EVERYTHING YOU EVER WANTED TO KNOW ABOUT SWEETPOTATO

TOPIC 4

# Nutrition and Orange-fleshed Sweetpotato

Reaching Agents of Change Training of Trainers (ToT) manual

October 2018

Biofortified foods
Building Nutritious Food Baskets

RAC
Support Vitamin A Sweetpotato

CIP
INTERNATIONAL POTATO CENTER
A CGIAR RESEARCH CENTER

UNIVERSITY of GREENWICH
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Orange-Fleshed SWEETPOTATO
Rich in Energy & Natural Vitamin A

**Everything You Ever Wanted to Know about Sweetpotato. Topic 4 - Nutrition and Orange-fleshed Sweetpotato (OFSP)**
Reaching Agents of Change ToT Training Manual


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International Potato Center
P.O. Box 1558, Lima 12, Peru
cip@cgiar.org • www.cipotato.org

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**Design and Layout**
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# Contents

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This team has brought together and shared their many years of experience of working with sweetpotato systems and farmer learning processes across Sub-Saharan Africa to compile this *Everything You Ever Wanted to Know about Sweetpotato* resource. None of this experience would have been gained without the partnership of many sweetpotato farmers and other stakeholders (extensionists, national researchers, traders, transporters, NGO staff, nutritionists, media and donors) across the region. We thank you, and hope that this resource can in return offer you support in your sweetpotato activities.

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This manual was originally produced as part of the Reaching Agents of Change project in 2013 and updated by the Building Nutritious Food Baskets project in 2017/2018 – both projects funded by the Bill & Melinda Gates Foundation.

# Acronyms and Abbreviations

| | |
|---|---|
| **AIs** | Adequate Intakes |
| **AVRDC** | The World Vegetable Centre |
| **BNFB** | Building Nutritious Food Baskets |
| **CBO** | Community Based Organisation |
| **CIP** | International Potato |
| **DAP** | Days After Planting |
| **DFE** | Dietary Folate Equivalents |
| **DONATA** | Dissemination of New Agricultural Technologies in Africa |
| **DVM** | Decentralised Vine Multipliers |
| **dwb** | Dry Weight Basis |
| **FAO** | Food and Agriculture Organisation of the United Nations |
| **FW** | Fresh Weight |
| **HH** | Household |
| **HKI** | Helen Keller International |
| **IBPGR** | Bioversity International |
| **IPM** | Integrated Pest Management |
| **IPPM** | Integrated Pest & Production Management |
| **K** | Potassium |
| **LGA** | Local Government Areas |
| **M&E** | Monitoring and Evaluation |
| **MAP** | Months After Planting |
| **m.a.s.l.** | Metres Above Sea Level |
| **Mm** | Mass Multiplication |
| **MSC** | Most Significant Change |
| **N** | Nitrogen |
| **NARO** | National Agricultural Research Organisation |
| **NGO** | Non-Government Organisations |
| **NHV** | Negative Horizontal Ventilation |
| **NRI** | Natural Resources Institute |
| **OFSP** | Orange-fleshed Sweetpotato |
| **P** | Phosphorous |
| **PMCA** | Participatory Market Chain Approach |
| **PMS** | Primary Multiplication Site |
| **PPP** | Public Private Partnership |
| **PVC** | Polyvinyl Chloride |
| **QDPM** | Quality Declared Planting Material |

| | |
|---|---|
| **QDS** | Quality Declared Seed |
| **RAC** | Reaching Agents of Change |
| **RAE** | Retinol Activity Equivalents |
| **RCT** | Randomised Control Trial |
| **RDA** | Recommended Daily Allowances |
| **RE** | Retinol Equivalents |
| **REU** | Reaching End Users |
| **RH** | Relative Humidity |
| **SASHA** | Sweetpotato Action for Security and Health in Africa |
| **SMS** | Secondary Multiplication Site |
| **SP** | Sweetpotato |
| **SPCSV** | Sweetpotato Chlorotic Stunt Virus |
| **SPFMV** | Sweetpotato Feathery Mottle Virus |
| **SPKP** | Sweetpotato Knowledge Portal |
| **SPVD** | Sweetpotato Virus Disease |
| **SSA** | Sub-Saharan Africa |
| **ToT** | Training of Trainers |
| **TMS** | Tertiary Multiplication Site |
| **Tshs.** | Tanzanian Shillings |
| **TSNI** | Towards Sustainable Nutrition Improvement |
| **UNICEF** | United Nations Children's Fund |
| **USD** | United States Dollar |
| **Ushs.** | Ugandan Shillings |
| **VAD** | Vitamin A Deficiency |
| **WAP** | Weeks After Planting |
| **WHO** | World Health Organisation |
| **WTP** | Willingness to Pay |

# Foreword

During the past decade, interest in sweetpotato in Sub-Saharan Africa (SSA) has expanded, the number of projects utilizing sweetpotato has increased, and the demand for quality training resources, training development practitioners and farmers has subsequently risen. Sweetpotato scientists at the International Potato Center and national research centres often received these requests and frequently held 1-3 day training sessions, drawing on whatever training materials they had or could quickly pull together.

The Reaching Agents of Change (RAC) project in 2011 changed that situation. Jointly implemented by the International Potato Center (CIP) and Helen Keller International (HKI), RAC sought to empower advocates for orange-fleshed sweetpotato (OFSP) to successfully raise awareness about OFSP and mobilize resources for OFSP projects. RAC also sought to build the capacity of public sector extension and non-governmental organizational personnel to effectively implement those projects to promote the dissemination and appropriate use of vitamin A rich, orange-fleshed sweetpotato. The Building Nutritious Food Basket (BNFB) is a three-year project (November 2015 to October 2018) that followed on from the RAC project. The project is implemented in Nigeria and Tanzania and funded by the Bill & Melinda Gates Foundation. The goal of the project is to accelerate and support scaling up of biofortified crops for food and nutrition security and to help reduce hidden hunger by catalyzing sustainable investment for the utilization of biofortified crops (OFSP, PVA maize, high iron beans and vitamin A cassava) at scale. BNFB develops institutional, community and individual capacities to produce and consume biofortified crops. The objectives of the project are to strengthen the enabling environment for increased investments in biofortified crops and to develop institutional and individual capacities to produce and consume biofortified crops.

RAC/BNFB goal of developing and revising the Training of Trainers (ToT) manual on *Everything You Ever Wanted to Know about Sweetpotato* was to see *sustained* capacity for training senior extension personnel about the latest developments in sweetpotato production and utilization in each of the major sub-regions of SSA: Eastern and Central Africa, Southern Africa, and West Africa. Hence, CIP identified local institutions to work with in Mozambique, Tanzania, and Nigeria to host an annual course entitled: *Everything You Ever Wanted to Know about Sweetpotato.* The course has progressed from initially having CIP scientists working closely with national scientists to implement it, to national scientists and partners independently organising and conducting the course. In subsequent years, institutions in Burkina Faso, Ethiopia, Ghana, Malawi and others have been capacitated in conducting the course.

In developing the course content, a long-time collaborator of CIP, Tanya Stathers of the Natural Resources Institute (NRI), University of Greenwich, worked with CIP Scientists to review the existing training material, added in new knowledge from sweetpotato scientists and practitioners, and designed the course with a heavy emphasis on learning-by-doing. The CIP personnel who contributed to the development of the initial manual include, (Robert Mwanga, Ted Carey, Jan Low, Maria Andrade, Margaret McEwan, Jude Njoku, Sam Namanda, Sammy Agili, Jonathan Mkumbira, Joyce Malinga, Godfrey Mulongo), Adiel Mbabu and HKI nutritionists (Margaret Benjamin, Heather Katcher, Jessica Blankenship) and an HKI gender specialist (Sonii David) as well as NRI colleagues (Richard Gibson, Aurelie Bechoff, Keith Tomlins). Some of the materials were adapted from the DONATA project training materials, the Reaching End Users project and many others. After practitioners had used the course and the manual, a review was held in 2012 and the manual and course were subsequently updated, and a standard set of accompanying Power Point presentations created. In 2017-2018, the Building Nutritious Food Baskets project led a further review of the manual working closely with Tanya Stathers, the above mentioned CIP teams again plus Robert Ackatia-Armah, Kwame Ogera, Srini Rajendra, Julius Okello, Fred Grant, Joyce Maru, Hilda Munyua and Netsayi Mudege to update the content of topics 3, 4, 5, 12 and 13 which cover: sweetpotato varietal selection; nutrition; seed systems; monitoring, learning and evaluation; and using the 10 and 5 day ToT course.

This manual is designed to potentially serve a wide variety of audiences (nutritionists and agronomists, policymakers, extension workers, community development workers, leaders of farmer organizations, farmers etc.). Not all the materials will be relevant to all audiences, but facilitators can adapt the content to their audience and facilitation best practices. To ensure sustainability and wide reach; a cascading approach in the delivery of training is recommended; where key experts (agriculturalists, nutritionists, health workers, marketing and gender experts) will attend more detailed ToT workshops. The experts trained will then become primary facilitators and drive the agenda for OFSP. This group will in turn deliver shorter version courses and step-down the training to various levels of audiences (secondary and tertiary) – based on needs identified. This trend will continue until the training cascades down to "farmer trainers" who finally train the end users in their communities.

The original version of the manual has also been translated into Swahili, French, Portuguese, and Amharic are available online at https://www.sweetpotatoknowledge.org/learn-everything-you-ever-wanted-to-know-about-sweetpotato/ with the intension of translating the revised chapters as soon as resources permit. We envision the course to continue to be improved as new knowledge comes in. In this way, we expect the vibrant and knowledgeable sweetpotato community of practice to continue to grow in the coming years. The *Everything You Ever Wanted to Know about Sweetpotato* course will help us to achieve the major objectives of the Sweetpotato Profit and Health Initiative (SPHI). Launched in October 2009, the SPHI seeks to improve the lives of 10 million sub-Saharan African families in 16 countries by 2020 through the diversified use of improved sweetpotato varieties.

Jan W. Low, Leader of the Sweetpotato for Profit and Health Initiative, International Potato Center
October 2018, 2nd edition.

# How to Use This Guide

This guide was designed to be used in two ways:

- As self-study material, or
- As a facilitator's guide for classroom training sessions

For each topic we have provided:

- A handbook (this volume)
- A PowerPoint presentation, and
- A handout for classroom training participants

If you plan to deliver this as classroom training, then we would encourage you to read the **Facilitator's Guide** (separate volume) prior to planning your lessons.

# Introduction: Nutrition and Orange-fleshed Sweetpotato (OFSP)

## Topic Objectives

By working through this topic, you will be able to:

- Discuss what is meant by good nutrition, and malnutrition including undernutrition, overnutrition, and micronutrient malnutrition.
- Explain the importance of good nutrition.
- List the foods that you eat which are rich in the different macro and micronutrients.
- Describe how supplementation, food fortification, dietary diversification and biofortification can be used for managing micronutrient malnutrition.
- Explain the role that sweetpotato and particularly orange fleshed sweetpotato can play in the diet.
- Compare nutrition-sensitive and nutrition-specific interventions.
- Describe a number of regional nutrition initiatives.
- Critique different nutritional behavioural change approaches.
- Identify crucial gender and diversity dimensions of nutrition interventions.

If you have additionally participated in the ToT course, you will also be able to:

- Suggest how local diets can be made more nutritious.
- Design balanced meals with locally available vitamin a rich food.
- Formulate a nutritious OFSP porridge suitable for children.
- Understand the benefits of and training requirements for a nutrition behavioural change strategy.

## Synopsis

Nutrition and Orange Fleshed Sweetpotato focuses on nutrition, exploring what we mean by good nutrition and why it is important, and the different ways we can be malnourished. The topic explains which foods contain which nutrients, and the roles of carbohydrates, proteins, fats, vitamins and minerals in our bodies. Different approaches for managing micronutrient malnutrition are described and compared. The nutritional benefits of sweetpotato are examined, alongside some of the challenges in preserving the nutrient levels after processing. The difference between nutrition-sensitive and nutrition-specific interventions are then discussed, followed by a review of nutrition behavioural change approaches, communication strategies and demand creation activities. Examples of why it is important to take gender and diversity into consideration in all nutrition activities is raised at strategic points throughout the topic. A training course outline is presented along with ideas for nutrition learning-by-doing activities.

# Unit 1 – Nutrition

## Objectives

By working through this section, you will be able to:

- Explain the difference between macro and micronutrients.
- Discuss what is meant by a healthy balanced diet, and why it is important.

## Key Points

- **Foods are categorised based on the main nutrients they contain: these are carbohydrates, proteins, fats, vitamins and minerals.**
- **To stay healthy, we need to consume a balanced diet of a diverse range of foods containing these different nutrients; we also need to consume fibre and drink plenty of water.**
- **We need to consume macronutrients in large amounts. These give us energy and include: carbohydrates, proteins which also help us build and repair our bodies, and fats which supply fatty acids and help us absorb some vitamins.**
- **We also need small amounts of vitamins and minerals, which we call micronutrients, which help our bodily functions and protect us from disease.**
- **Each micronutrient has a very specialized role in supporting growth and maintaining health**

## What Is Good Nutrition?

Good nutrition means eating balanced meals that contain a variety of foods and nutrients. People select the foods they eat for many reasons, such as taste, cultural factors, level of hunger, food availability, convenience, affordability and socio-economic status. However, we need to eat a diversity of foods of appropriate quantity, quality and combination to have a healthy body. Our bodies need foods that give us energy, promote growth and development, repair tissues, store energy and protect us from diseases.

We can categorise foods based on their main nutrient type and function:

- **Carbohydrates** (energy giving)
- **Proteins** (body building and energy giving)
- **Fats** (energy storage and giving, insulation)
- **Vitamins and minerals** (support and protect body development and functioning)

In addition to consuming foods which supply these four categories of nutrients, we also need to:

- **Eat fibre** (to help move food through the digestive track), and
- **Drink water** (which is a key component in many bodily functions).

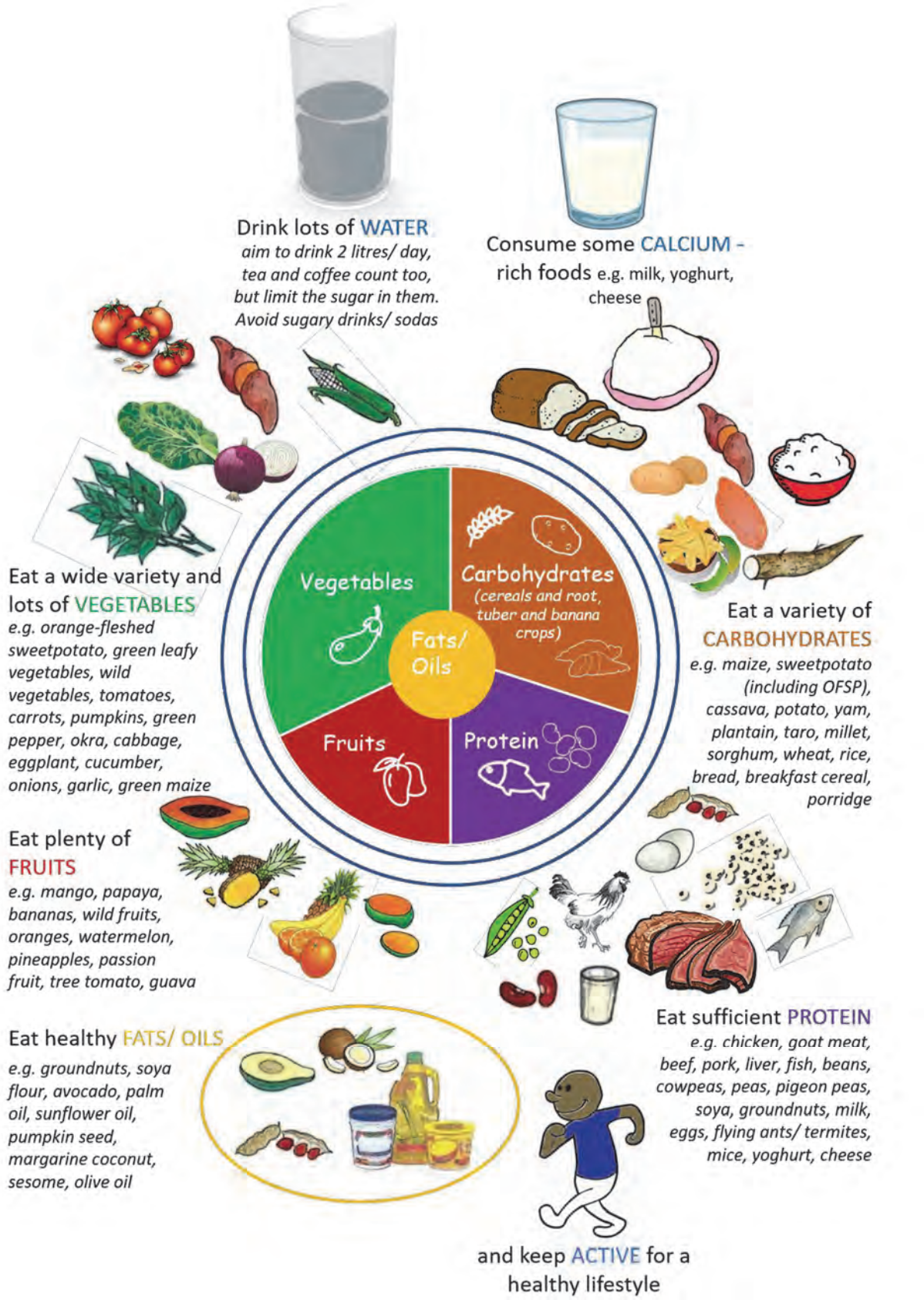
Carbohydrates, proteins and fats are called *macronutrients* because our bodies need them in large amounts.

Vitamins and minerals are called *micronutrients* because they are needed in small amounts. Even though micronutrients are only needed in small amounts they play important functions in the body and are essential for normal metabolism, growth and physical well-being.

Our nutrient requirements vary depending on our age, gender, physical activity level, health status, or if we are pregnant or breastfeeding. You can see your recommended daily dietary intake for the different nutrients in the table below.

To meet our nutrient requirements and stay healthy, we need to eat a balanced diet, this means eating a variety of foods from each of the food groups every day.

A balanced diet is one that on a regular basis provides an adequate amount and variety of foods to cover the energy and nutrient needs of the person eating it. Many countries have adopted a 'my plate' guide to help us to plan and eat a balanced diet. An example of the 'my plate' guide and the typical foods in each category is shown in the My Plate Guide below. Look down at your plate of food; if the proportions of the different types of food on your plate are similar to those shown in the 'my plate' guide, you are likely to be eating a nutritionally balanced meal. However, remember that most foods contain several different nutrients, and generalised classifications are just used to help people understand which foods typically provide which nutrients.




My Plate Guide to The Different Types and Proportions of Foods Needed for A Healthy Diet

## Why Is Nutrition Important?

Good nutrition is a central part of a healthy lifestyle. To grow and develop well we need an adequate and balanced intake of key nutrients or food components. This is especially important during the early stages of development: during pregnancy and in the first two years of life. It is very difficult to reverse the effects of poor nutrition during this important growth period. Breastfeeding and young child feeding guidance notes are given in Appendix 4.1 and Appendix 4.2. Good nutrition allows children to grow, develop, learn, play, participate and contribute effectively to their societies. Good nutrition provides our bodies with vital elements for survival and well-being.

A good nutritional status is achieved by consuming the correct amounts and diversity of foods, to meet the nutrient requirements specific to our age and sex. Most nutrients cannot be produced by our body and thus we need to obtain them by consuming appropriate foods in the correct quantities. The nutrients contained in our foods supply our bodies with energy, repair cells and tissues, prevent diseases, and support other bodily functions.

If children do not eat the right amounts of macronutrients (e.g. carbohydrates, proteins and fats) and micronutrients (e.g. vitamin A, iodine, iron, and zinc), they may become ill due to reduced immunity and an increased risk of disease and have poor growth and delayed mental and motor development, which causes adverse effects far-beyond childhood. Children with poor quality diets may have difficulty learning at school, be less active, and experience more frequent illness.

The causes of malnutrition are multi-faceted, which means many areas of our lives can have indirect consequences on nutrition. These include: agriculture; education; health; social protection; and water, sanitation and hygiene (WASH).

## Review Questions

1. What are the four main types of food, based on their main nutrient type?
2. What is the difference between macronutrients and micronutrients?
3. What could be some of the consequences of malnutrition?

# Unit 2 – Malnutrition

## Objectives

By working through section, you will be able to:

- List the three main types of malnutrition.
- Explain how poverty can cause malnutrition.
- Discuss the consequences of malnutrition at individual, household and national level.
- State how many African children under 5 years old are stunted, underweight or overweight.
- Discuss the causes and prevalence of hidden hunger.

## Key Points

- **There are three forms of malnutrition:**
  a) **Undernutrition (insufficient food intake, not enough calories, or protein or micronutrient deficiencies – wasting, stunting, underweight);**
  b) **Micronutrient deficient (not enough vitamins and minerals – hidden hunger),**
  c) **Overnutrition (too many calories – overweight and obesity)**
- **Poor nutrition in the first 1,000 days of a child's life can lead to irreversible stunting, poor micronutrient status and decreased cognitive ability**

## What Is Malnutrition?

Malnutrition means 'poor nutrition'. It describes a wide range of conditions which can occur due to a poor-quality diet (including insufficient, excessive or imbalanced nutrient intake) or illness. The term malnutrition addresses three broad groups of conditions:


- **Undernutrition**, which includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age);
- **Micronutrient-related malnutrition**, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and
- **Overweight, obesity and diet-related non-communicable diseases** (such as heart disease, stroke, diabetes and some cancers).

## What Are the Causes of Malnutrition?

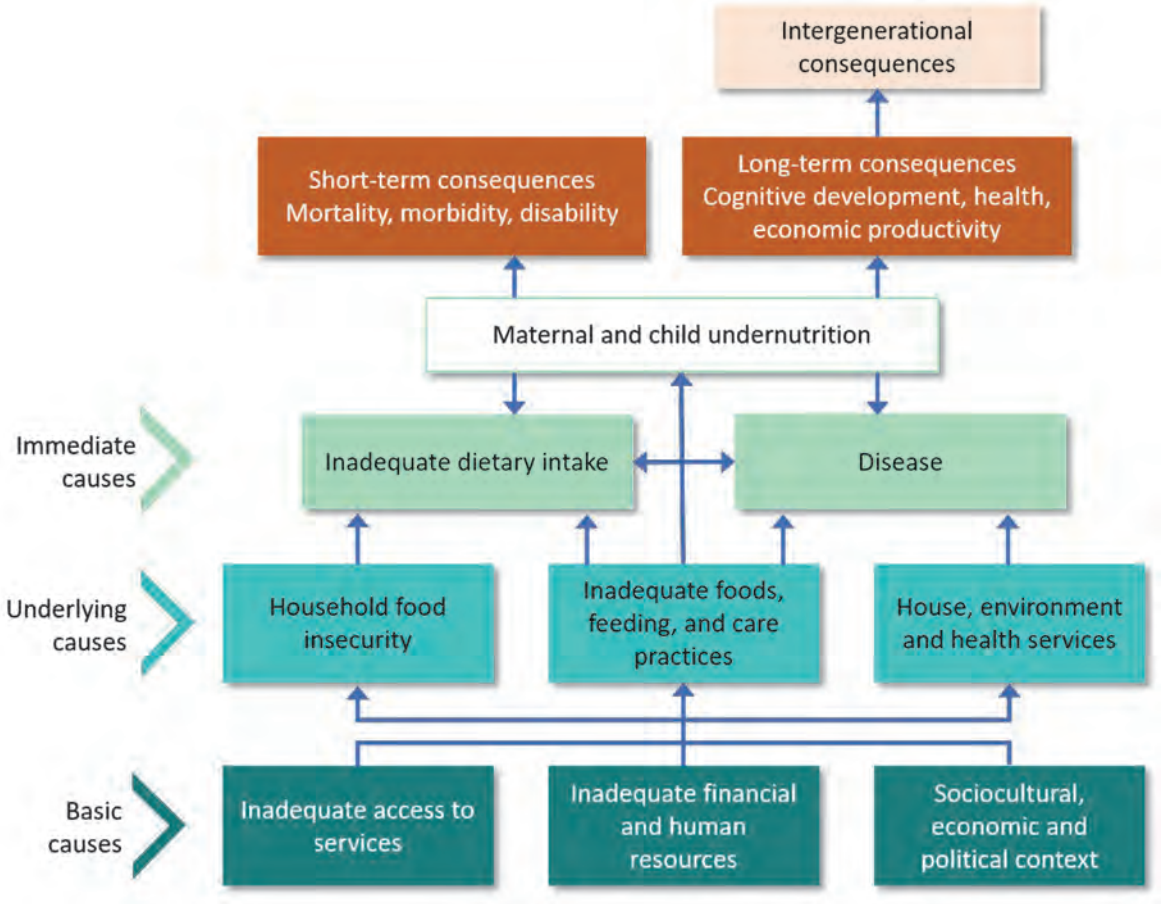
Malnutrition is caused by poor diet and illness. Poor diet and illness act together, worsening the effects of each other. Poor, inadequate diets do not supply the correct amounts of nutrients, thus weakening the body and increasing the risk of disease. Disease, in turn, often increases the body's need for food. Repeated and prolonged illnesses, such as diarrhoea and malaria, contribute to malnutrition, as nutritional needs are higher during and following illness. Frequent episodes of illness and acute infections make it almost impossible to maintain adequate nutritional status. Any situation that makes it difficult for people to get the food they need for themselves and their families can lead to malnutrition.

Macronutrient deficiency (a lack of carbohydrates, proteins or fats) can lead to stunting or wasting, and can occur due to a lack of food, poor quality of food, gastrointestinal illnesses (e.g. parasites or diarrhoea), poor sanitation, or chronic illness. Stunting is defined as a low height-for-age in comparison to internationally-accepted child growth standards and wasting a low weight-for-height.

Micronutrient deficiency, also referred to as 'hidden hunger' refers to a lack of vitamins and/ or minerals. Deficiencies in micronutrients, specifically, are detrimental to growth, immunity and overall health and are most common in children and women of reproductive age. These groups have particularly high requirements for micronutrients, to support growth and development of children, healthy pregnancies and breast milk production.

The framework shown below in UNICEF's Conceptual Framework, illustrates that these immediate causes of malnutrition (inadequate dietary intake and disease) are rooted in underlying problems at the household level. Low productivity and incomes lead to low food intake. Poor nutrition during pregnancy can lead to problems for women during pregnancy and childbirth, and to low birthweights of children. This can be a particular problem in large families and/ or short birth spacing. Poor feeding practices can also lead to inadequate intake in infants, even in households that do not face economic constraints. Lack of health care and of access to water and sanitation services lead to an increase in disease.

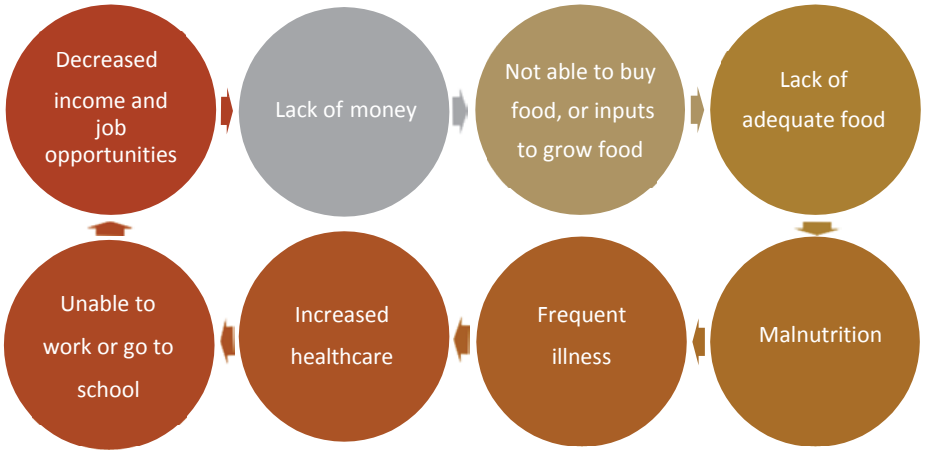
Each of these household-level problems (underlying causes), corresponds to problems at the community level (basic causes): as the local economy, the education system, the health system, and the water and sanitation system all provide critical inputs into the process of preventing malnutrition. Social and cultural factors, including those relating to a person's gender and age affect behaviours, and the national economic and political context also have major impacts on malnutrition.




**UNICEF's Conceptual Framework of the Causes of Malnutrition**

Although there may be many reasons for people being malnourished, such as droughts, floods, earthquakes, failed crops, interrupted food supplies, wars, conflicts, civil disturbances and other emergencies, much of the malnutrition in the world is due to poverty. Poverty can create situations in which people do not have enough to eat, or do not have the means to eat the variety and quality

of foods they need for good nutrition and health. Poverty and malnutrition often coexist, leading to a vicious cycle of repeated bouts of undernutrition. Some of the impact's poverty can have on nutrition are shown below.




*Source: FAO, 2013 – Eating Well for Good Health*

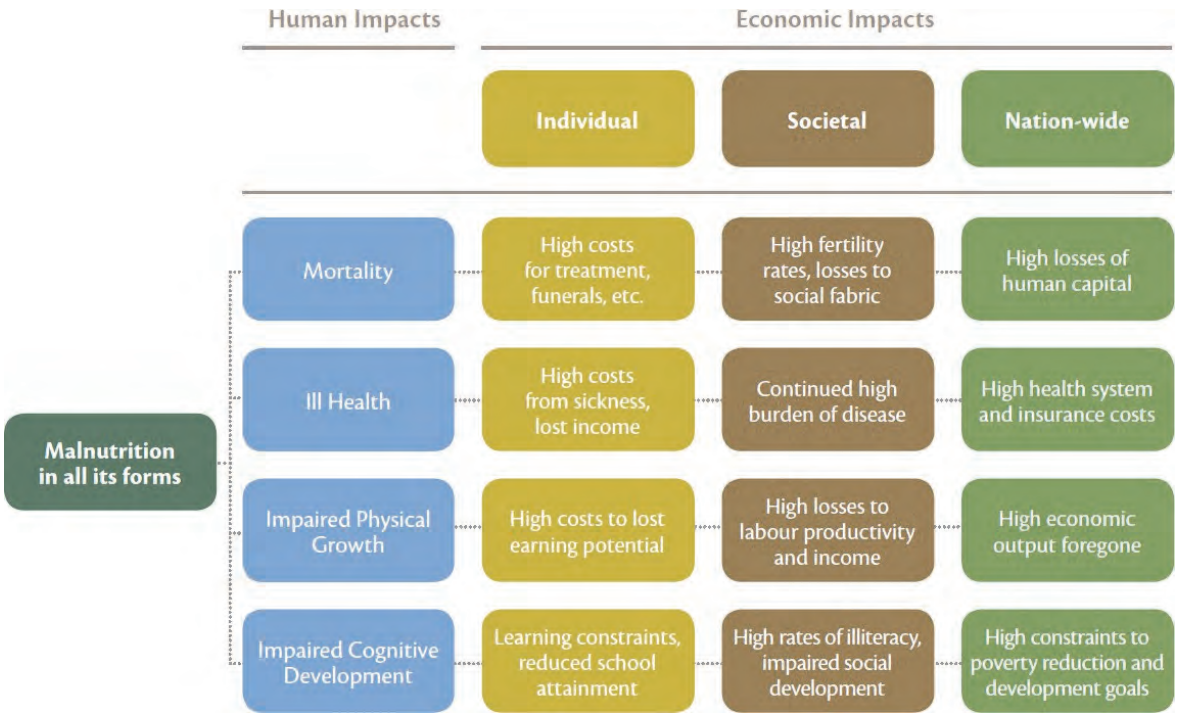
**Vicious Cycle of Poverty and Malnutrition**

## What Are the Consequences of Poor Nutrition?

Poor nutrition, or malnutrition, can have devastating impacts on the individual, the family, and society. It damages people's health and well-being and reduces their quality of life. Adequate nutrition is particularly essential in early childhood to ensure healthy growth, proper organ formation and function, a strong immune system, and neurological and cognitive development. Malnourished children often fall sick and perform poorly at school. This lowers their economic viability (e.g. ability to obtain good jobs and income) in the future.

From local to national and global levels, economic growth and human development require well-nourished populations who can learn new skills, think critically and contribute to their communities. Adults who are malnourished are less productive and have less energy to carry out their daily responsibilities. This loss of human potential creates additional poverty, and more hunger and malnutrition. Healthy people are vital to a country's economic growth and development, while sick people require additional care and resources from families and the community. The lost potential and high health care costs of malnutrition should not be underestimated. The many economic impacts from individual to national level are highlighted in the Economic Impacts chart below.

## The Economic Impacts of Malnutrition-Related Outcomes at Individual, Societal and National Levels




*Source: Global Panel on Agriculture and Food Systems for Nutrition, 2016*

One out of every three children in SSA is stunted, with a body and a brain that have failed to develop properly due to undernutrition. The social and economic impacts of malnutrition are felt from individual to national levels, though not only high child mortality (45% of which is attributed to poor nutrition) and increased health care requirements, but also reduced adult productivity, foregone economic growth, disease burden, impaired learning potential, poor school performance and premature adult mortality linked to diet-related non-communicable diseases.

## The Cost of Malnutrition

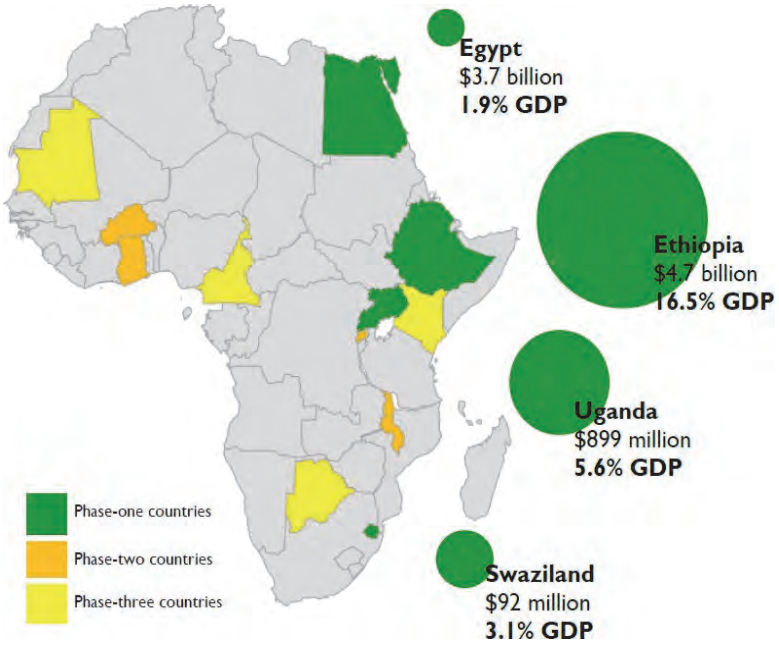
Estimates suggest 2-3% of a nation's income is lost due to malnutrition. For Tanzania, this equates to about US$ 1 billion per year, and for Nigeria to between US$10 billion and US$ 16 billion per year.

Globally it is estimated the impact of malnutrition could be as high as US$3.5 trillion per year, or US$500 per individual.

This growing evidence base of how poor nutrition impacts economic growth needs to be shared with and drawn on by policy makers.

A recent study of the Cost of Hunger in four countries in Africa revealed the staggering annual costs of child undernutrition, which ranged from US$4.7 billion per year for Ethiopia to US$92 million for Swaziland (see map below).

## The Annual Economic Costs of Child Undernutrition in Egypt, Ethiopia, Uganda And Swaziland




*Source: AU et al., 2014 – The cost of hunger in Africa*

The study also modelled the returns to investing in halving prevalence rates of child stunting by 2025. This reduction in stunting would lead to a decrease in medical treatment, lower repetition rates in the education system and an increase in manual and non-manual productivity and subsequently to national savings. By achieving the 50 % reduction in child stunting, the average annual savings would amount to US$3 million per year for Swaziland, US$88 million per year for Uganda, US$133 million per year for Egypt, and US$ 376 million per year for Ethiopia.

Micronutrient malnutrition forms part of this cost, and the table below shows estimates by the World Bank of the annual costs of micronutrient malnutrition for selected countries.

## Annual Cost of Micronutrient Malnutrition in Different African Countries

| Country | Annual loss in GDP |
|---|---|
| **Rwanda** | $ 50 million |
| **DRC** | $ 100 million |
| **Mozambique** | $ 116 million |
| **Uganda** | $ 145 million |
| **Burkina Faso** | $ 158 million |
| **Ghana** | $ 177 million |
| **Zambia** | $ 186 million |
| **Tanzania** | $ 518 million |
| **Malawi** | $ 600 million |
| **South Africa** | $ 1.1 billion |
| **Nigeria** | $ 1.5 billion |

*Source: Data from World Bank, 2010 – 'Nutrition at a glance' briefs*

## Global and Regional Distribution of Malnutrition

Whilst some progress in reducing malnutrition has been made in recent years, the global figures are still shocking:

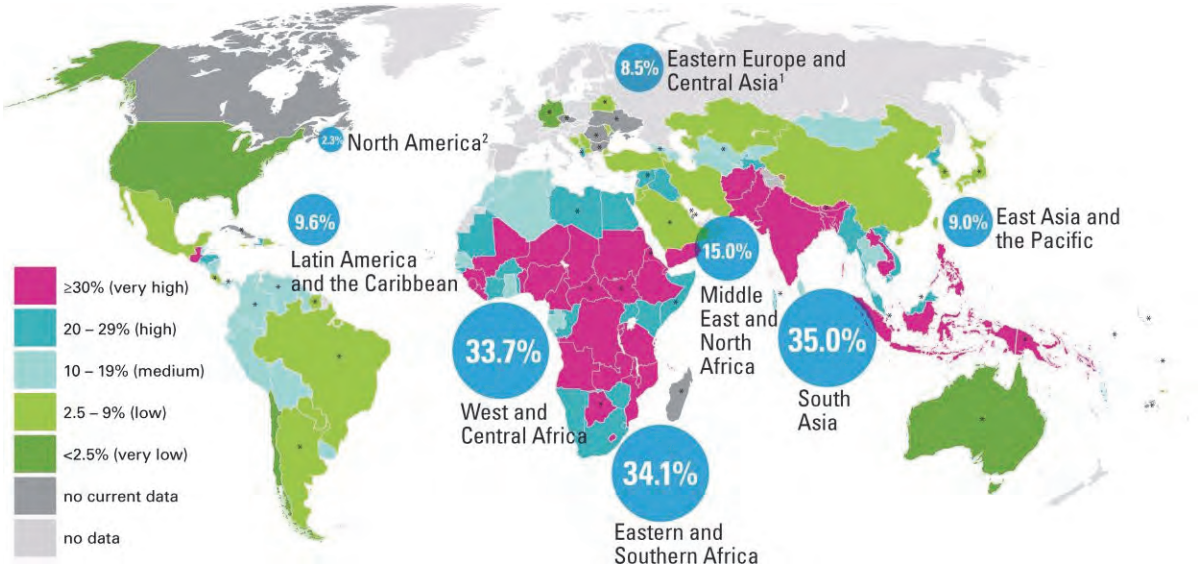
| Form of Malnutrition | Global Prevalence |
|---|---|
| **Undernutrition** *(not enough calories, or protein or micronutrient deficiency)* | • 815 million still go hungry, despite more than enough food being produced to feed everyone<br>• 155 million children under the age of 5 years suffering from stunting<br>• 52 million children under the age of 5 years suffering from wasting |
| **Micronutrient** deficient (not enough vitamins and minerals) | • 2 billion people micronutrients deficient |
| **Overnutrition** (an excessive intake of nutrients or calories) | • 1.9 million adults are overweight or obese, and<br>• 41 million children under 5 years of age are overweight or obese |

*Source: WHO, 2017; FAO, IFAD, UNICEF, WFP and WHO, 2017; Bailey et al., 2015*

Traditionally we associate undernutrition with low and middle-income countries and obesity with wealthy countries, but this situation is changing rapidly. Whilst undernutrition is still the most frequent form of malnutrition, many regions of the world are now suffering from multiple burdens of malnutrition, with undernutrition (wasting, stunting, underweight), micronutrient deficiency, and overnutrition (overweight and obesity) coexisting in countries, communities, families and even in individuals. A child who is stunted and deficient in vitamins and minerals can at the same time be overweight or obese.

Poor nutrition in the first 1,000 days of a child's life can lead to poor micronutrient status and stunted growth, which is irreversible after two years old, and associated with impaired growth, decreased cognitive ability and reduced school and work performance (see map below). Unaddressed, undernutrition can lead to a lethal vicious cycle of worsening illness and repeated decline in nutritional status. The lives of 3 million children under 5 are currently lost every year due to Undernutrition.

## Incidence of Stunting in Children Under 5 Years of Age Across the Globe




*Source: UNICEF, 2018* [https://data.unicef.org/topic/nutrition/malnutrition/#](https://data.unicef.org/topic/nutrition/malnutrition/#)

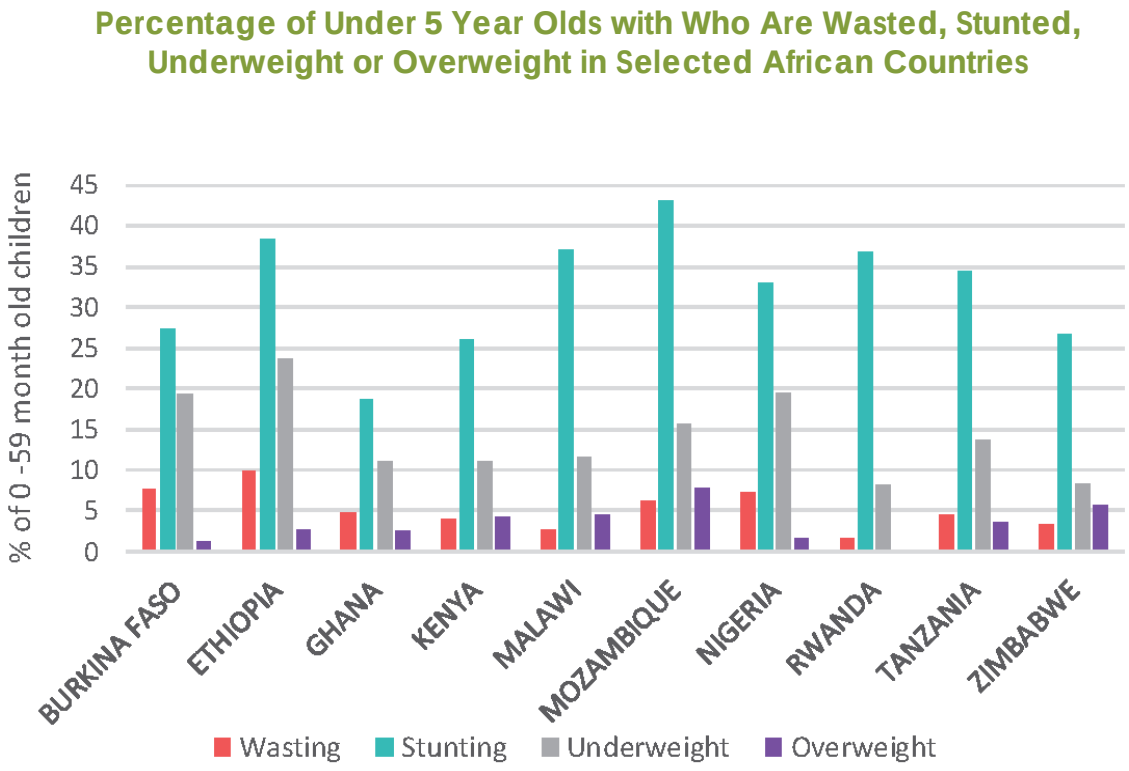
According to the 2017 Joint Child Malnutrition Estimates of UNICEF/ WHO/ World Bank Group:

In Africa, 59 million children under age 5 are **STUNTED** (low height or length-for-age). Stunting is associated with poor socio-economic conditions and increased risk of frequent and early exposure to adverse conditions such as illness or inappropriate feeding practices. Children suffering from stunting may never grow to their full height, and their brains may never develop to their full cognitive potential leading to a loss of human and economic potential for many of these countries.


In Africa, 10 million children under age 5 are **OVERWEIGHT** (high weight-for-height). The emergence of overweight and obesity has been shaped, at least in part, by growing economies, industry marketing and greater access to processed foods, along with lower levels of physical activity and increasing poverty. Being overweight increases the risk of non- communicable diseases later in life. In Africa, the number of overweight children under 5 has increased by nearly 50% since 2000. This increase if not addressed could lead to serious public health problems, as already being experienced in other parts of the world.

In Africa, 14 million children under age 5 are **WASTED** (low weight-for-height). Wasting or thinness in children is the life-threatening result of, in most cases, a recent and severe process of weight loss, hunger and disease often caused by acute starvation during drought, food insecurity, conflict or disease. Children suffering from wasting have weakened immunity and are susceptible to long-term developmental delays and face an increased risk of death: they require urgent treatment and care to survive.

The percentage of children 0 – 59 months old who are wasted, stunted, underweight or overweight in a range of sub-Saharan African countries is shown in the chart below.

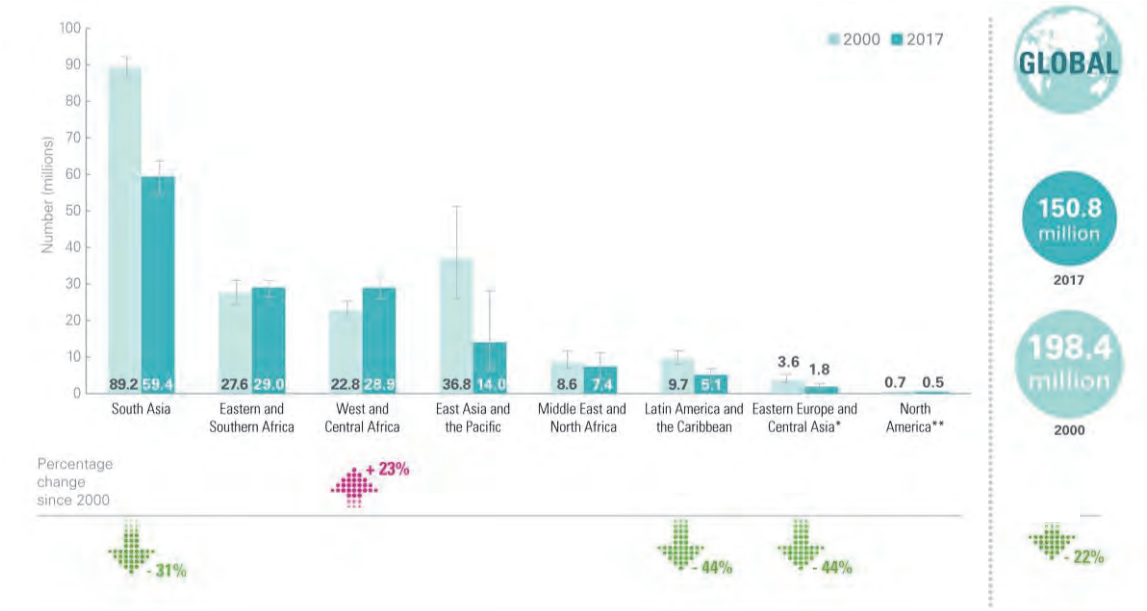



*Data source: Ministry of Health Surveys (2014-2016) compiled by UNICEF/ WHO/ World Bank Group, 2017*

*https://data.unicef.org/topic/nutrition/malnutrition/#*

Between 2000 and 2017, the number of stunted children under 5 worldwide declined from 198 million to 151 million. Africa is the only region where the number of stunted children has risen (see chart below). In West and Central Africa, stunting increased from 22.8 million to 28.9 million.

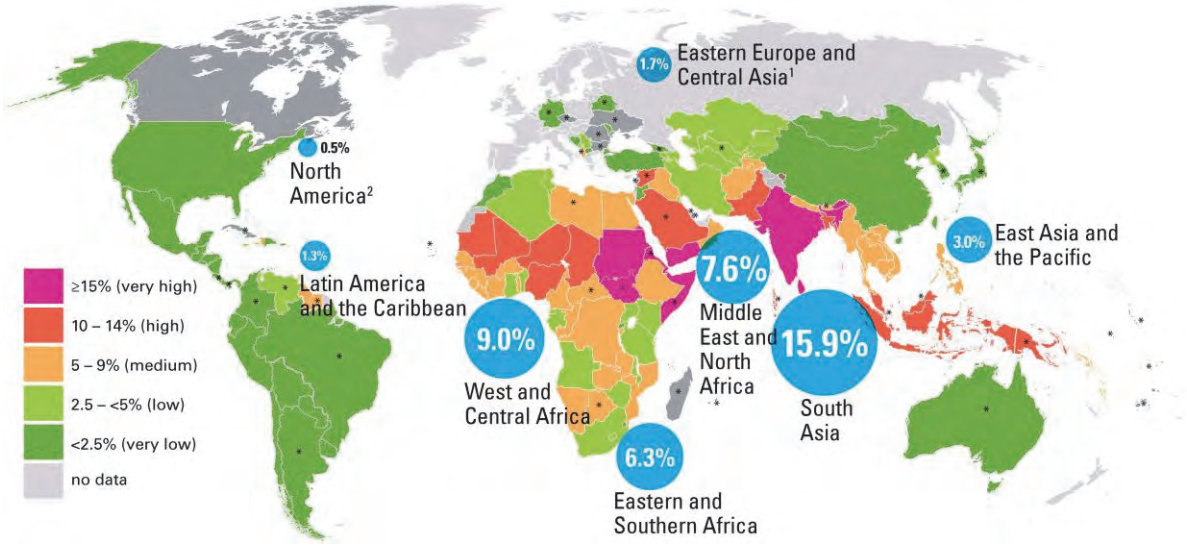
## Number (Millions) of Children Under 5 Who Are Stunted, By Region, 2000 And 2017




*Source: UNICEF/WHO/World Bank Joint Child Malnutrition Estimates, May 2018 edition Notes: * The Eastern Europe and Central Asia sub-region estimates do not include Russian Federation due to missing data; consecutive low population coverage for the 2017 estimate (interpret with caution)*

Globally, 51 million children under 5 (7.7 %) were wasted in 2017, with about 25 % of these cases in sub-Saharan Africa, and > 50 % of them in South Asia (see map below). In Africa in 2017, 7.4 % of children under 5 were wasted. Prevalence of wasting exceeding 5 % is considered alarming as it is associated with increased risk of morbidity; prevalence rates of 10-14 % are regarded as serious; and above or equal to 15 % as critical. Children are generally at higher risk of wasting during their second year.

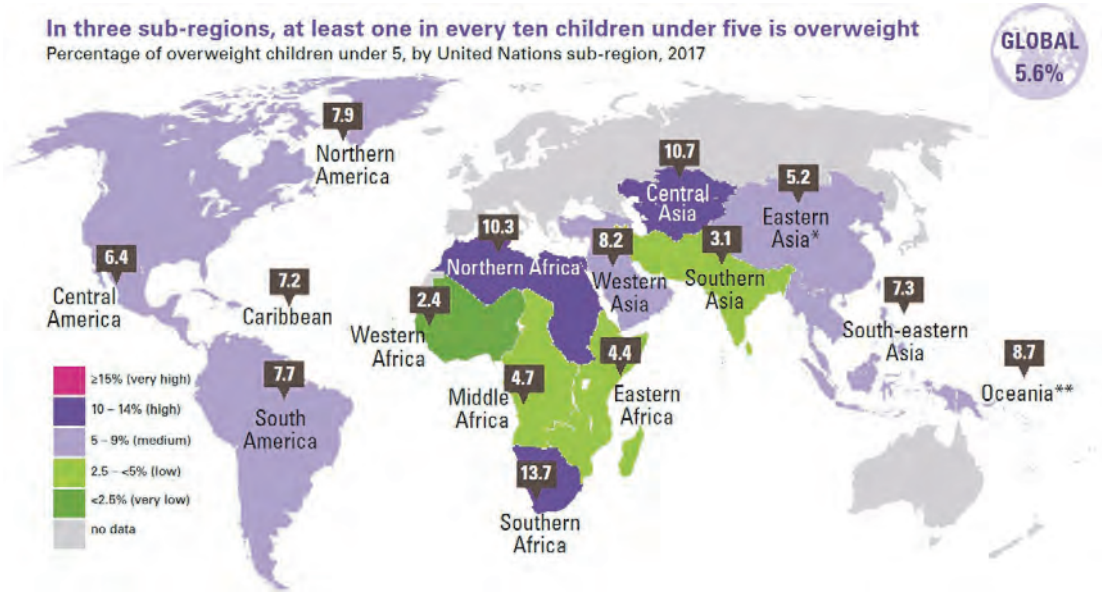
## Percentage of Wasted Children Under 5, By Sub-Region, 2017




*Source: UNICEF/WHO/World Bank Joint Child Malnutrition Estimates, May 2018. Levels and trends in child malnutrition.*

Globally, 38 million children under age 5 were overweight in 2017 (see map below), up from 30 million in 2000. This rapid global increase is of particular concern in Africa and East Asia where such increases worsen the multiple burden of malnutrition. As health-care systems are ill-equipped to manage this growing burden of malnutrition, this increasing trend is becoming a major public health concern.

### Percentage of Overweight Children Under 5, By Sub-Region, 2017




*Source: UNICEF/WHO/World Bank Joint Child Malnutrition Estimates, May 2018. Levels and trends in child malnutrition*

## Macronutrient Malnutrition

Macronutrient deficiency refers to a lack of the macronutrients (carbohydrates, proteins, fats) required for normal growth and development.

**Protein-Energy Malnutrition (PEM)** is a common macronutrient deficiency that occurs when children consume insufficient amounts of protein and energy (carbohydrates and fat) to meet the body's needs. PEM can lead to wasting (very low weight-for-length/height) or stunting (very low length/height-for-age). Whilst a lack of food can lead to PEM, it may also be caused by poor quality food, gastrointestinal illness (e.g., parasites), illnesses which cause malabsorption of nutrients, poor sanitation and hygiene, chronic illnesses including hepatitis, kidney disease, lung disease and heart defects, or a combination of some of these factors. If the PEM is severe it can lead to kwashiorkor or marasmus. Usually these types of malnutrition are caused by a deficiency in both macronutrients and micronutrients.

*Child suffering from kwashiorkor*

Kwashiorkor is a severe form of malnutrition caused by a lack of protein and micronutrients; it is more common in children than adults. Signs of kwashiorkor are an excess of fluid in the body which can cause swelling under the skin (oedema), usually beginning in the legs, but may affect the whole body including the face; this may be accompanied by loss of muscle mass, an enlarged tummy ('pot belly'), regular infections, inflamed patches of skin that darken and split open or peel, dry brittle hair that falls out easily or loses its colour, stunting, irritability, ridged or cracked nails. Kwashiorkor

can be fatal if left untreated. Treatment includes specially formulated milk- based feeds or ready-to-use therapeutic foods (RUTF) typically made up of peanut butter, milk powder, sugar, vegetable oil and added vitamins and minerals.

Marasmus is caused by an insufficient quantity of food or by illness that prevents absorption of nutrients. Children suffering from this typically become thin and lose subcutaneous fat and muscle mass, dehydrated, and may look older but have little energy or enthusiasm and can be irritable. Treatment is similar to that for kwashiorkor plus rehydration.

**PROTEIN ENERGY MALNUTRITION (PEM)**

- Macronutrient deficiency
- Insufficient consumption of protein and energy foods to meet the body's needs
- Can lead to wasting or stunting
- May occur due to lack of food, poor hygiene, or illness

*Child Suffering from Marasmus*

Micronutrient malnutrition can occur even if the person is getting enough energy and they are not thin or short. It is usually caused by a deficiency in one or a small number of specific micronutrients.

## Micronutrient Malnutrition


**Micronutrient deficiency**, also referred to as **'hidden hunger'** refers to a lack of vitamins and/ or minerals. Deficiencies in micronutrients, specifically, are detrimental to growth, immunity and overall health and are most common in children and women of reproductive age.

For example:

- Iron deficiency limits the mental capabilities of 2 billion children worldwide and is linked to approximately 25 percent of maternal deaths in developing countries.
- Iodine deficiency causes brain damage in almost 18 million new-borns per year and is the primary cause of preventable mental disability.
- Vitamin A deficiency causes 500,000 children to go blind and kills almost 670,000 children under five years of age each year.
- Approximately 150,000 new-borns experience acute birth defects each year as a result of Folate deficiency**.**
- An estimated one-third of the world lives in areas at high-risk for zinc deficiency, which can result in decreased immunity and increased mortality from infections such as diarrhoea, particularly in children.

More than one-third of the world's population or over 3 billion people are affected by deficiencies in the key micronutrients such as iron, iodine, vitamin A, folate and zinc. These deficiencies are discussed in detail in unit 3 which describes the function each micronutrient plays, the main food sources it is found in, and the prevalence and problems of these deficiencies.

## Recommended Daily Allowances of Key Nutrients

To help in addressing the widespread problem of malnutrition, a number of organizations including the World Health Organisation (WHO), the Food and Agriculture Organization (FAO) and the United States Institute of Medicine (National Academy of Sciences) have developed Recommended Daily Allowances (RDAs) and Adequate Intakes (AIs) of nutrients specific to an individual's age and reproductive status. The table below provides a summary of these.

## Daily Recommended Individual Intakes for Energy and Key Nutrients

| Sex | Age | Body Weight | Energy | Protein | Fat | Carbohydrate | Fibre | Calcium | Iodine | Iron[a] (if 12% bio- | Iron[b] (if 5% bio- avail) | Zinc (low bio-avail) | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kg | kcal | g | g | g | g | mg | mcg | mg | mg | mg | mcg RAE | mg | mcg DFE |
| BOTH SEXES *(breastfed 1st year of life)* | 0-6 months | 6.2 | 560 | 9.8 | 31 | 88 | ND | 300 | 90 | 0 | 0 | 6.6 | 375 | 25 | 80 |
| | 6-12 months | 8.7 | 688 | 11 | 30 | 108 | ND | 400 | 90 | 8 | 19 | 8.3 | 400 | 30 | 80 |
| | 1-4 years | 13 | 1,063 | 13 | 24 | 166 | 19 | 500 | 90 | 5 | 13 | 8.4 | 400 | 30 | 160 |
| | 4-7 years | 19 | 1,400 | 17 | 31 | 219 | 25 | 600 | 90 | 5 | 13 | 10.3 | 450 | 30 | 200 |
| GIRLS | 7-10 years | 27 | 1,700 | 26 | 38 | 266 | 26 | 700 | 120 | 7 | 18 | 11.3 | 500 | 35 | 300 |
| | 10-14 years | 42 | 2,200 | 37 | 49 | 344 | 26 | 1300 | 120 | 12/28[c] | 28/65[c] | 15.5 | 600 | 40 | 400 |
| | 14-18 years | 55 | 2,488 | 46 | 55 | 389 | 26 | 1300 | 150 | 26 | 62 | 15.5 | 600 | 40 | 400 |
| BOYS | 7-10 years | 27 | 1,833 | 26 | 41 | 286 | 31 | 700 | 120 | 7 | 18 | 11.3 | 500 | 35 | 300 |
| | 10-14 years | 40 | 2,456 | 36 | 55 | 384 | 31 | 1300 | 120 | 12 | 29 | 19.2 | 600 | 40 | 400 |
| | 14-18 years | 61 | 3,225 | 53 | 72 | 504 | 38 | 1300 | 150 | 16 | 38 | 19.2 | 600 | 40 | 400 |
| WOMEN *(moderate physical activity)* | 18 - 30 years | 55 | 2,300 | 46 | 52 | 359 | 25 | 1000 | 150 | 24 | 59 | 9.8 | 500 | 45 | 400 |
| | 30 - 60 years | 55 | 2,250 | 46 | 50 | 352 | 25 | 1000 | 150 | 24 | 59 | 9.8 | 500 | 45 | 400 |
| | Pregnant | 55 | 2,585 | 60 | 57 | 404 | 28 | 1200 | 250 | NK, SR | NK, SR | 15 | 800 | 55 | 600 |
| | Breastfeeding | 55 | *2,800* | 65 | 62 | 438 | 29 | 1000 | 250 | 12 | 30 | 18.3 | 850 | 70 | 500 |
| | 60 & over | 55 | 2,050 | 46 | 46 | 320 | 21 | 1300 | 150 | 9 | 23 | 9.8 | 600 | 45 | 400 |
| MEN *(moderate physical activity)* | 18 - 30 years | 65 | 2,900 | 54 | 64 | 453 | 38 | 1000 | 150 | 11 | 27 | 14 | 600 | 45 | 400 |
| | 30 - 60 years | 65 | 2,850 | 54 | 63 | 445 | 38 | 1000 | 150 | 11 | 27 | 14 | 600 | 45 | 400 |
| | 60 & over | 65 | 2,350 | 54 | 52 | 367 | 30 | 1300 | 150 | 11 | 27 | 14 | 600 | 45 | 400 |

Key: a = Iron 12% bioavailability (i.e. diet has some haem iron and vitamin C); b = Iron 5% bioavailability (i.e. diet is mainly cereals with high phytate content); c = iron requirement dependent on whether menstruation has started; NK = not known; SR = Supplement Recommended

*Sources: Nutrition for developing countries (2015); FAO (2001, 2004); WHO (2007); Institute of Medicine (2002/2005)*

1) ENERGY: FAO. 2004. Human energy requirements. Report of a Joint FAO/WHO/UNU Expert Consultation. Rome.
2) PROTEIN: WHO/FAO/UNU. 2007. Protein and amino acid requirements in human nutrition, Report of a joint FAO/WHO/UNU expert consultation. WHO Technical Report Series 935
3) FAT: 0-12-month data. Institute of Medicine. Dietary Reference Intakes for Energy, Carbohydrate, Fibre, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (2002/2005), and data for other ages calculated as 20%E given acceptable range of 20-35% from FAO. 2010. Fats and fatty acids in human nutrition, FAO Food and Nutrition Paper, 91.
4) CARBOHYDRATE: FAO/WHO (2007) Scientific update on carbohydrates in human nutrition, which recommends 50-75%E from carbohydrates, for our calculations we used an average figure of 62.5% of energy from carbohydrates.
5) FIBRE: Institute of Medicine. Dietary Reference Intakes for Energy, Carbohydrate, Fibre, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (2002/2005).
6) MINERALS and VITAMINS: FAO. 2001. Human vitamin and mineral requirements. Joint FAO/WHO consultation.

kcal= kilocalorie; MJ = mega joules (1000 kcal = 4.18 MJ); RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene. DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate = 0.6 mcg folic acid - fortified food or supplement.

It is worth noting that the consistency of a food type affects its nutrient density (the number of micronutrients in a particular food in relation to its total energy and in relation to the body's

requirements). A cup of thick porridge will have more nutrients than a cup of thin/watery porridge. The combination of the ingredients used to make the particular food will also determine the nutrient content. High nutrient density meals are particularly important for groups of people who typically eat small portion sizes such as young children, the elderly or people who are sick.

## Dietary Approaches for Addressing Malnutrition

There are multiple strategies for addressing malnutrition, many of which can be managed within the home. One is by preparing balanced and nutritious meals. This does not need to be difficult or time consuming. Many nutrient rich foods can be prepared in advance. For example, nuts and millet can be ground beforehand. Nutrient rich foods, such as groundnut or sesame/simsim pastes, can also be added to any household's normal meal.

A good/balanced meal should contain:

- An energy giving food (e.g. cereals, sweetpotato or cassava roots, plantain)
- Other foods that may be made into a sauce, stew or relish. These should include:
  1) Legumes (beans/groundnuts) or foods from animals (meat, eggs, milk, etc.)
  2) At least one vegetable
  3) Some fat or oil (but not too much) to increase the energy intake and improve taste

It is also good to eat fruits with a meal or as a snack and to drink plenty of water during the day. Try to vary which fruits and vegetables are eaten at different meals, because different fruits and vegetables vary in the amount and kind of micronutrients they contain.

Care must be taken to store food safely and to prepare food hygienically, good hand washing before food preparation and eating can help to reduce the chances of illness resulting from contamination.

Malnutrition resulting in micronutrient deficiencies can be addressed using various approaches. These include supplementation, food fortification, crop biofortification, dietary diversification, nutrition education and improved agricultural productivity. Typically, more than one of these approaches can be implemented either concurrently or sequentially. Approaches for managing micronutrient malnutrition are discussed in more detail in Unit 4, *Tackling Micronutrient Malnutrition*.

## Review Questions

1. What are the types of malnutrition?
2. What is the number one cause of malnutrition?
3. What is 'hidden hunger'?

# Unit 3 – Nutrients

## Objectives

By working through this section, you will be able to:

- Describe which of the foods commonly consumed in your location are good sources of carbohydrates, proteins, fats, vitamins and minerals.
- Name at least four important vitamins and minerals and explain what health problems deficiencies in each of them causes.
- Explain the importance of vitamin A in the diet and discuss the prevalence and implications of vitamin A deficiency (VAD) particularly in young children and pregnant women.

## Key Points

- **Although we only need vitamins in small/ micro amounts they are still vitally important, and a lack of any vitamin can cause serious health problems.**
- **Vitamin A food sources include liver, eggs, dark orange or green coloured vegetables and fruits such as orange-fleshed sweetpotato, mangoes, spinach, milk.**
- **Vitamin A helps maintain our eyesight, immune system, cell division, growth and reproductive systems. An estimated 250 million preschool children are vitamin A deficient, and a large proportion of pregnant women.**
- **Vitamin D food sources include fish oils and liver and can also be synthesised by the body when our skin is exposed to sunlight. Vitamin D is important for bone formation and strength, and helps the immune system, brain, nervous system, skin, muscles and cartilage, kidneys, intestines and reproductive organs.**
- **Our bodies need minerals to form structures such as bones, teeth, nails, muscles, and red blood cells and to regulate chemical reactions.**
- **Eating a varied and balanced diet will help ensure an adequate supply of most minerals.**
- **Deficiencies in iron, iodine, zinc and calcium are common and a serious public health concern.**

## Nutrients

Nutrients can be classified as either essential or non-essential nutrients.

- **Essential nutrients** are not synthesized in the body. Thus, we need to supply them through our food, by eating a well-balanced diet with a variety of nutrient dense foods. Proteins, fats, and carbohydrates, vitamins, minerals, fibre and water are needed by our body every day.
- **Non-essential nutrients** are nutrients which the body can synthesize from other compounds as well as from food sources. Although referred to as non-essential, they are still required by the body to maintain health. Some non-essential nutrients include: vitamin D, which is synthesised by skin cells using sunlight; non-essential amino acids (e.g. alanine, arginine, asparagine, tyrosine etc.); and cholesterol.

Nutrients can also be classified as either macro or micronutrients.

- **Macronutrients** are needed by the body in large amounts. Carbohydrates, proteins and fats are macronutrients. Macro means large.
- **Micronutrients** are needed by the body in small amounts, but are still vital for normal

metabolism, growth and physical well-being. Vitamins and minerals are micronutrients.

A nutrient can perform one or several functions in the body. Adequate and balanced amounts of both macro and micronutrients are essential for proper growth, development, good health and prevention of disease.

By eating a healthy, varied diet we can obtain all the nutrients we need. However, if pregnant or planning to become pregnant, a daily folic acid supplement is recommended until the 12$^{th}$ week of pregnancy to help prevent deformities such as spina bifida developing in the baby.

## Macronutrients (Carbohydrates, Proteins, Fats)

Macronutrients are the nutrients needed by our body in large amounts. Carbohydrates, proteins, and fats are macronutrients and form the base of most diets and are the major source of energy in our diets. The energy provided from these foods helps humans perform daily activities, growth and other body functions (thinking, breathing, digesting and absorption). As energy is important for survival, humans have developed the ability to store excess energy as fat for future use.

Carbohydrates, proteins and fats, in addition to providing energy, each also have very specific functions in the body and need to be supplied in sufficient amounts to carry out those functions.

The functions and sources of the different nutrients are described in the table below.

## Nutrients, What Do They Do and Where Can We Get Them From

| Nutrient | Function | Sources |
|---|---|---|
| **Carbohydrates** *(energy giving)*  | **Carbohydrates** provide energy for the body | Roots, tubers and plantains: *Sweetpotato, cassava, potato, yam, plantain, taro*<br>Cereals and cereal products: *Millet, sorghum, maize, wheat, rice, bread, biscuits, breakfast cereals, foods prepared with cereals (e.g. porridge, chapati)* |
| | **Dietary fibre** is a term used for non-digestible carbohydrates. Fibre helps reduce risk of heart disease, type 2 diabetes, colon cancer and constipation | *Whole grain cereals (e.g. brown rice) and breads, beans, pulses, fruit and vegetables, high fibre breakfast cereals* |
| **Protein** *(body building)*  | **Protein** provides amino acids and energy. Amino acids are needed for normal growth and maintenance of health (e.g. repair of tissues during illness, regulation of hormones). We can't make all the amino acids we need ourselves and so have to get them from our diet | Pulses, seeds and nuts: *Beans, cowpeas, peas, pigeon peas, groundnuts, bambara nuts, soya*<br>Meat and animal products: *Milk, eggs, goat meat, beef, chicken, pork, fish, flying ants/termites, mice, ice cream, yoghurt, infant formula, cheese* |
| **Fat** *(energy storage)*  | **Fat** provides essential fatty acids (that we can't make ourselves but need in small amounts) and energy. We need fat for a range of bodily processes and to maintain the normal structure of cells. It also carries essential fat-soluble vitamins enabling our bodies to absorb them | Oils and fats: *Groundnuts, soya flour, avocado, palm oil, sunflower oil, other cooking oils, pumpkin seed, margarine, coconut, sesame, olive oil, oily fish, nuts, seeds, meat and meat products* |
| **Vitamins and Minerals** *(body protective)*  | **Vitamins** help turn macronutrients into energy, and build body tissues, fight infections, protect cells from damage<br>**Minerals** help form bones, nails, teeth, blood cells etc. and regulate chemical reactions and heart beats, nerve responses, blood clotting, fluid regulation, energy metabolism | Different vitamins and minerals are found in different foods. Fruits and vegetables are a good source of many. Fruits: e.g. *mango, papaya, bananas, wild fruits, oranges, pineapples, passion fruit, guava*<br>Vegetables: *e.g. orange-fleshed sweetpotato, green leafy vegetables (Amaranth, Chinese cabbage, cowpea leaves etc.), tomatoes, carrots, pumpkins, green pepper, okra, cabbage, eggplant, cucumber, onions, garlic, green maize* |
| **Water** *(hydration)*  | **Water** regulates temperature and other bodily functions | *Water, watery drinks and foods (e.g. soups, stews)* |

## Carbohydrates

### *Role*

Is to provide energy to every cell in the body; we need this energy for physical activity, growth and maintenance of our bodies.

Carbohydrates should be the body's main source of energy; they are broken down into glucose before being absorbed into the bloodstream. All our body's activities, whether breathing or running, are fuelled by this energy. Fibre is important for digestion, bowel health and cholesterol levels. High fibre foods add bulk to a meal helping us feel full.

## Sources

Carbohydrates generally come from plants. Examples of carbohydrate-rich foods include: root and tuber crops such as potatoes, sweetpotato, yams and cassava; cereal grains such as maize, millet, sorghum, rice, wheat, and foods made from cereal grains; legumes such

as peas and beans, vegetables, fruits, and sugars. Remember most foods contain a mixture of nutrients and many of these carbohydrate-rich foods also provide essential vitamins and minerals.

## Forms

Carbohydrates are found in three forms: **starch, fibre and sugar**. Each form of carbohydrate serves different purposes and is important in our diets. A healthy diet obtains at least half its daily calories from carbohydrates (50–75%), with plenty of starch and fibre and limited sugar.

| Form | Starch | Fibre | Sugar |
|---|---|---|---|
| **What does it do?** | is broken down by the body into simple sugars to provide a slow and steady release of energy through the day | is found in the cell walls of food that come from plants. It cannot be digested by our body but helps in absorbing water and getting rid of the body's waste products. It reduces blood cholesterol and normalises blood sugar levels. Helps prevent cancer, heart disease, type 2 diabetes and constipation | is quickly absorbed by the body and provides a concentrated source of energy<br>Excess sugar consumption can lead to overweight and obesity, and also may result in a reduced intake of other foods that contain important nutrients |
| **Which food sources are rich in it?** | Maize, rice, wheat, oats, starchy roots and tubers, such as sweetpotato, potatoes, yams and cassava; dry beans and peas, starchy fruits, such as breadfruit, banana, plantain | Vegetables and fruits particularly with their skins/peel on, whole grains of maize, oats, barley, rye, brown rice, beans, chickpeas, lentils, nuts, whole grain bread, whole wheat pasta, high fibre breakfast cereals | Sugar is found naturally in some foods (e.g. fruit, honey, milk), tree saps, and is processed from sugar cane and beet.<br>Fruits, fruit juices, milk, sweetened drinks, table sugar, honey, corn syrup, biscuits, cakes, sweets.<br>It is recommended that consumption of concentrated sweet foods is limited, but not fruits or milk |

### *Problems with Excess Carbohydrate Consumption*

If more carbohydrate is consumed than used as energy, it is converted to fat for long-term energy storage. As we get older or become less active we need less energy and carbohydrates and will put on weight if we do not adjust our diet or increase our activity.

## Proteins

### *Role*

Proteins are the building blocks of life. They are diverse in structure and function: enzymes, blood transport molecules, the intracellular matrix, finger nails and hair are all composed of proteins, as are most hormones and components of membranes. Amino acids, the building blocks of proteins, also act as precursors for the synthesis of many coenzymes, hormones, nucleic acids and other molecules essential for life.

Almost all the cells in the body are constantly being broken down and then rebuilt; this process requires a steady supply of protein. Proteins from our diets build and repair body tissues such as muscles, bones and organs, blood, skin, and hair and repairing damaged tissues due to illness or injury. Proteins are necessary for blood clotting and for keeping the immune system strong by developing antibodies to fight disease. Protein is also a major component of the body's transportation system that carries oxygen and nutrients to all cells of the body. Sufficient protein is necessary to maintain proper fluid regulation; without protein to help fluids remain in their appropriate place in veins, arteries, and cells, liquid can leak out into body extremities (feet and legs) and the abdominal cavity (this is what happens in Kwashiorkor, a severe form of malnutrition).

Protein intake is particularly important during periods of high growth, such as pregnancy, infancy, childhood, and adolescence as rapid growth requires amino acids from which to build new tissue, in addition to keeping up the normal maintenance and repair of existing tissue, hormones and enzymes. If body energy levels are low, the body will use protein for energy, but this is not the best use of protein. This takes protein away from performing its specific essential functions.

### *Sources of Proteins*

Animal and plant foods are good sources of protein and provide different combinations of amino acids needed by the body. A good variety of both high-quality protein (from animal sources) and low-quality protein (from plant sources) is needed to supply the body with essential amino acids to be used to manufacture body protein. Animal proteins contain all the essential amino acids while vegetable proteins, except soya, offer an unbalanced assortment of amino acids that cannot alone satisfy the body's needs. But by mixing different sources of vegetable proteins together this can be overcome.

**PROTEIN-RICH FOODS**

***Animal sources***: All types of meat, poultry, fish, eggs, milk, cheese, yoghurt, insects

***Vegetable sources***: Dried beans, peas, lentils and other legumes, nuts, pumpkin seeds, soy bean

# Fats

## *Role*

Fats (lipids) provide us with energy and the essential fatty acids that are needed for the absorption of fat-soluble vitamins A, D, E and K and other essential physiological functions. Fats contain the highest level of energy (9 calories per gram) of any nutrient and are essential for growth and health, but if overconsumed can lead to weight gain. Fat is also an important component of body tissue. The brain and central nervous system is rich in fat and so during pregnancy and the first years of life when these tissues are developing, fat must be sufficient in the diet. The body uses fat to manufacture hormones, keep warm, protect the cells and internal organs, and to store calories for periods when food is not available.

## *Sources*

Dietary fats are found naturally in foods of both plant and animal origin. Almost all foods contain some fat, even if in very small amounts. Not all fats are the same. Fats can be composed of unsaturated, saturated or trans fatty acids. The type of fat in the diet has important effects on health. Most of the fat in the diet should come from unsaturated fatty acids, especially from seeds, nuts and fatty fish that provide omega-3 fatty acids. Only small amounts (< 10%) should come from saturated fatty acid, and trans fats or foods containing trans fats should be avoided or consumed sparingly (<1% of calories).

| Dietary Fat | Typical Sources |
|---|---|
| ***UNSATURATED FATTY ACIDS***: are liquid at room temperature and usually derived from vegetable oils or fish oils | |
| ***Polyunsaturated***: are essential fatty acids and cannot be made by the body and must come from the foods we eat. The two main types of polyunsaturated fats are omega-6 and omega-3<br>Omega-3 fatty acid, an essential unsaturated fat, has several important health benefits such as lowers the risk of heart disease and stroke, reduced inflammation, has a critical role in brain function and normal growth and development. | Omega-6 fats from: Sunflower oil; corn oil; soybean oil; flaxseed oil; walnuts, flaxseeds; and fish<br>Omega-3 fats from: Fatty fishes, including sardines, tuna, anchovies, eel, swordfish, trout, salmon, mackerel, herring, kipper, bloater, jackfish |
| ***Monounsaturated***: can protect our hearts by maintaining levels of good HDL cholesterol and reducing levels of bad LDL cholesterol | Peanut oil; olive oil; canola oil, avocados; peanut butter, nuts; and pumpkin and sesame seeds etc. |
| ***Saturated Fatty Acids:*** are solid at room temperature, and mainly derived from animal sources. Animal fats (except for some fish) tend to have a higher proportion of saturated fatty acids and should be consumed in small amounts due to their perceived health risks, e.g. coronary heart disease  | Butter, ghee, lard, cow's milk fat, cheese, ice cream, meat, sausages<br>Red palm oil, coconuts, coconut oil (NB these oils do not increase risk of heart disease) |
| ***Trans fatty acids***: should be consumed as little as possible (<1% of calories) or avoided as they are linked to heart disease and diabetes  | Hydrogenated fat in margarines, shortening, biscuits and cakes, milk, beef, lamb |

## *Health Advice on Fat Consumption*

To reduce the amount of saturated fat in the diet use:

- Lower fat versions of dairy products (e.g. Skimmed milk);
- Chicken or fish or vegetable protein as opposed to red meats and remove visible skin and fat;
- Less fat in cooking and low-fat spreads on bread;
- Grilled, microwaved or baked foods instead of fried or roasted;
- Use monounsaturates, e.g. Olive oil or rapeseed oil, or very sparingly (sunflower or corn oil).

**A Healthy Balanced Diet**

Involves the consumption of a sufficient quantity and diversity of foods that contain the necessary **macronutrients** (carbohydrates, proteins and fats) and **micronutrients** (vitamins and minerals).

## Micronutrients (Vitamins, Minerals)

Micronutrients are vitamins and minerals. They are needed in miniscule but essential quantities to help the body perform specific functions that promote growth and reproduction and help maintain health and life.


Micronutrients have specific functions in the body and must be supplied in different forms and in sufficient amounts. During times of rapid growth, such as during pregnancy and breastfeeding, early infant and child growth and during periods of certain illnesses, it is especially important to get enough micronutrients. Eating a balanced diet that includes a variety of different foods is the best way to ensure that we get enough of each of the vitamins and minerals we need.

Micronutrient deficiency occurs if we consume insufficient quantities of any of these essential vitamins and minerals we require. Micronutrient malnutrition is also referred to as 'Hidden Hunger". Micronutrients deficiencies of public health significance are Vitamin A, Iron, Zinc and Iodine. A lack of sufficient intake of these micronutrients represents a major threat to health and development of population the world over, and particularly children and pregnant or lactating women in low-income countries (read through unit 3 below for further details).

## Vitamins (With A Focus on Vitamins A and D)

Each vitamin has a very specific function and not getting enough of each one can lead to the development of serious health problems and diseases (see table The Main Functions and Sources of Vitamins below). Some vitamins help us turn the carbohydrates, protein, and fats we eat into the energy our bodies use. Other vitamins help build healthy tissues and hormones, even though they are not parts of those body tissues. Some vitamins help our immune systems fight against infection and serve as antioxidants, protecting cells and tissues from damage. The many different vitamins can be divided into two types: "fat-soluble" vitamins, which dissolve in fat, and "water-soluble" vitamins, which dissolve in water.

| Fat-soluble Vitamins | Water-soluble Vitamins |
|---|---|
| • Do not dissolve in water or body fluids<br>• Are heat stable so not lost in cooking<br>• Are not excreted by the body<br>• Build-up in the body if intake is high<br>• Are important for eye, skin, lung, bone, teeth, nervous system, immune system and blood health<br>• Are vitamins a, d, e and k | • Dissolve in water<br>• Are not stored by the body<br>• Pass out of the body in urine if present in excess<br>• Are easily damaged or lost in food cooking or storage<br>• Need to be consumed regularly to meet the body's Needs<br>• Are vitamin c and the eight b-complex vitamins<br>• The b-vitamins help cells to generate energy from carbohydrates, proteins and fats and to build and repair tissue<br>• Vitamin c helps form bones, teeth and scars;<br>• Absorb iron; and may strengthen the immune system |

## The Main Functions and Sources of Vitamins

| Vitamin | Functions | Important Sources |
|---|---|---|
| **Vitamin A** (retinol) | Eyesight, healthy skin and mucous lining of body organs, cell division and differentiation, immune system, reproduction and growth | Liver, dairy products, fish oils, orange and green vegetables and fruits, fortified margarines |
| **Vitamin D** (cholecalciferol) | Bone formation | Fish oils, salmon, herring, liver, skin exposure to UV light |
| **Vitamin E** (tocopherol) | Antioxidant properties, protecting cells from oxidative damage | Vegetable oils, whole grain cereals, nuts, seeds, green leafy vegetables |
| **Vitamin K** | Blood clotting | Colonic bacteria |
| **Vitamin C** (ascorbic acid) | Formation of supporting tissues of cells for wound healing. Absorption of non-haem iron. | Citrus fruits, peppers, tomatoes, cabbage |
| **Vitamin B1** (thiamin) | Carbohydrate utilisation | Whole grain cereals and breads, legumes, nuts, meat |
| **Vitamin B2** (riboflavin) | Nervous system function. | Green leafy vegetables, meat, |

| | | |
|---|---|---|
| | Protein metabolism. Growth | eggs, milk |
| **Vitamin B3** (niacin or nicotinic acid) | Energy metabolism | Whole grain cereals, nuts, legumes, meat, poultry, fish |
| **Vitamin B12** (cyanocobalamin) | Red blood cell formation.<br><br>Nervous system function | Meat, eggs, fish, poultry, milk,<br>roots/nodules of legumes (otherwise not generally present in plants) |
| **Folic acid** | To aid maturation or red blood cells | Yeast, liver, kidneys, green leafy vegetables, orange juice |
| **Vitamin B6** (pyridoxine) | Protein metabolism. Formation and growth of red blood cells. | Liver, kidneys, meat, whole grain cereals, egg yolk |
| **Biotin** | Cofactor for gluconeogenesis and fat metabolism | Liver, egg yolk, soya flour, cereals, yeast |
| **Pantothenic acid** | Essential for numerous reactions involved in lipid and carbohydrate metabolism | Animal products, whole grain, legumes |
| | | *Source: Adapted from WHO, 2003* |

Deficiencies in vitamin A and D are the most serious vitamin-deficiency public health problems globally.

**Vitamin A**

**Functions:**

- Is essential for normal cell growth, division and differentiation
- Is important for good vision, healthy skin and mucous membranes, bone formation, growth, immunity and reproduction
- Is particularly important for good eyesight and vision, including protecting against eye damage from infections and preventing night blindness

**Forms:**

- Vitamin A exists in several forms.
- Pre-formed vitamin A (*retinol*) is found in foods of animal origin (e.g. Animal livers, eggs, milk, butter) and is easily absorbed by the body.
- Another form of vitamin A is manufactured by the body from substances (certain *carotenoids*) found in certain plant foods, this conversion occurs in the wall of the small intestine.

**Sources:**

- Foods rich in vitamin A are eggs, liver, milk, orange-fleshed sweetpotato, mangoes, pawpaw, pumpkin, carrots, dark green leafy vegetables.
- Our vitamin A needs can be met through a healthy diet containing a range of vitamin A rich foods.
- For the body to absorb vitamin A, we also need to consume fat along with iron, zinc and protein.
- The body stores any extra vitamin A in the liver, these stocks can act as a reserve when vitamin A intake is not sufficient, thus protecting the body from vitamin A deficiency.

- If vitamin A foods are not available, supplements or food fortified with vitamin A can, be used.

**Prevalence and eye signs of Vitamin A deficiency (VAD):**


Bitot spot caused by VAD

- Vitamin A deficiency is one of the most common nutritional deficiencies in the world.
- Vitamin A deficiency (VAD) is the leading cause of preventable blindness in children and increases the risk of disease and death from severe infections. In pregnant women, VAD causes night blindness and may increase the risk of maternal mortality.
- Vitamin A deficiency is a public health problem in more than half of all countries, especially in Africa and South-East Asia, hitting young children and pregnant women in low-income countries hardest.
- An estimated 250 million preschool children are VAD and it is likely that in VAD areas a substantial proportion of pregnant women are VAD.


Corneal clouding / xerosis in VAD

- An estimated 250,000 to 500,000 VAD children/ year become blind, half of them dying within 12 months of losing their sight.
- **Note**: not all children who are VAD have the eye signs known as *xeropthalmia* (dry eyes). The children with eye signs are just the tip of the iceberg, there will be many others in the community who are VAD but have completely normal vision. Hence why community approaches to control are so important.
- Children with any eye signs of VAD are at high risk of dying. Eye signs of VAD in children include: night blindness, conjunctival xerosis, Bitot's spots, corneal xerosis, corneal ulcer, corneal scarring.

## PREVALENCE OF VITAMIN A DEFICIENCY

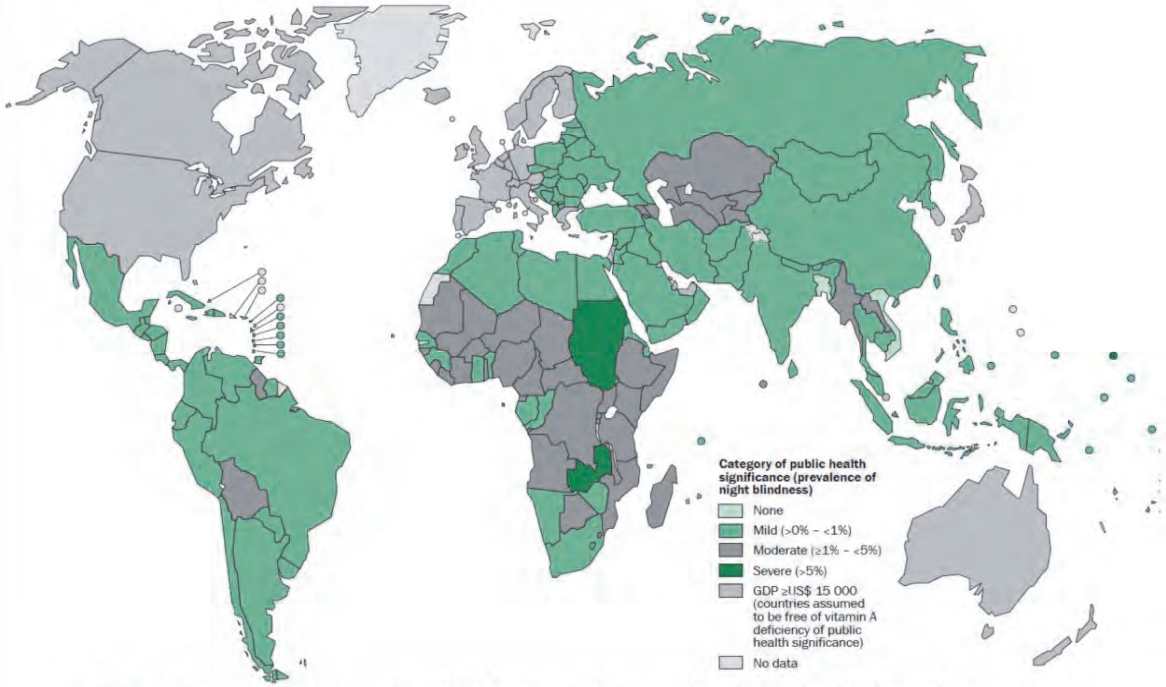



**Figure 4.11 Prevalence of night blindness in pre-school-aged children, by country**

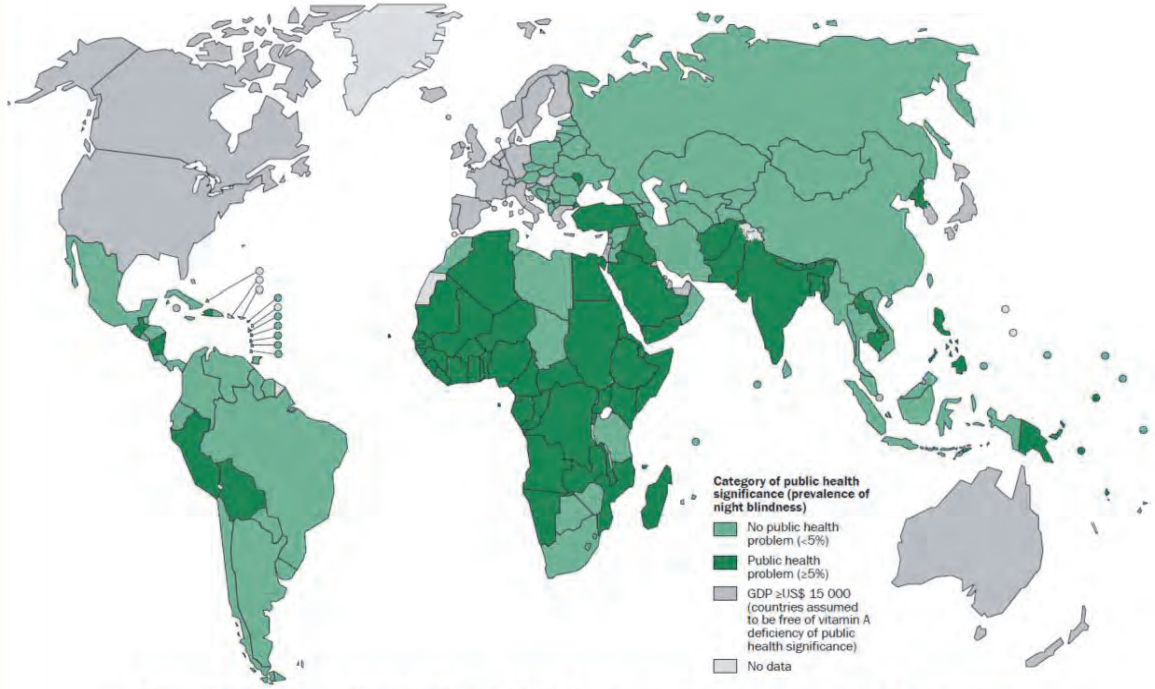



**Figure 4.12 Prevalence of night blindness in pregnant women, by country**

*Source: WHO, Global Database on Vitamin A Deficiency, Global prevalence of vitamin A deficiency in populations at risk, 1995-2005– survey data and regression-based estimates*
*http://www.who.int/vmnis/database/vitamina/en/*

**Vitamin D**

- Along with calcium and other vitamins and minerals, helps bones grow in density and strength
- Also helps the immune system, the brain and the nervous system, the skin, muscles and cartilage, the kidneys, intestines and the reproductive organs
- If insufficient, can cause poor bone growth (rickets) in children and soft bones in adults
- If levels are too low, the body's ability to fight infections is decreased
- Is the only nutrient the body can synthesise, and is produced by the body when the skin is exposed to sunlight
- Levels are typically sufficient in people who spend time outside, while those who spend a lot of time indoors or who often cover themselves if outdoors, are at risk of vitamin d deficiency
- Is found naturally in very few foods, i.e. Egg yolks, liver and fatty fish and their oil
- Is added to milk, butter and margarine in some countries

## Minerals (With A Focus on Iron, Iodine, Zinc and Calcium)

Minerals are micronutrients needed by the body in miniscule amounts to form structures such as our bones, teeth, nails, muscles and red blood cells, and to regulate chemical reactions. Minerals are required to regulate heartbeat, nerve response and reactions, blood clotting, fluid regulation and the release of energy from food. Unlike macronutrients, they do not provide energy.

Minerals are found in the soil, and taken up by plants, and then animals and people obtain them when they eat the plants. Minerals cannot be broken down or changed by our bodies and are not destroyed by heat or air. Each essential mineral is important, and although some are needed in only very small amounts, the body does not function properly unless all are supplied in sufficient quantities. Minerals are often absorbed more efficiently by the body if supplied in foods rather than as supplements. Eating a varied and balanced diet will help ensure an adequate supply of most minerals for healthy people.

The bioavailability of a mineral (i.e. how readily it can be absorbed and used by the body) may be influenced by a variety of factors. For example, the bioavailability of iron from plant sources (non-haem iron) is poor compared with iron from meat (haem iron) but absorption is increased when vitamin C is consumed during the same meal, as the vitamin C converts it to a more bioavailable chemical form. Conversely, some dietary constituents reduce bioavailability. Phytate (found in products made from wholegrain cereals, e.g. unleavened chapattis), can reduce the absorption of calcium, iron and zinc. Iodine absorption may be hindered by nitrates. Similarly, oxalate present in spinach and rhubarb binds any calcium present, making it unavailable for absorption. Unlike some vitamins, minerals are fairly stable in normal food processing and storage conditions.

The minerals currently known to be essential in human nutrition are: iron, iodine, zinc, calcium, phosphorus, potassium, sodium, chlorine, magnesium, sulphur, fluoride, manganese, chromium, cobalt, molybdenum, copper and selenium. While all of these minerals are important for good health, deficiencies in four of them are common (iron, iodine, zinc and calcium), causing serious health problems and thus are of public health significance.

## Iron

**Functions:**

- Is essential for the formation of haemoglobin in red blood cells; haemoglobin binds oxygen and transports it around the body
- Is also an essential component in many enzyme reactions and has an important role in the immune system, it is also required for normal energy metabolism and to metabolise foreign substances that need to be removed from the body

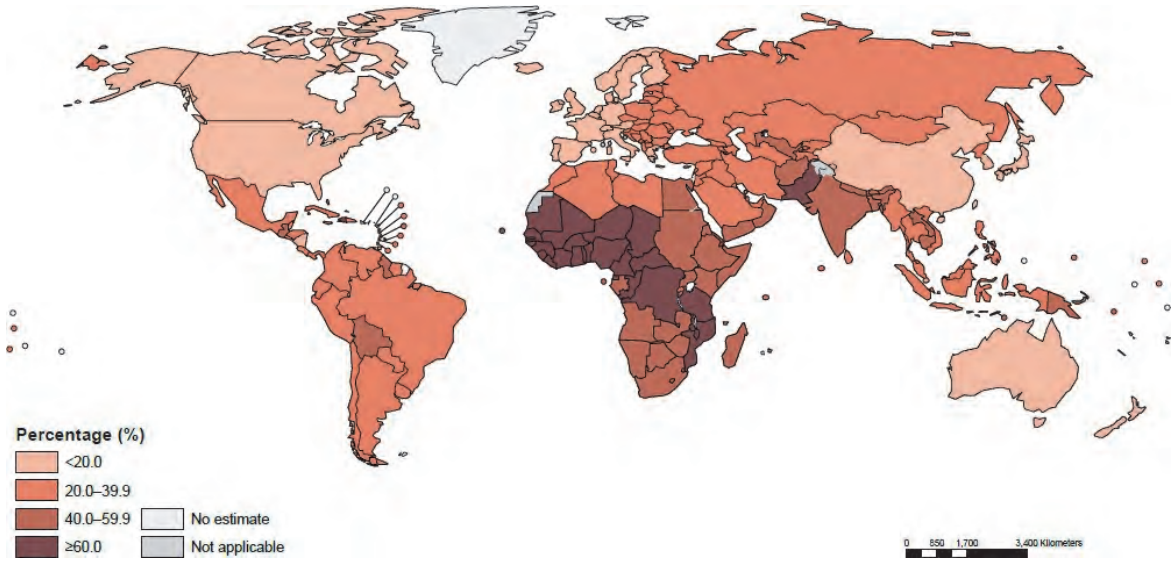
**Deficiency**

- Iron deficiency anaemia, which occurs when iron is low is the most common nutritional deficiency in the world
- Contributes to deaths in pregnancy and childbirth and poor growth and development, low resistance to disease, poor reproductive functions and lower resistance to infections leading to increased illness
- Globally 1.62 billion people affected, over 24 % of the world's population, including 47 % of all preschool age children (see maps below)
- In Africa, 84.5 million children under 5 years old, 70 million non-pregnant women, and 9 million pregnant women are anaemic

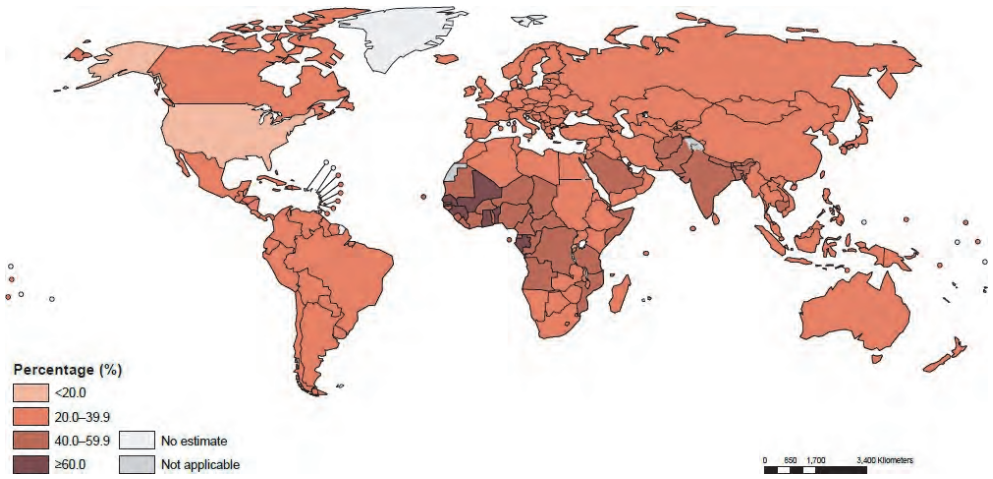
**Sources:**

- Found in animal and plant foods, iron in animal foods is easier for the body to absorb and use
- Meat, especially red meat, liver, eggs, fish and poultry
- Plant sources include: beans, soy beans, tofu, leafy green vegetables, dried fruits and food fortified with extra iron, such as enriched bread. Vitamin c can help the body absorb iron, so eating iron-rich foods together with lemons, limes, oranges, tomatoes will increase the iron we get from foods. While phytates in bran and tannins in tea can inhibit iron absorption

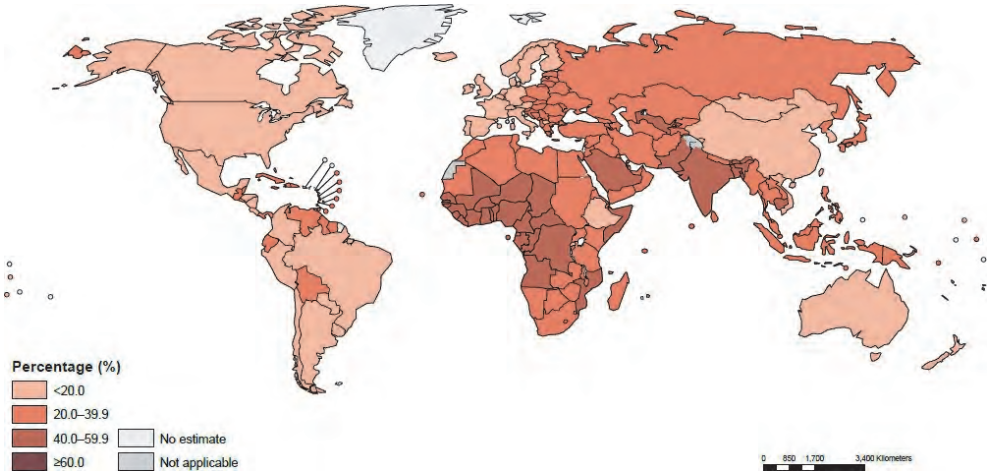
### Estimates of The Prevalence of Anaemia in Infants and Children Aged 6-59 Months, 2011



## Prevalence of Anaemia, In Pregnant Women Aged 15-49 Years, 2011




## Prevalence of Anaemia, In Non-Pregnant Women Aged 15-49 Years, 2011




*Source: WHO, 2011 – The global prevalence of anaemia in 2011*

| **Iodine** |
|---|
| **Functions:**<br>• Is essential for the formation of haemoglobin in red blood cells; haemoglobin binds oxygen and transports it around the body<br>• Is also an essential component in many enzyme reactions and has an important role in the immune system, it is also required for normal energy metabolism and to metabolise foreign substances that need to be removed from the body |
| **Deficiency**<br>• Iron deficiency anaemia, which occurs when iron is low is the most common nutritional deficiency in the world<br>• Contributes to deaths in pregnancy and childbirth and poor growth and development, low resistance to disease, poor reproductive functions and lower resistance to infections leading |

to increased illness
- Globally 1.62 billion people affected, over 24 % of the world's population, including 47 % of all preschool age children (see maps above)
- In Africa, 84.5 million children under 5 years old, 70 million non-pregnant women, and 9 million pregnant women are anaemic (see maps above)

**Sources:**
- Found in animal and plant foods, iron in animal foods is easier for the body to absorb and use
- Meat, especially red meat, liver, eggs, fish and poultry
- Plant sources include: beans, soy beans, tofu, leafy green vegetables, dried fruits and food fortified with extra iron, such as enriched bread. Vitamin c can help the body absorb iron, so eating iron-rich foods together with lemons, limes, oranges, tomatoes will increase the iron we get from foods. While phytates in bran and tannins in tea, can inhibit iron absorption

## Zinc

**Functions:**
- Is needed as a catalyst in a wide range of reactions in our body, it is involved in protein, lipid, carbohydrate and energy metabolism, and is essential for cell division and therefore growth and tissue repair and for normal reproductive development.
- It also assists the immune system, is important in wound healing and for producing the active form of vitamin a in the eye

**Deficiency**
- Can interfere with the functioning of the central nervous system and the brain especially during infancy, childhood or pregnancy

**Sources:**
- Zinc is present in many foods and most readily absorbed from meat, it is also present in milk, cheese, eggs, shellfish (shrimp, crab, oysters), wholegrain cereals, nuts and pulses. Although in cereals and pulses zinc's bioavailability is limited by phytates

## Calcium

**Functions:**
- Is needed to develop and maintain healthy bones and teeth, for nerve signal transmission and the control of muscle contraction (including the heart), and blood clotting
- Adults have about 1kg of calcium stored in our bones, this is released into the body to maintain a constant level in the blood to control muscle movements and nerve impulse transmission
- Without an exact level of calcium in the blood, our heart would not be able to beat, and we would not be able to breathe or move

**Deficiency**
- Leads to reduced bone density. Adequate calcium intake is important at all stages of life. During childhood and adolescence, it is particularly important to eat and drink calcium rich foods to ensure maximum calcium storage and strong bones, as calcium is most easily absorbed into the bones until late adolescence
- Calcium needs are high during pregnancy when the infant's bones are developing, and

during breastfeeding calcium intake is important for the prevention of osteoporosis, where bones become brittle

**Sources:**

- Milk, cheese, yoghurt, small fresh or dried fish or fish sauce with the bones, white beans, soy bean, almonds and sesame seeds. Bread flour may be fortified with calcium, making it a source
- Some leafy green vegetables such as broccoli and cabbage (but not spinach) contain calcium but large quantities of them must be eaten to ensure sufficient calcium

## Nutrient Interactions, Bioavailability and Anti-Nutrients

Whilst plants contain various nutrients, not all of them can be easily digested or used by our bodies. What nutrients we obtain from a food depends not only on the amount of the nutrients in the food but also on how available for absorption and utilization these nutrients are to our body. This availability of nutrients to our biological system (bioavailability) varies and can be influenced by numerous factors. Understanding nutrient bioavailability can help us to optimize diets and to set appropriate nutrient recommendations.

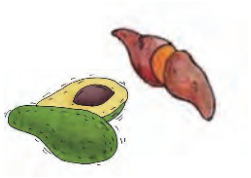
The bioavailability of macronutrients (carbohydrates, proteins, fats) is usually high, with more than 90% of the amount ingested being absorbed and utilized in the human body. While micronutrients vary widely in the extent to which they are absorbed and utilized after ingestion.

Until a nutrient passes from the digestive system into the bloodstream, it has little or no value. Bioavailability can be defined as the amount of a nutrient absorbed from the gut which becomes available for normal physiological functions or storage. There are various factors which influence nutrient bioavailability including enhancers and inhibitors.

### *Enhancers*

May be effective by keeping a nutrient soluble or protecting it from interaction with inhibitor, examples include:

#### Iron and Vitamin C



Vitamin C-rich foods improve the absorption of plant-based iron. For example, the addition of sweetpotato (rich in vitamin C) when consuming biofortified iron-rich beans will make more iron available to the body for absorption.

Citrus fruits (lemons, oranges, mandarins, and limes, etc.) contains considerable amounts of vitamin C and consumed together with plant-based sources of iron (e.g. beans and other legumes) will help release iron and make it available to the body for absorption.

By contrast, tea and coffee contain inhibitors of iron and should not be consumed with meals that are rich in iron, as they can impair iron absorption.

#### Vitamin A and Fat

Vitamin A, D, E and K are fat-soluble vitamins. For vitamin A to be properly transported in the body, it requires the simultaneous consumption of a small amount of fat. This is why we encourage the consumption of OFSP (rich in beta-carotene/vitamin A) together with healthy fat options e.g. avocado, as this enhances the absorption of the beta-carotene by our body.

## *Inhibitors*

Prevent the absorption of nutrients. Anti-nutrient compounds that reduce the absorption of nutrients from the digestive system are mainly found in cereal and legume grains. Common plant anti-nutrients include:

### Phytate (Phytic Acid)

Mostly found in plant-based foods such as seeds, grains, and legumes; the amount of phytate present varies by crop. Phytic acid reduces the absorption of minerals (including iron, zinc, magnesium and calcium) from a meal. Consumption of high- phytate foods during most meals, may lead to mineral deficiencies over time for those individuals who are at risk of developing them.

### Tannins

Antioxidant compounds (polyphenols) that may weaken the digestion of various nutrients when present in foods

### Lectins

Found in all plant-based foods, but they are more common in cereal and legume grains. They also interfere with the absorption of nutrients and when consumed in considerable amounts may be dangerous.

### Protease Inhibitors

Most common in plants, particularly cereal and legume grains and some root crops, such as OFSP and taro (arrow root), when consumed without processing. They may interfere with the digestion of protein by inhibiting digestive enzymes.

### Calcium Oxalate

The primary form of calcium in many vegetables, such as spinach and sweetpotato leaves. The calcium bound to oxalate (an organic acid found in many plants) is poorly absorbed and not made available to the body. Consumption of oxalates can trigger increased inflammation in the body, and if they form crystals can, together with low urine volume, be a cause of kidney stones.

However, these anti-nutrients may also have benefits as they tend to also be antioxidants.

In places where high-quantities of plant-based cereal and grains are consumed, it is important that alternative processing methods are used for foods rich in phytates to help reduce their impact on the availability of nutrients. Methods that can be used to significantly reduce the phytic acid, tannins, and oxalate content of foods include:

### Fermentation

Used to preserve food in many cultures. It is a process that occurs naturally when microorganisms, such as bacteria or yeasts, start digesting carbohydrates in food. Controlled fermentation leads to the release of special acids, which promote the breakdown of anti-nutrients particularly phytates. Lactic acid fermentation is a good example, which is used to produce sourdough from fermented maize or cassava.

### Soaking

Cereals and legumes in water overnight, can reduce phytic acid, protease inhibitors, lectins, and tannins. Soaking may also decrease oxalates in leafy vegetables. Many of these anti- nutrients are water-soluble and many are found in the skin and thus simply dissolve when foods are soaked for extended periods.

### Sprouting

Cereal and legume seeds, also known as germination, increases the availability of nutrients in the seeds, and can cause degradation of 80 % of the phytate. Sprouting also breaks down starch and enhancing its conversion to sugars and may remove phytates and protease inhibitors. This produces more energy dense and nutritious porridges for complementary feeding of children.

### Boiling

Effective for reducing various anti-nutrients, including lectins, tannins, protease inhibitors and calcium oxalate but may not be effective for phytic acid which tends to be heat-resistant.

Combinations of these processing methods can reduce the anti-nutrient contents of foods substantially. For example, sprouting and lactic acid fermentation of white sorghum and maize may completely degrade and eliminate any phytic acid present.

It is worth noting that with a diverse and well-balanced diet, the presence of phytic acid is rarely a concern. Such diets may include interactions between both enhancers and inhibitors and will improve nutrition overall. However, those with diets mainly composed of cereal grains may be at higher risk of mineral deficiencies.

To improve the nutrient density of complementary foods made from cereal grains and or reduce phytic acid and other anti-nutrients (such as cyanide in cassava), other nutrient-rich crops such as OFSP can be added to cereal flour mixes when making porridges for children as complementary foods. The addition of OFSP puree and small amounts of oil can significantly improve nutrient and energy density of commonly prepared gruels/ porridges.

## Review Questions

1. What is the difference between essential and non-essential nutrients?
2. What is the role of carbohydrates?
3. What type of food is called, ‘building blocks of life’? Why?
4. What are the most common micronutrient deficiencies?

# Unit 4 – Tackling Micronutrient Malnutrition or Hidden Hunger

## Objectives

By working through this section, you will be able to:

- Describe and compare four different approaches used for tackling micronutrient malnutrition.

### Key Points

- **Micronutrient malnutrition or 'hidden hunger' can be managed using a range or combination of different approaches, including:**
  1. **Supplementation – taking a capsule or injection containing a sufficient amount of the deficient micronutrient**.
  2. **Food fortification – adding an essential micronutrient to commonly consumed processed foods such as cooking oil, sugar, salt, flour**.
  3. **Dietary diversification – increase the variety and quantity of micronutrient-rich foods, through social and behaviour change activities, often including the increased production of or access to nutrient-rich foods**.
  4. **Biofortification – breeding varieties of a popular staple food crop with high amounts of at least one important micronutrient**.
- **Remember, each of the approaches has advantages and disadvantages.**

## Tackling Micronutrient Malnutrition or Hidden Hunger

Whilst there are more than 800 million undernourished people worldwide, there are many more who are affected by a different, 'hidden' kind of hunger, micronutrient deficiency – the lack of essential vitamins and minerals. Two-thirds of the world's population – for the most part women and children from resource poor households – suffer from at least one micronutrient deficiency. These vitamin and mineral deficiencies impose a considerable burden on the affected persons and the societies in which they live: causing stunting, increased susceptibility to infectious diseases, physical impairments, cognitive losses, blindness, and premature mortality.

Micronutrient malnutrition can be addressed in different and complementary ways, through:

**Supplementation**

Raking supplementary capsules or injections of the micronutrient

**Food Fortification**

Eating fortified foods

**Dietary Diversification**

Food-based approaches

**Biofortification**

Improving the nutritional quality of staple food crops

These interventions, together with nutrition education and improved agricultural productivity, are recommended in countries where micronutrient deficiencies are a public health concern. However, the interventions differ in their cost-effectiveness, their methods of delivery, and the time it takes

for them to affect the general population and are most effective when used together. These aspects are discussed in more detail below.

## Supplementation

Supplementation generally involves taking a tablet or capsule containing a sufficient amount of the deficient micronutrient(s) or using an intramuscular injection.

The per capita cost per unit is estimated to be low:

- Iron supplementation is estimated to cost between USD 0.5 and USD 3.17 per capita
- A dose of vitamin A is estimated to cost between USD 1.00 and USD 2.5 per capita

The greatest cost-benefit effect comes from giving supplementary vitamin A to children under two years old as the damage caused by micronutrient deficiency in the early years of life is irreversible. This is why this first 1000 days of a child's life (from conception to two years of age), is referred to nutritionally and promoted as a unique 'window of opportunity' by the United Nations' 'Scaling Up Nutrition' (SUN) initiative.

In the case of vitamin A, a mega dose of retinol (100 000 International Units) is given to children under the age of five years every six months (or twice a year) in many developing countries where vitamin A deficiency (VAD) is a public health problem. These mega doses of vitamin A are meant to boost the liver stores of vitamin A in these children, and these can then be slowly released into the body for normal metabolism. The major causes of VAD in many developing countries is the inadequate dietary intake of vitamin A. Animal-based foods are rich sources of preformed bioavailable vitamin A. However, these animal source foods such as dairy, poultry, meats, and fish are expensive and beyond the reach of many poor people.

Many governments and international organizations use Vitamin A supplementation (VAS) for addressing vitamin A deficiency because it is very effective, not only for reducing VAD but also child morbidity and mortality. Also, VAS is often coupled with measles vaccination days thus using an already existing delivery mechanism. VAS does not require behaviour change by the subjects.

However, VAS programs require huge capital to purchase the supplements from big pharmaceutical companies. Many governments in developing countries cannot afford to buy these supplements on their own. As a result, most VAS programs are supported by donors directly or through UNICEF and other development partners such as Helen Keller International (HKI) and Nutrition International (formerly Micronutrient Initiative) among others. This makes vitamin A supplementation unsustainable because donor funding may end due to changes in donor priorities, other competing international humanitarian emergencies, and global recessions.

*Child receiving a vitamin A supplement*

Since VAS uses existing primary health care delivery infrastructure, the coverage rates vary by location and by country, ranging from about 10 – 99 %. Even in high coverage cases, children in remote areas and in hard to reach areas are often left out. VAS programs are considered a short-term intervention strategy aimed to mitigate the harmful effects of severe to moderate VAD, while

medium to long-term sustainable strategies such food fortification, dietary diversification, and nutrition education are yet to take effect.

In addition to VAS, some programs provide iron supplements to women vulnerable to iron deficiency anaemia (IDA). Pregnant women may be given iron supplements during pre/ante-natal clinic appointments. However, some women have reported unpleasant side effects and bad taste of the iron sulphate tablets. Additionally, iron supplementation is complicated in areas with high prevalence of malaria where routine screening for iron deficiency rarely occurs. Some studies with young children have suggested that iron supplementation may increase the risk of malaria and death in iron-replete children (those with more than sufficient levels of iron) living in malaria-endemic regions.


*Single-dose packets of micronutrients to use in fortifying children's meals*

## Food Fortification

Food fortification is the practice of deliberately increasing the content of an essential micronutrient, i.e., vitamins and minerals in a food, to improve the nutritional quality of the food and provide a public health benefit with minimal risk to health.


*Examples of fortified flour and sugar*

Large-scale food fortification has been used as an effective mechanism for delivering micronutrients to the diets of many people in industrialized and semi-industrialized countries for many years. The foods chosen for fortifying, are those that the general population frequently consume in large amounts, such as cooking oil, sugar, salt, wheat flour and maize flour. Industrial fortification of maize flour with at least iron has been practiced for many years in several African and American countries, where maize flour is an ingredient in many common dishes.

Food fortification can be an efficient, simple and inexpensive strategy for supplying vitamins and minerals to the diets of large segments of the population. Fortification of staple foods with vitamin A may be a cost-effective intervention for reducing VAD, especially in settings where improving dietary quality through increased food variety

is not possible. Foods such as edible oils and fats, cereal grains, condiments, refined sugar, and milk have been successfully fortified with vitamin A and led to improved vitamin A status.

Food fortification is attractive because it does not require the target groups to change their diet but can be implemented by the food industry and because it reaches large numbers of consumers through retail.

It is a particularly effective way of tackling deficiencies in densely populated urban areas. Mandatory labelling tells consumers that the food they are buying has been fortified and accompanying 'social marketing campaigns' are often effective. However, in poor less-industrialized countries, where consumers do not buy centrally processed foods, but instead purchase food from less regulated local and informal markets it is much more difficult to implement. In some less industrialized countries, legislation or mandatory fortification has been effective in addressing iodine deficiency disorders and VAD.

While large-scale implementation of food fortification is commercially sustainable, alone it is often not sufficient to address micronutrient deficiency. The currently available fortified foods have been developed to provide micronutrient amounts appropriate for the 'average adult'. Since micronutrient requirements differ based on a variety of factors such as age and health status, the fortified foods do not meet the needs of all populations. For example, fortified foods do not provide the high levels of micronutrients that children and pregnant women need for growth and reproduction functions. Access can also be a problem as fortified foods are only accessible to those populations who regularly purchase packaged foods.

### Point of Use Fortification

Large-scale food fortification may also not effectively reach people in rural and remote communities. To address this and the differential micronutrient needs of children or pregnant women etc., multiple micronutrient powders (single-dose packets of vitamins and minerals in powder form that can be sprinkled onto any ready to eat semi-solid food consumed at home, school or any other point of use), have been developed as an alternative. The powders can be used to increase the micronutrient content of a child or pregnant woman's diet without changing their usual dietary habits.

## Dietary Diversification

Dietary diversification aims to change the household's diet to increase the variety and quantity of micro-nutrient-rich foods, including animal- source foods. In most resource-poor settings, starch-based diets with limited access to meats, dairy, fruits, or vegetables dominate.

Dietary diversification can be achieved through social and behaviour change activities and can include the increased production of nutrient-rich foods and improved access to a more diverse range of foods. Examples of interventions might include: improved agricultural production, development of vegetable plots, building knowledge of the need for a good variety of foodstuffs and sound preparation methods within families, or multi-sector nutritional advice and training in schools (including alongside food supplementation and fortification programmes).

Amongst poor people, more than 80% of vitamin A intake comes from provitamin A carotenoids in plant source foods. The bioavailability and bioconversion of provitamin A carotenoids to vitamin A is often complicated by many factors such as the amount and type of oil in the meals. Oil enhances the absorption of the provitamin A carotenoids. The food composition and type of cooking or processing and the consumers age, immune status, gender, race and genetic makeup also affect the bioconversion of provitamin A carotenoids to vitamin A.

## Biofortification

Biofortification is the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology. The process is used as an approach to address micronutrient deficiency and allows low-income households to meet their micronutrient needs through their own food production. Crop *bio*fortification refers to the breeding of varieties of a staple food crop with high amounts of at least one important micronutrient. For example: orange-fleshed sweetpotato (OFSP) varieties are sweetpotato varieties that are naturally very rich in pro-vitamin A. If eaten regularly, biofortified staple foods can contribute to the body's stores of micronutrients and prevent deficiencies.

The advantages of biofortification are:

- It builds on what poor households grow and eat – staple foods.
- Its ability to reach malnourished rural populations who may have limited access to commercially marketed fortified foods and supplements.
- As marketed surpluses of these biofortified crops make their way into retail outlets, they can reach consumers in both rural and urban areas.
- The one-time investment to develop seeds that fortify themselves keep the recurrent costs low and the germplasm can be shared making it highly cost-effective.
- It is sustainable, farmers can continue to grow their biofortified crops.

Biofortification differs from conventional food fortification in that biofortification aims to increase nutrient levels in crops during plant growth rather than through manually adding nutrients during processing of the crops. Thus, biofortification offers a way to reach agricultural populations where supplementation and conventional fortification activities may be difficult to implement and limited.

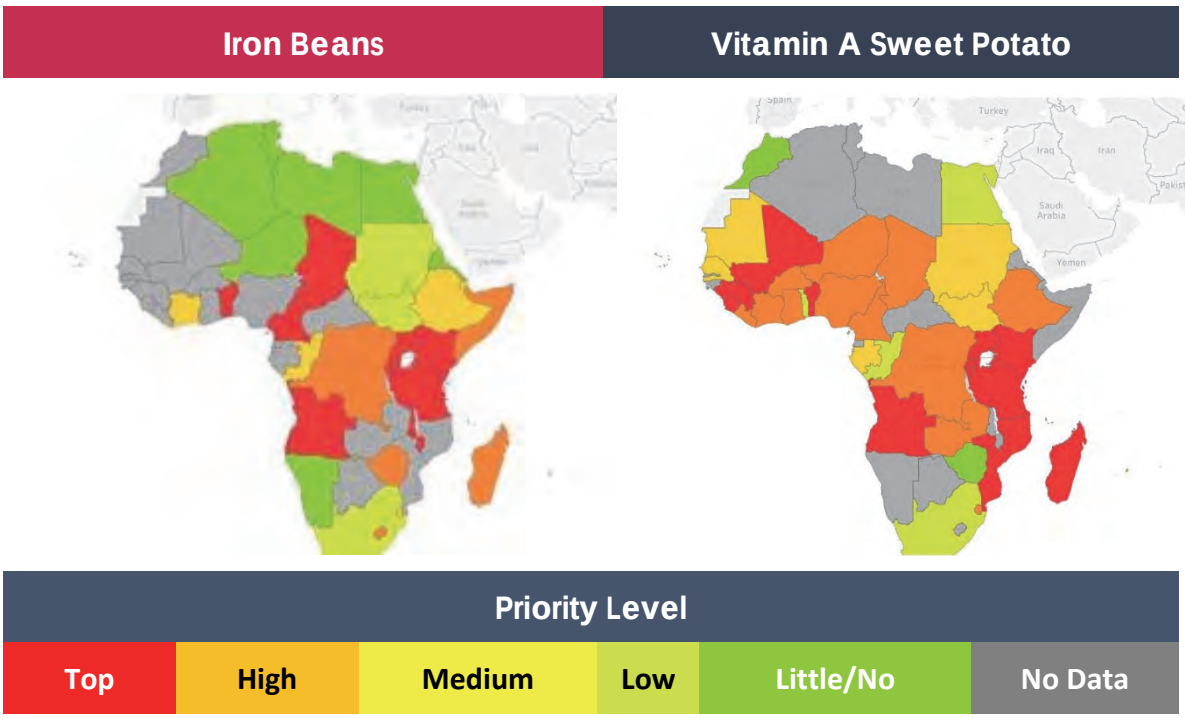
Examples of biofortification projects include:

- Iron-Biofortification Of Rice, Beans, Sweetpotato, Cassava and Legumes,
- Zinc-Biofortification Of Wheat, Rice, Beans, Sweetpotato And Maize;
- Provitamin A Carotenoid-Biofortification of Sweetpotato, Maize and Cassava; And
- Amino Acid and Protein-Biofortification of Sorghum and Cassava.

There is evidence from a large number of countries and crops that biofortification can significantly impact on micronutrient malnutrition and in a cost-effective way.

HarvestPlus, are pioneers of the biofortification process, and are working to increase access to three key micronutrients, zinc, iron and vitamin A, by biofortifying seven staple crops: beans, cassava, maize, pearl millet, rice, sweetpotato and wheat. Although some biofortification processes apply genetic engineering, orange-fleshed sweetpotato is bred using conventional breeding techniques.

A biofortification priority index mapping tool has been created by Harvest Plus for visualising priority regions for investment in the development and promotion of biofortified crop varieties www.harvestplus.org/ knowledge-market/BPI




*Priority countries for investing in high iron beans (left), investing in Vitamin A sweetpotato (right)*

Source: www.harvestplus.org/knowledge-market/BPI

## Comparative Pros and Cons of Different Approaches for Addressing Hidden Hunger

Some of the pros and cons of the different approaches for addressing micronutrient deficiencies or hidden hunger such as vitamin A deficiency are presented in the table below.

### Pros and Cons of Different Approaches for Addressing Micronutrient Deficiencies

| Approach | Pros | Cons |
|---|---|---|
| **Supplementation**<br>  <br>*e.g. high dose vitamin A capsule given to children 6-59 months old, twice per year* | • Can use a high dose twice per year to reach a large population of young children<br>• Cost effective if combined with effective health delivery programmes | • Targeted, but difficult to reach the hard to reach population. Universal coverage hard to sustain<br>• Benefits are typically short-term<br>Usually only targets the under-five's not the whole population<br>• Risk that it inhibits the development of alternative and more sustainable programmes<br>• Supplementation campaigns are typically donor dependent and may not be sustainable in the long-term |

| | | |
|---|---|---|
| **Food fortification**<br>  <br>*e.g. cooking oils, sugar, flours, margarine, infant foods fortified with vitamin A* | • One input point (industry) can reach many people every day | • Requires Public private partnership (PPP)<br>• Access to fortified foods may be limited by availability and purchasing power, particularly in rural areas<br>• Young children can eat only small quantities of the fortified foods, so this approach needs to be combined with other interventions<br>• Requires enforcement and strong political commitment<br>• There have been difficulties sustaining these programmes |
| ***Dietary diversification***<br>  <br>*e.g. consumption of a wide variety of foods* | • Long term impact as it embeds behavioural patterns that combat deficiency<br>• Complementarity with many other objectives<br>• Requires no external inputs | • Requires long-term investment in nutrition education with high start-up costs<br>• Current food crop systems often contain little variety<br>• Seasonality needs addressing through dietary and food storage advice |
| **Crop *bio*fortification**<br>  <br>*e.g. use of OFSP varieties* | • Reaches rural areas<br>• Owned and managed by farmers | • Takes time to obtain specific breeding qualities, and for promotion and uptake/ adoption to occur<br>• Public awareness needed |

To understand why eating orange-fleshed sweetpotato can promote good nutrition, it is important to learn more about vitamin A, one of the key micronutrients discussed in the previous sections.

## Review Questions

1. What are the four approaches to tackling micronutrient malnutrition?
2. What are the advantages of biofortification?

# Unit 5 – The Nutritional Value of Orange-Fleshed Sweetpotato

## Objectives

By working through this section, you will be able to:

- List at least five locally available foods that are rich in vitamin A
- Discuss how cooking, drying and storage processes effect beta-carotene levels in OFSP
- Describe the consequences of vitamin A deficiency

## Key Points

- **Orange fleshed sweetpotato is a rich source of vitamin A**
- **Other sources of vitamin A include dark orange or green vegetables or fruits, liver, milk, egg yolks, fish**
- **Vitamin A deficient children are at risk of night blindness, a weakened immune system and body development disorders**
- **Some nutrients such as beta-carotene can be reduced during cooking, drying or storage processes**
- **Sweetpotato leaves contain high levels of vitamins A, B and C, calcium, antioxidants and protein**

## What Is Orange-Fleshed Sweetpotato?

Conventional selective breeding techniques have been used to produce a biofortified orange-fleshed sweetpotato (OFSP) that provides high levels of vitamin A, zinc and iron. The production and distribution of biofortified OFSP can significantly contribute to reducing the global public health problem of vitamin A, zinc and iron deficiencies, particularly in high-risk populations.

## Sources of Vitamin A

The vitamin A content of fruits and vegetables is generally linked to physical appearance; the deeper the colour of a fruit, vegetable or root, the higher the concentration of vitamin A.

For example, the brightly coloured orange flesh of some sweetpotato varieties indicates a high pro-vitamin A content. Other vitamin A-rich vegetables and fruits include: pumpkin, pawpaw, mangoes, carrots, red pepper, red palm oil, fruits of the Néré/ African locust tree/ mkunde (*Parkia biglobosa*) tree, butternut squash, Spinach (*Amaranthus viridis*), African breadfruit/ mabungo (*Treculia africana*), pumpkin leaves, Amaranth leaves (*Amaranthus*).

Carrot and orange-fleshed sweetpotato have much higher levels of vitamin-A than pumpkin, butternut squash and spinach (see table below).

## Nutrient Content Of 100g Edible Portions of Vitamin A-Rich Foods

| Food | Water | Energy_Kcal | Protein | Lipid_Total | Carbohydrate | Fibre_TD | Calcium | Iron | Magnesium | Phosphorus | Potassium | Zinc | Vitamin C | Thiamine | Riboflavin | Niacin | Vitamin B6 | Folate_Total | Vitamin A (RAE) | Vitamin K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | gm | kcal | gm | gm | gm | gm | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | ug | ug | ug |
| Pumpkin, raw | 91.6 | 26 | 1.0 | 0.1 | 6.5 | 0.5 | 21 | 0.8 | 12 | 44 | 340 | 0.32 | 9 | 0.05 | 0.11 | 0.6 | 0.06 | 16 | 369 | 1.1 |
| Squash, cooked | 91.1 | 30 | 1.5 | 0.4 | 6.5 | 2.9 | 10 | 0.3 | 13 | 14 | 214 | 0.1 | 6.5 | 0.04 | 0.03 | 0.3 | 0.10 | 10 | 200 | |
| Yellow fleshed SP, cooked | 80.1 | 76 | 1.4 | 0.1 | 17.7 | 2.5 | 27 | 0.7 | 18 | 32 | 230 | 0.2 | 12.8 | 0.06 | 0.05 | 0.5 | 0.17 | 6 | 162 | 2.1 |
| OFSP, cooked | 80.1 | 76 | 1.4 | 0.1 | 17.7 | 2.5 | 27 | 0.7 | 18 | 32 | 230 | 0.2 | 12.8 | 0.06 | 0.05 | 0.5 | 0.17 | 6 | 788 | 2.1 |
| Carrots, cooked | 90.2 | 35 | 0.8 | 0.2 | 8.2 | 3 | 30 | 0.3 | 10 | 30 | 235 | 0.2 | 3.6 | 0.07 | 0.04 | 0.6 | 0.15 | 2 | 845 | 14 |
| Amaranthus leaf, cooked | 91.5 | 21 | 2.1 | 0.2 | 4.1 | | 209 | 2.3 | 55 | 72 | 641 | 0.88 | 41.1 | 0.02 | 0.13 | 0.6 | 0.18 | 57 | 139 | |
| Pumpkin leaves, cooked | 92.5 | 21 | 2.7 | 0.2 | 3.4 | 2.7 | 43 | 3.2 | 38 | 79 | 438 | 0.2 | 1 | 0.07 | 0.14 | 0.8 | 0.20 | 25 | 80 | 108 |
| SP leaves, cooked | 88.7 | 34 | 2.3 | 0.3 | 7.3 | 1.9 | 24 | 0.6 | 61 | 60 | 477 | 0.26 | 1.5 | 0.11 | 0.27 | 1.0 | 0.16 | 49 | 46 | 109 |
| Mango, raw | 81.7 | 65 | 0.5 | 0.3 | 17.0 | 1.8 | 10 | 0.1 | 9 | 11 | 156 | 0.04 | 27.7 | 0.06 | 0.06 | 0.6 | 0.13 | 14 | 38 | 4.2 |
| Papaya, raw | 88.8 | 39 | 0.6 | 0.1 | 9.8 | 1.8 | 24 | 0.1 | 10 | 5 | 257 | 0.07 | 61.8 | 0.03 | 0.03 | 0.3 | 0.02 | 38 | 55 | 2.6 |
| Milk, whole fat | 88.3 | 60 | 3.2 | 3.3 | 4.5 | 0 | 101 | 0.0 | 10 | 84 | 133 | 0.38 | 0 | 0.04 | 0.18 | 0.1 | 0.04 | 5 | 28 | 0.2 |
| Egg, hard boiled | 74.6 | 155 | 12.6 | 10.6 | 1.1 | 0 | 50 | 1.2 | 10 | 172 | 126 | 1.05 | 0 | 0.07 | 0.51 | 0.1 | 0.12 | 44 | 169 | 0.3 |
| Chicken, stewed | 53.1 | 285 | 26.9 | 18.9 | 0.0 | 0 | 13 | 1.4 | 20 | 180 | 182 | 1.77 | 0 | 0.09 | 0.24 | 5.8 | 0.25 | 5 | 39 | |
| Lamb, LIVER, cooked | 56.7 | 220 | 30.6 | 8.8 | 2.5 | 0 | 8 | 8.3 | 22 | 420 | 221 | 7.89 | 4 | 0.23 | 4.03 | 12.2 | 0.49 | 73 | 7491 | |

** OFSP = Orange-fleshed sweetpotato*

*Source: USDA, 2003*

In order to maximize the benefit from vitamin A rich foods, it is important to eat them in combination with fats such as groundnuts, coconut milk, avocado, vegetable oil or margarine. Fats help the body absorb and use vitamin A. Just adding a teaspoon of oil to a meal with OFSP really improves absorption. Certain preparation methods, such as chopping spinach or grating carrots, can also assist the body in absorbing vitamin A.


In addition to the plant sources mentioned above, some animal sources are also rich in vitamin A, including liver, whole milk, egg yolks, fish, fish oils and some artificially fortified food products (margarine, oil).

## Orange-Fleshed Sweetpotato As A Source of Vitamin A

Orange-fleshed varieties of sweetpotato are excellent sources of vitamin A because they have naturally high beta-carotene levels. The human body can easily transform beta-carotene, a natural pre-cursor of vitamin A, into vitamin A as needed.

Sufficient Vitamin A is essential for healthy eyes, skin, bones, immunity, reproduction and cell growth.

One medium-sized boiled OFSP root or a handful of pieces (~150 g) can meet a child's daily needs of vitamin A. While the vitamin A needs of most adults can be met by consuming 200-300 g of OFSP per day (daily needs range from 700 µg for non- breastfeeding women to 1,300 µg for breastfeeding women). This is particularly important in Sub- Saharan Africa and Asia, where vitamin A deficiency is among the leading causes of blindness, disease and premature death among children under five and pregnant women.

If more vitamin A is consumed than can be immediately utilised, the excess vitamin A is stored in the liver for several months. This enables the body to build up a reserve to avoid vitamin A deficiency during the times when access to vitamin A-rich foods is limited.

Different sweetpotato varieties have different concentrations of beta-carotene. Orange-fleshed sweetpotato roots have a nutritional advantage over white- or cream-fleshed sweetpotato roots because their beta-carotene, and therefore vitamin A, content is higher. The deeper the orange colour of the sweetpotato flesh, the higher beta-carotene and vitamin A content (see Beta-carotene colour chart in Appendix 3.2).

Orange-fleshed sweetpotato roots are also a recommended source of vitamin A because they are inexpensive. In Zambézia province, Mozambique, OFSP were found to be the cheapest source of vitamin A in the food system. Costing less than one cent per day to meet the recommended daily allowance of vitamin A for a child under six years through the consumption of OFSP.

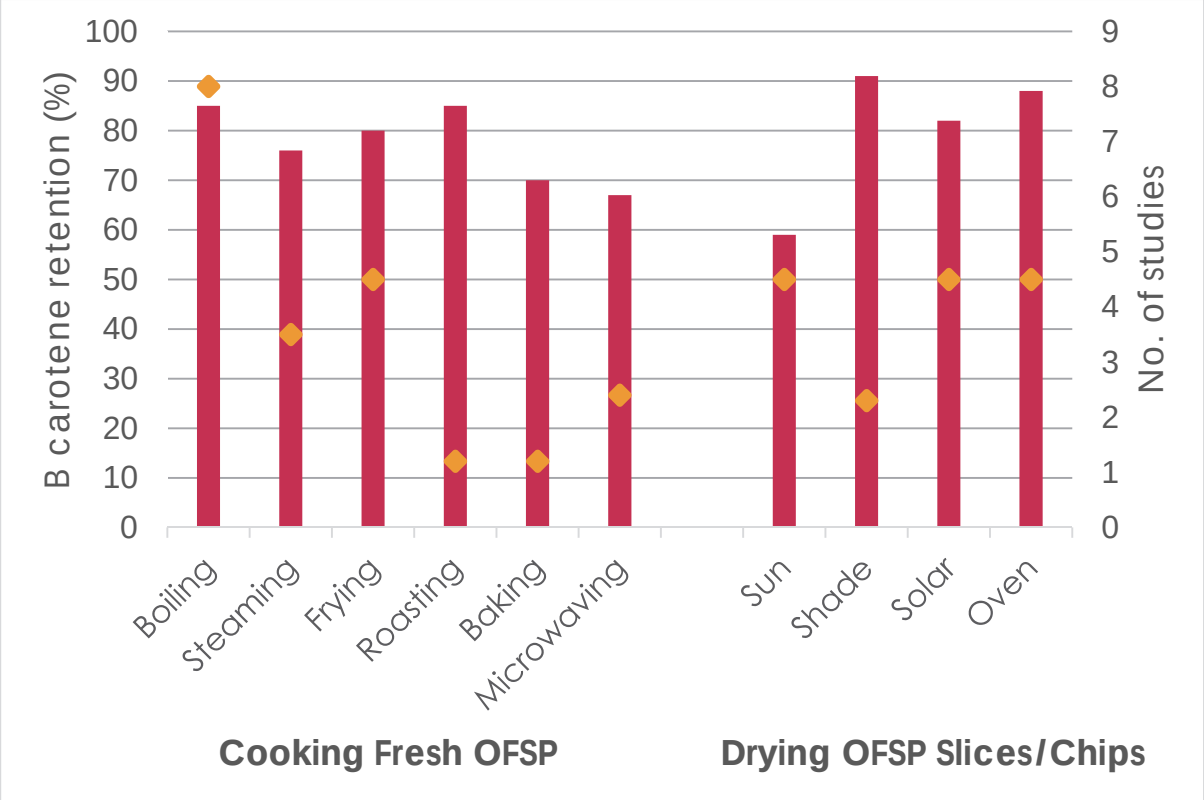
In most locations across SSA, an area of just 500m$^2$ of OFSP can provide enough vitamin A for a family of five each year. In addition to the vitamin A and energy that OFSP roots provide, they have high levels of vitamins C and E, several B vitamins, iron, zinc, potassium and fibre. The levels of fibre also mean the glycaemic index of sweetpotato roots is moderate, i.e. 70 compared with 111 for baked Irish potato. OFSP is a gluten-free, high energy food. Across SSA, OFSP is one of the cheapest sources of vitamin A.

Studies in Uganda showed that the development and distribution of OFSP cost $15-$20 USD per Disability Adjusted Life Year (DALY) saved, which is considered highly cost-effective by World Bank standards.

## How Cooking, Drying and Storage Effect Beta-Carotene Levels in Orange-Fleshed Sweetpotato

Cooking, drying and storage processes affect the beta-carotene content and therefore the degree of vitamin A actually available during consumption of OFSP. The findings from several studies on beta-carotene retention with different cooking and drying processes are combined in the graph below. Most cooking methods (boiling, steaming, frying and roasting) retained more than 75% of the beta-carotene in the root. Meanwhile, baking and microwaving led to slightly higher losses, although only a few studies of this exist.

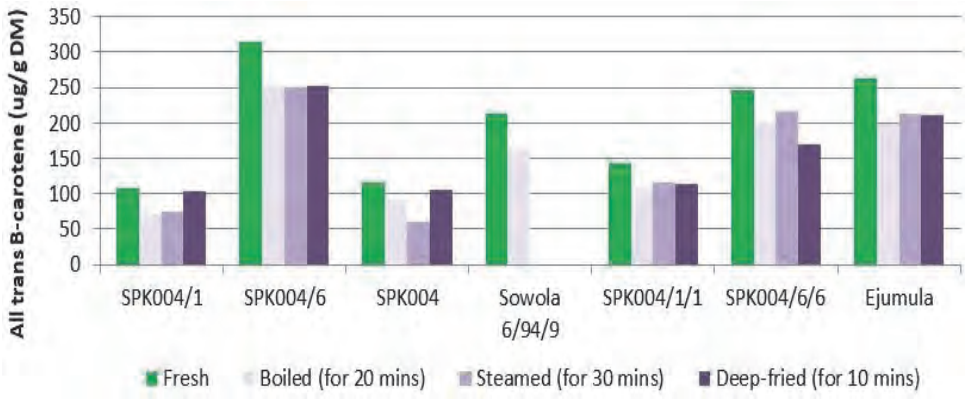
## Effect of Cooking and Drying on Beta-Carotene in OFSP and Number of Studies




*Source: Boy, 2009*

A comparison of beta-carotene contents of seven improved OFSP cultivars when boiled, steamed or fried is shown in the figure below. These cooking methods retained most (>68%) of the beta-carotene in the fresh roots; however, to maximise vitamin A intake the roots of OFSP varieties with high initial beta-carotene contents should be consumed. If boiling or steaming OFSP roots, beta-carotene retention is improved by covering the pot with a lid and keeping the cooking period as short as possible. It is assumed that boiling small or peeled pieces of OFSP roots increases the beta-carotene loss compared to boiling whole unpeeled OFSP roots, due to both the reduced surface area and the peel's protective effect. For details on the nutrient content and effect of processing on sweetpotato leaves see above and below tables.

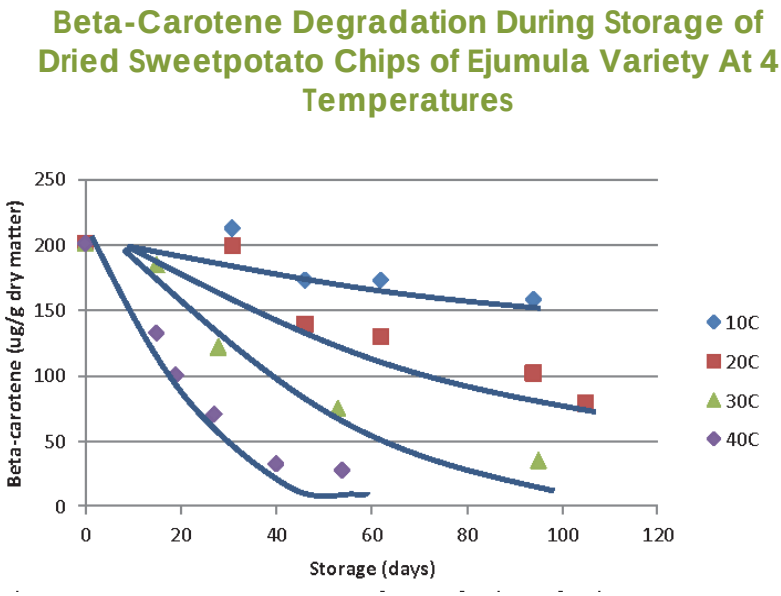
## Total Trans Beta-Carotene in Different Uganda OFSP Cultivars Before and After Cooking




*Source: Bengtsson et al., 2008*

Drying of sweetpotato roots as sliced chips is an important food security strategy in many areas of Sub-Saharan Africa and can retain 50-90% of the beta-carotene depending on drying method used. Sun-drying is currently the most common drying method practiced by smallholder rural households. The thickness of the slices of sweetpotato and the depth of the layer or loading (g/m$^2$) also influence drying speeds and beta-carotene retention. In solar drier trials, wide slices (~5mm thick) and thin loads (~430 g/m$^2$) had much higher beta-carotene retention rates than narrow slices (~3mm thick) and thick loads (~715g/m$^2$).

Where sweetpotato slices or chips are dried, this is done so that they can be stored as a food supply for several months. Storage of dried sweetpotato at ambient temperatures for several months has however been shown to result in extremely high loss of beta- carotene (e.g. 70-80% loss from the initial dried product after 4 months). Loss was linked to storage duration and shorter storage periods of 2 months meant losses were less. Beta-carotene loss during storage increased with temperature (see figure below).




*Source: Bechoff, 2010*

## Other Nutritional Benefits of Orange-Fleshed Sweetpotato Roots

Orange-fleshed sweetpotato roots are a nutritious food. In addition to providing high levels of vitamin A, OFSP roots contain high levels of vitamins B, C, E and K, all of which help protect our bodies and assist us in recovering from illness.

Orange-fleshed sweetpotato roots also have a high carbohydrate content, allowing them to produce more edible energy per hectare per day than other common sources of carbohydrates such as maize, rice, cassava, banana, sorghum, yam or millet. This makes it an important food security crop, particularly as it can be harvested just 4 months after planting, and two crops of OFSP a year can be grown in most locations. A comparison of the energy yields of OFSP and other commonly grown African crops is shown in the table below.


*OFSP roots help boost energy and immunity*

### Comparative Energy Yields of Sweetpotato and Other Major Crops

| Crop[a] | Average Tropical Yield (Tons/ Hectare) | Edible Energy Value (MJ/kg) | Proportion of Edible Energy (%) | Edible Energy per Hectare ($10^3$ MJ) | Mean Growth Period (Days) | Edible Energy (MJ/ha/day) |
|---|---|---|---|---|---|---|
| **Sweetpotato** | **7** | **4.8** | **88** | **27.2** | **140** | **194** |
| Rice[b] | 2 | 14.8 | 70 | 20.8 | 140 | 149 |
| Maize | 1 | 15.2 | 100 | 18.8 | 130 | 145 |
| Cassava | 9 | 6.3 | 83 | 45.6 | 330 | 138 |
| Banana | 13 | 5.4 | 59 | 41.4 | 365 | 113 |
| Sorghum | <1 | 14.9 | 90 | 11.1 | 110 | 101 |
| Yam | 7 | 4.4 | 85 | 26.2 | 280 | 94 |
| Millet | <1 | 15.0 | 100 | 8.2 | 100 | 82 |

Source: Woolfe (1992), p. 4 Notes: de Vries *et al.*, 1967.[a] Cereals, air-dry; roots/tubers/bananas fresh. [b] Paddy Rice.

Comparison of the nutrition-related characteristics of different flesh coloured sweetpotato and cassava roots and maize grains is given in the table below.

**Nutritional Composition of Sweetpotato, Cassava and Maize**

| Nutrients | Units/ 100g | Sweetpotato | | | Cassava | | Maize | |
|---|---|---|---|---|---|---|---|---|
| | | Orange fleshed raw roots | Yellow fleshed raw roots | White fleshed raw roots | Yellow cassava raw roots | White raw roots | Orange maize grain | White maize grain |
| Vitamin A (RAE) | µg | 727 | 150 | 3 | 33 | 1 | 30 | |
| Iron | mg | 0.61 | 0.61 | 0.61 | 0.39 | 0.27 | 1.87 | 1.4 |
| Zinc | mg | 0.3 | 0.3 | 0.3 | 0.47 | 0.34 | 2.03 | 1.73 |
| Protein | g | 1.57 | 1.57 | 1.57 | 1.06 | 1.36 | 9.78 | 8.51 |

*Source: USDA, 2003; HarvestPlus data set, 2018 (pro-vitamin A rich cassava and maize) Note: conversions from pro-vitamin A carotene (pVAC) µg/g ß-carotene equivalent to µg/100g RAE used the Institute of Medicine, Food and Nutrition Board, 2001 conversion rate: 1 RAE = 1 µg retinol = 12 µg ß-carotene. For example: if yellow cassava has 3.94 µg/g* pVAC *ß-carotene eq., this converts to (3.94/12) = 0.32833 µg/g RAE (or 32.833 µg/100g RAE)*

## Vitamin A Deficiency

Vitamin A deficiency is a serious public health problem in Sub-Saharan Africa, affecting >40% of the children under five years old. Children with vitamin A deficiency are at a higher risk of dying from measles, diarrhoea and malaria.

Young children are particularly at risk of vitamin A deficiency because:

- They are growing fast and so their vitamin A needs are greater;
- They get more infections; and
- They are often not fed enough of the right kinds of foods to meet their daily nutrient needs.

If children do not get enough vitamin A, either through eating vitamin A-rich foods or supplementation, they are at risk of developing night blindness (inability to see at dusk and in dim light), dry eye membranes (*xeropthalmia*), body development disorders and a compromised or weakened immune system (see the picture below).

It is important to note that a child can look perfectly healthy and still be vitamin A deficient and may have no clinical signs of vitamin A deficiency (eye problems) until the deficiency becomes very severe. Eye disease caused by vitamin A deficiency is not commonly seen, and the effects on growth and infection are far more significant.

Adults also experience significant consequences from vitamin A deficiency including a compromised immune system and a slower recovery time after illness. Pregnant and breastfeeding women, like children, are

*Child with corneal clouding/xerosis due to Vitamin A deficiency*

at a high risk for vitamin A deficiency because they have an increased need for the micronutrient. During pregnancy, vitamin A maintains essential tissues and contributes to the health and growth of the foetus. Vitamin A deficiency in pregnant and lactating women can result in severe health concerns for both mother and child including stunted growth and higher risks of mortality and anaemia.

### Consequences of Vitamin A Deficiency

| Consequence of VAD | Explanation |
|---|---|
| Poor child growth and development | Children with vitamin A deficiency often have a poor appetite and lose weight. Children who are malnourished have a lower resistance to infection and they are more likely to fall ill than well-nourished children. During serious infections, such as measles and diarrhoeal diseases, children lose a lot of weight. Frequent infections are therefore often associated with poor child growth. |
| *Increased risk of infection* | Children who are vitamin A deficient are more prone to infection, especially gastrointestinal (causing diarrhoea) and respiratory infections. |
| *Increased severity of infection* | The severity of infections, particularly measles, is greater among children who are vitamin A deficient. |
| *Death* | Vitamin A deficient children are more likely to die than well-nourished children. |
| *Eye-related problems* | One of the earliest signs of vitamin A deficiency is night blindness, which is a difficulty or inability to see in dim light such as at dusk or night. This can progress to structural eye damage such as Bitot's spots (foamy white patches on the white part of the eye) and, in severe cases, irreversible blindness. |

*Source: Faber et al., 2010*

## Benefits of Sweetpotato Leaves and Vines

Sweetpotato leaves and vines can also be eaten, and, like the sweetpotato root, they have nutritional benefits. Sweetpotato leaves and vines are excellent sources of vitamins A, B (thiamine, niacin, and pyridoxine) and C and contain comparatively high levels of protein (~3% of fresh weight basis), calcium and antioxidants (see the table below).

Sweetpotato leaves are commonly eaten as a vegetable dish throughout Sub-Saharan Africa with the exception of a few countries such as Kenya, Uganda and Nigeria where farmers prioritise using them for animal feed. The leaves can be used as a backyard or kitchen garden crop, harvested continuously to provide an on-going nutritional addition to meals.

Sweetpotato leaves are convenient as they are usually available during the dry season when there are few other vegetables present. People typically prefer the leaves of certain sweetpotato varieties over others. For example, in Tanzania and Malawi they prefer narrow leaves with deep lobes over those varieties with broader leaves.

Depending on preference, the leaves can be consumed fresh or sun-dried. During harvesting, transport and marketing the leaves should be handled carefully to reduce bruising and kept in cool shady places, and then used as rapidly as possible. The traditional drying technique involves withering fresh leaves in the sun, then parboiling them for 20-30 minutes, removing the excess water and then sun-drying them.

Sweetpotato leaf recipes are given in the Topic, Marketing and Entrepreneurship, remember to cook fresh sweetpotato leaves for the minimum time possible, and consume the cooking water too, as it

contains water-soluble vitamins lost by leaching. Processing methods affect the β-carotene content of various leafy vegetables as seen in the table below.

Both the roots and leaves of orange-fleshed sweetpotato have significant nutritional benefits. These nutritional benefits, along with the low cost, easy accessibility and short maturity duration make OFSP an ideal crop.

### Comparison of Protein, Minerals, Oxalate and Vitamins in Leafy Vegetables (Raw Fwb)

| | Total | Minerals | | | Oxalate | Vitamins | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetable | protein (g/100g) | Ca (mg/ 100g) | Fe (mg/ 100g) | Zn (mg/ 100g) | (%) | B-carotene equiv.(ug) | Thiamine (mg) | Riboflavin (mg) | Niacin (mg) | Pyridoxine (mg) | Folic acid (ug) | Ascorbic acid (mg) |
| Sweetpotato leaves | 2.9 | 183 | 2.4 | 0.5 | 0.37 | 2700 | 0.13 | 0.35 | 0.9 | 0.21 | 88 | 41-103 |
| Sweetpotato tips | | 75 | 3.9 | | | 2290-7050 | | 0.29-0.41 | 0.9 | | | 32-136 |
| Amaranthus | 2.8 | 176 | 2.8 | | 0.82 | 6545 | 0.04 | 0.22 | 0.7 | | 85 | 23 |
| Cassava leaves | 7.0 | 160 | 2.4 | | 0.517 | 8280 | 0.16 | 0.32 | 1.8 | | | 82 |
| Chinese cabbage | | | | | | 1200 | 0.04 | 0.14 | 0.5 | | | 40 |
| Taro leaves | 3.3 | 96 | 0.95 | | 0.426 | 5535 | 0.13 | 0.34 | 1.5 | 0.19 | 163 | 63 |
| Cabbage | 1.9 | 44 | 0.4 | 0.3 | 0.002 | trace | 0.06 | 0.05 | 0.6 | 0.15 | 26 | 40 |

*Source: Woolfe,1992; Stathers et al., 2005*

### Comparison B-Carotene Content of Leafy Vegetables During Processing (Ug/G DW)

| | | Blanched | Solar dried | | Open sun-dried | |
|---|---|---|---|---|---|---|
| Leafy vegetable | n | (ug/g DW) | (ug/g DW) | % | (ug/g DW) | % |
| Mgagani | 3 | 917 ± 55 | 776 ± 45 | 88 | 484 ± 31 | 53 |
| Amaranth | 3 | 677 ± 44 | 449 ± 46 | 66 | 367 ± 15 | 54 |
| Cowpea | 3 | 526 ± 58 | 462 ± 41 | 88 | 296 ± 25 | 56 |
| Sweetpotato | 2 | 771 ± 6 | 522 ± 23 | 68 | 425 ± 69 | 55 |
| Pumpkin | 2 | 630 ± 61 | 427 ± 2 | 68 | 264 ± 33 | 42 |
| Ngwiba | 2 | 554 ± 16 | 499 ± 17 | 90 | 308 ± 43 | 55 |
| Nsonga | 1 | 633 | 545 | 86 | 407 | 64 |
| Maimbe | 1 | 588 | 338 | 57 | 272 | 46 |
| *Mean ± SD* | | *662 ± 128* | *502 ± 128* | *76* | *353 ± 80* | *53* |

*Source: -Mulokozi (undated)*

## Review Questions

Use the data found in the prior table Nutrient Content of 100g Edible Portions of Vitamin A-Rich Foods to calculate:

1. Besides vitamin A, what other nutrients does OFSP contain?
2. What cooking method retains the most vitamins?

# Unit 6 – Nutrition Interventions

## Objectives

By working through this section, you will be able to:

- Explain the difference between nutrition-sensitive and nutrition-specific interventions
- Describe the different but often interrelating ways in which a nutrition-sensitive agricultural intervention may be impacting on nutrition at individual, household and community levels
- Analyse your existing agricultural projects to determine if they could be enhanced to make them more nutrition-sensitive or improved through the addition of nutrition-specific interventions

### Key Points

- **Amplify agriculture's contribution to nutrition**
- **Are deliberately planned to make an impact on nutrition**
- **Incorporate nutrition objectives and indicators into their design**
- **Can impact nutrition through many pathways, including: income from crop sales, food access and dietary diversity from self-production or increased income, women's empowerment and health, natural resource management**
- **Might include: biofortification, home gardens, value chain interventions**

Food and agricultural interventions can be important in enhancing dietary quality and improving nutritional status, particularly if nutritional objectives and activities are integrated into the design of the intervention right from the start. Nutrition interventions can be classified as: **nutrition-specific** or **nutrition-sensitive**. This section discusses the differences between these two groups of interventions and describes the characteristics which can make agricultural programmes nutrition-sensitive.

Many countries across SSA are actively promoting agricultural growth; however, more food does not necessarily mean better nutrition. Many people in SSA, including young children, have diets that consist almost entirely of starchy foods. Whilst they may get enough calories, these people miss out on sufficient variety in their diet that would provide enough protein and vital vitamins and minerals.

Agricultural programmes may have varying objectives: some focus only on increasing production, while others seek to translate this into improved nutrition.

Attention needs to be paid to the quality as well as the quantity of the food produced, to promoting methods which help to retain nutrients during food processing, and to teaching those preparing food about the importance of a balanced, diverse diet.

## Nutrition-Specific Interventions

Nutrition-specific interventions are direct nutrition interventions. They address the immediate causes of undernutrition: inadequate dietary intake, and disease or poor health status.

Nutrition-specific interventions focus on:

- Ensuring that specific populations consume specific nutrients and are educated regarding proper nutritional practices, and
- The prevention or treatment of diseases that worsen nutrition status.

Some nutrition-specific interventions may also address underlying causes of malnutrition, such as inadequate infant and young child feeding practices, poor hygiene and sanitation.

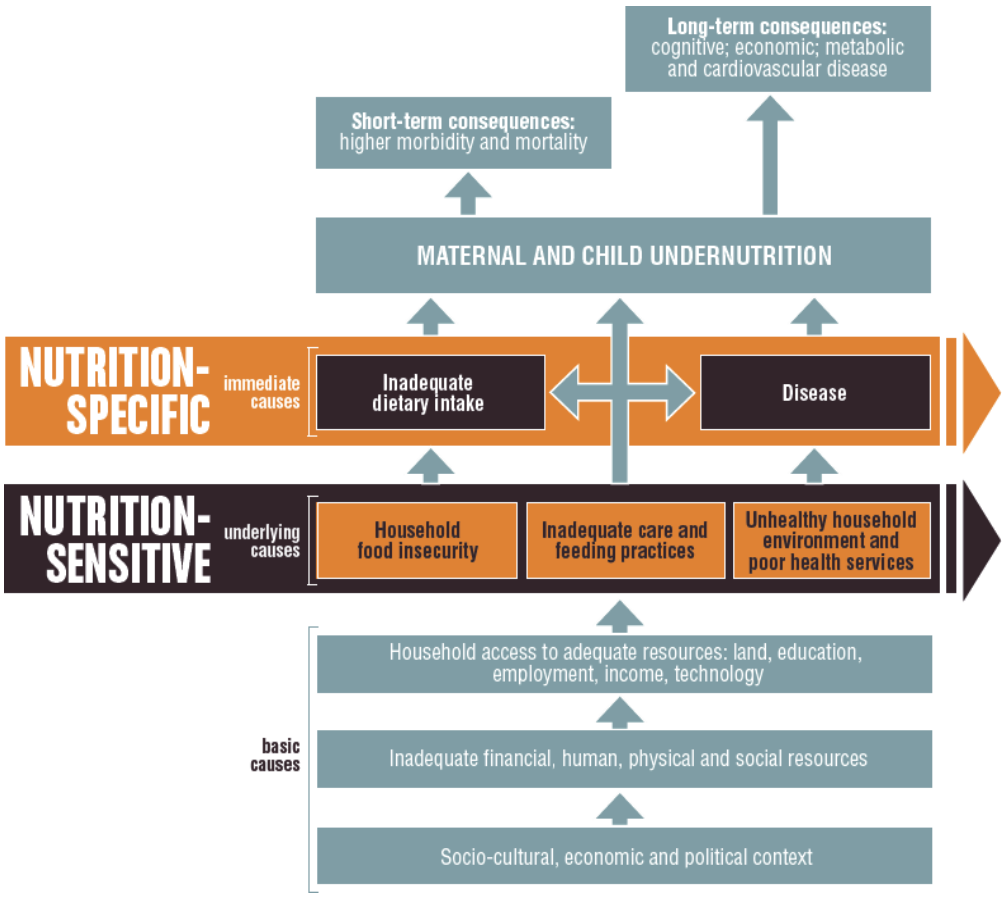
**Nutrition-specific Interventions**

Address the immediate causes of malnutrition, inadequate dietary intake and disease, and some underlying causes, e.g. Inadequate feeding practices, poor hygiene and sanitation.

Examples include:

- Vitamin A supplementation
- Promotion of good feeding and hygiene practices for infants and young children
- Micronutrient supplementation during pregnancy
- Oral rehydration therapy for diarrhoea management
- Staple food fortification
- Pro-breastfeeding policies and campaigns
- Treatment of acute malnutrition

## The Multiple Causes of Malnutrition and Where Nutrition-Sensitive and Nutrition- Specific Interventions Fit In




*Source: Bread for the World Institute, 2017 adaptation of UNICEF framework on causes of malnutrition*

**Nutrition-sensitive Interventions**

Address the underlying causes of undernutrition and incorporate nutrition goals and actions.

Examples include:

- Crop biofortification
- School feeding programmes
- Home gardens and other dietary diversity initiatives
- Agriculture programmes aimed at increasing women's incomes
- Cash transfers with health and nutrition participation conditions
- WASH services targeted to households with children under 2

## Nutrition-Sensitive Interventions

Nutrition-sensitive interventions explicitly incorporate nutritional objectives into programmes from a wide range of sectors and include indicators to monitor nutrition impact.

These programmes, which may involve agriculture, education or social-welfare sectors, have the potential for much greater coverage and impact, compared to nutrition-specific programmes.

Nutrition-sensitive interventions can address:

- Some of the underlying causes of undernutrition, such as food insecurity and a lack of caregiving resources at community, household, and individual levels, and/or
- Some of the basic causes of undernutrition, such as inadequate access to health services, inadequate financial or human resources, or sociocultural, economic and political factors.

## Nutrition-Sensitive Agricultural Interventions

Nutrition-sensitive agricultural interventions seek to amplify agriculture's contribution to nutrition. These interventions recognise the multiple linkages between agriculture and nutrition and use these linkages to achieve positive nutritional outcomes.
The many pathways through which agriculture can impact nutrition include:

**Nutrition-sensitive Agriculture**

An agricultural intervention which seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner

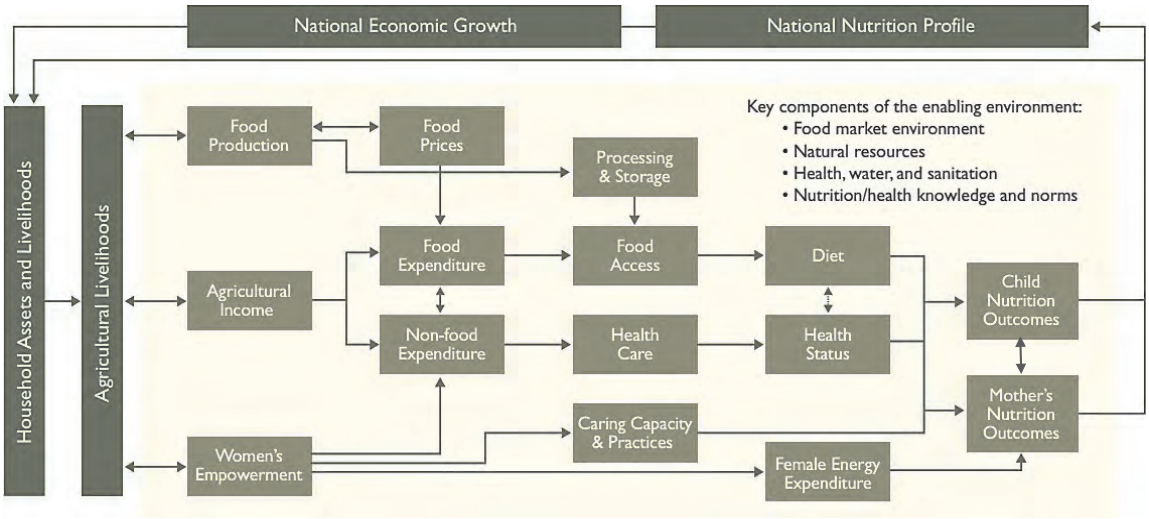
- Income from sale of commodities produced, which may enable access to more nutritious or a wider diversity of foods through markets;
- Food access from increased smallholder farmer production, with a greater quantity or diversity of foods available for home consumption;
- Food prices from changes in supply and demand, influencing the affordability of foods;
- Empowerment and social status of women, which affects access to and control of resources, household income, time and labour, as well as caring capacity and household diets;
- Women's time through participation in agriculture, which can be either positive or negative for their own nutrition and that of their children,
- Women's health and nutrition through engagement in agriculture, which also can have either positive or negative impacts, depending on exposure to toxic agents and the balance between energy intake and expenditure;
- Natural resource management (particularly of water) which may safeguard against health risks associated with agricultural production, such as through contact with livestock, standing water and agrochemicals;

Most OFSP development projects are nutrition-sensitive. The pathways described above influence how these projects are designed and implemented, and which outcomes are measured.

The following framework (see below) depicts how agricultural interventions can improve access to food and health care; how they impact and are affected by the enabling environment; and how they can ultimately affect the nutrition of target groups such as women and children. This framework simplifies the connections between agriculture and nutrition to three main routes:

1. Food production, which impacts the food available for household consumption as well the price of diverse foods;
2. Agricultural income for expenditure on food and non-food items; and
3. Women's empowerment, which affects income and expenditure, carrying capacity and practices, and female energy expenditure.

## Framework Depicting the Multiple Pathways and Interactions Between Agricultural Interventions and Nutrition Outcomes




Source: Adapted for Feed the Future by Herforth, Harris and SPRING, 2014 from Gillespie *et al.*, 2012 and Headey *et al.*, 2011

All of these pathways are influenced by the enabling environment. This includes natural resources; market environments; health, water, and sanitation; nutrition and health knowledge and practices; and policy and governance. Together, all these components affect the nutrition of farming households and other consumers, within the local community and ultimately the nation. Children's nutrition influences their growth, development and health status, with long-term effects on socio-economic status, livelihoods and national economic growth.

Most nations across SSA recognise the importance of investing in agriculture for economic growth and have few other options for tackling mass rural poverty in the short to medium-term; however, their longer-term vision is based on complex service and industrial economies. Improving children's nutrition is a crucial priority in the short-term, to develop the human resources for this economic transformation.

Nutrition-sensitive agricultural programmes can be implemented by:

- Making food more available and accessible. Increased agricultural production and improved postharvest management can make food more available and affordable to consumers. Sustained income growth can improve local livelihoods and socio-economic status, with the potential to indirectly reduce undernutrition.
- Increasing food diversity, including by growing and promoting nutrient-rich crops. Community farming and home/kitchen gardening projects help ensure that a variety of nutrient-rich crops are available locally.
- Promoting sustainable production practices, such as conservation agriculture, water

management, and integrated pest management (IPM). These strategies can improve nutrition without depleting natural resources.

- Increasing the nutrient content of foods. The levels of micronutrients in staple crops and foods may be enhanced through plant breeding, processing, and improved soil fertility.

## Examples of Nutrition-Sensitive Agriculture Interventions:

### Biofortification

Breeding of staple foods to increase their micronutrient contents. Examples include pro-vitamin A biofortified OFSP, iron-rich beans and pearl millet, pro-vitamin A-rich maize. The impact pathway for the Mama SASHA programme which linked antenatal care, nutrition training and production and distribution of OFSP cuttings is shown in the following figure, Impact Pathway for Mama SASHA Programme.

### Home Gardens and Homestead Food Production

Involving livestock keeping, vegetable production (including OFSP). This may allow for more frequent consumption of nutrient-rich food items, increasing dietary diversity and intake of protein and micronutrients. The success of these programmes is often enhanced by a focus on crops and livestock managed by women.

### Value Chain Interventions

Working within market-based systems to improve nutrition. Value chains often involve multiple different groups of people, including producers, transporters, processors, retailers, and consumers. Some nutrition-sensitive interventions might focus on the supply side (e.g. production **technologies** to ensure consistent supply to markets) and others on the demand-side (e.g. marketing and education campaigns).

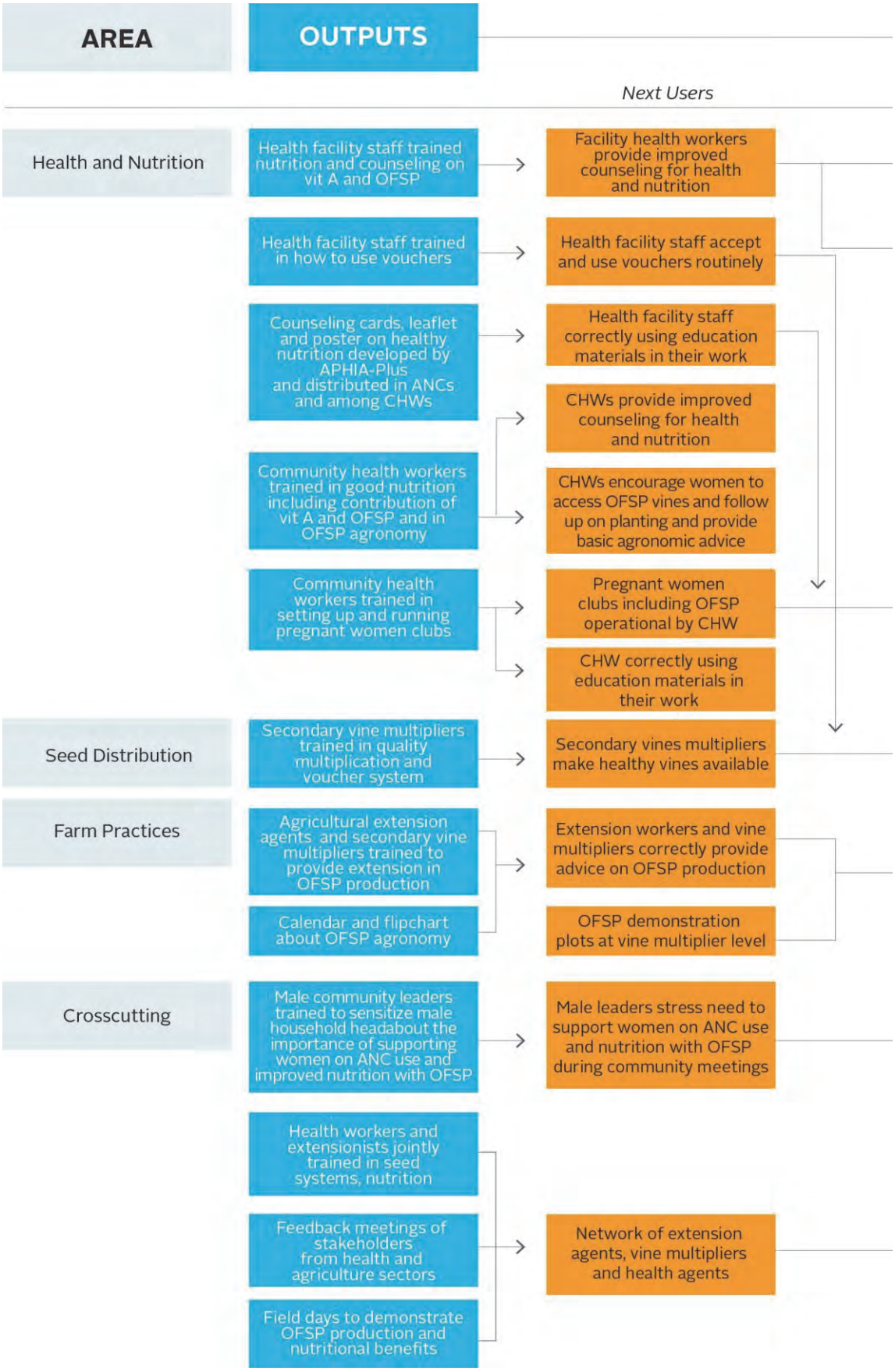
### Women's Financial Empowerment

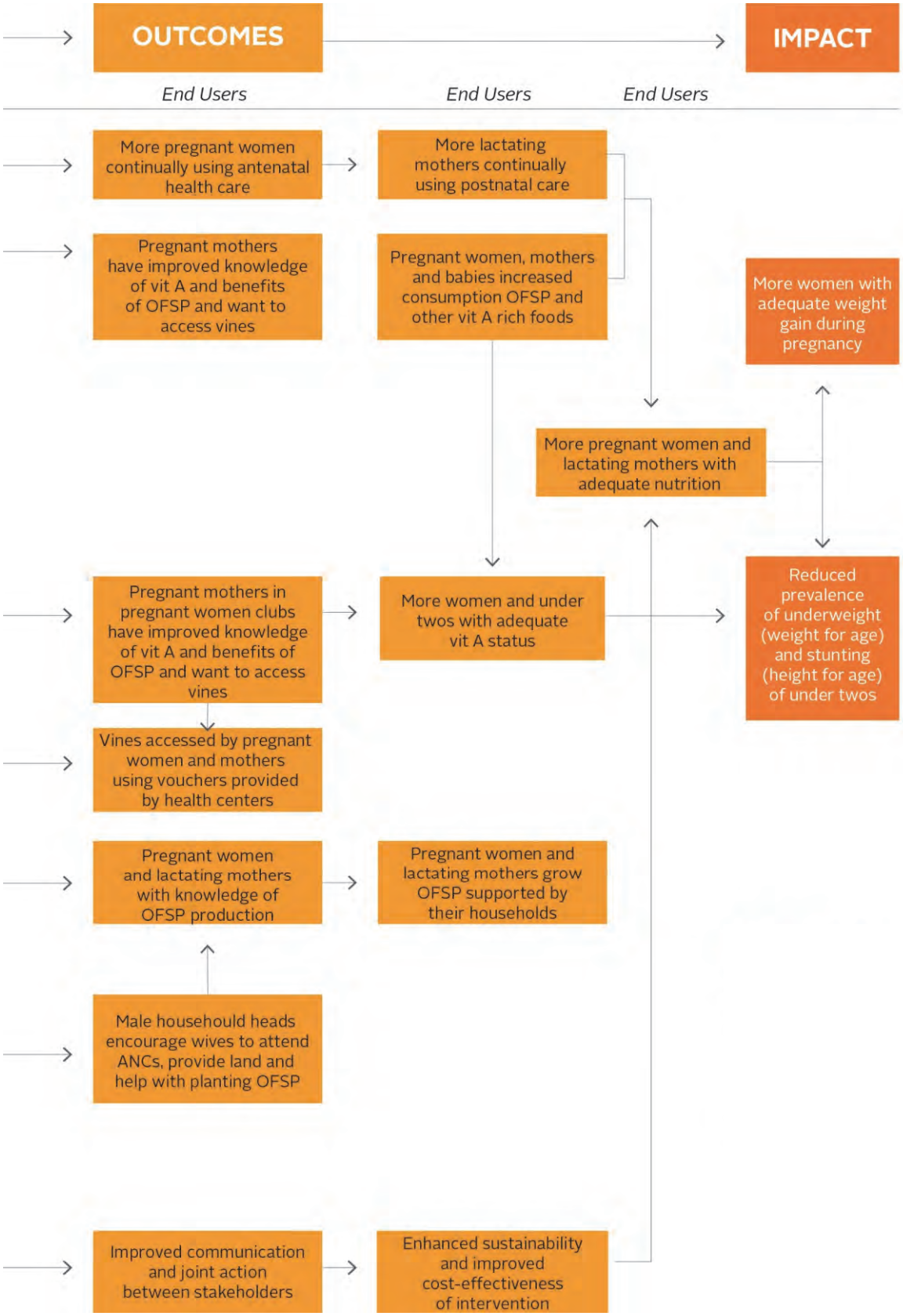
Agricultural programmes aimed at increasing women's incomes. These may target livelihood activities primarily managed by women- (e.g. chicken- keeping or vegetable growing) or support women's financial capacity through loans and savings schemes.

### Gender Sensitive Monitoring and Learning

Monitoring agriculture and other programmes that they respond to women's priorities and constraints, enable women's involvement and benefit, and do not add to women's time and labour burdens or disadvantage women or other groups in other ways.

## Impact Pathway for Mama SASHA Programme



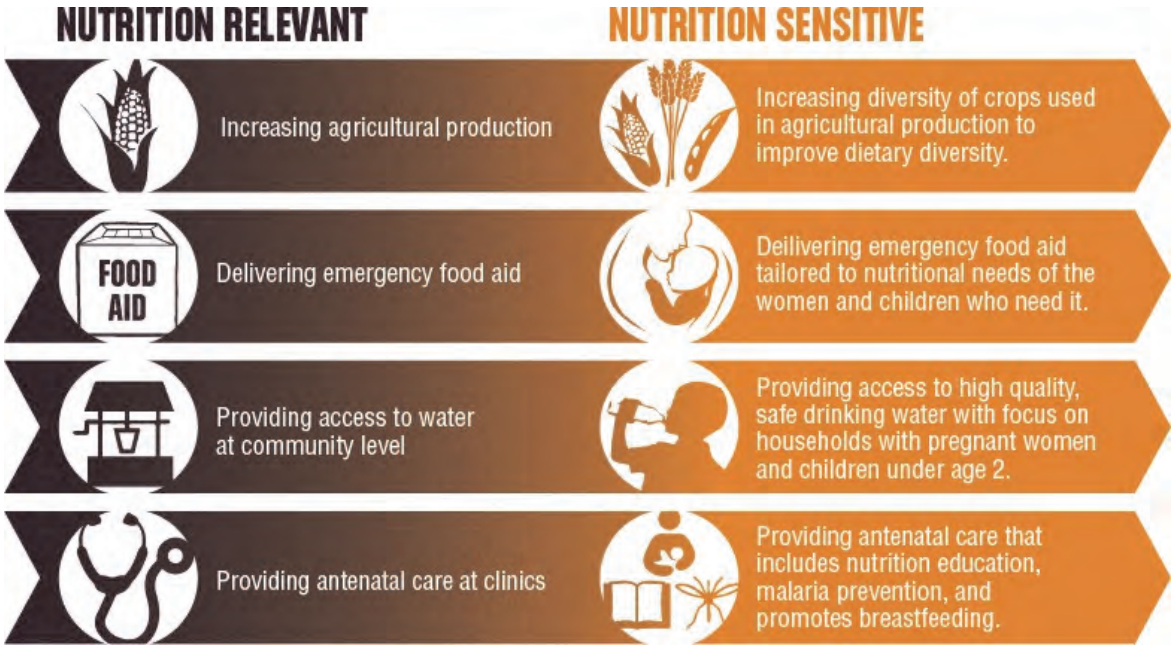



Source: Cole *et al*., 2016

## How to Make Agriculture and Food Systems Activities Nutrition-Sensitive?

Agriculture and food systems activities are obviously relevant to nutrition, but to ensure they have a positive impact on nutrition they need to be consciously transformed into nutrition-sensitive activities, by making improved nutrition a formal objective of the program and/or by targeting vulnerable groups (see examples in the figure below).

### Moving from Nutrition-Relevant to Nutrition-Sensitive Interventions




**How do you make agriculture and food systems interventions nutrition-sensitive?**

Work by the FAO suggests agricultural and food system interventions which apply the following set of principles are more likely to have positive impacts on nutrition, and avoid negative impacts:

1. Incorporate explicit **nutrition objectives and indicators** into their design, and track and mitigate potential harms.
2. **Assess the context** at the local level, to design appropriate activities to address the types and causes of malnutrition.
3. **Target the vulnerable and improve equity** through participation, access to resources and decent employment.
4. **Collaborate with other sectors** and programmes.
5. **Maintain or improve the natural resource base.**

| | |
|---|---|
| 6. | **Empower women.** |
| 7. | Facilitate production **diversification** and increase production of **nutrient-dense crops** and small-scale livestock. |
| 8. | **Improve processing, storage and preservation** to retain nutritional value and food safety, to reduce seasonality and post-harvest losses, and to make healthy foods convenient to prepare. |
| 9. | **Expand market access for vulnerable groups,** particularly for marketing nutritious foods. |
| 10. | Incorporate **nutrition promotion and education.** |

*Source: Bread for the World Institute, 2017*

Nutrition-sensitive investments can take on the added task of delivering nutrition-specific interventions. The greatest impact will be achieved through a combination of both nutrition-specific and nutrition-sensitive interventions as there are multiple causes and forms of malnutrition.

## Global and Regional Nutrition Initiatives

The current attention on improving nutrition, including through multi-sectoral strategies, presents an unprecedented opportunity to achieve large-scale impact.

### Decade of Action on Nutrition

In 2016, UN Member States committed to ten years of sustained and coherent nutrition action. The main purpose being to increase nutrition investments and implement policies and programmes to improve food and nutrition security within the framework agreed at the Second International Conference on Nutrition (ICN2). The UN General Assembly also reaffirmed its commitment under the 2030 Agenda for Sustainable Development to "end malnutrition in all its forms."



### The Sustainable Development Goals (SDGs)

In 2015, 193 countries adopted a set of goals to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda leading to the SDGs. The SDGs are made up of 17 Goals building on the successes of the Millennium Development Goals, and including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace, and justice. SDG2 Zero Hunger aims to "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture" by 2030.

### Africa Regional Nutrition Strategy (ARNS)

Outlines the specific role of the AU from 2015-2025 in the elimination of hunger and malnutrition. Targets include: 40 % reduction in under 5's stunting, 50 % reduction in anaemia in women of child-bearing age, 30 % reduction in low birth weights.

### Scaling Up Nutrition (SUN)

The SUN movement, strategy and 2016– 2020 roadmap emphasizes the importance of nutrition as a universal agenda integral to delivering the SDGs and the UN Decade of Action on Nutrition. The SUN movement, composed of country governments and civil society organisations has the potential to accelerate progress in reducing stunting and improving nutrition through its learning networks, a common results framework, and communities of best practice. www.scalingupnutrition.org

More recently, **the G20**, at their Summit made important commitments that highlight the determination of the global community to support the efforts of African countries to fight hunger and malnutrition.

## Review Questions

1. What is the difference between nutrition-specific and nutrition-sensitive interventions?
2. What are some of the ways agricultural interventions can improve nutrition?

# Unit 7 – Behaviour Change for Improved Nutrition and Agriculture

## Objectives

By working through this section, you will be able to:

- Relate details of Alive and Thrive's infant and young child feeding behaviour change Programme.
- Summarise key factors for a successful social behavioural change communication message.
- Discuss how radio spots, market stall signs, and nutrition training can be used to drive demand creation for nutritional behaviour change in a nutrition-sensitive agricultural project.

## Key Points

- **To bring about improved nutrition behaviour it is necessary to understand the causes of 'non-optimal' behaviour.**
- **Behaviour change will involve the change in knowledge, attitudes and practices of individuals, and social change to create an enabling environment.**
- **Nutrition behaviour change approaches need to strategically collect and use data to inform the design, implementation, monitoring and where necessary redesign of their activities.**
- **Well-designed social behavioural change communication (SBCC) messages are simple, memorable, easily understood, culturally appropriate and meaningful to the key audience.**
- **Demand creation campaigns, can raise awareness about the nutritional focus and help enable the desired behavioural changes.**

## Nutrition Behaviour Change Approaches

Human behaviour is complex and profoundly influenced by social norms, access to resources, self-belief that one can manage the improved behaviour (self-efficacy), structural constraints and opportunities, and habits. To bring about improved nutrition it is necessary to understand the causes of 'non- optimal' behaviour, in order to then address the range of behaviours that have a direct or indirect impact on nutrition as well as the social and environmental factors that influence the adoption and maintenance of these behaviours. For the sustainable and meaningful changes required to improve nutrition, the change processes need to be decentralised, participatory, multi-stakeholder and empowering in nature.

Improving nutrition is a complex and multi-faceted problem and therefore a single institution is unlikely to be able to address it adequately.

Successfully influencing human behaviour requires an understanding of *how* behaviours change.

A dauntingly large number of theories and approaches exist on behavioural change, and these typically focus on change at different scales or levels, e.g. the enabling environment level, the community level, the interpersonal level or the individual level. Usually 'behaviour change' of individuals that involves change in knowledge, attitudes or practices will need to be linked to 'social change' that focuses on change at community or national level to create an enabling environment

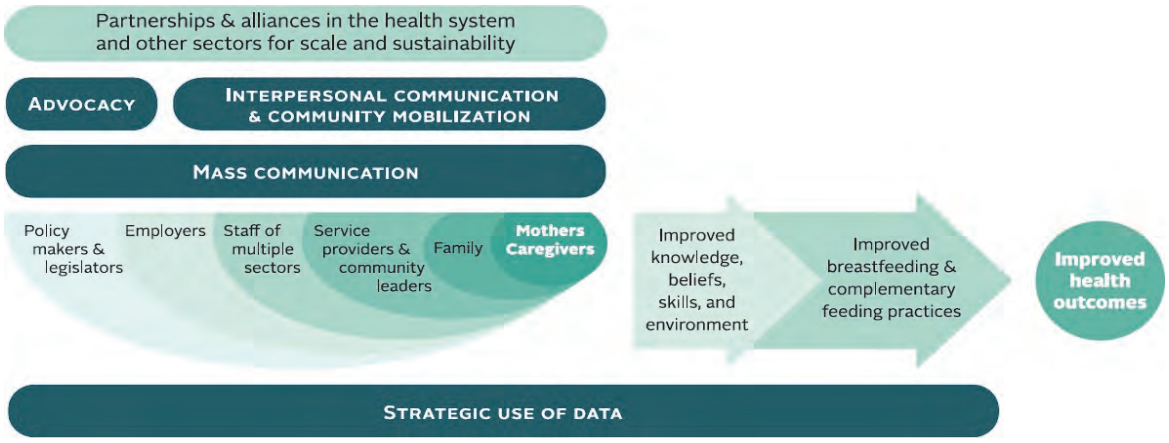
for change. For behaviours to change, certain harmful cultural practices, societal norms and structural inequalities have to be considered and addressed.

For the sake of simplicity, we present two successful nutritional behavioural change approaches: Alive and Thrive's infant and young child feeding programme, and the positive deviance approach.

**Alive and Thrive's Infant and Young Child Feeding Programme in Bangladesh**

Alive and Thrive (A&T) is an initiative that began in 2009 to combat global child undernutrition through interventions to support appropriate infant and young child feeding (IYCF) practices, and later to also address maternal nutrition. The initiative implemented large-scale interventions, including interpersonal counselling, mass media campaigns, community mobilisation, and policy advocacy efforts (see Framework below). Together, these interventions aimed to address the multiple behavioural, social and policy barriers to optimum IYCF practices. The different programme components used are described in the table below. All strategic decisions were evidence-based, after programme launch, ongoing data from programme monitoring, assessments, small studies and quantitative surveys were used to adjust strategies.

**Alive and Thrive's Framework for Delivering Improved Infant and Young Child Feeding Behaviour Change Results at Scale**




| Examples of Components of The Alive and Thrive Behavioural Change Programme |
|---|
| **Advocacy**<br>Advocacy to promote child nutrition and accelerate scale up of programmes.<br>***Local, Regional and National Decision Makers and Stakeholders***<br>Advocacy video shows on IYCF, meetings with the national alliance of over 20 stakeholders, dissemination of government-branded materials to implementing stakeholders.<br>***Engaging Journalists***<br>Orientations and scholarships for journalists, TV talk shows and newspaper supplements.<br>***Individualised Dialogue with Government Decision-Makers and Donors***<br>Memorandum of understanding (MoU), task forces and sharing evidence. |

**Interpersonal Communication and Community Mobilisation**

***Mothers***

Counselling provided through home visits at specific ages of the child on breastfeeding, complementary feeding and handwashing before feeding, and group community meetings of pregnancy and lactating women with trained community workers.

***Community Opinion Leaders***

Mobilisation of support for child nutrition and IYCF through orientations, video shows, seminars and forums to reach doctors, religious leaders, fathers local government and NGOs working at community level.

***Health Providers***

3-to 5-day in-service training, messages through national and regional newspapers, wall posters for government and private clinics, job aids for government staff and materials tailored for formal and informal health practitioners.

**Mass communication**

***Families, Frontline Workers and Opinion Leaders***

TV and radio spots on key topics for mothers, fathers, frontline workers and opinion leaders at all levels.

***Rural Community Members in Media Dark Areas***

Interactive community events including village theatre, community video showings and quiz shows on IYCF and handwashing topics.

A large number of findings have come out of Alive & Thrive's work that can benefit other nutrition behaviour change programmes; these included the need to:

- Base intervention design on extensive formative research and behaviour change theory and principles and tailor to the local context, and use ongoing monitoring to adjust programme;
- Focus on small, achievable actions for key audience segments identified by rigorous testing;
- Take underlying behavioural determinants into account in promotion strategies;
- Have repeated contact with the priority groups;
- Harmonise efforts of multiple implementing NGOs and donors;
- Develop a national training module for government frontline workers;
- Introduce strategies for promoting interpersonal counselling that went beyond the government health services, which A&T did by partnering with an NGO (brac) which had scaled-up presence in the country and a ready-made cadre of multi-purpose community volunteers;
- Convert the existing high awareness amongst the population about the importance of exclusive breastfeeding for the first 6 months into practice - which they did by emphasising specific desirable practices (e.g. Correct positioning and attachment, manual expression of breastmilk and frequent breastfeeding, self-assessment of the adequacy of their breast milk production and understanding how to maintain adequate breast milk supply to help overcome mothers' perceptions of 'insufficient milk') and building a basic understanding about complementary feeding;
- Use the evidence which pointed to the importance and feasibility of promoting home-based food approaches, particularly the giving of animal source foods to young children, discouraging junk food, encouraging food variety and age-appropriate texture, reducing watery and low- nutrient density snack foods and spending more time feeding;
- Determine the motivating factors for changes in IYCF practices, which for mothers included benefits for child's brain and physical development and protection from illnesses, perception of positive child responses ('child likes it'), convenience and satisfaction in being able to breastfeed adequately or motivate a child to eat sufficient quantities of complementary

foods;
- Use mass media and community mobilisation on a large scale;
- Rapidly reach secondary audiences who could encourage mothers (family members, healthy workers and neighbours) through mass media. Tv use was widespread in Bangladesh, and cut across economic and education levels, and a single main language and culture context were crucial factors. However, media habits changed rapidly, therefore adjustments were needed regularly. NB: Bangladesh had already effectively controlled mass media advertising of breast milk substitutes;
- Target multiple influential audiences, as mothers said health professionals and family members were their primary sources of support when faced with problems of infant feeding, and as men were primarily responsible for food purchases. In the latter half of the programme a focus on fathers, religious leaders and doctors/local opinion leaders for community mobilisation was prioritised. Doctors were found initially to not have the skills, knowledge or motivation for improving IYCF practices, but could be reached with high coverage through both print media and tv;
- Provide performance-based monetary incentives to volunteers rather than a fixed salary to conduct home visits and support them with full time mentors (IYCF promoters) with one mentor per 10 volunteers. Volunteers received a cash incentive (totalling us$6 to us$8 per month on average) based on each eligible mother who practiced the IYCF behaviours this motivated volunteer to counsel almost every eligible woman in their respective areas and work on problem-solving for changing behaviours rather than only giving messages;
- Do further research which led to them hypothesising that mothers' complaints that they were unable to feed their children because of 'poor appetite' might be due to enteropathic infections from contaminated complementary foods, and so they worked on handwashing before child feeding. The unavailability of soap and water near the cooking place was a physical barrier to handwashing before food preparation – and so visits focused on establishing handwashing stations close to the place of food preparation and child feeding. Mass media was used to change perceptions towards using soap as the norm;
- Introduce a 'media dark' strategy involving mobile video shows and interactive Q&A sessions to access those in hard-to-reach and low electricity villages;
- Strategically use data to ensure all decisions, plans and actions are evidence-based and current.

### Positive Deviance

An approach that seeks out well-nourished children living in disadvantaged contexts to understand the local growth-promoting behaviours that enable these children to thrive while others are struggling.

**Why does a *positive deviance* approach work?**

Key aspects:

- *Discovering local solutions* – helping community members realise they already have the solutions to malnutrition and don't need outside resources
- *Participatory adult learning* – encourages community ownership, and provides caregivers with the opportunity to actively learn and practice new child feeding and care behaviours in a supportive environment
- *Seeing is believing* – as child nutrition and health improves it provides evidence that the positive deviance practices work, and this motivates families to continue them at home

In searching for explanations, the critical factors that contribute to this positive deviance are determined, these can be viewed as forms of social, behavioural and/or physiological adaptation to nutritional stress. By learning from the childcare and feeding behaviours of these positive deviants, policies and programmes can be designed that reinforce and transfer these adaptive mechanisms to

the malnourished through a peer learning process. Positive deviance is a method that uses existing (but often overlooked) community wisdom to sustainably reduce malnutrition in young children. Such an approach builds community ownership of the program.

Whichever approach is used all affected sectors, (e.g. the community, its leadership, community health services; water and sanitation and hygiene (WASH); food security; agriculture; economic development etc.) should be involved from the beginning.

## Social Behavioural Change Communication (SBCC)

How can new food habits and agricultural practices necessary for improved nutrition be promoted?

Communication efforts, objectives and activities should aim to improve nutritional knowledge of the target audience and ultimately lead to a sustained change in behaviour relating to production and consumption of nutritionally important foods such as OFSP. Orange-fleshed sweetpotato is rich in vitamin A and other micronutrients and therefore has the potential to be used as an entry point for changing behaviours to lead to a significant increase in Vitamin A intakes among children, mothers and other vulnerable groups.

Behaviour Change Communication (BCC) is an interactive process to develop tailored messages and approaches using a variety of communication channels to create positive behaviours, promote and sustain individual, community, and societal behaviour change and maintain appropriate behaviours. The process employs a systematic process starting with formative research and behaviour analysis followed by the communication planning, implementation, and monitoring, learning and evaluation.

### What is nutrition SBCC?

Nutrition SBCC covers a range of interventions which systematically combine elements of interpersonal communication, social change, community mobilization activities, mass media and advocacy to support individuals, families, communities, institutions, and countries in adopting and maintaining high-impact nutrition-specific and nutrition-sensitive behaviours or practices.

Effective nutrition SBCC leverages enablers of behaviours and reduces barriers to adopting and maintaining these behaviours.

The formative and behaviour analysis research process includes identifying, understanding, and segmenting audiences. The communication planning and implementation involve providing target audiences with relevant pre-tested nutrition knowledge through clear strategies, using an appropriate mix of interpersonal, group, and media channels including interactive methods. Lessons learned in the process are used to fine-tune the delivery and improve future communication approaches.

To effectively communicate and advocate for production and consumption of OFSP, it is essential to use creative and innovative approaches to reach different audiences by educating, sharing information, creating awareness, promoting social change, behaviour, practices, and attitudes. More recently, the letter ‘S’ for “social” has been added to BCC to help in recognising the need for systematic, socio-ecological thinking within communication initiatives. Thus, when BCC is implemented within a social-ecological context/framework, we can define it as Social Behaviour Change Communication (SBCC).

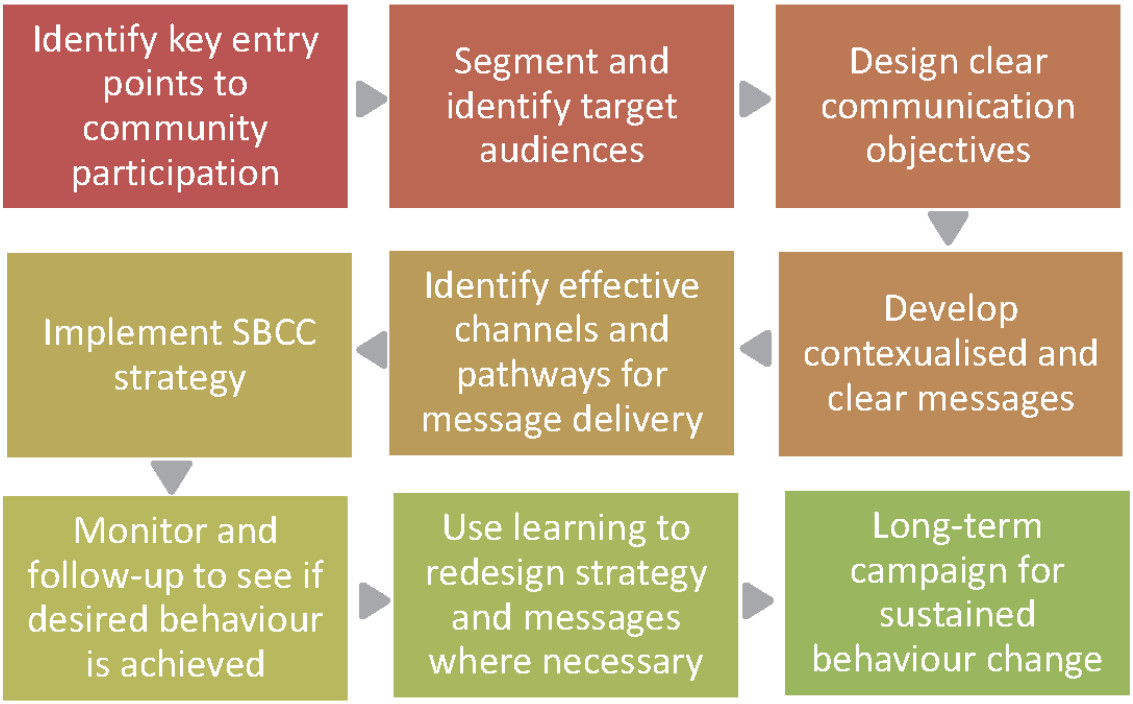
SBCC encompasses three core elements:

1) **Tailored communication** using channels and themes which respond to target audience’s needs and preferences
2) **Behaviour Change** through efforts to make specific intervention-related actions easier, feasible, and closer to an ideal that will protect or improve intervention outcomes.

3) **Social Change** to achieve shifts in the definition of an issue, people's participation and engagement, policies, and gender norms and relations.

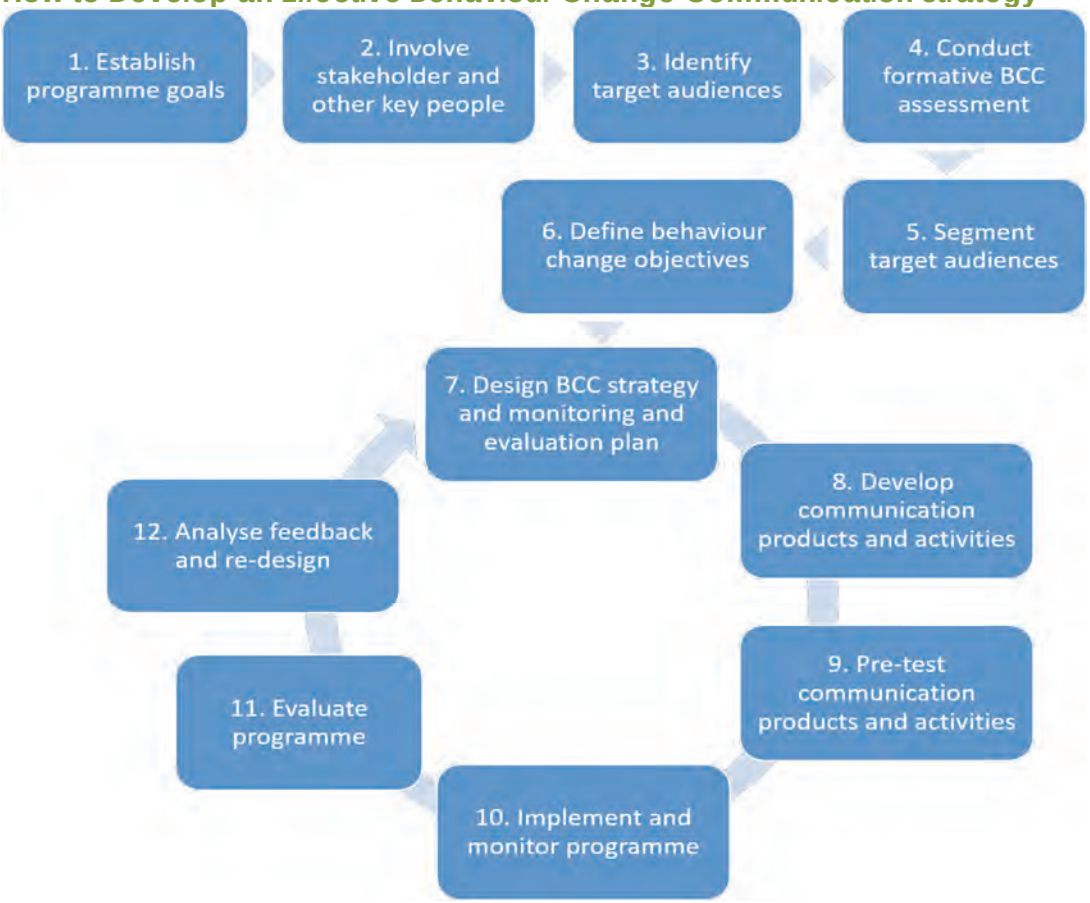
Examples of evidence-based behaviours that can help reduce micronutrient malnutrition (hidden hunger) may include regular consumption of micronutrient (such as iron, vitamin A and zinc) enriched foods including biofortified food crops, such as the pro-vitamin A-rich OFSP. Plus building the habit of consuming adequate amounts of a balanced and diverse diet rich in both micronutrients and macronutrients to ensure adequate and balanced nutrition.

Some of the success factors for effective SBCC include:




However, BCC is not a one-off intervention, achieving sustained behaviour change requires time, dedication and sufficient follow-up. In addition, individual and community nutrition behaviours are directly or indirectly influenced by multiple factors in their environment - social; economic; physical; policy and regulatory. Successful implementation of SBCC depends on overall programme design; the timing of the activities, the capacity of the target audience, the quality of the messages and the quality of monitoring and evaluation (see below).

## How to Develop an Effective Behaviour Change Communication Strategy




To develop appropriate messages and materials for a promotional campaign with the above components, it is important to understand the existing food and marketing customs, preferences of the target community and to operate with sensitivity surrounding cultural norms. An initial situation analysis will collect information to help determine which messages will be most effective in creating demand for OFSP and how messages must differ for different segments of the population.

Understanding your target audience underpins successful delivery of SBCC interventions. It is important to segment and target a wide range of audiences and contextualize the messages and communication products to the audience needs taking into consideration their level of awareness, knowledge and attitudes on OFSP.

Target audiences are those whose behaviour when effectively influenced will be a key indicator of the project's success. Examples may include;

- Self/caregivers, such as pregnant and breastfeeding women, as well as other immediate caregivers of children under five;
- Direct influencers, including partners/fathers, mothers' in-law, siblings, other family and peers;
- Stakeholders within the local community, including community members, community leaders; women; youth groups, opinion leaders, social groups, health staff; teachers and providers; and
- Stakeholders within the enabling environment, including the government (national, sub-regional, district and/or municipal), business, faith and movement leaders.

## 7 C's of Effective Communication

- **Command attention**

Attract and hold the audience's attention. Make it memorable. *Does the message stand out?*

- **Clarify the message**

Ensure the message is clear and easily understood. Less is more! *Is the message simple and direct?*

- **Communicate a benefit**

Stress the advantages of adopting the new behaviour being promoted. *Is it clear what benefit the audience receives if they take the action?*

- **Consistency counts**

Repeat the same message consistently to avoid confusion and enhance the impact of the message. *Are all messages consistent? Can the message be conveyed across different media?*

- **Create trust**

The credibility of the message is important. Without trust and credibility, the message will go unheeded. *Is the message credible? What source will make the message most credible?*

- **Cater to the head and heart**

People are swayed by both facts and emotions. Use both to maximize the persuasiveness of the message. *Does the message use emotion, as well as logic and facts?*

- **Call to action**

Include a clear call to action. Tell the audience precisely what they should do. *Does the message clearly communicate what the audience should do?*

*Source: Healthcompass*

**How to Design SBCC Messages**

Successful, well- designed messages are simple, memorable, easily understood, culturally appropriate and meaningful to the audience. A message to a key audience, therefore, typically reflects:

1) A desired action (which should be small/do-able) from the audience.
2) The key promise or benefit if they perform the action.

The key message often has supporting information associated with it. Messages should be designed after the team had done the situation analysis and audience analysis. A small team can focus on designing the key messages, and it is helpful to include representatives that are fluent in both the language the messages are designed in and the language to which they will be translated. When designing the message content remember to ask:

- Who is the audience and what are its needs, motivations and barriers to change?
- What action does the program want the audience to take?
- Why should the audience take the action?
- Always pre-test and finalise key messages.

## Tips and Recommendations for SBCC Messages

- **Avoid jargon and technical terms**. Use simple language, closer to spoken language than written language.
- **Be relevant**. Speak to the audience in a language, tone and complexity that works for it. Tailor the message carefully to each audience.

- **Keep it brief**. For short form materials such as posters, radio and TV spots, and stickers, messages should be focused on the most important information only. For longer forms, like ongoing weekly or radio or TV programs, you can afford to stretch out the message to cover more layers of the issue.
- **Respect the priority audience**. Do not talk down to the audience. You are not there to tell them what to do. You are doing this to help people make good choices. Think of your message from their perspective. Would you accept that message in their shoes?

### Demystifying Myths

Social norms are very powerful influencers of behaviour both at individual and community levels. Individuals act according to culturally influenced identities, hierarchies, and socially accepted norms. Recent evidence reinforces the notion that social support, perceived and actual, is often key in trying and sustaining behavioural changes. In communicating for behaviour change, it is also important to target not only the allies but also those who may be opposed to adoption to ensure support and positive response from these audiences. Adoption and acceptability can be a challenge if target audiences are not well informed and aware of the benefits and nutritional value of OFSP. The opponents' behaviour if effectively influenced can impact on demand, consumption and adoption of OFSP. Demand and adoption of OFSP and biofortified crops, in general, can be negatively influenced by cultural perceptions, social norms, myths and inaccurate beliefs; which needs to be demystified by providing accurate information. Many incorrect beliefs around sweetpotato affect demand for OFSP.

Some examples of these common myths include:

| **Myth: OFSP is a genetically modified crop (GMO)** |
| --- |
| **Fact: OFSP is developed using conventional plant breeding.** |
| Fact: Conventional breeding methods exploit natural variations existing within crops. Plant breeders identify parent varieties with high pro-vitamin A levels and then cross (male and female) varieties over several generations to produce plants that have the desired nutrient and agronomic traits.<br>Sweetpotato is a genetically rich and diverse crop, and all its different flesh colours (white, cream, yellow, orange and purple) are found in nature.<br>Some varieties produce roots and vines and others produce only vines and leaves. Over 5,000 different sweetpotato varieties are kept in the gene bank of the international potato centre (CIP) to preserve its biodiversity and serve the world`s breeding programs. OFSP has NOT been genetically modified to increase its pro-vitamin A content. |

**Myth: Eating sweet foods, including sweetpotato, causes diabetes**

**Fact: Sweetpotato is often a recommended food for diabetics since it has a lower glycaemic index (GI) than many other starchy foods.**

Fact: Type 2 diabetes (a condition where the body does not produce enough insulin, or insulin is not working correctly, with resultant high blood sugar), the most common type of diabetes, is not caused by eating sweet foods. However, a poor diet, especially one full of certain types of sugars and fats as well as unhealthy lifestyles, increase the probability of getting the disease. Risk factors for developing type 2 diabetes include hypertension, high blood triglyceride(fat) levels, a high-fat-diet, high alcohol intake, a sedentary lifestyle (little exercise), and being overweight or obese.

Contrary to this myth, sweetpotato is often a recommended food for diabetics since it has a lower glycaemic index (GI) than many other starchy foods. This is due in part to its high fibre content. Low GI foods release glucose slowly into the bloodstream which helps to control blood sugar (glucose) level. Many diets promote sweetpotato as a fat-burning food and it is at the top of many 'Best Foods to Eat' lists.

**Myth: Sweetpotato and sweet foods are suitable for women and children but not for men because they cause infertility and sterility in men**

**Fact: Sweet tasting foods do NOT have a negative effect on male fertility.**

Fact: Vitamin A found in OFSP and other foods are important for preventing sluggish sperm. OFSP is also high in folic acid, a B vitamin with antioxidant properties that are crucial for keeping sperm free of chromosomal abnormalities. Adequate folate intake (folate is the form of folic acid that naturally occurs in the body) is also essential for women before and during pregnancy. OFSP, packed with vitamins A, C, E and folate, is the perfect fertility food for men and a healthy food choice to be enjoyed by the whole family.

**Myth: Eating sweet foods such as sweetpotato causes worms in children**

**Fact: Eating sweet foods such as sweetpotato does not cause worms in children.**

Fact: Worms are intestinal parasites which infest people as well as animals. The common ones are roundworm, pinworm, tapeworm, hookworm.

Worms get into the human body from three possible sources: the air we breathe, the water we drink, the food we eat and the environment we live and play in.

**Myth: Eating sweet foods, such as sweetpotato, makes people more likely to get malaria**

**Fact: Malaria is transmitted to humans when an infected Anopheles mosquito bites a person and injects the malaria parasite (sporozoites) into the blood.**

Fact: Malaria develops after a couple of weeks when the parasites grow and attack the body. Widespread beliefs across Africa that standing in the sun, eating sweet and oily foods, poor environmental sanitation and consumption of unripe fruits together with deep cultural beliefs in witchcraft have impeded efforts to prevent and properly treat malaria.

**Myth: Sweetpotato leaves are not suitable for human consumption**

**Fact: Sweetpotato leaves are eaten in many parts of Africa and other parts of the world.**

Fact: They are rich in nutrients and functional compounds including complex carbohydrates, protein, amino acids, vitamins and minerals (vitamin A, folate, vitamin C, calcium, magnesium, phosphorus), antioxidants, and other bioactive compounds. Younger leaves (less than three months) are more tender and preferred to mature leaves. For maximum nutritional benefit, leaves should not be overcooked.

**Myth: OFSP can improve your eyesight and reverse blindness**

**Fact: Vitamin A in OFSP and other foods promote good vision and helps prevent problems but cannot reverse blindness once it has occurred.**

Fact: Children and pregnant women who do not have enough Vitamin A in their diet may suffer from night blindness (difficulty or inability to see in dim light such as in early morning or evening) because of the need for increased nutrient intake during these high growth periods. In children, this can progress to conditions that damage the eye such as Bitot's spots (foamy white patches on the white part of the eye) and xerophthalmia (dryness of the cornea and conjunctiva) which can eventually lead to irreversible blindness.

## Nutritional Behaviour Change Through Demand Creation Campaigns

Promotional campaigns are successful methods for introducing new nutritional behaviours. For example, following a promotion campaign in Mozambique, three-quarters of consumers said they preferred OFSP roots to white-fleshed sweetpotato roots. An effective promotion strategy for OFSP should include elements of target audience identification, creative communication and nutrition education.

For a promotional campaign to be effective and efficient, target audiences must be identified. For example, an OFSP promotional campaign might target food processors who could substitute OFSP puree or flour for wheat or other ingredients in their products. The target audience could also be traders who sell sweetpotato, farming households who grow their own sweetpotato or consumers who purchase sweetpotato.

**Nutrition case study: Scaling Up Sweetpotato through Agriculture and Nutrition (SUSTAIN) project**

During 2016/17, those who participated in the SUSTAIN project nutrition training were predominantly women: Kenya (73%), Malawi (59%), Mozambique (82%), Rwanda (66%) and

Bangladesh (100%).

It has been noted in several projects that it is difficult to involve men in nutrition training as they do not see any immediate associated financial benefits and regard nutrition as a woman's duty. This is problematic as research in Malawi and Tanzania illustrated that men are key decision makers in household nutrition related decisions. For example, they may allocate land for crop cultivation, and decide how much to invest in the production of different crops including food crops. Evidence from Malawi shows very low investments in food crops compared to commercial crops such as tobacco.

To overcome this division between female and male spheres of extension messaging, the SUSTAIN project in Malawi is increasingly promoting the participation of men in nutrition education and nutrition counselling. In 2016, 2,670 men and 3,755 women participated in nutrition-related training activities. Similarly, in Bangladesh the project has adopted approaches to strengthen capacities of both women and men in nutrition, hygiene and child care to promote the safe and effective consumption of OFSP. For example, men were specifically invited to the opening sessions that also included gender sensitisation, and explained the importance of allowing women to attend all the twelve sessions.

In addition to targeting by category, gender responsive messages should be part of any behaviour change campaign strategies. While the technical nutrition information is key, the social context in which the information is disseminated needs to be considered since this can determine the success and failure of strategies. For example, if in a context where women do not have access to the resources needed to make informed nutrition decisions it may be better in addition to targeting women to also create advocacy messages on men's engagement. The campaign managers need to develop a gender responsive communication plan so that they are able to reach both men and

women with appropriate messages. The nutritional behaviour change campaigns may seek to document and share gender-based best practices in nutrition campaigns for example, sharing case studies of men, women and families' success stories.

If a new technology is disseminated, a supply is generated. However, if the potential consumers of that technology do not demand it, rates of adoption will be low. The promotion of solutions to micronutrient malnutrition is particularly challenging because micronutrient deficiencies, or "hidden hunger" are often hard to detect and can go unnoticed until the deficiency is severe. If people do not realise they have a problem, they will be less likely to take up behaviours presented as solutions.

Therefore, creating demand is a complex yet essential component in OFSP promotion projects. The process of fostering demand has two elements:

1) Creating **awareness** about:
   - The importance of vitamin A
   - The high vitamin A content in orange-fleshed sweetpotato (OFSP)
2) Designing and implementing programs that will enable actual behavioural change, typically related to:
   - Improving young child feeding practices
   - Diversifying the overall diet at the household level
   - Improving marketing chains for sweetpotato roots and/or leaves and products


To develop appropriate messages and materials for a promotional campaign with the above components, we need to understand the existing food and marketing customs, preferences of the target community and to operate with sensitivity surrounding cultural norms. For this reason, a pre-campaign situation analysis is beneficial. Information collected will help determine which messages will be most effective in creating demand for OFSP and how messages must differ for different segments of the population.

The type of information collected during this diagnostic stage should be gender-responsive and could include:

1) Information about the target audiences (including those who influence nutritional behaviours) and their existing behaviours, knowledge, channels of information and attitudes toward OFSP. Information should be collected from both men and women within the target audiences as they may have different experiences and perceptions about nutrition.
2) Identification of national and sub-national policy makers who could influence resource allocation and support policies to facilitate the introduction of new sweetpotato varieties.
3) Community level dynamics and networks that could support the introduction of OFSP varieties or pose challenges to an intervention. Men and women may use different networks to access information. One needs to understand what these networks are and how they can best be mobilised to promote positive nutritional behaviour change. Approaches that target mother and baby clinics only for example may leave men out. Appropriate messages and targeting to directly influence men need to be developed. For example, one could consider taking advantage of community meetings, which men attend, and men's peer groups to spread nutrition information to men.
4) An understanding of existing consumer preferences for certain varieties of sweetpotato and beliefs concerning sweetpotato consumption as compared to other staple foods and vitamin A rich foods.
5) Household level dynamics and practices that might act as barriers or facilitators to developing behaviour change communication.

The diagnostic data can provide a basis for determining appropriate communication programs to target difference audiences. As human and financial resources allow, communication programs should:

1) Identify the key entry points into the communities and target groups of interest.
2) Segment and prioritize target audiences and develop specific activities for each audience.
3) Position promotional messages and identify any barriers to adoption and how to best address them.
4) Include a monitoring system to see if the desired behavioural change is present. This monitoring system should also have gender targets.
5) Use the most effective channels or pathways for message delivery.


These demand creation strategies of collecting diagnostic data and developing relevant communications strategies were utilised in the Towards Sustainable Nutrition Improvement (TSNI) project in Mozambique and the Reaching End Users Project (REU) in Uganda and Mozambique and resulted in significant increases in OFSP and vitamin A intakes among children under five years of age.

Demand creation activities that can create awareness about OFSP include:

1) Slogans painted on vehicles, caps and wraps worn by women. For example, "*O Doce que dá Saúde*" or "*the Sweet that gives Health.*"


2) Wide coverage radio programs (~15 minutes) to cover a target issue. Some examples include the importance of vitamin A, the value of OFSP and how to grow the crop, good child. feeding practices, the basic food groups and the range of vitamin A rich foods
3) Short radio announcements (~30 seconds) on the value of OFSP and where to obtain sweetpotato products.
4) Market stalls painted orange and decorated with key messages.
5) Professional or local community theatre performances (edutainment - that informs and educates the audience), including songs (sticky messages which typically last a long time).
6) Orange painted push-carts for selling sweetpotato with key promotional messages.

Examples of demand creation activities linked to behavioural change include:

1) Stakeholder meetings with community leaders or health service personnel to provide key campaign messages.
2) Group nutrition sessions with various stakeholder groups (including those who influence nutritional behaviours, e.g. fathers, grandmothers, traders and local leaders as opposed to just mothers), led by trained extension personnel or community health workers, supported with job aids such as counselling cards or posters. Some key areas to cover include:
   a) Frequency of feeding the young child.
   b) Importance of giving the first milk (colostrum) after birth.
   c) Exclusive breastfeeding until 6 months of age (*no* other liquids, including water).
   d) What to feed your young child at different stages in life.
   e) What are vitamin A rich foods and why are they so important.
   f) Monitoring the growth of your child.
3) Cooking demonstrations led by trained extension personnel or community health workers, with an emphasis on utilising locally available foods and integrating new orange-fleshed sweetpotato varieties.
4) One-on-one counselling sessions with mothers of malnourished children.
5) Demonstration crop plots to compare the new varieties to the existing varieties, with associated community field days.
6) Advertising campaigns that subsidize access to new OFSP-based products and planting materials (e.g. offer sweetpotato products or planting materials at a reduced price).
7) Holding special sessions with men and others (such as local leaders and mothers-in-law) who influence dietary practices of the children and the overall household.


## Nutrition E-Modules – Good Examples

Follow the links below for 'community level nutrition approaches' and 'nutrition-sensitive agriculture and food systems' e-learning courses:

- Care Group Model: http://pdf.usaid.gov/pdf_docs/PNADP104.pdf
- Community Nutrition Education (CNE) Logic Model: https://nifa.usda.gov/resource/community-nutrition-education-cne-logic-model

- Nutrition-sensitive agricultural programming course: https://www.agrilinks.org/training/nutrition-sensitive-agricultural-programming
- Nutrition-sensitive agriculture and food systems e-learning modules: http://www.fao.org/policy-support/resources/resources-details/en/c/884191/

## Review Questions

1. What is Positive Deviance?
2. What are some of the factors that contributed to the success of Alive and Thrive?
3. What are the 7 C's of successful messaging?

# Unit 8 – Gender and Diversity Aspects of Nutrition and Orange-Fleshed Sweetpotato

## Objectives

By working through this section, you will be able to:

- Describe at least three reasons why a gender responsive approach is required in any nutritional training or behavioural change work.

## Key Points

- **Nutritional requirements including Vitamin A requirements vary by age, sex and workloads.**
- **It is important to understand local nutritional practices and beliefs and how these can be combined with improved nutritional behaviours and outcomes.**
- **It is important to monitor and evaluate nutrition activities in order to learn whether promotional messages and activities reaching both men and women audiences are being correctly understood, and whether they are utilised by the target audiences for whom they were designed; and if not, what changes are needed in order to improve their effectiveness.**

A thorough discussion of gender and diversity aspects in relation to sweetpotato is presented in the topic, Gender and Diversity Aspects. Key gender and diversity issues are also woven into the text of each topic, and those relevant to OFSP and nutrition are highlighted here.

As with any training or promotion activity, in nutrition training attention needs to be paid not only to imparting appropriate and practical information to those who will be involved in preparing the food (mothers, women), but also to those who control access to the raw materials and food (husbands) and who influence consumption patterns (grandmothers, husbands, traders, community leaders).Timing, duration, location, delivery language, approach and participant composition of training events also need to be considered to ensure certain groups are not unintentionally prevented from accessing it. Men and women may be targeted differently in terms of the language used, or when they receive the information and training. In many instances, men may not attend nutritional training because of the assumption that nutrition is under the women's responsibilities. Under these conditions innovative means may need to be used to reach men.

It is important to understand local nutritional practices and beliefs and how these can be combined with improved nutritional behaviours and outcomes. Thus, when conducting diagnostic studies, it is important to collect gender-related data that will help you to design appropriately targeted messages.

It is important to monitor and evaluate nutrition activities in order to learn whether promotional messages and activities reaching both men and women audiences are being correctly understood, and whether they are utilised by the target audiences for whom they were designed; and if not, what changes are needed in order to improve their effectiveness.

# Activities

These learning-by-doing activities will provide hands-on discovery opportunities for participants.

## Activity 4.1 How Well-Balanced Are Our Diets?

### *Objectives*

Gain an understanding of how local diets can be made more nutritious

### *Time*

40 mins

### *Materials*

- Flip chart
- Pens
- Masking tape

### *Suggested Steps*

1. With the trainees working in groups of 5 or 6, ask them to identify at least two meals that are commonly eaten by the community in their area. Note: they may wish to think about a meal that is eaten by a poor household and another by a medium wealth group household, or by a rural household and an urban household.
2. Ask the group to analyse the adequacy of these meals in terms of the food categories that are needed by the body (e.g. energy giving- cereals, roots, tubers, plantains; body building – pulses, seeds, nuts, milk, eggs, fish, meat; energy storage – fats and oils; body protective – fruits and vegetables). After each small group has presented their analysed meals, open up a general discussion to enable the participants to highlight gaps, questions or differences of opinions regarding the meals and their food/nutrient type categories. Ensure the discussion covers: adequacy in terms or quality, quantity, and value; seasonality and common food substitution practices; gendered aspects of food consumption and sharing; and food hygiene.
3. In their small groups, ask the participants to discuss the challenges of preparing balanced diets in the community, and any solutions they know of.
4. Then go around the room asking each group to share one key challenge to preparing a balanced diet and suggested solutions for overcoming it. List these on a flip **chart and** open the topic up for a few minutes of general discussion to see if any extra suggestions can be added.

## Activity 4.2 Dining from A Vitamin A-Rich Menu

### *Objectives*

Understand how to prepare balanced meals with locally available vitamin A-rich foods

### *Time*

20 mins

### *Materials*

- A4 sheets of paper and pens
- Actual examples of vitamin A-rich local foods such as pumpkins, pawpaw, OFSP, local and exotic green leafy vegetables etc. if available

### *Suggested Steps*

1) Divide the trainees into 4 groups and let each group come up with two meal plans that contain locally available vitamin A-rich foods (including orange-fleshed sweetpotato). Ask each group to write their meal plans on A4 sheets of paper, and then stick these on the wall.
2) Give participants a few minutes to look through the other groups' vitamin A rich meal plans and open up a short general discussion addressing any issues the participants want to discuss or raise. Probe for ways in which the meals could be improved. Emphasise the importance of having oil in the dishes as the fats help in absorption of vitamin A and therefore make it more accessible to the body.
3) Arrange for the vitamin A meal plans to be typed up onto a page that will then be photocopied for the participants to take away with them.

## Activity 4.3 Virtual Porridge Making

### *Objectives*

Be able to prepare a nutritious porridge suitable for children from OFSP.

### *Time*

1 hour (Note: the actual porridge making activity planned on Day 1 will also link to this)

### *Materials*

- 4 sets of the virtual porridge cards with photos and descriptions of different ingredients that could be used to make a nutritious child's porridge (see Handout below)
- Masking tape
- Flip chart
- Paper and pens

*Note:* The porridge can only have a maximum of 4 ingredients.

### *Suggested Steps*

1) Divide the trainees into 4 groups, give each group a set of the 25 ingredient cards, ask them to use the cards to develop nutritious and acceptable porridge recipes that a typical household could use to feed children from 6 to 24 months old. Discuss how these recipes will change as the child grows and new foods are incorporated into their diet. Explain that it is very important for the porridge to be dense; it should NOT drip off the spoon. Children have small stomachs, so they need to come up with a recipe that does not weigh more than 150 grams yet are nutritious. Explain that they will need to present their recipe to the whole group at the end, note that a recipe includes the steps as well as the ingredients.
2) Invite each of the 4 small groups to present their porridge recipes to the whole group.
3) Ask the participants to discuss the differences in the choices of ingredients between the recipes presented, the pros and cons of the different ingredients used, the practicalities of obtaining the ingredients and the importance of food diversity and varying the recipes. They should make notes about their selected recipes and the reasons behind choosing them.

## Activity 4.4 Develop a Gender Responsive Nutrition Behaviour Change Strategy

### *Objectives*

Gain experience in identifying behavioural issues associated with poverty and gender, and in developing a gender-sensitive behaviour change program

### *Time*

1 hour

### *Materials*

- This topic of the manual
- The short story below
- Flip chart
- Marker pens

### *Suggested Steps*

1. Ask the trainees to read through the short story on the following page.
2. Divide the trainees into 4 groups. Ask them to discuss how poverty and gender issues affected the nutrition and health status of Chio, Tuy, the oldest girl, the other children and the baby in the womb. They should record their answers on two flip charts, one for "Poverty" and the other "Gender", and then ask the groups to share their answers/ discussions in plenary.
3. In their same groups, ask them to design a nutrition communication behaviour change program on how they could reach Chio, Tuy and Tuy's parents with information and knowledge they need to change their nutritional behaviour. They should sketch their behaviour change program and then present it back to the plenary group.

## SHORT STORY: Poverty, gender and development of nutrition behaviour change strategies

Chio had five children ranging from an infant boy, Tuy, who was 10 months old, to a 12-year-old girl who had already started menstruating. The family was poor. Some days, Chio didn't know how she was going to feed everyone.

She herself had never gone to school. Her husband was a truck driver in the nearby town. She lived in the village with her children whilst her husband would come to the village every month. She had decided to return to the village because her husband lived in two small rooms on the outskirts of the city and there was not enough room for everyone to fit. In addition, it was difficult for her when she had her infant son because there were no sanitation facilities and she had to fetch water every day from the common well. In addition, in the rural area Chio's husband had inherited a piece of land from his parents, so Chio and her family could stay there and cultivate their own food. This was better than living in the city where they had to buy everything and never had enough money. She had recently received training on how to make a home garden and plant orange fleshed sweetpotato (OFSP); however, her husband was not convinced that OFSP would be helpful to the family at all.

Chio felt very tired and went to the clinic. She took her infant boy, Tuy, as she was still breastfeeding. The doctor told her she was pregnant. Tuy, who was born small, had started eating complementary food (besides the breast milk); however, he was not eating much, and she did not have the time to feed him. She decided to stop breastfeeding to keep her energy for the new baby. Chio was unhappy about being pregnant; they couldn't afford it and there was too much work to do already. She had to tend to the field and feed the cattle. She also had to feed the two pigs that her husband had purchased. She had to walk long distances to look for the pig feed.

Recently her husband had lost his job, so he had come back home, and there was not enough money. They were not able to produce enough on their small piece of land because of the depleted soil fertility, and anyway the land was too small to cater for the needs of their growing family. When her husband was home he helped with looking for the pig feed; however, usually during the day he was out looking for a job and only came back home at night. When she made the evening meal, she gave her husband food first (because he was tired from looking for a job the whole day and also that is what she had learnt from her mother: 'men eat first because they do all the hard work'), and then divided the rest among the children, leaving a little for herself; she was too tired to eat anyway. Their food on most nights consists of rice, a sauce made from tomatoes, some cassava and vegetables from Chio's home garden.

*Source: Adapted from a story in WHO, 2010*

## Activity 4.5 Raising Awareness and Creating Demand for Orange-Fleshed Sweetpotato

### *Objectives*

Gain experience in using a range of tools to raise community awareness about OFSP

### *Time*

55 mins

### *Materials*

This topic of the manual

### *Suggested Steps*

1) Divide the trainees into 4 groups. Explain that due to the 'hidden' nature of micronutrient malnutrition, it is often necessary to create demand for OFSP. Explain that they are going to practice using different.
2) OFSP community awareness raising techniques. Give them 15 minutes to discuss and practice before sharing with the rest of the participants in a 5-minute presentation.
   a) One group will develop a short play using a theatre script
   b) One group will create a short song
   c) One group will act out a potential radio or television advertisement
   d) One group will give a short speech
3) Give each group 5 minutes to present their community awareness activity or strategy.
4) Ask the participants to discuss the practicalities and pros and cons of using the different techniques and any ideas they have for other OFSP awareness raising methods. They should make notes on the awareness creation techniques presented, their pros and cons and any other good ideas.

## Handout: Virtual Porridge Making Ingredient Cards (photocopy and cut into separate cards)

### AVOCADO, fresh and ripe

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 16 | 0.2 | 0.67 | 0.055 | 0.064 | 0.7 | 1 | 5.8 |
| 30 grams | 48 | 0.6 | 2.01 | 0.165 | 0.192 | 2.1 | 3 | 17.4 |
| 100 grams | 160 | 2 | 6.7 | 0.55 | 0.64 | 7 | 10 | 58 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

### PUMPKIN, cooked

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 3 | 0.148 | 0.29 | 0.028 | 0.01 | 20 | 0.65 | 1 |
| 30 grams | 9 | 0.444 | 0.87 | 0.084 | 0.03 | 60 | 1.95 | 3 |
| 100 grams | 30 | 1.48 | 2.9 | 0.28 | 0.1 | 200 | 6.5 | 10 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

### SUGAR, granulated

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 38.7 | 0 | 0 | 0.001 | 0 | 0 | 0 | 0 |
| 30 grams | 116.1 | 0 | 0 | 0.003 | 0 | 0 | 0 | 0 |
| 100 grams | 387 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0 |


*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

### GROUNDNUTS, boiled and mashed

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 31.8 | 1.35 | 0.88 | 0.101 | 0.183 | 0 | 0 | 7.5 |
| 30 grams | 95.4 | 4.05 | 2.64 | 0.303 | 0.549 | 0 | 0 | 22.5 |
| 100 grams | 318 | 13.5 | 8.8 | 1.01 | 1.83 | 0 | 0 | 75 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

### RICE, cooked

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 13 | 0.238 | 0.03 | 0.149 | 0.042 | 0 | 0 | 9.7 |
| 30 grams | 39 | 0.714 | 0.09 | 0.447 | 0.126 | 0 | 0 | 29.1 |
| 100 grams | 130 | 2.38 | 0.3 | 1.49 | 0.42 | 0 | 0 | 97 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**COCONUT MILK, expressed from grated coconut meat and water**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | *mg* | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 23 | 0.229 | 0.22 | *0.164* | 0.067 | 0 | 0.28 | 1.6 |
| 30 grams | 69 | 0.687 | 0.66 | *0.492* | 0.201 | 0 | 0.84 | 4.8 |
| 100 grams | 230 | 2.29 | 2.2 | *1.64* | 0.67 | 0 | 2.8 | 16 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**CASSAVA flour**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 32 | 0.16 | 0.17 | 0.026 | 0.034 | 0 | 0.4 | 2.7 |
| 30 grams | 96 | 0.48 | 0.51 | 0.078 | 0.102 | 0 | 1.2 | 8.1 |
| 100 grams | 320 | 1.6 | 1.7 | 0.26 | 0.34 | 0 | 4 | 27 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**CABBAGE, boiled**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 2.2 | 0.102 | 0.19 | 0.017 | 0.009 | 0.7 | 2.01 | 2 |
| 30 grams | 6.6 | 0.306 | 0.57 | 0.051 | 0.027 | 2.1 | 6.03 | 6 |
| 100 grams | 22 | 1.02 | 1.9 | 0.17 | 0.09 | 7 | 20.1 | 20 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**EGG, raw**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 14.7 | 1.258 | 0 | 0.183 | 0.111 | 14 | 0 | 4.7 |
| 30 grams | 44.1 | 3.774 | 0 | 0.549 | 0.333 | 42 | 0 | 14.1 |
| 100 grams | 147 | 12.58 | 0 | 1.83 | 1.11 | 140 | 0 | 47 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**PUMPKIN leaves**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 2.1 | 0.272 | 0.27 | 0.32 | 0.02 | 8 | 0.1 | 2.5 |
| 30 grams | 6.3 | 0.816 | 0.81 | 0.96 | 0.06 | 24 | 0.3 | 7.5 |
| 100 grams | 21 | 2.72 | 2.7 | 3.2 | 0.2 | 80 | 1 | 25 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**ORANGE FLESHED SWEETPOTATO ROOTS, boiled and mashed**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 7.6 | 0.137 | 0.25 | 0.072 | 0.02 | 58.8 | 1.28 | 0.6 |
| 30 grams | 22.8 | 0.411 | 0.75 | 0.216 | 0.06 | 176.4 | 3.84 | 1.8 |
| 100 grams | 76 | 1.37 | 2.5 | 0.72 | 0.2 | 588 | 12.8 | 6 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**VEGETABLE OIL**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 88.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 grams | 265.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 100 grams | 884 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**BEANS, boiled and mashed**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 12.7 | 0.867 | 0.64 | 0.22 | 0.1 | 0 | 0.12 | 13 |
| 30 grams | 38.1 | 2.601 | 1.92 | 0.66 | 0.3 | 0 | 0.36 | 39 |
| 100 grams | 127 | 8.67 | 6.4 | 2.22 | 1 | 0 | 1.2 | 130 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**WHITE-FLESHED SWEETPOTATO ROOTS, boiled and mashed**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 7.6 | 0.137 | 0.25 | 0.07 | 0.02 | 0 | 1.28 | 0.6 |
| 30 grams | 22.8 | 0.411 | 0.75 | 0.21 | 0.06 | 0 | 3.84 | 1.8 |
| 100 grams | 76 | 1.37 | 2.5 | 0.72 | 0.2 | 0 | 12.8 | 6 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**SWEETPOTATO LEAVES, cooked**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 3.4 | 0.23 | 0.19 | 0.06 | 0.026 | 4.6 | 0.15 | 4.9 |
| 30 grams | 10.2 | 0.69 | 0.57 | 0.18 | 0.078 | 13.8 | 0.45 | 14.7 |
| 100 grams | 34 | 2.3 | 1.9 | 0.6 | 0.26 | 46 | 1.5 | 49 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**WHITE MAIZE flour**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 36.1 | 0.693 | 0.96 | 0.238 | 0.173 | 0 | 0 | 2.5 |
| 30 grams | 108.3 | 2.079 | 2.88 | 0.714 | 0.519 | 0 | 0 | 7.5 |
| 100 grams | 361 | 6.93 | 9.6 | 2.38 | 1.73 | 0 | 0 | 25 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**FISH, Sardines**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 11.2 | 2.14 | 0 | 0.09 | 0.04 | 4.3 | 0 | 1.1 |
| 30 grams | 33.6 | 6.42 | 0 | 0.27 | 0.12 | 12.9 | 0 | 3.3 |
| 100 grams | 112 | 21.4 | 0 | 0.9 | 0.4 | 43 | 0 | 11 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**FISH, small, dried, freshwater**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 33.5 | 5.86 | 0 | 0.25 | 0.52 | 0 | 0 | 2.8 |
| 30 grams | 100.5 | 17.58 | 0 | 0.75 | 1.56 | 0 | 0 | 8.4 |
| 100 grams | 335 | 58.6 | 0 | 2.5 | 5.2 | 0 | 0 | 28 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**RED PALM OIL**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 86.2 | 0 | 0 | 0 | 0 | 500 | 0 | 0 |
| 30 grams | 258.6 | 0 | 0 | 0 | 0 | 1500 | 0 | 0 |
| 100 grams | 862 | 0 | 0 | 0 | 0 | 5000 | 0 | 0 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**BANANA, fresh and ripe**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 8.9 | 0.11 | 0.26 | 0.03 | 0.02 | 0.3 | 0.87 | 2 |
| 30 grams | 26.7 | 0.33 | 0.78 | 0.09 | 0.06 | 0.9 | 2.61 | 6 |
| 100 grams | 89 | 1.1 | 2.6 | 0.3 | 0.2 | 3 | 8.7 | 20 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**BAOBAB, pulp**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 30.5 | 0.42 | 0.51 | 0.19 | 0.03 | 0 | 20.1 | 1.3 |
| 30 grams | 91.5 | 1.26 | 1.53 | 0.57 | 0.09 | 0 | 60.3 | 3.9 |
| 100 grams | 305 | 4.2 | 5.1 | 1.9 | 0.3 | 0 | 201 | 13 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**Juice from an ORANGE**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 4.7 | 0.094 | 0 | 0.01 | 0.007 | 1.1 | 5.32 | 3 |
| 30 grams | 14.1 | 0.282 | 0 | 0.03 | 0.021 | 3.3 | 15.96 | 9 |
| 100 grams | 47 | 0.94 | 0 | 0.1 | 0.07 | 11 | 53.2 | 30 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**MANGO, ripe**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 6.5 | 0.05 | 0.18 | 0.01 | 0 | 3.8 | 2.77 | 0.6 |
| 30 grams | 19.5 | 0.15 | 0.54 | 0.03 | 0 | 11.4 | 8.31 | 1.8 |
| 100 grams | 65 | 0.5 | 1.8 | 0.1 | 0 | 38 | 27.7 | 6 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**PAPAYA, ripe**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 3.9 | 0.06 | 0.18 | 0.01 | 0.01 | 13.5 | 6.2 | 3.8 |
| 30 grams | 11.7 | 0.18 | 0.54 | 0.03 | 0.03 | 40.5 | 18.6 | 11.4 |
| 100 grams | 39 | 0.6 | 1.8 | 0.1 | 0.1 | 135 | 62 | 38 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

**WATERMELON, raw**

| | Energy | Protein | Fibre | Iron | Zinc | Vitamin A | Vitamin C | Folate |
|---|---|---|---|---|---|---|---|---|
| | kcal | g | g | mg | mg | mcg RAE | mg | mcg DFE |
| 10 grams | 3.9 | 0.06 | 0.04 | 0.02 | 0.01 | 2.8 | 0.81 | 0.3 |
| 30 grams | 11.7 | 0.18 | 0.12 | 0.06 | 0.03 | 8.4 | 2.43 | 0.9 |
| 100 grams | 39 | 0.6 | 0.4 | 0.2 | 0.1 | 28 | 8.1 | 3 |

*kcal= kilocalorie. RAE: retinol activity equivalent: 1 RAE = 1 mcg retinol, 12 mcg beta-carotene.*
*DFE: dietary folate equivalent: 1 DFE= 1 mcg food folate*

# Answers to Review Questions

## Unit 1

1. What are the four main types of food, based on their main nutrient type?
    - *Carbohydrates (energy giving); Proteins (body building and energy giving); Fats (energy storage and giving, insulation); Vitamins and minerals (support and protect body development and functioning).*
2. What is the difference between macronutrients and micronutrients?
    - *Carbohydrates, proteins and fats are called macronutrients because our bodies need them in large amounts.; Vitamins and minerals are called micronutrients because they are needed in small amounts.*
3. What could be some of the consequences of malnutrition?
    - *Poor growth, being less active, frequent illnesses. Could be irreversible.*

## Unit 2

1. What are the types of malnutrition?
    - *Undernutrition, micronutrient malnutrition (deficiency or excess), overnutrition.*
2. What is the number one cause of malnutrition?
    - *Poverty: lack of food and/or bad quality food.*
3. What is 'hidden hunger'?
    - *Micronutrient malnutrition*

## Unit 3

1. What is the difference between essential and non-essential nutrients?
    - *Essential nutrients are not synthesized in the body, so we need to supply them through food, whereas non-essential nutrients can be synthesized in the body from other compounds and food sources.*
2. What is the role of carbohydrates?
    - *The main source of energy; Fibre helps digestion, bowel health and optimal cholesterol levels.*
3. What type of food is called 'building blocks of life'? Why?
    - *Proteins; Build and repair body tissues, such as muscles, bones and organs, blood, skin and hair.*
4. What are the most common micronutrient deficiencies?
    - *Iron, iodine, zinc and calcium.*

## Unit 4

1. What are the four approaches to tackling micronutrient malnutrition?
    - *Supplementation, Fortification, Dietary diversification, Biofortification*
2. What are the advantages of biofortification?
    - *Builds on staple foods that poor households already enjoy; Reaches rural and urban populations—any area where supplementation or fortification may be difficult; Sustainable approach.*

## Unit 5

1. Besides vitamin A, what other nutrients does OFSP contain?
    - *Fibre, iron, zinc, vitamin B. Sweetpotato leaves contain high levels of vitamins A, B and C, calcium, antioxidants and protein.*
2. What cooking method retains the most vitamins?

- *Boiling whole root with peel on.*

## Unit 6

1. What is the difference between nutrition-specific and nutrition-sensitive interventions?
   - *Nutrition-specific interventions address direct issues. Nutrition-sensitive address root causes and long-term impact.*
2. What are some of the ways agricultural interventions can improve nutrition?
   - *Increasing food access by increasing smallholder production; Reducing food prices by increased supply; Developing and planting higher-nutrient varietals of crops; Effective natural resource management, especially water; Empowerment and social status of women.*

## Unit 7

1. What is Positive Deviance?
   - *An approach that seeks out well-nourished children living in disadvantaged contexts to understand the local growth-promoting behaviours that enable these children to thrive while others are struggling.*
2. What are some of the factors that contributed to the success of Alive and Thrive?
   - *Advocacy: Improving political conditions, removing barriers; Interpersonal communication and community mobilization; Improved knowledge, skills and environment lead to improved health outcomes; Bringing together communities, media and regulators.*
3. What are the 7 C's of successful messaging?
   - *Command attention; Clarify the Message; Communicate a benefit; Consistency counts; Create trust; Cater to the head and heart; Call to Action.*

# Glossary

*1000 days:* the period between conception and two years of age when irreversible damage caused by malnutrition can and should be prevented

*Acute malnutrition (wasting/ low weight-for-height):* wasting or thinness indicates in most cases a recent and severe process of weight loss, which is often associated with acute starvation and/or severe disease. Children under 5 years of age are the most exposed to risks of acute malnutrition, in particular when transitioning from exclusive breastfeeding to complementary feeding

*Balanced diet*: a diet that providers an adequate amount and variety of food to meet a person's macro and micronutrient needs for a healthy, active life

*Bioavailability:* the amount of an ingested nutrient that can be digested, absorbed and used by the body

*Biofortification:* the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology

*Chronic malnutrition (stunting/ low height for age):* a form of growth failure that causes both physical and cognitive delays in growth and development, which arises when the body is not able to absorb the sufficient amounts of nutrients (due to lack of access to adequate foods and/or to disease) to meet dietary energy and nutrient requirements over a prolonged period of time

*Complementary feeding*: nourishment of an infant with foods in addition to breastmilk or breastmilk substitutes. After six months of age, when breastmilk is no longer enough to meet the nutritional needs of the infant, complementary foods should be added to the diet of the child

*Dietary diversity*: a measure of the variety of foods from different food groups consumed by an individual or by a group over a determined period

*Macronutrients*: are the nutrients that we need to eat in relatively large amounts in our diet as they provide our bodies with energy and also the building blocks for growth and maintenance of the body.

Carbohydrates, proteins and fats are macronutrients

*Malnutrition*: a condition which occurs when a person's diet does not contain the right amount of nutrients, there are three forms of malnutrition, under nutrition, over nutrition, and micronutrient malnutrition

*Metabolism*: the range of biochemical processes that occur within a living organism to maintain life. In metabolism some substances are broken down to yield energy for vital processes while other substances, necessary for life, are synthesized

*Micronutrients*: are essential nutrients our body needs in small amounts to work properly. Vitamins and minerals are micronutrients

*Nutrient-dense crops*: crops with a high content of nutrients per gram

*OFSP*: orange-fleshed sweetpotato, high in beta-carotene the precursor to vitamin A

*Protein-Energy Malnutrition (PEM):* common macronutrient deficiency which occurs when children consume insufficient amounts of protein and energy

*Situation analysis:* first step in the social behavioural change communication (SBCC) process, helps to identify and understand the specific health issue to be addressed and provides a detailed picture of the situation

*Staple food*: a staple food is one that is eaten regularly and, in such quantities, as to constitute the dominant part of the diet and supply a major proportion of energy and nutrient needs. A staple food does not meet a population's total nutritional needs: a variety of foods is required

*Stunting*: is the impaired growth and development that children experience if they have poor nutrition, repeated infection, and inadequate psychosocial stimulation. Children are defined as stunted if their height-for-age is more than two standard deviations below the WHO Child Growth Standards median. Stunting generally occurs before age two, and effects are largely irreversible

*Wasting*: a low weight-for-height or thinness usually indicates a recent and severe process of weight loss, often associated with acute starvation and/or severe disease but can be a result of a chronic unfavourable condition. Children are defined as wasted if their weight-for-height is below minus two standard deviations from median weight-for-height of reference population

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# Appendix 4

## Appendix 4.1. Guidance Notes on How to Breastfeed Your Baby

*Source: Translated from Tanzanian Ministry of Health and Social Welfare information materials*

*What should I know?*

- Breast milk is the best food for a baby. It provides all the nutrients and water needed for growth during the first six months of life.
- Thick yellowish milk called colostrum in the first few days is very important because it protects your baby against many illnesses.
- Exclusive breastfeeding means giving your baby only breast milk without anything else (no milk from animals, no water, no other drinks or food) during the first six months, except for drugs that are advised by a doctor or nurse.
- It is very important to start breastfeeding immediately after birth, within one hour, and continue breastfeeding until your child reaches six months of age.
- HIV-positive women can transmit HIV to their baby through breastmilk, however not all children will be infected. Exclusive breastfeeding reduces the likelihood of HIV infection. To protect your child, it is important to be tested and know your HIV status.

*How do I breastfeed?*

- Start breastfeeding immediately after delivery, within one hour. When you start breastfeeding, you should hold your baby and place them to your breast carefully to avoid hurting your nipples.
- Your child's stomach should be in contact with your stomach. Make sure you support your child's whole body and not just their head. Touch the baby's lips with your nipple. Your child's mouth will open, and they will navigate quickly to the breast, if you direct their lower lip to be just below the nipple.
- Ensure a large part of the dark area surrounding the nipple enters the child's mouth. Their tongue should come out and cover the lower gums. If your child does not attach properly, or you feel any pain, try again to bring your child to the breast and attach well.
- You will recognise that your child is feeding properly when you can see the following:
  - Mouth is evenly open
  - Lower lip is protruding
  - Chin is touching the breast
  - Cheeks are rounded
- Your child may feed slowly and rest in the middle. You can hear your child swallowing milk.

*Continued breastfeeding*

- Let your baby continue to feed from one breast until they finish of their own accord. This will ensure that your child receives enough milk, with nutrients and water, then you can offer your child the other breast if they need to continue feeding.
- Breastfeed your baby frequently during the day and at night, as they request – at least ten times in 24 hours. If your child is crying and constantly seeking to be fed, do not worry. This is normal and indicates that your baby is growing.
- Breastfeeding often helps the body to produce enough milk and also prevents very full, swollen and aching breasts. Allowing your child to sleep with you will make it easy for you to breastfeed overnight.
- You can tell that your child is receiving enough milk if they are urinating at least six times a day. The urine should be a pale colour and not have a strong odour.

*How to avoid problems*

- Frequently check your child's mouth for any ulcers or wounds. If you notice any problems, visit a health facility straight away for treatment.
- Make sure your child is properly held and brought to your breast, with a large part of the dark tissue surrounding the nipple in their mouth. If you have any problems, seek advice and treatment from a health care provider.
- Try to breastfeed regularly, this will help avoid your breasts becoming overly full which can make it difficult for your child to suckle. If you are not able to breastfeed, express milk to empty your breasts. Expressed breast milk can normally be stored in a warm place for 6-8 hours, in a fridge for 24 hours or in a freezer for 72 hours.
- Feeding your child, a combination of breast milk and other dairy products, water, drinks or other foods before six months of age is **not good for your**
- **child's health**. This can reduce the amount of breast milk that your child consumes and can also cause your baby to become sick. If there are problems which make it difficult to give your child breastmilk alone, seek advice from a counsellor.

*Things to remember*

- If you experience pain or bruised nipples, this indicates that your child is not being placed properly on your breast. Breastfeeding does not cause pain. You will need to be shown how to hold your child and bring them to your breast.
- If you find bruises on your nipples, place some breast milk on them and allow it to dry. This helps to heal the bruises. Do not use anything else, like creams or tablets, unless instructed to by a health care provider.
- If you have questions about feeding your child, see a counsellor for help. Look out for symptoms of diarrhoea, fever, breathing difficulties or refusing food. If your child has any of these symptoms, take them to the health facility immediately.

# Appendix 4.2. Guidance Notes on How to Feed Your Child After it is 6 Months Old

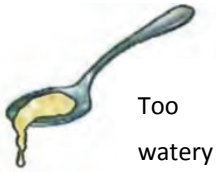
*What do I need to know?*

*Source: Translated from Tanzanian Ministry of Health and Social Welfare information materials*

- Breast milk is the only food and drink a child needs from birth until the age of 6 months. The
- child should not be given any other food or water during these first 6 months
- After the age of 6 months, an infant's need for energy and nutrients will start to exceed what is provided by breast milk, and so complementary foods are necessary to meet those needs.
- Breast milk should continue to be an important part of a child's diet until 2 years of age or beyond. When feeding a 6 to 12 months old child, always give them breast milk first before giving other foods.
- HIV-positive mothers should seek counselling on how to feed their baby and how to use preventive medications and ARVs
- Children need to be fed regularly because their stomachs are small and so they cannot eat much food at one time.

*Helping your child begin to eat*

- Give the child 1 or 2 teaspoons of soft food, twice daily. Increase the amount, thickness and types of food slowly as the child grows. To start, the baby's food should be soft, but not thin and runny.
- The child will eventually get used to eating and digesting a variety of foods, but it is important to begin slowly by eating mashed food and gradually moving to thicker and harder foods.



Too watery

Correct

- Improved porridge and baby foods with milk, roasted and crushed groundnuts, or other oil seeds.
- In addition to staples like porridge, rice, mashed bananas and potatoes, a child also needs food such as cowpeas, meat, chicken, fish or eggs every day together with leafy vegetables and fruits to obtain minerals and vitamins.
- It may help to add a little oil or sugar to baby food. Oil can help the absorption of some vitamins and enhances the flavour of the food.
- Use of malted flour, and fermented foods helps improve the foods quality and digestability.

*Safe preparation and storage of food for young children*

1. Before preparing food and feeding a child, wash your hands well using soap and clean running water. It is important to wash your hands after using the toilet and after cleaning of a child who has defecated. Also wash the child's hands before it eats.

2. Wash all utensils, pans and dishes well using clean water and washing-up soap, and then store them in a covered place. Avoid the use of bottles and teats as it can be hard to clean them properly and they can they cause the child to become ill.

3. Prepare food in a clean environment, and keep all foods covered. Give the child their food in their own bowl. Feed the child as soon as you have prepared the food. Do not give the child leftover food.

4. The child will slowly learn to feed themselves. However, they must be supervised by an adult or older child while eating to ensure they eat enough food and do not contaminate it.

*Guidelines for child feeding at different ages*

**Complementary foods for breastfeeding children at 6 months of age**
*Types of food*: porridge and well mashed foods
*Number of meals*: 2 or 3 times per day *Amount*: 2-3 spoons of food per meal

**At 6 – 9 months of age**
*Types of food*: well mashed foods
*Number of meals*: 2 or 3 times per day
*Amount*: Half (1/2) a cup each meal (1 cup = 250ml)

**At 9 - 12 months of age**
*Types of food*: Foods chopped into tiny pieces or mashed so that the child can hold them themselves
*Number of meals*: 3 to 4 times per day, plus 1-2 snacks
*Amount*: Half (1/2) a cup each meal (1 cup = 250ml)

**At 12 - 24 months of age**
*Types of food*: the same foods as eaten by the rest of family, but cut up or mashed if necessary
*Number of meals*: 3 to 4 times per day, plus 2 snacks
*Amount*: One full cup each meal (1 cup = 250ml)

*Things to remember*

- Between the ages of 6 months and 2 years' children continue to require their mother's breast milk every day, together with nutritious food for energy and health. If the child is not breastfed it will still need 2 cups (500 ml) of milk every day until 2 years or more. If you cannot get milk, see a counsellor for advice. While you wait to get milk, give your child 1 - 2 meals per day.
- Avoid giving your child drinks that are not nutritious such as tea, coffee, soda or artificial juices. Give the child a little real fruit juice.
- Any animal source milk or water that is given to a young child must be boiled then cooled first. Children of 6 months and older should be given clean water every day to satisfy their

thirst.

- Always feed the baby using a clean open cup. Avoid using bottles and teats since they are difficult to clean and can then cause the child to become ill.
- Increasing weight is a sign of good health and good nutrition. Continue to take the child to the clinic every month for health and development monitoring and immunizations (vaccines).
- If the child is sick they should be fed small meals more frequently and be given lots to drink, breast milk or other dairy products. Feed the child a variety of foods that they like. As they recover increase the amount of food and number of meals again.

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