FCRN Food Climate Research Network

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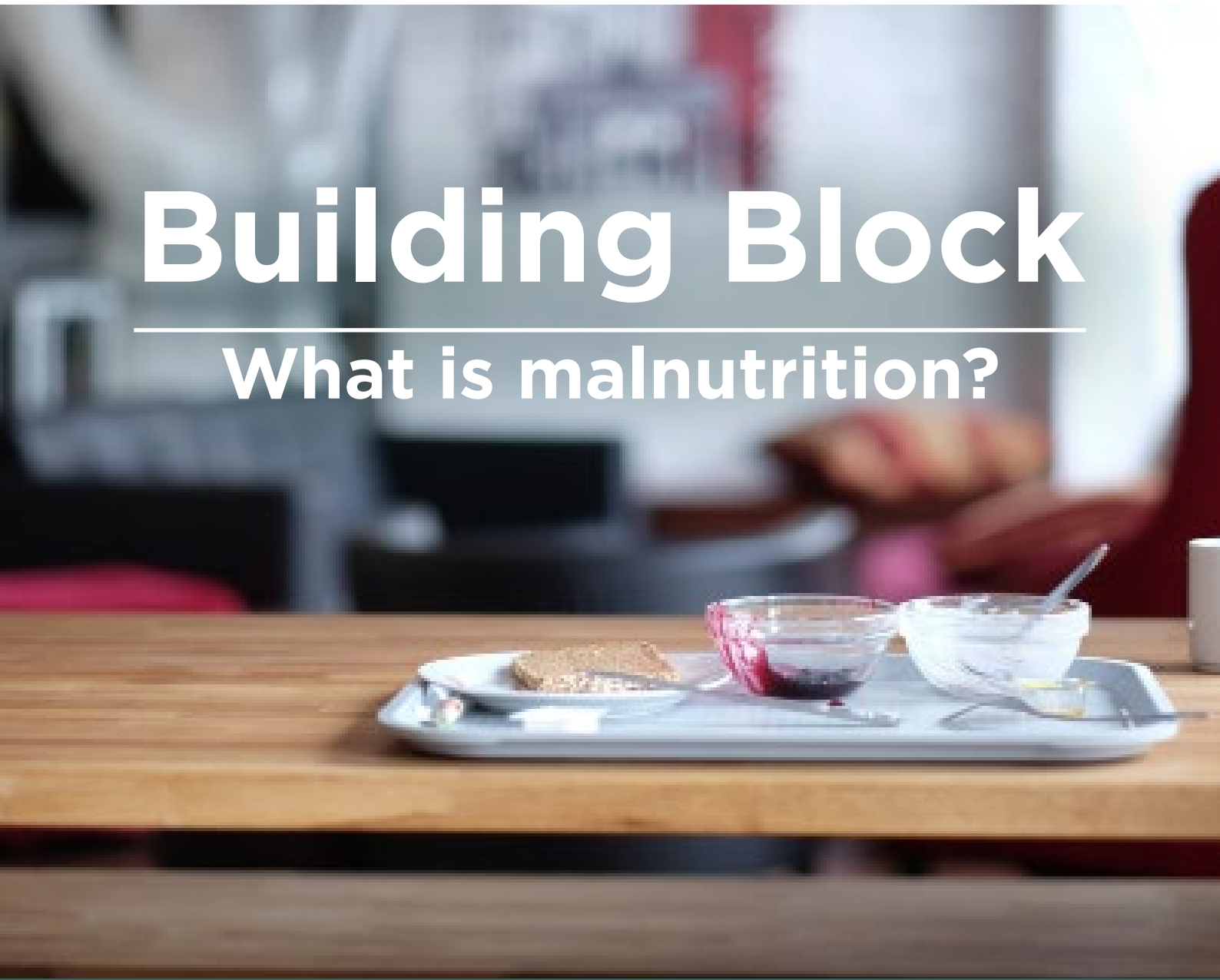
FCRN foodsource

A free and evolving resource to empower informed discussion on sustainable food systems



Building Block

What is malnutrition?

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Contents

Why should you read this building block?

People need to be able to obtain and utilise a healthy amount and balance of nutrients. Without this, they can suffer severe impacts to their health and well-being. This building block explains malnutrition and its causes, prevalence and consequences.

Definitions

Malnutrition: deficiencies, excesses or imbalances in the energy, macronutrients or micronutrients that a person obtains, either because their diet is lacking or because their body is not able to fully absorb the nutrients from the foods eaten, e.g. due to illness[1–3].

Undernutrition: deficiencies of a particular component of food, usually due to insufficient intake and/or absorption of that component. This usually refers to energy (often measured in calories) or macronutrients (such as protein, carbohydrates, or fat), but can also refer to micronutrients (vitamins or minerals)[2].

Overnutrition: excesses of energy or a particular nutrient. Overnutrition generally refers to excessive intake of energy, but it can sometimes be used to refer to excessive intake of one or more other dietary components such as specific macronutrients or micronutrients. Overnutrition in terms of energy often results in being overweight or obese[2].

Macronutrients: fats, proteins and carbohydrates (starch, fibre, sugar) that are needed for a wide range of bodily functions and processes[2].

Micronutrients: vitamins and minerals required by the body in smaller amounts for good health[2].

Micronutrient deficiency: not getting enough of one or more micronutrients. This can happen even if a person is getting sufficient energy from their diet[2].

Multiple burden of malnutrition: the simultaneous presence of more than one form of malnutrition in an individual, household or population[4,5].

Non-communicable diseases: non-communicable diseases are diseases which are not passed from person to person. They are often long lasting and generally progress slowly. Examples include cardiovascular diseases, cancer, chronic respiratory diseases and diabetes[6]. Unhealthy diets are one of the major risk factors for non-communicable diseases[7].

1. Introduction

Malnutrition is a major driver of death and disease worldwide. Both consuming too much food and not getting enough cause problems and are exacerbated by inequalities in access to food of sufficient quality and quantity, despite the world producing enough food to feed everyone an adequate diet[8]. The effects of ***malnutrition*** are wide-ranging, from suboptimal health for individuals to widespread, severe deprivation and extreme suffering, such as in famines.

This building block will explore what malnutrition is and why it is a problem in all its forms, for both individuals and society.

2. What is malnutrition?

Malnutrition has been defined in various ways.

The World Health Organisation (***WHO***)[1] defines malnutrition as: "Deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients."

The United Nations Children's Fund (UNICEF)[2] says: "People are malnourished if their diet does not provide adequate nutrients for growth and maintenance or if they are unable to fully utilize the food they eat due to illness (***undernutrition***). They are also malnourished if they consume too much energy (***overnutrition***)."

The Food and Agriculture Organisation of the United Nations (***FAO***) gives the following definition[3]: "Malnutrition results from deficiencies, excesses or imbalances in the consumption of macro- and/or ***micronutrients***."

In short, malnutrition occurs when there are deficiencies, excesses or imbalances in the energy, macronutrients or micronutrients that a person obtains. This might happen because:

- Their diet does not contain a sufficient variety of foods to provide nutrients in the appropriate amounts, either providing less than or more than is appropriate[2].
- Their body is unable to absorb or make use of certain nutrients optimally[2]. For example, various intestinal worms can cause loss of iron and protein and decreased absorption of nutrients[9]. Diarrhoea due to poor sanitation can also lead to poor absorption of nutrients[10].
- Their body loses too much of particular nutrients, even if the nutrients are present in the diet. For example, heavy menstrual bleeding can cause high iron loss.

A state of balanced nutrition requires suitable levels of many different nutrients in a diet, depending on individual bodily requirements. Malnutrition therefore takes many different forms, as people can consume inappropriate levels of various nutritional components. Nutrients can have maximum appropriate levels (e.g. added sugar[11]), minimum required levels (e.g. fibre[12]), or both minimum and maximum recommended limits (e.g. many vitamins and minerals[13]). Nutrients to which malnutrition can apply include:

- Total energy, often measured in calories.
- Macronutrients, which comprise:
    - Protein
    - Fat
    - Carbohydrate (which includes starch, fibre and sugar)
- Micronutrients – both vitamins and minerals. Examples of micronutrients include:
    - Vitamin A
    - Iron
    - Iodine

Overnutrition means that there is too much of a component, and undernutrition means that there is not enough.

3. What are the effects of malnutrition?

Malnutrition can cause ill health and severely affect people's lives in many ways. This can have knock-on social and economic effects. Globally, malnutrition is estimated to cost the economy around 5% of economic output, an estimate that only accounts for lost labour productivity and direct healthcare costs[14].

3.1 What are the effects of undernutrition?

The effects of undernutrition are widespread and can impact whole communities. Undernutrition kills: in 2011, 45% of deaths in children under 5 years were linked to malnutrition[15], a figure cited in the Global Nutrition Report 2016[16].

Undernutrition can increase people's susceptibility to other forms of ill health. For example, being underweight can weaken the immune system[17,18].

The cost of undernutrition and ***micronutrient deficiencies*** to the global economy, measured in terms of healthcare costs and productivity losses, could be around 2-3% of economic output[14]. Certain individual countries can be more strongly affected, e.g. child undernutrition is estimated to cost the Democratic Republic of Congo around 4.5% of its GDP[19] and Malawi 10.3% of its GDP[20].

Undernutrition in the form of hunger and macronutrient deficiencies

People who don't obtain enough energy to enable them to maintain their body weight and carry out any necessary physical activity are at risk of ill health. The FAO calculates the threshold for undernourishment (its measure of hunger) based on the proportion of people in a country not getting enough energy to conduct "sedentary or light activities"[3]. The threshold varies between countries, ranging from 1,650 to more than 1,900 kilocalories per day, depending on the population's composition by age and sex[21]. However, many people work in physically demanding jobs and will therefore need more energy than this if they are to avoid hunger[21,22].

Energy deficiency can cause problems with growth such as wasting (a person being too thin for their height by more than two standard deviations compared to the reference population[23]), stunting (a child being too short for their age by more than two standard deviations compared to the reference population[23]) and underweight (in children, underweight means having a low weight for one's age by more than two standard deviations compared to the reference population[23]; in adults, underweight means having a Body Mass Index below 18.5 – Body Mass Index is a metric that accounts for both the height and weight of the individual[17]).

The burden of health problems can be measured in various ways, including the numbers of people affected and the number of lost Disability-Adjusted Life Years (***DALYs***)[24]. One DALY can be thought of as one lost year of healthy life[25]. In 2016, around 2.3 billion years of healthy life were lost to all causes[26].

Child wasting affected 51 million children under 5 years old, worldwide, in 2017[27] and caused 3.6% of DALYs in 2016[28]. Child stunting affected 151 million children under 5 years old, worldwide, in 2017[27] and caused 0.6% of DALYs in 2016[28]. Child underweight caused 1.4% of DALYs in 2016[28]. Stunting is linked to the disruption of healthy brain development[29].

As well as hunger arising from insufficient energy intake, deficiency in protein can lead to kwashiorkor (swelling under the skin and loss of muscle mass), marasmus (loss of fat and muscle) and sarcopenia (loss of muscle mass, particularly in older people). 12% of the global population is estimated to be currently at risk of protein deficiency[30]. Protein-energy malnutrition causes 0.9% of globally lost healthy years of life[28].

Hunger can keep people trapped in a cycle of poverty, while poverty also drives hunger. Being less able to work because of illness and a lack of energy, hungry people are less able to earn money to buy enough food, invest in farming or maintain sanitary living conditions. Undernourishment also undermines physical and cognitive development, adding to the cycle of poverty. Chronically malnourished children often grow up to have low incomes as adults, increasing their likelihood of remaining poor and hungry[31].

To read more about ***food security*** and how it relates to malnutrition, see the Foodsource building block What is food security?

Undernutrition in the form of micronutrient deficiencies

Globally, more than 2 billion people have at least one chronic micronutrient deficiency[29,32]. Two of the most serious micronutrient deficiencies worldwide are iron and iodine, affecting roughly 2 billion people each[33,34]. Vitamin A deficiency is also important: between 1995 and 2005, 33% of preschool-age children and 15% of pregnant women were estimated to be at risk, with particularly high prevalence in Africa and South-East Asia, for preschool-age children, and Western Pacific and South-East Asia, for pregnant women[35].

Some examples of different forms of micronutrient deficiency are given in the table below[1,36].

Deficient component	Health effects	More information
Calcium	Osteoporosis (brittle bones) Rickets (soft bones) Tetany (muscle spasms)	One paper estimates that around 3.5 billion people are at risk of calcium deficiency, due to inadequate dietary supply of calcium[32]. 0.14% of global DALYs are attributed to a diet low in calcium (note, however, that this may be an underestimate: in the data source, all of these DALYs are due to colon and rectum cancer; no DALYs from other known side-effects of calcium deficiency, such as rickets, appear to be included)[28].
Iodine	Goitre (swelling in the neck)	Nearly 2 billion people are estimated to have insufficient iodine intake[33]. 0.13% of global DALYs are attributed to iodine deficiency[28].
Iron	Anaemia (lack of healthy red blood cells)	2 billion people worldwide are anaemic, many due to iron deficiency[34]. 1.45% of global DALYs are attributed to dietary iron deficiency[28].
Zinc	Halting of growth Weakened immune system	1.1 billion people are estimated to be at risk of zinc deficiency due to inadequate dietary supply of zinc[32]. 0.095% of global DALYs are attributed to zinc deficiency[28].

Vitamin A	Night blindness Impaired immune system	33% of preschool-age children and 15% of pregnant women were estimated to be at risk of Vitamin A deficiency between 1995 and 2005[35]. 0.17% of global DALYs are attributed to vitamin A deficiency[28]. Many countries have little data or outdated data[37].
Thiamine (Vitamin B1)	Beriberi (damage to heart or nerves)	More prevalent in East Asian countries because of consumption of milled rice and raw fish[38].
Folic acid (Vitamin B9)	Megaloblastic anaemia Neurological disorders, e.g. spina bifida	Spina bifida affects 1 per 1000 births worldwide[39].
Vitamin B12	Megaloblastic anaemia Neurological disorders	Unknown global prevalence due to insufficient data. Risk factors include lack of animal products in the diet and poor absorption due to aging or infection[40].
Vitamin C	Scurvy (tiredness, weakness and joint pain)	Rare in developed countries but still sometimes found in developing countries or refugee camps[41].

3.2 What are the effects of excess calorie intake?

If a person consumes more energy than they need, they can become overweight or obese[42]. As a rough guide, for adults, overweight refers to having a body mass index of 25 or more, but less than 30, and obesity refers to having a body mass index of 30 or more[43–45].

Overweight and obesity increase the risk of many ***non-communicable diseases***, including heart disease, stroke, some cancers, type 2 diabetes and musculoskeletal disorders such as osteoarthritis[45–49].

A review study found that the risk of premature death (totalled across all causes) increases as a person's body mass index increases above 25 (the risk of premature death also increases for a body mass index below 20)[50]. In 2015, around 4 million deaths were attributed to overweight and obesity, of which nearly 40% were in people who were overweight but not obese. Most of these 4 million deaths were due to cardiovascular disease[51].

The economic effects of obesity and resultant diseases can include greater healthcare costs, loss of income, absence from work and higher disability insurance premiums[16,49,52].

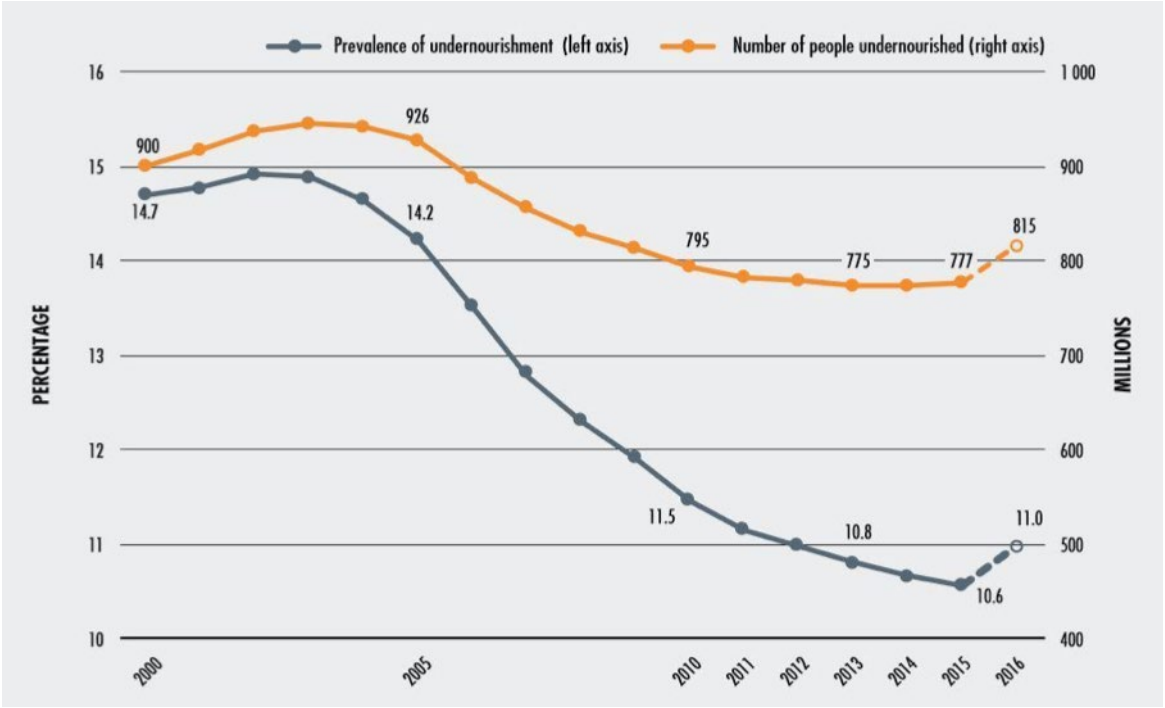
As well as consequences that follow directly from being overweight, prejudice in society can lead to people who are overweight suffering from negative social effects. These effects include discrimination, bullying, avoidance of healthcare services due to perceived bias, lower wages and higher social isolation[49,53]. In contrast, however, overweight can be regarded as a status symbol in some countries, including many sub-Saharan African countries[54].

Overnutrition is also sometimes used to refer to excessive intake of a particular macronutrient or micronutrient. For example, eating a lot of sugar can increase the risk of tooth decay[55], too much saturated fat can increase the risk of heart disease[56] and too much selenium can cause selenosis, affecting hair and nails[57].

4.Who is malnourished?

4.1 Who is undernourished?

In 2016, 800 million people did not get enough energy, i.e. suffered from hunger[16]. While both the proportion and absolute number of undernourished (as in hungry) people have fallen since the early 2000s, the number of undernourished people may have risen slightly in recent years, as shown below. The rise has been attributed to several factors, including conflicts, droughts and economic slowdowns[4].

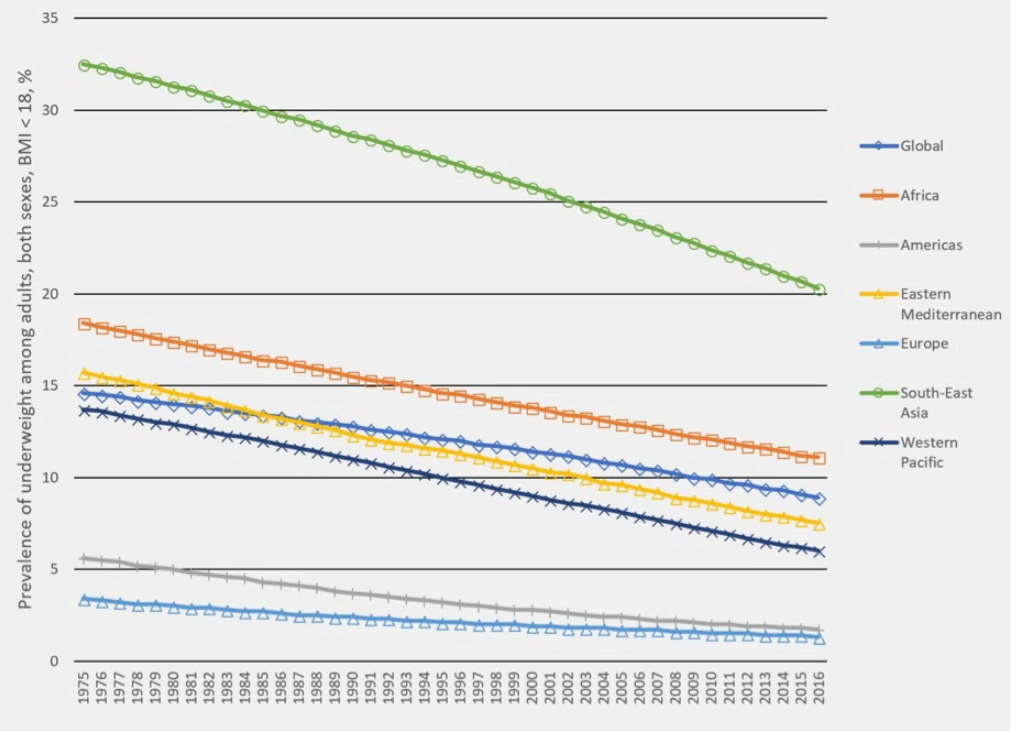


The number of undernourished people has been on the rise since 2014, reaching an estimated 815 million in 2016. Figure shows prevalence and number of undernourished people in the world, 2000–2016. Undernourishment in this case refers to insufficient energy intake. Figures for 2016 are projected estimates. Image source[4]: FAO, IFAD, UNICEF, WFP and WHO. 2017. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome, FAO. © FAO 2017

Hunger is most severe in some sub-Saharan African countries and is also moderately widespread in some parts of Asia, parts of the Middle East and some central and south American countries[58]. As shown below, Africa has the highest proportion of undernourished people, but Asia has the most undernourished people in absolute terms. Some people in relatively wealthy countries are also hungry. For example, 3% of the UK population was estimated to be undernourished (as in hungry) in 2015[59].

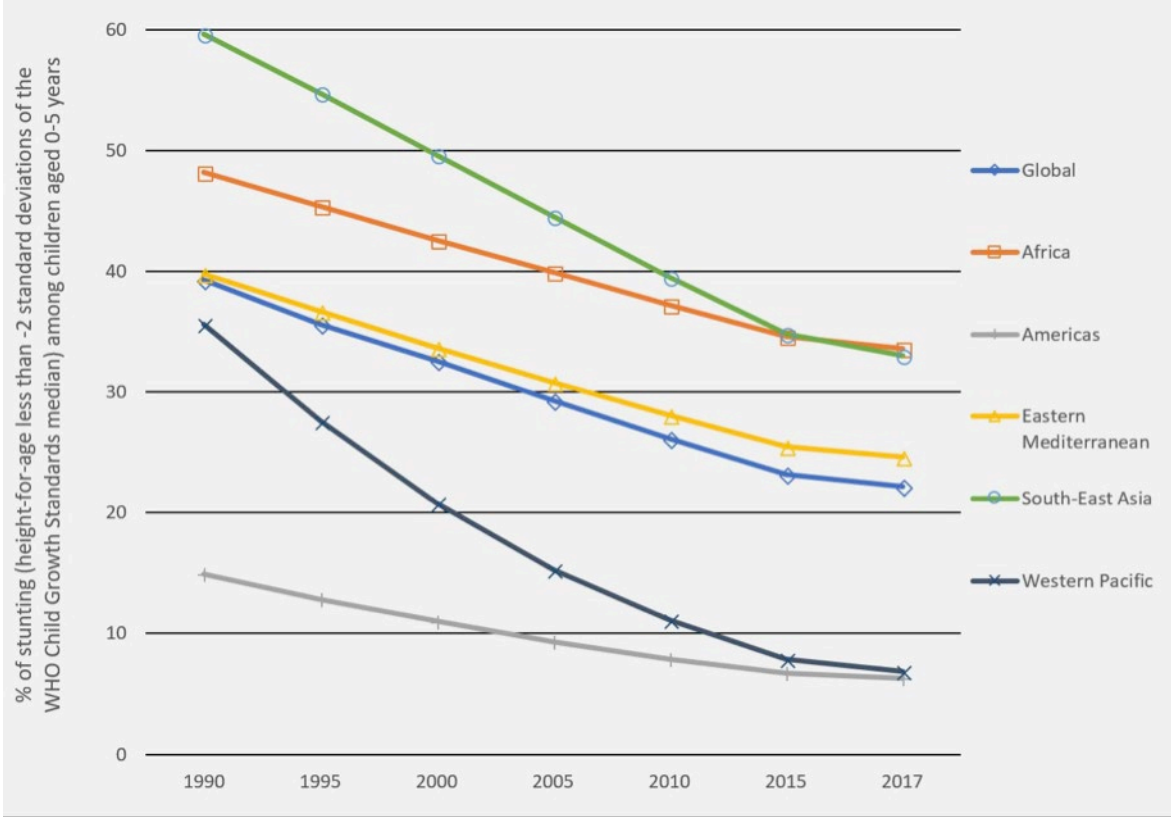
The prevalence of undernourishment is highest in Africa; the absolute number of undernourished people is largest in Asia. Figure shows comparison of prevalence and number of undernourished people by region. The size of the circles represents the number of undernourished people in millions, as labelled. Undernourishment in this case refers to insufficient energy intake. Figures for 2016 are projected values. Image source[4]: FAO, IFAD, UNICEF, WFP and WHO. 2017. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome, FAO. © FAO 2017

Undernourishment (as insufficient energy or macronutrient intake) can lead to underweight, i.e. low Body Mass Index. The proportion of adults with a Body Mass Index less than 18 is currently highest in South-East Asia and has been falling across all regions since 1975, as shown below.



Prevalence of underweight among adults 18+ years of age, measured by BMI < 18, by WHO region, both sexes, 1975 to 2016. Prevalence is defined as % of the relevant population. This is the crude estimate (as opposed to the age-standardised estimate). Data source[60]: World Health Organization. 2017. Global Health Observatory data repository - Prevalence of underweight among adults, BMI < 18, crude - Estimates by WHO region. Graph prepared by the Food Climate Research Network.

Chronic malnutrition leading to stunting (low height for age) has particularly serious consequences for future health when it happens in young children[61]. The prevalence of stunting in children aged 0 to 5 years has been falling across all regions since 1990. Child stunting is currently most prevalent in Africa and South-East Asia, as shown below.



Prevalence of child stunting (height-for-age less than -2 standard deviations of the WHO Child Growth Standards median) as a percentage of children aged 0-5 years, 1990 to 2017. The data source does not include Europe. Data source[62]: World Health Organization. 2018. Global Health Observatory data repository - Global and regional trends by WHO Regions, 1990-2025 - Stunting: 1990-2025. Graph prepared by the Food Climate Research Network.

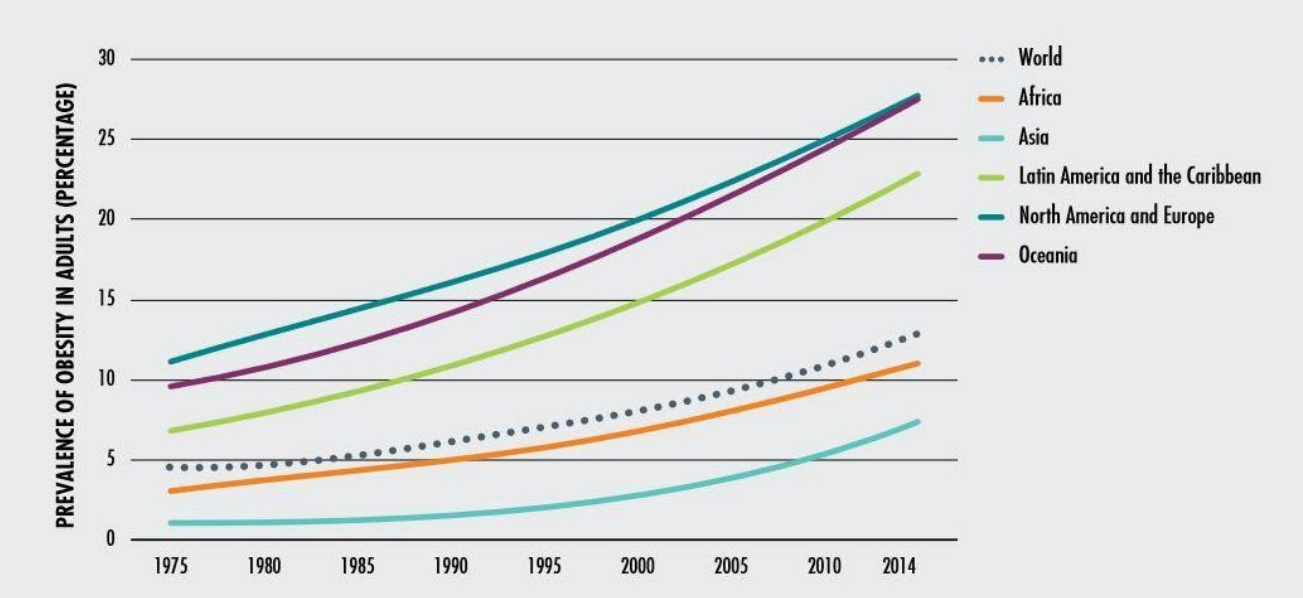
Around 2 billion people suffer from micronutrient deficiencies[29]. In 2006, WHO found that micronutrient deficiencies were widespread in industrialised countries, but even more common in developing countries. Young children and women of reproductive age are at high risk compared to other demographic groups. Anaemia was found to be particularly prevalent in South-East Asia (at 57% of the population), Africa (46%) and the Eastern Mediterranean (45%), and lowest in Europe (10%). Insufficient iodine intake was particularly prevalent in Europe (57%) and the Eastern Mediterranean (54%), and lowest in the Americas (10%)[40].

4.2 Who is overweight or obese?

In 2016, more than 1.9 billion adults (39% of adults) were overweight. Of these, over 650 million (13% of adults) were obese[49]. Furthermore, 41 million children under 5 and 340 million people aged between 5 and 19 were overweight or obese[45].

The percentage of overweight adults varies highly between countries, ranging from, for example, 18% in Vietnam to 89% in Nauru (these figures are age-standardised estimates for 2016). Countries with a high percentage of overweight people can be found across the world, including Saudi Arabia (70%), the United States of America (68%), Mexico (65%), Australia (65%), the United Kingdom (64%) and Argentina (63%)[63].

Adult obesity is rising on all continents, as shown below.



Adult obesity is rising everywhere at an accelerating pace. Figure shows prevalence of obesity in adults 18 years and over, 1975–2014. Image source[4]: FAO, IFAD, UNICEF, WFP and WHO. 2017. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome, FAO. © FAO 2017

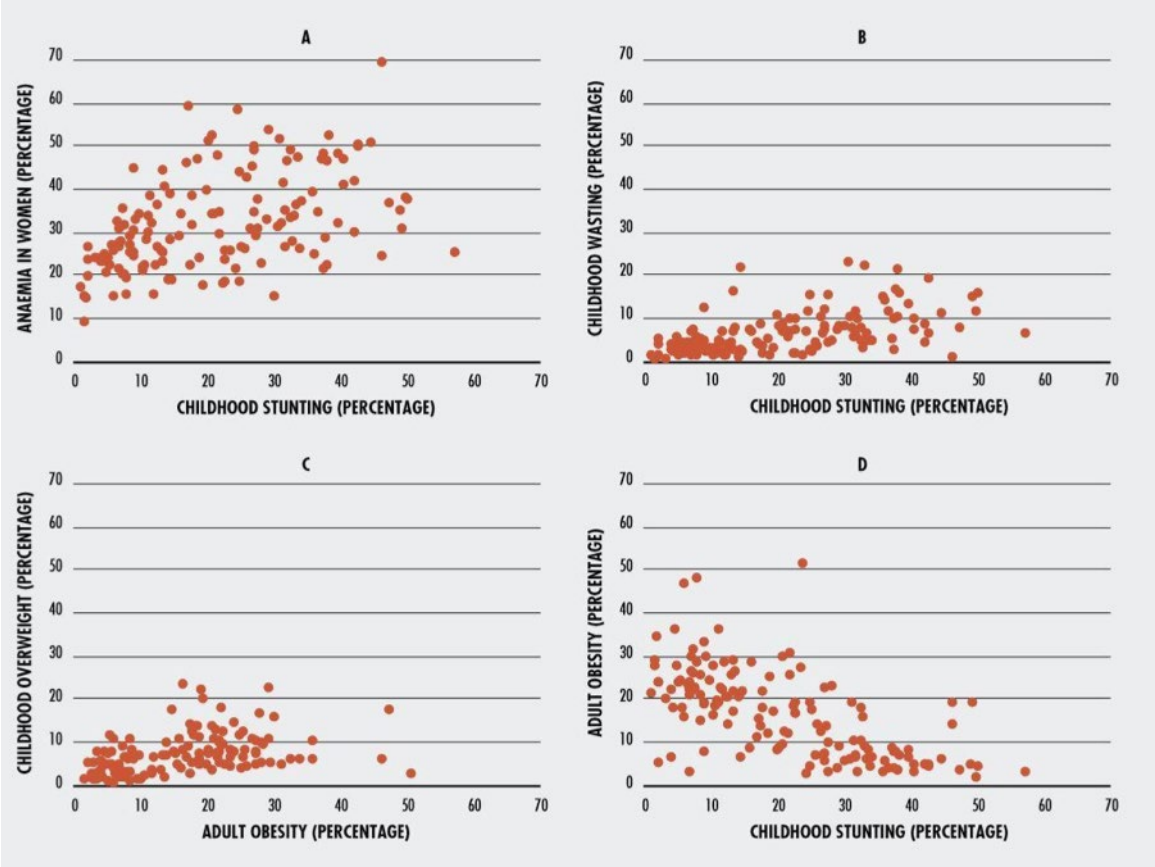
In low- and middle-income countries, obesity is generally highest in urban areas[64]. In low income countries, people with a higher socioeconomic status are more likely to be obese than people with a lower socioeconomic status. This is true of both men and women. In middle income countries, obesity has a mixed correlation with socioeconomic status for men while obesity and socioeconomic status are negatively correlated for women[65].

4.3 Where are multiple forms of malnutrition found?

The "multiple burden" of malnutrition refers to more than one form of malnutrition present in the same individual, household or population[4,5]. 88% of countries for which there are data are simultaneously experiencing serious burdens of either two or three of the following forms of malnutrition: childhood stunting, anaemia in women of reproductive age and overweight in adult women[29]. The figure below illustrates this.

Number of countries facing burdens of malnutrition. Image source[29]: Development Initiatives. Global Nutrition Report 2017: Nourishing the SDGs. (2017). The International Food Policy Research authorises the use of this material subject to the terms and conditions on its website.

Section D of the figure below shows that, while adult obesity and childhood stunting are inversely correlated, they are often present in the same country.



Most countries experience multiple forms of malnutrition. Image source[29]: FAO, IFAD, UNICEF, WFP and WHO. 2017. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome, FAO. © FAO 2017

It is also possible for an individual to simultaneously have more than one form of malnutrition[1]. For example, they could be overweight because of excess energy intake, but deficient in iron because of insufficient intake or absorption of iron[66].

Recommended resources

To learn more about this topic we recommend:

- Report: 2016 Global Nutrition Report - Unicef Data
- Report: The State of Food Security and Nutrition in the World 2017, by FAO, IFAD, UNICEF, WFP and WHO
- World Health Organisation - What is malnutrition?
- FAO - Help eliminate hunger, food insecurity and malnutrition
- United Nations World Food Programme - What Causes Hunger?
- Graphic: UN WFP - Hunger Map 2015 (PDF link)
- In pictures: Hungry Planet: What the World Eats
- Book: Stuffed and Starved, by Raj Patel (2009)
- Online courses: Nutrition and Health: Macronutrients and Overnutrition and Nutrition and Health: Micronutrients and Malnutrition by Wageningen University
- Online resource from Our World In Data: Hunger and Undernourishment, by Max Roser and Hannah Ritchie (2018)
- Data visualisation from Global Burden of Disease: GBD Compare
- Book: Hidden Hunger, by Hans Konrad Biesalski (2013)

Glossary

Disability-adjusted Life Years
Disability-Adjusted Life Years (DALYs) are a way of measuring the burden of ill health. One DALY can be thought of as one lost year of healthy life. Across a population, DALYs are calculated by adding together years of life during which illness is experienced, weighted according to the severity of the illness, and years of life lost to premature mortality.

Food security
Food security is an idealised state or goal where all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Macronutrients
Fats, proteins and carbohydrates (starch, fibre, sugar) that are needed for a wide range of bodily functions and processes.

Malnutrition
Deficiencies, excesses or imbalances in the energy, macronutrients or micronutrients that a person obtains, either because their diet is lacking or because their body is not able to fully absorb the nutrients from the foods eaten, e.g. due to illness. Malnutrition is an umbrella term that includes overnutrition (an excess of food energy), undernutrition (a lack of food energy and macronutrients such as protein), and micronutrient deficiencies (insufficient micronutrients such as iron, vitamin A or iodine).

Micronutrients
Micronutrients are minerals (e.g. iron) and organic compounds (e.g. vitamin A) found in food, which the body requires in very small amounts to produce substances such as enzymes and hormones. They are essential for proper growth, development and bodily functioning. Essential micronutrients are those that cannot be synthesised by the body and so must be obtained through diet.

Micronutrient deficiencies
Micronutrient deficiencies result from a diet lacking the essential vitamins and minerals that humans require in small amounts for proper growth, development, and bodily functioning. These include iodine, calcium, iron, zinc, and vitamins A, B, and C, among others. Micronutrient deficiencies are the cause of a range of diseases affecting physical and mental development, and can increase susceptibility to infectious diseases.

Non-communicable diseases
Non-communicable diseases are diseases which are not passed from person to person. They are often long lasting and generally progress slowly. Examples include cardiovascular diseases, cancer, chronic respiratory diseases and diabetes. Unhealthy diets are one of the major risk factors for non-communicable diseases.

Overnutrition
Excesses of energy or a particular nutrient. Overnutrition generally refers to excessive intake of energy, but it can sometimes be used to refer to excessive intake of one or more other dietary components such as specific macronutrients or micronutrients. Overnutrition in terms of energy often results in being overweight or obese.

The Food and Agriculture Organisation (FAO)
The Food and Agriculture Organisation is a specialised agency of the United Nations. It is dedicated to leading international efforts to defeat hunger worldwide.

The World Health Organisation (WHO)
The World Health Organisation is a specialised branch of the United Nations. It is dedicated to improving public health worldwide.

Undernutrition
Deficiencies of a particular component of food, usually due to insufficient intake and/or absorption of that component. This usually refers to energy (often measured in calories) or macronutrients (such as protein, carbohydrates, or fat), but can also refer to micronutrients (vitamins or minerals).

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