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Nutrition – A global challenge for health

GLOBAL HELSE

KATHARINA KLOHE

E-mail: katharina.klohe@tum.de
Katharina Klohe (born 1988), MSc, Coordinator of the Center for Global Health, Technical University of Munich.
The author has completed the ICMJE form and reports no conflicts of interest.

CLARISSA PRAZERES DA COSTA

Clarissa Prazeres da Costa (born 1968), MD, Professor, Infectious Disease Specialist, Center for Global Health, Institute for Medical Microbiology, Immunology and Hygiene, Technical University of Munich.
The author has completed the ICMJE form and reports no conflicts of interest.

NANNA LIEN

Nanna Lien (born 1970), PhD, Professor, Department of Nutrition, University of Oslo.
The author has completed the ICMJE form and reports no conflicts of interest.

GERD HOLMBOE-OTTESEN

Gerd Holmboe-Ottesen (born 1944), PhD, Professor emeritus, Department of Community Medicine and Global Health, University of Oslo.
The author has completed the ICMJE form and reports no conflicts of interest.

MICHAEL RYCHLIK

Michael Rychlik (born 1964), PhD, Professor, Chair of Analytical Food Chemistry, Technical University of Munich; Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Australia.
The author has completed the ICMJE form and reports no conflicts of interest.

INGEBORG HAAVARDSSON

Ingeborg Haavardsson (1967), MSc, Coordinator of the Centre for Global Health, University of Oslo.
The author has completed the ICMJE form and reports no conflicts of interest.

GUNHILD STORDALEN

Gunhild Stordalen (born 1979), MD, PhD, President and Founder of the EAT Foundation.
The author has completed the ICMJE form and reports the following conflict of interest: She is the President and Founder of the EAT Foundation, an independent not-for-profit Foundation promoting a science-based transformation of the global food system to result in a healthier global population and a more sustainable planet.

SUDHVIR SINGH

Sudhvir Singh (born 1987), MBChB, Policy Director at the EAT Foundation.
The author has completed the ICMJE form and reports the following conflict of interest: He is the Policy Director of the EAT Foundation, an independent not-for-profit Foundation promoting a science-based transformation of the global food system to result in a healthier global population and a more sustainable planet.

INGUNN ENGEBRETSEN

Ingunn Engebretsen (born 1974), Cand. Mag, MD, PhD, Professor, Centre for International Health, Department of Global Public Health and Primary Care (IGS), Faculty of Medicine and Dentistry University of Bergen.
The author has completed the ICMJE form and reports no conflicts of interest.

PER OLE IVERSEN

Per Ole Iversen (born 1964), MD, Professor, Department of Nutrition, University of Oslo. Guest Professor, Division of Human Nutrition, Stellebosch University, Tygerberg, South Africa. Consultant

Haematologist, Department of Haematology, Oslo University Hospital.
The author has completed the ICMJE form and reports no conflicts of interest.

ANDREA SYLVIA WINKLER

Andrea Sylvia Winkler (born 1966), MD, PhD, Professor, Department of Community Medicine and Global Health. Director, Centre for Global Health, University of Oslo. Specialist Neurologist and Senior Researcher, Center for Global Health, Department of Neurology, Technical University of Munich.
The author has completed the ICMJE form and reports no conflicts of interest.

Malnutrition represents a serious global burden with around 800 million people being undernourished and over 2 billion people being overweight or obese. The associated medical, developmental, social and economic consequences are serious, lasting and extremely costly for the affected families, communities as well as countries. While nutrition is increasingly being paid attention, rarely is it discussed in an all-encompassing way.

It is worth noting that we are currently witnessing a decade of political actions aimed at ending hunger and all forms of malnutrition that exist worldwide. Important commitments have been made (box 1). In addition, the Sustainable Development Goals that were released in 2015 are a particularly useful concept since they highlight the interdisciplinary and intersectorial nature of nutrition. Goal 2 has been specifically allocated to nutrition ("Zero hunger: End hunger, achieve food security and improved nutrition and promote sustainable agriculture"), but many other goals make reference to food and hunger. Goal 3 on health as well as Goal 12 on responsible consumption and production are cases in point, since they highlight the relationship between nutrition, food and health as well as production and consumption patterns that relate to our eating behaviours and thus ultimately the health of our planet and its ability to sustain us.

Box 1 Political Actions on Nutrition (1, 2)

2012: the World Health Assembly adopts the 2025 Global Targets for Maternal, Infant and Young Child Nutrition

2013: the World Health Assembly agrees upon the targets for non-communicable diseases

2013: the first Nutrition for Growth summit takes place – donors commit US$ 23 billion to actions to improve nutrition

2014: the Second International Conference on Nutrition takes place in Rome with a commitment to eradicate hunger and prevent all forms of malnutrition worldwide

2016: UN calls for a Decade of Action on Nutrition from 2016–2026

Malnutrition and its consequences for health

Amongst the global nutrition targets adopted by the World Health Assembly in 2012 are 1) 40 % reduction in childhood stunting (low height-for-age), 2) 0 % increase in childhood overweight and 3) a reduction in childhood wasting (low weight-for-height) to less than 5 % (3). The necessity to achieve these targets is very clear. In particular, when considering that in 2016 an estimated 155 million, 22.9 % of all children under five worldwide, were stunted, 52 million (7.7 %) were wasted and 41 million (6 %) were overweight (4), and that malnutrition is associated with both illness and premature death (4).

While a detailed discussion of the complex mechanisms underlying the relationship between malnutrition, metabolism and immunity go beyond the scope of this paper, it can be said that much of the relationship between malnutrition, in terms of macro- and micro-deficiency, and disease is explained by a greater susceptibility to infectious agents as a result of immunodeficiency (5). Chronic undernutrition in children leads to an appearance of immature T cells, which results in reduced antibody responses to infectious agents challenging the person's body or to commonly used vaccines.

Moreover, an immune system stimulated by an infection requires an increased demand for energy in order to work effectively – thus the better the nutritional status, the better the outcome of the infection (5).

Double burden of disease and its economic consequences

According to the nutrition transition theory (6) changes in food habits over time, due to changes in food production and lifestyle, would be reflected in a parallel transition in prevailing epidemiology, from under- to overnutrition and from infectious diseases to non-communicable diseases. However, what we see in some low- and middle-income countries is a rise in obesity and non-communicable disease prevalence as well as persisting incidence rates of infectious diseases, since changes in nutrition and improvements in health care do not take place simultaneously or equally across populations. This co-existence of disease types is called "the double burden of disease" (7).

What is more is that food consumption and production patterns keep converging towards the "western diet" of highly processed/energy-dense foods. The result is a deficiency in micronutrients (7). Since both chronic macro- and

micronutrient deficiency leads to growth restriction (stunting) in children, stunting has long been taken as proxy for chronic undernutrition.

However, it has now been realised that micronutrient deficiency could be a common cause for stunting in both undernourished and obese children (7). This triple burden theory implies a co-existence of both micro- and macronutrient deficiencies as well as an anomalous intake of surplus energy, all of which can coincide within communities, families and even individuals and lead to a plethora of health implications. The compounding and long term sequelae of stunting in undernourished children is emphasised by the link to obesity as stunted children who are then exposed to energy-dense, nutrient-poor food, tend to have a higher likelihood of obesity later in life (8).

The costs of the triple burden of malnutrition for the global economy are considerable. According to the Food and Agriculture Organization of the United Nations, the loss of productivity and direct health care costs could be as high as 5 % of global Gross Domestic Product, which is equivalent to US$ 3.5 trillion per year (9). On top of that come the individual and social costs, including increased risk of compromised development, health and ultimately thriving, learning and productivity (10).

Nutrition – not just a matter of weight

According to Margaret Chan, former Director General of the World Health Organization, “We can reduce (…), low birth weight and child stunting and bring down the risk of NCDs within a generation. We can achieve this by giving nutrition the attention it deserves” (11). While the World Health Organization’s commitments to and targets for nutrition in terms of overweight and underweight are unquestionably important, there are concerns that the nutrition and food security strategies employed do not fully address malnutrition and nutritional threats.

The Global Nutrition Report 2016, for example, states, “food security strategies do not comprehensively address malnutrition in all its forms, including the vicious circle of malnutrition and foodborne and other infectious diseases“ (12). Aspects of food safety and food insecurity in terms of agriculture, ecosystem services, and climate change are also not sufficiently addressed.

Food Safety

According to World Health Organization estimates, 600 million people per year fall ill and 420 000 die after eating contaminated food. This adds up to the loss of 33 million Disability Adjusted Life Years (a Disability-Adjusted Life Year can be considered as one year lost of “healthy life”, measuring the gap between current health status and an ideal health situation). Contamination here refers to unsafe food containing harmful bacteria, viruses, parasites or chemical substances, which are said to cause more than 200 diseases – ranging from diarrhoea to cancers (13).

Neglected tropical diseases, now called poverty-related diseases, are good examples of the interactions between malnutrition and foodborne- and infectious diseases. These diseases can lead to diarrhoea, anaemia, and nutrient deprivation and are common in poor communities lacking clean water, sanitary facilities, and access to medical treatment. When chronically infected, many of these diseases can cause stunting as well as cognitive impairment (14). A classic example that bridges the field of food safety and infectious diseases is the pork tapeworm, *Taenia solium*. Infection takes place as a result of consumption of parasitic cysts in undercooked pork meat. The worm was declared the number one food-borne parasite in 2014 (15).

Moreover, given that agri-business is a global chain of activities, from production, processing, transportation to consumption, bacterial contaminations and naturally occurring toxins e.g. mycotoxins, as well as the use of certain pesticides or chemicals, can affect consumers globally. The recent scandal in Europe concerning eggs contaminated with fipronil demonstrates this nicely. The insecticide fipronil, not authorised for use in animals farmed for human consumption purposes, was combined with a plant-based disinfectant and bottled up by a company in Belgium. Poultry farmers in the Netherlands and in Germany then used this mixture in their henhouses. Eggs contaminated with fipronil have since reached cafés, supermarkets and the like in twelve European countries (16).

To alleviate the risks from contamination with microorganisms and toxins, simple hygienic measures or coarse sorting are most efficient. However, in particular at the level of small-scale farmers this would require for more appropriate information to be disseminated about what constitutes good hygenic and storage measures. Likewise, careful controls and regulations for marketed foods as well as coordination between governments and producers are required to ensure global food safety.

Food Security and Global Warming

For food and nutrition security strategies to be complete, we believe they also have to make some reference to sustainability of food and agricultural systems as well as the impact climate change has on the quality and quantity of bred, farmed and fished food. Agriculture itself is already responsible for up to 30 % of global greenhouse gas emissions and 70 % of total freshwater withdrawals, as well as it has expanded like no other human land use at the expense of carbon sequestaring forests (17, 18).

Moreover, greenhouse gas emissions generated by all of human activities are almost unanimously considered to alter the earth's climate, with average temperatures rising, seasonal patterns changing and weather conditions becoming more severe and frequent. For the Middle East and North Africa (MENA) region, maximum temperatures on the hottest days are projected to increase from 43 °C to 46 °C by the middle and even 50 °C by the end of this century (19).

This affects human health in many ways, one of which is nutrition, via challenges to agri- and aquacultural production and output. For example, it is currently projected that there will be a reduction in global crop production by 10 % by 2050 (20). The pressure to produce more food will consequently increase, which in turn, will put more pressure on land and water systems. Food security is thus increasingly threatened, and possible consequences include migration, displacement and even conflict (21), all of which can add additional strain on food production and availability and are themselves associated with forms of malnutrition.

A discussion on global challenges to nutrition must thus include global food consumption, distribution, and production patterns as they directly determine our future food security. We believe this interconnectedness of physical and planetary health is not sufficiently being paid attention to in the form of discussion and concrete policy action.

A systematic approach is needed

We are witnessing a rise in diseases that are associated with our current nutritional habits as well as we are facing threats to our food security that are of increasing complexity. Governments across the globe are facing high costs, if they are to ensure sustainable health and livelihoods for the global population. Importantly, because nutrition and food production have become so multifactorial and global, the associated concerns cannot be tackled in isolation as well as access to sufficient, nutrient-rich and safe nutrition goes beyond governmental responsibility. Instead, the global community needs to increasingly work together to address all aspects of nutrition.

The Sustainable Development Goals may act as a useful guide, highlighting the interconnectedness of health, nutrition, food production, food consumption and the climate. The targets and indicators of the individual goals should be used to direct researchers of different backgrounds to research areas that require transdisciplinary collaboration.

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