



A REVIEW ON MANAGEMENT OF MALNUTRITION AND DEFICIENCY STATES

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ABSTRACT

Malnutrition is the condition that results from taking an unbalanced diet in which certain nutrients are lacking, in excess (too high an intake), or in the wrong proportions. A number of different nutrition disorders may arise, depending on which nutrients are under or overabundant in the diet. In most of the world, malnutrition is present in the form of undernutrition, which is caused by a diet lacking adequate calories and protein. While malnutrition is more common in developing countries, it is also present in industrialized countries. In wealthier nations it is more likely to be caused by unhealthy diets with excess energy, fats, and refined carbohydrates. A growing trend of obesity is now a major public health concern in lower socio-economic levels and in developing countries as well.

Key words: Malnutrition, Clinical signs, Mortality.

INTRODUCTION

The World Health Organization cites malnutrition as the greatest single threat to the world's public health. Improving nutrition is widely regarded as the most effective form of aid. Emergency measures include providing deficient micronutrients through fortified sachet powders or directly through supplements. WHO, UNICEF, and the UN World Food Programme recommend community management of severe acute malnutrition with ready-to-use therapeutic foods, which have been shown to cause weight gain in emergency settings. The famine relief model increasingly used by aid groups calls for giving cash or cash vouchers to the hungry to pay local farmers instead of buying food from donor countries, often required by law, to prevent dumping hurting local farmers.

Long term measures include fostering nutritionally dense agriculture by increasing yields, while making sure negative consequences affecting yields in the future are minimized. Recent efforts include aid to farmers. However, World Bank strictures restrict government subsidies for farmers, while the spread of fertilizer use may adversely affect ecosystems and human health and is hampered by various civil society groups.

Malnutrition has shown to be an important concern in women, children, and the elderly. Because of pregnancies and breastfeeding, women have additional nutrient requirements. Children can be at risk for malnutrition even before birth, as their nutrition levels are directly tied to the nutrition of their mothers. Breastfeeding can reduce rates of malnutrition and mortality in children, and educational programs for mothers could have a large impact on these rates. The elderly have a large risk of malnutrition because of unique complications such as changes in appetite and energy level, and chewing and swallowing problems. Adequate elderly care is essential for preventing malnutrition, especially when the elderly cannot care for themselves.

Malnutrition is a medical condition caused by an improper or insufficient diet. Malnutrition is technically a category of diseases that includes: undernutrition, obesity and overweight, and micronutrient deficiency among others. However it is frequently used to mean just undernutrition from either inadequate calories or inadequate specific dietary components for whatever reason.

People who are malnourished may:

- not consume adequate calories and protein for growth and maintenance, (undernutrition or protein-energy malnutrition)
- consume too many calories (overnutrition)
- have abnormal nutrient loss (due to diarrhoea or chronic illness) or increased energy expenditure (secondary malnutrition)

Undernutrition encompasses stunting, wasting, and deficiencies of essential vitamins and minerals (collectively referred to as micronutrients). The term hunger, which literally describes a feeling of discomfort from not eating, has also been used to describe undernutrition, especially in reference to food insecurity. The term severe malnutrition is often used to refer specifically to protein-energy malnutrition. Protein-energy malnutrition (PEM) is often associated with micronutrient deficiency. Two forms of protein-energy malnutrition are kwashiorkor and marasmus, and they commonly coexist. Kwashiorkor ('displaced child') is mainly caused by inadequate protein intake resulting in a low concentration of amino acids. The main symptoms are oedema, wasting, liver enlargement, hypoalbuminaemia, steatosis, and possibly depigmentation of skin and hair. Kwashiorkor is identified by swelling of the extremities and belly, which is deceiving of actual nutritional status.

Marasmus is caused by an inadequate intake of both protein and energy. The main symptoms are severe wasting, leaving little or no oedema, minimal subcutaneous fat, severe muscle wasting, and non-normal serum albumin levels. Marasmus can result from a sustained diet of inadequate energy and protein, and the metabolism adapts to prolong survival. It is traditionally seen in famine, food restriction, or anorexia. Conditions are characterized by extreme wasting of the muscles and a gaunt expression [1].

Classification

In 1956, Gómez and Galvan studied factors associated with death in a group of malnourished children in a hospital in Mexico City, Mexico and defined categories of malnutrition: first, second, and third degree. The degrees were based on weight below a specified percentage of median weight for age. The risk of death increases with increasing degree of malnutrition. An adaptation of Gomez's original classification is still used today. While it provides a way to compare malnutrition within and between populations, the classification has been criticized for being arbitrary and for not considering overweight as a form of malnutrition. Also, height alone may not be the best indicator of malnutrition; children who are born prematurely may be considered short for their age even if they have good nutrition.

Degree of PEM % of desired body weight for age and sex

Normal 90%-100%

Mild: Grade I (1st degree) 75%-89%
 Moderate: Grade II (2nd degree) 60%-74%
 Severe: Grade III (3rd degree) <60%

Waterlow

In a paper titled Classification and Definition of Protein-Calorie Malnutrition, John Conrad Waterlow established a new classification for malnutrition. Instead of using just weight for age measurements, the classification established by combines weight-for-height (indicating acute episodes of malnutrition) with height-for-age to show the stunting that results from chronic malnutrition. Waterlow was the chair of human nutrition at the London School of Hygiene and Tropical Medicine from 1970 to 1982, and was considered an expert on severe malnutrition and malnutrition in children. One advantage of the Waterlow classification over the Gomez classification is that weight for height can be examined even if ages are not known.

Degree of PEM - Stunting (%) Height for age - Wasting (%) Weight for height

Normal: Grade 0 - >95% - >90%
 Mild: Grade I - 87.5-95% - 80-90%
 Moderate: Grade II - 80-87.5% - 70-80%
 Severe: Grade III - <80% - <70%

These classifications of malnutrition are commonly used with some modifications by WHO.

Effects

Malnutrition increases the risk of infection and infectious disease, and moderate malnutrition weakens every part of the immune system. For example, it is a major risk factor in the onset of active tuberculosis. Protein and energy malnutrition and deficiencies of specific micronutrients (including iron, zinc, and vitamins) increase susceptibility to infection. Malnutrition affects HIV transmission by increasing the risk of transmission from mother to child and also increasing replication of the virus. In communities or areas that lack access to safe drinking water, these additional health risks present a critical problem. Lower energy and impaired function of the brain also represent the downward spiral of malnutrition as victims are less able to perform the tasks they need to in order to acquire food, earn an income, or gain an education.

Clinical signs of malnutrition

Site - Signs & symptoms

Face - Moon face (kwashiorkor, simian facies (marasmus))
 Eye - Dry eyes, pale conjunctiva, Bitot's spots (vitamin A), periorbital edema, Mouth Angular stomatitis, cheilitis, glossitis, spongy bleeding gums (vitamin C), parotid enlargement
 Teeth - Enamel mottling, delayed eruption

Hair - Dull, sparse, brittle hair, hypopigmentation, flag sign (alternating bands of light and normal color), broomstick eyelashes, alopecia

Skin - Loose and wrinkled (marasmus), shiny and edematous (kwashiorkor), dry, follicular hyperkeratosis, patchy hyper- and hypopigmentation, erosions, poor wound healing

Nail - Koilonychia, thin and soft nail plates, fissures or ridges

Musculature - Muscles wasting, particularly in the buttocks and thighs

Skeletal - Deformities usually a result of calcium, vitamin D, or vitamin C deficiencies

Abdomen - Distended - hepatomegaly with fatty liver, ascites may be present

Cardiovascular - Bradycardia, hypotension, reduced cardiac output, small vessel vasculopathy

Neurologic - Global development delay, loss of knee and ankle reflexes, impaired memory

Hematological - Pallor, petechiae, bleeding diathesis

Behavior - Lethargic, apathetic [2]

Mortality

According to Jean Ziegler, mortality due to malnutrition accounted for 58 percent of the total mortality in 2006: In the world, approximately 62 million people, all causes of death combined, die each year. One in twelve people worldwide is malnourished. In 2006, more than 36 million died of hunger or diseases due to deficiencies in micronutrients.

According to the World Health Organization, malnutrition is by far the biggest contributor to child mortality, present in half of all cases. Six million children die of hunger every year. Underweight births and intrauterine growth restrictions cause 2.2 million child deaths a year. Poor or non-existent breastfeeding causes another 1.4 million. Other deficiencies, such as lack of vitamin A or zinc, for example, account for 1 million. Malnutrition in the first two years is irreversible. Malnourished children grow up with worse health and lower educational achievements. Their own children also tend to be smaller. Malnutrition was previously seen as something that exacerbates the problems of diseases as measles, pneumonia and diarrhea. But malnutrition actually causes diseases as well, and can be fatal in its own right.

Psychological

Malnutrition in the form of iodine deficiency is the most common preventable cause of mental impairment worldwide. Even moderate iodine deficiency, especially in pregnant women and infants, lowers intelligence by 10 to 15 I.Q. points, shaving incalculable potential off a nation's development. The most visible and severe effects — disabling goiters, cretinism and dwarfism — affect a tiny minority, usually in mountain villages. But 16 percent of

the world's people have at least mild goiter, a swollen thyroid gland in the neck.

Iron deficiency anemia in children under two years of age likely affects brain function acutely and probably also chronically. Folate deficiency has been linked to neural tube defects. Protein-calorie malnutrition can cause cognitive impairments. For humans, critical period varies from the final third of gestation to the first 2 years of life.

Nutritional supplement treatment may be appropriate for major depression, bipolar disorder, schizophrenia, and obsessive compulsive disorder, the four most common mental disorders in developed countries. Supplements that have been studied most for mood elevation and stabilization include eicosapentaenoic acid and docosahexaenoic acid (each of which are an omega-3 fatty acid contained in fish oil, but not in flaxseed oil), vitamin B12, folic acid, and inositol [3].

Impact on learning

Research indicates that improving the awareness of nutritious meal choices and establishing long-term habits of healthy eating has a positive effect on a cognitive and spatial memory capacity, potentially increasing a student's potential to process and retain academic information.

Some organizations have begun working with teachers, policymakers, and managed food service contractors to mandate improved nutritional content and increased nutritional resources in school cafeterias from primary to university level institutions. Health and nutrition have been proven to have close links with overall educational success. Better nourished children often perform significantly better in school, partly because they enter school earlier but mostly because of greater learning productivity per year of schooling. There is limited research available that directly links a student's Grade Point Average (G.P.A.) to their overall nutritional health. Additional substantive data is needed to prove that overall intellectual health is closely linked to a person's diet, rather than just another correlation fallacy.

Better nutrition has been shown to have an impact on both cognitive and spatial memory performance; a study showed those with higher blood sugar levels performed better on certain memory tests. In another study, those who consumed yogurt performed better on thinking tasks when compared to those who consumed caffeine free diet soda or confections. Nutritional deficiencies have been shown to have a negative effect on learning behavior in mice as far back as 1951. Better learning performance is associated with diet induced effects on learning and memory ability. The nutrition-learning nexus demonstrates the correlation between diet and learning and has application in a higher education setting. Nutritional education is an effective and workable model in a higher education setting. More engaged learning models that encompass nutrition is an

idea that is picking up steam at all levels of the learning cycle.

Cancer

According to a study by the International Agency for Research on Cancer, In the developing world, cancers of the liver, stomach and esophagus were more common, often linked to consumption of carcinogenic preserved foods, such as smoked or salted food, and parasitic infections that attack organs. Developed countries tended to have cancers linked to affluence or a 'Western lifestyle' — cancers of the colon, rectum, breast and prostate — that can be caused by obesity, lack of exercise, diet and age. Weight loss in cancer patients of over 10 percent of pre-illness weight, or weight in the preceding 3–6 months, is often associated with a high risk of malnutrition [4].

Metabolic syndrome

Several lines of evidence indicate lifestyle-induced hyperinsulinemia and reduced insulin function (i.e. insulin resistance) as a decisive factor in many disease states. For example, hyperinsulinemia and insulin resistance are strongly linked to chronic inflammation, which in turn is strongly linked to a variety of adverse developments such as arterial microinjuries and clot formation (i.e. heart disease) and exaggerated cell division (i.e. cancer). Hyperinsulinemia and insulin resistance (the so-called metabolic syndrome) are characterized by a combination of abdominal obesity, elevated blood sugar, elevated blood pressure, elevated blood triglycerides, and reduced HDL cholesterol. The negative impact of hyperinsulinemia on prostaglandin PGE1/PGE2 balance may be significant.

The state of obesity clearly contributes to insulin resistance, which in turn can cause type 2 diabetes. Virtually all obese and most type 2 diabetic individuals have marked insulin resistance. Although the association between overweight and insulin resistance is clear, the exact (likely multifarious) causes of insulin resistance remain less clear. Importantly, it has been demonstrated that appropriate exercise, more regular food intake and reducing glycemic load (see below) all can reverse insulin resistance in overweight individuals (and thereby lower blood sugar levels in those who have type 2 diabetes).

Obesity can unfavourably alter hormonal and metabolic status via resistance to the hormone leptin, and a vicious cycle may occur in which insulin/leptin resistance and obesity aggravate one another. The vicious cycle is putatively fuelled by continuously high insulin/leptin stimulation and fat storage, as a result of high intake of strongly insulin/leptin stimulating foods and energy. Both insulin and leptin normally function as satiety signals to the hypothalamus in the brain; however, insulin/leptin resistance may reduce this signal and therefore allow continued overfeeding despite large body fat stores. In addition, reduced leptin signalling to the brain may reduce

leptin's normal effect to maintain an appropriately high metabolic rate.

There is a debate about how and to what extent different dietary factors— such as intake of processed carbohydrates, total protein, fat, and carbohydrate intake, intake of saturated and trans fatty acids, and low intake of vitamins/minerals—contribute to the development of insulin and leptin resistance. In any case, analogous to the way modern man-made pollution may potentially overwhelm the environment's ability to maintain homeostasis, the recent explosive introduction of high glycemic index and processed foods into the human diet may potentially overwhelm the body's ability to maintain homeostasis and health (as evidenced by the metabolic syndrome epidemic) [5].

Causes

Major causes of malnutrition include poverty and food prices, dietary practices and agricultural productivity, with many individual cases being a mixture of several factors. Clinical malnutrition, such as in cachexia, is a major burden also in developed countries. Various scales of analysis also have to be considered in order to determine the sociopolitical causes of malnutrition. For example, the population of a community may be at risk if the area lacks health-related services, but on a smaller scale certain households or individuals may be at even higher risk due to differences in income levels, access to land, or levels of education.

Diseases and infections

Malnutrition can be a consequence of health issues such as gastroenteritis or chronic illness, especially the HIV/AIDS pandemic, Diarrhea and other infections can cause malnutrition through decreased nutrient absorption, decreased intake of food, increased metabolic requirements, and direct nutrient loss. Parasite infections can also lead to malnutrition.

Dietary practices

A lack of breastfeeding can lead to malnutrition in infants and children. Possible reasons for the lack in the developing world may be that the average family thinks bottle feeding is better. The World health organization says mothers abandon breastfeeding because they do not know how to get their baby to latch on properly or suffer pain and discomfort. Deriving too much of one's diet from a single source, such as eating almost exclusively corn or rice, can cause malnutrition. This may either be from a lack of education about proper nutrition, or from only having access to a single food source.

Overnutrition caused by overeating is also a form of malnutrition. In the United States, more than half of all adults are now overweight — a condition that, like hunger, increases susceptibility to disease and disability, reduces worker productivity, and lowers life expectancy.

Overeating is much more common in the United States, where for the majority of people, access to food is not an issue. Many parts of the world have access to a surplus of non-nutritious food, in addition to increased sedentary lifestyles. Yale psychologist Kelly Brownell calls this a toxic food environment where fat and sugar laden foods have taken precedent over healthy nutritious foods. Not only does obesity occur in developed countries, problems are also occurring in developing countries in areas where income is on the rise. The issue in these developed countries is choosing the right kind of food. Fast food is consumed more per capita in the United States than in any other country. The reason for this mass consumption of food is the affordability and accessibility. Oftentimes the fast food, low in cost and nutrition, is high in calories and heavily promoted. When these eating habits are combined with increasingly urbanized, automated, and more sedentary lifestyles, it becomes clear why gaining weight is difficult to avoid. However, overeating is also a problem in countries where hunger and poverty persist. In China, consumption of high-fat foods has increased while consumption of rice and other goods has decreased. Overeating leads to many diseases, such as heart disease and diabetes, that may result in death [6].

Poverty and food prices

In Bangladesh, poor socioeconomic position was associated with chronic malnutrition since it inhibits purchase of nutritious foods such as milk, meat, poultry, and fruits. As much as food shortages may be a contributing factor to malnutrition in countries with lack of technology, the FAO (Food and Agriculture Organization) has estimated that eighty percent of malnourished children living in the developing world live in countries that produce food surpluses. The economist Amartya Sen observed that, in recent decades, famine has always a problem of food distribution and/or poverty, as there has been sufficient food to feed the whole population of the world. He states that malnutrition and famine were more related to problems of food distribution and purchasing power.

It is argued that commodity speculators are increasing the cost of food. As the real estate bubble in the United States was collapsing, it is said that trillions of dollars moved to invest in food and primary commodities, causing the 2007–2008 food price crisis. The use of biofuels as a replacement for traditional fuels leaves less supply of food for nutrition and raises the price of food. The United Nations special rapporteur on the right to food, Jean Ziegler proposes that agricultural waste, such as corn cobs and banana leaves, rather than crops themselves be used as fuel.

Agricultural productivity

Local food shortages can be caused by a lack of arable land, adverse weather, lower farming skills such as

crop rotation, or by a lack of technology or resources needed for the higher yields found in modern agriculture, such as fertilizers, pesticides, irrigation, machinery and storage facilities. As a result of widespread poverty, farmers cannot afford or governments cannot provide the resources necessary to improve local yields. The World Bank and some wealthy donor countries also press nations that depend on aid to cut or eliminate subsidized agricultural inputs such as fertilizer, in the name of free market policies even as the United States and Europe extensively subsidized their own farmers. Many, if not most, farmers cannot afford fertilizer at market prices, leading to low agricultural production and wages and high, unaffordable food prices. Reasons for the unavailability of fertilizer include moves to stop supplying fertilizer on environmental grounds, cited as the obstacle to feeding Africa by the Green Revolution pioneer Norman Borlaug. Colony collapse disorder is a phenomenon where bees are dying in large numbers. Since many agricultural crops worldwide are pollinated by bees, this represents a serious threat to the supply of food. An epidemic of stem rust on wheat caused by race Ug99 is currently spreading across Africa and into Asia and, it is feared, could wipe out more than 80 percent of the world's wheat crops [7].

Management

Fighting malnutrition, mostly through fortifying foods with micronutrients (vitamins and minerals), improves lives at a lower cost and shorter time than other forms of aid, according to the World Bank. The Copenhagen Consensus, which look at a variety of development proposals, ranked micronutrient supplements as number one. However, roughly \$300 million of aid goes to basic nutrition each year, less than \$2 for each child below two in the 20 worst affected countries. In contrast, HIV/AIDS, which causes fewer deaths than child malnutrition, received \$2.2 billion—\$67 per person with HIV in all countries.

Emergency measures

Micronutrients can be obtained through fortifying foods. Fortifying foods such as peanut butter sachets (see Plumpy'Nut) and Spirulina have revolutionized emergency feeding in humanitarian emergencies because they can be eaten directly from the packet, do not require refrigeration or mixing with scarce clean water, can be stored for years and, vitally, can be absorbed by extremely ill children. The United Nations World Food Conference of 1974 declared Spirulina as 'the best food for the future' and its ready harvest every 24 hours make it a potent tool to eradicate malnutrition. Additionally, supplements, such as Vitamin A capsules or Zinc tablets to cure diarrhea in children, are used.

There is a growing realization among aid groups that giving cash or cash vouchers instead of food is a cheaper, faster, and more efficient way to deliver help to

the hungry, particularly in areas where food is available but unaffordable. The UN's World Food Program, the biggest non-governmental distributor of food, announced that it will begin distributing cash and vouchers instead of food in some areas, which Josette Sheeran, the WFP's executive director, described as a revolution in food aid. The aid agency Concern Worldwide is piloting a method through a mobile phone operator, Safaricom, which runs a money transfer program that allows cash to be sent from one part of the country to another.

However, for people in a drought living a long way from and with limited access to markets, delivering food may be the most appropriate way to help. Fred Cuny stated that the chances of saving lives at the outset of a relief operation are greatly reduced when food is imported. By the time it arrives in the country and gets to people, many will have died. U.S. Law, which requires buying food at home rather than where the hungry live, is inefficient because approximately half of what is spent goes for transport. Fred Cuny further pointed out studies of every recent famine have shown that food was available in-country — though not always in the immediate food deficit area and even though by local standards the prices are too high for the poor to purchase it, it would usually be cheaper for a donor to buy the hoarded food at the inflated price than to import it from abroad. Ethiopia has been pioneering a program that has now become part of the World Bank's prescribed recipe for coping with a food crisis and had been seen by aid organizations as a model of how to best help hungry nations. Through the country's main food assistance program, the Productive Safety Net Program, Ethiopia has been giving rural residents who are chronically short of food, a chance to work for food or cash. Foreign aid organizations like the World Food Program were then able to buy food locally from surplus areas to distribute in areas with a shortage of food. Not only has Ethiopia been pioneering a program but Brazil has also established a recycling program for organic waste that benefits farmers, urban poor, and the city in general. City residents separate organic waste from their garbage, bag it, and then exchange it for fresh fruit and vegetables from local farmers. As a result, this reduces its countries waste and the urban poor get a steady supply of nutritious food [8].

Prevention

The effort to bring modern agricultural techniques found in the West, such as nitrogen fertilizers and pesticides, to Asia, called the Green Revolution, resulted in decreases in malnutrition similar to those seen earlier in Western nations. This was possible because of existing infrastructure and institutions that are in short supply in Africa, such as a system of roads or public seed companies that made seeds available. An investment in agriculture, such as subsidized fertilizers and seeds, increases food harvest and reduces food prices. For example, in the case

of Malawi, almost five million of its 13 million people used to need emergency food aid. However, after the government changed policy and subsidies for fertilizer and seed were introduced against World Bank strictures, farmers produced record-breaking corn harvests as production leaped to 3.4 million in 2007 from 1.2 million in 2005, making Malawi a major food exporter. This lowered food prices and increased wages for farm workers. Proponents for investing in agriculture include Jeffrey Sachs, who has championed the idea that wealthy countries should invest in fertilizer and seed for Africa's farmers. Breastfeeding education helps. Breastfeeding in the first two years and exclusive breastfeeding in the first six months could save 1.3 million children's lives. In the longer term, firms are trying to fortify everyday foods with micronutrients that can be sold to consumers such as wheat flour for Beladi bread in Egypt or fish sauce in Vietnam and the iodization of salt [9].

Restricting population size is a proposed solution. Thomas Malthus argued that population growth could be controlled by natural disasters and voluntary limits through moral restraint. Robert Chapman suggests that an intervention through government policies is a necessary ingredient of curtailing global population growth. However, there are many who believe that the world has more than enough resources to sustain its population. Instead, these theorists point to unequal distribution of resources and under- or unutilized arable land as the cause for malnutrition problems. For example, Amartya Sen advocates that, no matter how a famine is caused, methods of breaking it call for a large supply of food in the public distribution system. This applies not only to organizing rationing and control, but also to undertaking work programmes and other methods of increasing purchasing power for those hit by shifts in exchange entitlements in a general inflationary situation. One suggested policy framework to resolve access issues is termed food sovereignty, the right of peoples to define their own food, agriculture, livestock, and fisheries systems in contrast to having food largely subjected to international market forces. Food First is one of the primary think tanks working to build support for food sovereignty. Neoliberals advocate for an increasing role of the free market. Another possible long term solution would be to increase access to health facilities to rural parts of the world. These facilities could monitor undernourished children, act as supplemental food distribution centers, and provide education on dietary needs. These types of facilities have already proven very successful in countries such as Peru and Ghana. New technology in agricultural production also has great potential to combat under nutrition. By improving agricultural yields, farmers could reduce poverty by increasing income as well as open up area for diversification of crops for household use. The World Bank itself claims to be part of the solution to malnutrition, asserting that the best way for countries to succeed in

breaking the cycle of poverty and malnutrition is to build export-led economies that will give them the financial means to buy foodstuffs on the world market.

When aiming to prevent rather than treat overeating, which is also a form of malnutrition, starting in the school environment would be the perfect place as this is where the education children receive today will help them choose healthier foods during childhood, as well as into adulthood. As seen in Singapore, if we increase nutrition in school lunch programs and physical activity for children and teachers, obesity can be reduced by almost 30–50 percent [10].

Epidemiology

There were 925 million undernourished people in the world in 2010, an increase of 80 million since 1990, despite the fact that the world already produces enough food to feed everyone — 7 billion people — and could feed double — 12 billion people.

Year: 1990 – 1995 – 2005 - 2008

Undernourished people in the world (millions):

843 – 788 – 848 - 923

Year: 1970 – 1980 – 1990 – 2005 - 2007

Percentage of people in the developing:

37 % - 28 % - 20 % - 16 % - 17 %

World who are undernourished (%)

In special populations

Undernutrition is an important determinant of maternal and child health, accounting for more than a third of child deaths and more than 10 percent of the total global disease burden according to 2008 studies.

In women

Researchers from the Centre for World Food Studies in 2003 found that the gap between levels of undernutrition in men and women is generally small, but that the gap varies from region to region and from country to country. These small-scale studies showed that female undernutrition prevalence rates exceeded male undernutrition prevalence rates in South/Southeast Asia and Latin America and were lower in Sub-Saharan Africa. Datasets for Ethiopia and Zimbabwe reported undernutrition rates between 1.5 and 2 times higher in men than in women; however, in India and Pakistan, datasets rates of undernutrition were 1.5-2 times higher in women than in men. Intra-country variation also occurs, with frequent high gaps between regional undernutrition rates. Gender inequality in nutrition in some countries such as India is present in all stages of life [11].

Within the household, there may be differences in levels of malnutrition between men and women, and these differences have been shown to vary significantly from one region to another, with problem areas showing relative deprivation of women. Samples of 1000 women in India in

2008 demonstrated that malnutrition in women is associated with poverty, lack of development and awareness, and illiteracy. The same study showed that gender discrimination in households can prevent a woman's access to sufficient food and healthcare. In some cases, such as in parts of Kenya in 2006, rates of malnutrition in pregnant women were even higher than rates in children.

Women have unique nutritional requirements, and in some cases need more nutrients than men; for example, women need twice as much calcium as men. Studies on nutrition concerning gender bias within households look at patterns of food allocation, and one study from 2003 suggested that women often receive a lower share of food requirements than men. Gender discrimination, gender roles, and social norms affecting women can lead to early marriage and childbearing, close birth spacing, and undernutrition, all of which contribute to malnourished mothers. Frequent pregnancies with short intervals between them and long periods of breastfeeding add an additional nutritional burden. During pregnancy and breastfeeding, women must ingest enough nutrients for themselves and their child, so they need significantly more protein and calories during these periods, as well as more vitamins and minerals (especially iron, iodine, calcium, folic acid, and vitamins A, C, and K). In 2001 the FAO of the UN reported that iron deficiency afflicted 43 percent of women in developing countries and increased the risk of death during childbirth. A 2008 review of interventions estimated that universal supplementation with calcium, iron, and folic acid during pregnancy could prevent 105,000 maternal deaths (23.6 percent of all maternal deaths). Women in some societies are traditionally given less food than men since men are perceived to have heavier workloads. Household chores and agricultural tasks can be arduous and require additional energy and nutrients; however, physical activity, which largely determines energy requirements, is difficult to estimate. According to the FAO, women are often responsible for preparing food and have the chance to educate their children about beneficial food and health habits, giving mothers another chance to improve the nutrition of their children.

In children

The World Health Organization estimates that malnutrition accounts for 54 percent of child mortality worldwide. Even mild degrees of malnutrition double the risk of mortality for respiratory and diarrheal disease mortality and malaria. This risk is greatly increased in more severe cases of malnutrition. There are three commonly used measures for detecting malnutrition in children: stunting (extremely low height for age), underweight (extremely low weight for age), and wasting (extremely low weight for height). These measures of malnutrition are interrelated, but studies for the World Bank found that only 9 percent of children exhibit stunting,

underweight, and wasting. According to a 2008 review an estimated 178 million children under age 5 are stunted, most of whom live in sub-Saharan Africa. A 2008 review of malnutrition found that about 55 million children are wasted, including 19 million who have severe wasting or severe acute malnutrition. Measurements of a child's growth provide the key information for the presence of malnutrition, but weight and height measurements alone can lead to failure to recognize kwashiorkor and an underestimation of the severity of malnutrition in children. The 2008 Copenhagen Consensus estimated that undernutrition causes 35 percent of the disease burden in children younger than 5 years old, and that the nutrition of children 5 years and younger depends strongly on the nutrition level of their mothers during pregnancy and breastfeeding. Infants born to young mothers who are not fully developed are found to have low birth weights. The level of maternal nutrition during pregnancy can affect newborn body size and composition. Iodine-deficiency in mothers usually causes brain damage in their offspring, and some cases cause extreme physical and mental retardation. This affects the children's ability to achieve their full potential. In 2011 UNICEF reported that thirty percent of households in the developing world were not consuming iodized salt, which accounted for 41 million infants and newborns in whom iodine deficiency could still be prevented. Maternal body size is strongly associated with the size of newborn children.

Undernourished girls tend to grow into short adults and are more likely to have small children. Short stature of the mother and poor maternal nutrition stores increase the risk of intrauterine growth retardation (IUGR). However, environmental factors can weaken the effect of IUGR on cognitive performance. Studies in Bangladesh in 2009 found that the mother's literacy, low household income, higher number of siblings, less access to mass media, less supplementation of diets, unhygienic water and sanitation are associated with chronic and severe malnutrition in children. Prenatal malnutrition and early life growth patterns can alter metabolism and physiological patterns and have lifelong effects on the risk of cardiovascular disease. Children who are undernourished are more likely to be short in adulthood, have lower educational achievement and economic status, and give birth to smaller infants. Children often face malnutrition during the age of rapid development, which can have long-lasting impacts on health.

Children suffering from severe acute malnutrition are very thin, but they often also have swollen hands and feet, making the internal problems more evident to health workers. Undernutrition in children causes direct structural damage to the brain and impairs infant motor development and exploratory behavior. Children who are undernourished before age two and gain weight quickly later in childhood and in adolescence are at high risk of chronic diseases related to nutrition. Inadequate food

intake, infections, psychosocial deprivation, the environment, and perhaps genetics contribute. Children with severe malnutrition are very susceptible to infection. However, children with chronic diseases like HIV have a higher risk of malnutrition, since their bodies cannot absorb nutrients as well. Diseases such as measles are a major cause of malnutrition in children; thus immunizations present a way to relieve the burden.

Studies have found a strong association between undernutrition and child mortality. Once malnutrition is treated, adequate growth is an indication of health and recovery. Even after recovering from severe malnutrition, children often remain stunted for the rest of their lives. A study in Bangladesh in 2009 reported that rates of malnutrition were higher in female children than male children. Other studies show that, at the national level, differences between undernutrition prevalence rates between young boys and girls are generally small. Girls often have a lower nutritional status in South and Southeastern Asia compared to boys. In other developing regions, the nutritional status of girls is slightly higher. In almost all countries, the poorest quintile of children has the highest rate of malnutrition. However, inequalities in malnutrition between children of poor and rich families vary from country to country, with studies finding large gaps in Peru and very small gaps in Egypt. In 2000, rates of child malnutrition were much higher in low income countries (36 percent) compared to middle income countries (12 percent) and the United States (1 percent).

Measures have been taken to reduce child malnutrition. Studies for the World Bank found that, from 1970–2000, the number of malnourished children decreased by 20 percent in developing countries. Iodine supplement trials in pregnant women have been shown to reduce offspring deaths during infancy and early childhood by 29 percent. However, universal salt iodization has largely replaced this intervention. The Progres program in Mexico combined conditional cash transfers with nutritional education and micronutrient-fortified food supplements; this resulted in a 10 percent reduction the prevalence of stunting in children 12–36 months old. Milk fortified with zinc and iron reduced the incidence of diarrhea by 18 percent in a study in India. Breastfeeding can reduce rates of malnutrition and dehydration caused by diarrhea, but mothers are sometimes wrongly advised to not breastfeed their children. Breastfeeding has been shown to reduce mortality in infants and young children. Since only 38 percent of children worldwide under 6 months are exclusively breastfed, education programs could have large impacts on children malnutrition rates. However, breastfeeding cannot fully prevent PEM if not enough nutrients are consumed.

In the elderly

Multiple studies note that malnutrition and being underweight are more common in the elderly than in adults

of other ages. If elderly people are healthy and active, the aging process alone does not usually cause malnutrition. However, changes in body composition, organ functions, adequate energy intake and ability to eat or access food are associated with aging, and may contribute to malnutrition. Sadness or depression can play a role, causing changes in appetite, digestion, energy level, weight, and well-being. A study on the relationship between malnutrition and other conditions in the elderly found that Malnutrition in the elderly can result from gastrointestinal and endocrine system disorders, loss of taste and smell, decreased appetite and inadequate dietary intake. Poor dental health, ill-fitting dentures, or chewing and swallowing problems can make eating difficult.

As a result of these factors, malnutrition is seen to develop more easily in the elderly. Rates of malnutrition tend to increase with age in the elderly population; a study in Clinical Nutrition noted that less than 10 percent of the young elderly (up to age 75) are malnourished, while 30 to 65 percent of the elderly in home care, long-term care facilities, or acute hospitals are malnourished. Many elderly people require assistance in eating, which may contribute to malnutrition. Because of this, one of the main requirements of elderly care is to provide an adequate diet and all essential nutrients. Researchers in Australia conducting mini-nutritional assessments (MNAs) reported that malnutrition or risk of malnutrition occurs in 80 percent of elderly people presented to hospitals for

admission. Malnutrition and weight loss can contribute to sarcopenia with loss of lean body mass and muscle function. Abdominal obesity or weight loss coupled with sarcopenia lead to immobility, skeletal disorders, insulin resistance, hypertension, atherosclerosis, and metabolic disorders. A paper from the Journal of the American Dietetic Association noted that routine nutrition screenings represent one way to detect and therefore decrease the prevalence of malnutrition in the elderly [12].

CONCLUSION

There are a number of potential disruptions to global food supply that could cause widespread malnutrition. Climate change is of great importance to food security. With 95 percent of all malnourished peoples living in the relatively stable climate region of the subtropics and tropics. According to the latest IPCC reports, temperature increases in these regions are very likely. Even small changes in temperatures can lead to increased frequency of extreme weather conditions. Many of these have great impact on agricultural production and hence nutrition. An increase in extreme weather such as drought in regions such as Sub-Saharan would have even greater consequences in terms of malnutrition. Even without an increase of extreme weather events, a simple increase in temperature reduces the productiveness of many crop species, also decreasing food security in these regions.

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