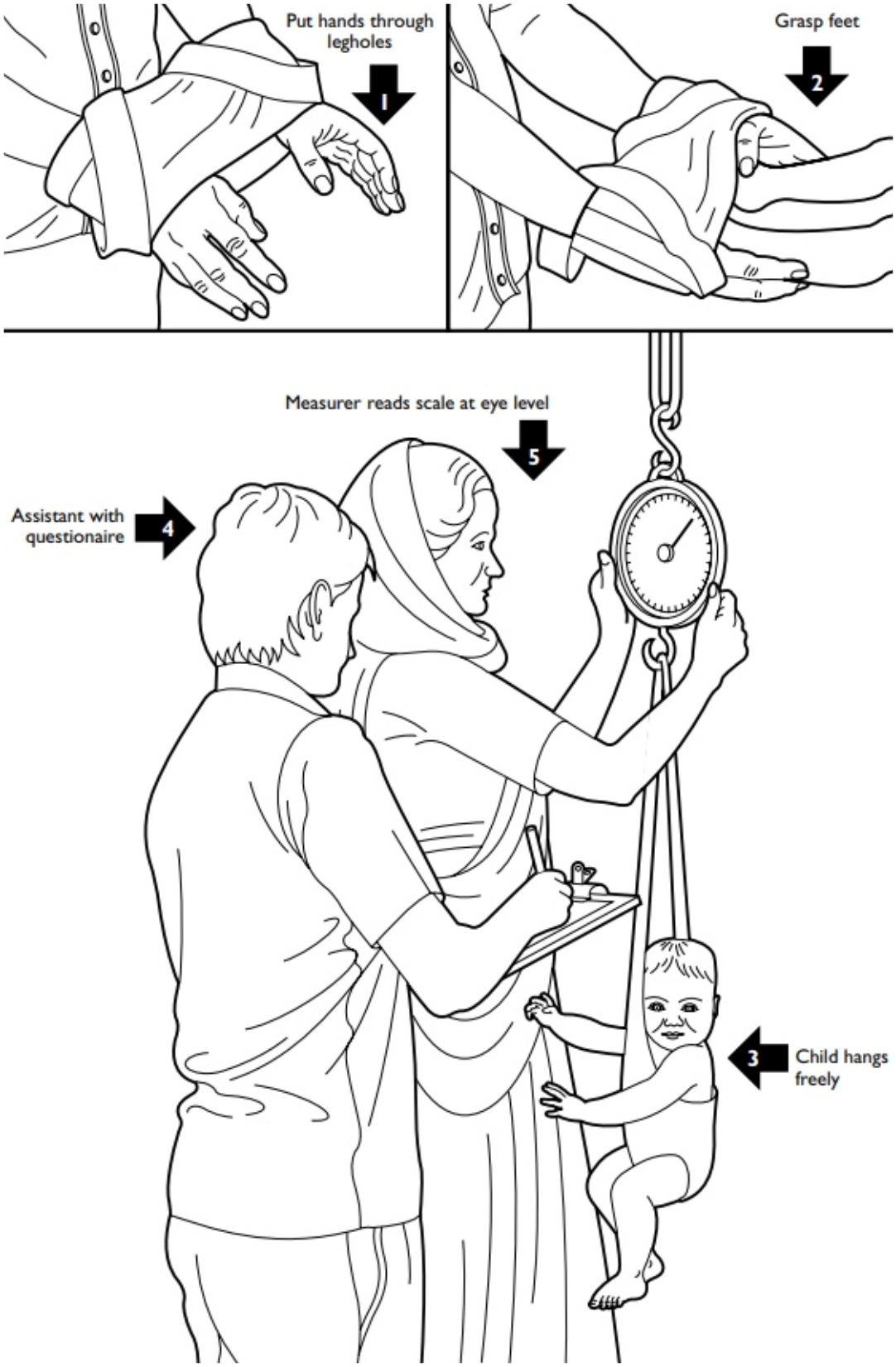


Fig 31: Weighting children with Salter's scale

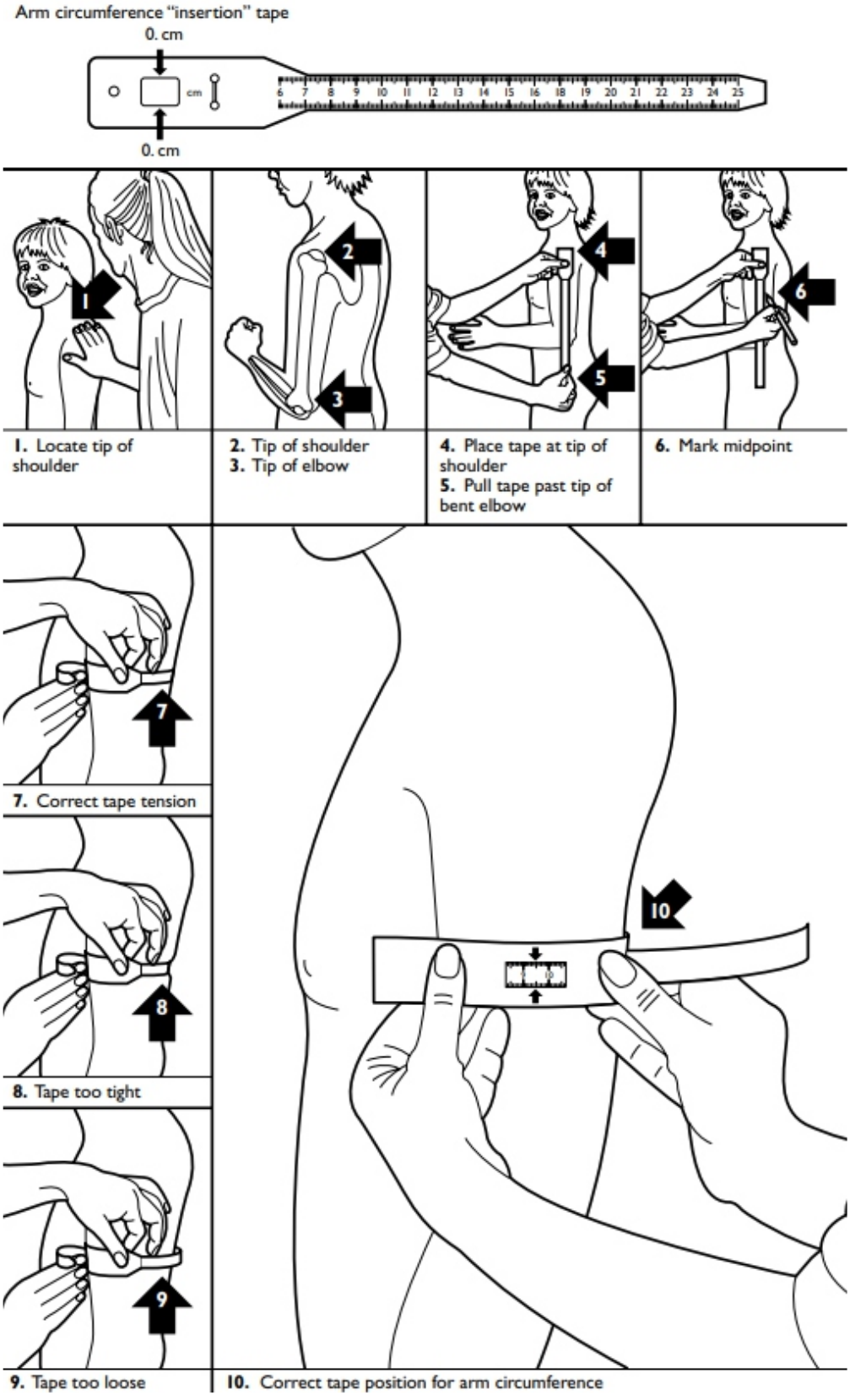


Fig 32: Measuring MUAC

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NOTE

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