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Undernutrition, malnutrition and wastage of food

Niedożywienie a marnowanie żywności

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Summary

On the one hand, there were 925 million people undernourished worldwide in 2010, and on the other hand, 1.3 billion tons of food (about one third of global food production) are lost or wasted annually. The biggest number of hungry people is located in developing countries but hunger, on a minor scale, is also known in developed countries. Malnutrition applies mainly to population of poverty and people in extreme age groups, as well as hospitalized patients chronically ill, or with serious compromised immune systems. Malnutrition affects the function and recovery of every human's organ system.

Wastage of food occurs in each step of entire food supply chain "from farm-to fork". The percentage of food being wasted by consumers, in industrialized countries, is very high (222 million ton) and is almost comparable to the total net food production in sub-Saharan Africa (230 million ton). In response to the problem of food wastage and increasing problem of hunger/undernutrition, on 19th of January 2012, the European Parliament adopted resolution towards more efficient food chain in the EU. The resolution notes that reducing food wastage is a significant preliminary step in combating hunger in the world and improving people's nutritional state.

Key words: hunger, undernutrition, malnutrition, food loss, food waste

Streszczenie

Według statystyk, w roku 2010 na świecie z jednej strony było 925 milionów ludzi niedożywionych, a z drugiej strony co-rocennie 1,3 miliarda ton żywności (około jedna trzecia globalnej produkcji żywności) jest tracona lub marnowana. Najwięcej ludzi głoduje w krajach rozwijających się, ale przypadki głodu, na mniejszą skalę, spotykane są również w krajach rozwiniętych. Problem niedożywienia dotyczy głównie populacji ubóstwa i osób ze skrajnych grup wiekowych oraz hospitalizowanych pacjentów przewlekle chorych lub z poważnymi zaburzeniami układu immunologicznego. Niedożywienie wpływa na funkcjonowanie i rekonwalescencję każdego ludzkiego narządu.

Marnowanie żywności ma miejsce na każdym etapie w całym łańcuchu żywnościowym „od pola – do stołu”. Procent żywności marnowanej przez konsumentów w krajach uprzemysłowionych jest bardzo wysoki (222 milionów ton) i jest porównywalny z wielkością produkcji żywności w Afryce Subsaharyjskiej (230 milionów ton). W odpowiedzi na marnowanie żywności i rosnący problem głodu/niedożywienia, 19 stycznia 2012 roku. Parlament Europejski wydał rezolucję, której celem jest przyjęcie strategii w kierunku efektywniejszego gospodarowania żywnością w łańcuchu żywnościowym w krajach UE. Rezolucja wskazuje, że ograniczenie marnowania żywności jest ważnym wstępnym krokiem w walce z głodem na świecie oraz poprawą stanu odżywienia ludzi.

Słowa kluczowe: głód, niedożywienie, straty żywności, marnowanie żywności

INTRODUCTION

Hunger, undernutrition and malnutrition aspects, next to food wastage, are the most discussed topics nowadays. On the one hand, there are almost one billion of people suffering from hunger, and on the other hand, 1.3 billion tons of edible food is wasted annually (1, 2). Predicted statistics show that the problem arises. This paper is devoted to the problem. It dis-

cusses also prevention programmes undertaken in the EU countries designed to reduce the scale of the phenomenon.

UNDERNUTRITION WORLDWIDE, IN EUROPE AND POLAND

According to Food and Agriculture Organization of the United Nations (FAO) the most recent statistics,

in 2010 there were 925 million people undernourished worldwide, which is slightly above 13.6% of 6.8 billion world population. That means, almost 1 in 7 people are hungry in the world. The biggest number of hungry people is located in Asia and the Pacific (578 million people), Sub-Saharan Africa (239 million people), Latin America and the Caribbean (53 million), Near East and North Africa (37 million people). Hunger is also known in developed countries but on a minor scale – 19 million people. The number of hungry people worldwide has increased since period of 1995-1997. The increase has been due to three main factors, which the first is – a neglect of agriculture by governments and international agencies, the second – the current worldwide economic crisis, and the third – the significant increase of food prices in the last several years (1, 3-6).

There are a few underlined causes of hunger: poverty, harmful economic systems which are actually the principal cause of poverty and hunger, conflict connected with increasing number of refugees which causes a poverty followed by a hunger, and the last but not least – climate change. Three main groups of population are most at risk of hunger: the rural poor, the urban poor, and victims of catastrophes (3, 7).

Children are the most visible victims of undernutrition. It was estimated that poorly nourished children suffer up to 160 days of illness each year. Annually, there are 5 million children's deaths from undernutrition (3, 8-10).

According to the most recent data of statistic office of European Union – Eurostat, in 2010, 115 million of European population (23.4%) was at risk of poverty or social exclusion. For comparison, in Poland, that year, there was 10.4 million of people at the poverty risk which was 27.8% of total Polish population. Children were the most affected, as 30.8% of them were at risk of poverty (11, 12). In Europe, it was estimated that undernutrition affects approximately of 20 million citizens and costs EU governments up to 120 million euros each year (13, 14).

In Poland, in turn, it was assessed by WHO (14), that level of undernutrition for the whole population was 2.5%, and among children before ages of 15, increased to 15%. Numerous studies clearly show a significant scale of undernutrition among children in Poland. In 2010, over 130 thousands of children required a supplementary nutrition in Poland, therefore Poland is in third place in the European Union after Bulgaria and Romania (11, 16-19) According to Central Statistical Office's survey on the living conditions of the Poles in 2005, there were 36% of the families in Poland, which could not afford to eat meals involving meat other than poultry, poultry or fish (or their vegetarian equivalent) every two days. Over 26% of households stated that, comparing to 2005, meeting the needs of the foodstuffs has deteriorated, and only 12% of households reported improvement in this field. However, the situation has not changed in 62% of households (20).

In a study conducted by the Institute for Market Research and Public Opinion – Millward Brown, commissioned by “Danone” and the Polish Banks of Food in 2011, as part of the „Share a meal” Programme, it was demonstrated that there were 130 thousands of undernourished children in Poland in ages of 7-12 or 6% of the total primary school students. 220 thousand of primary school students ate improperly. In 40% of primary schools, at least one child was undernourished. 13% of children requiring supplementary nutrition and weren't covered by any support social assistance (21, 22).

UNDERNUTRITION, MALNUTRITION AND HUNGER

There are several terms describing problem of “hunger” which are very often use as synonymous in publications but actually differ. “Undernutrition” is defined by FAO (23) as “the result of prolonged low levels of food intake and/or low absorption of food consumed. Generally applied to energy (or protein and energy) deficiency, but it may also relate to vitamin and mineral deficiencies”. Furthermore, term of “undernourishment or chronic hunger” is defined as “the status of persons, whose food intake regularly provides less than their minimum energy requirements” having regard “the average minimum energy requirement per person is about 1800 kcal per day” but “the exact requirement is determined by a person's age, body size, activity level and physiological conditions such as illness, infection, pregnancy and lactation”. The third term, the most popular indeed, and uses in medical publications is “malnutrition”. It is defined by FAO (23) as “a broad term for a range of conditions that hinder good health, caused by inadequate or unbalanced food intake or from poor absorption of food consumed. It refers to both undernutrition (food deprivation) and overnutrition (excessive food intake in relation to energy requirements)”. The more simple and clear definition was provided by Malnutrition Advisory Group (24, 25) which stated that term of malnutrition supposed to be used “to describe a deficiency, excess or imbalance of a wide range of nutrients, resulting in measurable adverse effects on body composition, function and clinical outcome”. Protein-energy malnutrition (PEM), in turn, refers to a form of malnutrition where there is inadequate protein intake. Actually, it is the most lethal form of malnutrition/hunger. As it was assessed, in the United States 25-50% of hospital patients suffer from PEM (26). PEM includes the following types: kwashiorkor (protein malnutrition predominant), marasmus (deficiency in calorie intake) as well as marasmic kwashiorkor (marked protein deficiency and marked calorie insufficiency signs present, sometimes referred to as the most severe form of malnutrition) (27).

Malnutrition, similarly to infection, applies mainly to population of poverty and people in extreme age groups, as well as hospitalized patients chronically ill, or with serious compromised immune systems (28-31).

Malnutrition can refer to individuals who are either over – or under – nourished and, in contrary to typical

hunger prevalence, in developed countries, except to poverty, it occurs for psychological reasons like for instance social isolation, substance misuse, and as a consequence of disease. These diseases arise from several sources divided into several groups, which first is inadequate intake involving poor diet (resulting very often from age, dementia, physical disability and inability to nourish self), poor appetite, pain/nausea with food, dysphagia, depression and unconsciousness. The second – altered nutrient processing including increased/changed, metabolic demands, liver dysfunction. The third, in turn – excess losses involving vomiting, NG tube drainage, diarrhoea, surgical drains, fistulae, stomas, and the last one group of diseases – malabsorption including pathology of stomach, intestine, pancreas and liver (25).

MALNUTRITION RELATED DISEASES

Malnutrition predisposes to infection, leads to serious complications such as septic, respiratory failure and cardiac and sudden cardiac arrest. It also increases the risk of mortality. Malnourished patients' stay at hospital prolongs for 6-7 days (28, 32).

In the developed countries of Europe and North America, a nutritional state of hospitalized patients is assessed as unsatisfactory. There are 35-55% malnourished patients admitted to hospitals (32).

Malnutrition affects the function and recovery of every organ system. Loss of weight connected with not enough of food intake, cause depletion of fat and muscle mass involving internal organs. Loss of bone mass is also observed, especially when intakes of calcium, magnesium and/or vitamin D are insufficient (25). Malnutrition causes negative changes also in gastrointestinal function, nervous system, heart and kidney disorders and as a consequence, the improper physical and mental development (22). Chronic malnutrition results in impaired pancreatic (pancreatic exocrine function). Dysfunction of colon may lead to diarrhoea and as a consequence, result in mortality (25). Malnutrition can also lead to impaired liver function and necrosis. It devastates function of gut manifested as impaired gut integrity and immunity. Furthermore, malnutrition may cause impaired renal function. Dysfunction of cardiovascular and respiratory are also one of malnutrition consequences. Loss of respiratory muscle mass may lead to hypoxic responses and a reduction in cardiac muscle mass resulted in reduced cardiac output (25). Delay of wound healing is also known as a consequence of improper nutritional state (25, 33). It is also proved, that malnutrition decreases immunity and organism's resistance to infection (25, 28). Malnutrition, except physical consequences, affect mental condition demonstrated as apathy, depression, anxiety and self-neglect. As "Maillard Brown" study states (22), malnourished children have problems with learning, concentration and relationships with peers. They manifest aggression or raise aggression within a group they play. They are not accepted by their peers.

Malnutrition increases the effect of many diseases, including measles and malaria. As mentioned before malnutrition, quite often, results in deaths. The estimated proportions of deaths as a consequence of malnutrition are roughly comparable to those involving diarrhea (61%), malaria (57%), pneumonia (52%), and measles (45%) (34, 35).

Some cancer statistics show that undernutrition is responsible for 22% up to 67% of all cancer deaths (33).

WASTAGE OF FOOD

Wastage of food is the second important subject, except to hunger being discussed nowadays worldwide. It was assessed that 1.3 billion tons of food (about one third of global food production) are lost or wasted annually (1, 2). In Europe, more and more food is wasted or lost. According to European Commission data, there is 89 million tons of food wasted in Europe each year. European Commission assessed that, within next 8 years, the amount of wasted food will rise up to 126 million tons while there are still 79 million of people living below the poverty in EU countries (12, 36).

Wastage of food occurs in each step of entire food supply chain "from farm-to fork". These include primary production (rearing, harvesting or hunting animals or producing primary products of animal origin, as well as producing or harvesting plant products), as well as secondary production – production, processing and distribution of food to the final consumer. Food is also wasted in households. There are two main terms use to describe food wastage – food losses and food waste conducted by Swedish Institute for Food and Biotechnology (SIK) on behalf of FAO, where food loss supposed to be used to describe a decrease of edible food mass with exclusion of inedible by-products and seed, throughout the whole food supply chain. Food loss refers to edible food, which is losing during its postharvest – production and processing stages. In turn, food waste is more related to food loss during retail: retail, mass catering and consumption in households. Food waste refers to throwing away of food (2, 37). There is observed a tendency, that in developing countries most wastage occurs during the production and processing of food, while in developed countries more food is wasted at the consumption stage of food chain (2). As FAO in 2011 assessed, in Europe and North-America, per capita, food loss and food waste was 280-300 kg/year whereas, in Sub-Saharan Africa and South/Southeast Asia it was 120-170 kg/year, taking into consideration, that the total per capita production of edible parts of food for human consumption, in Europe and North-America, was about 900 kg/year and, in sub-Saharan Africa and South/Southeast Asia – 460 kg/year. The only food waste produced by the consumer, in Europe and North-America, per capita is 95-115 kg/year and in sub-Saharan Africa and South/Southeast Asia – only 6-11 kg/year (2). Thus, the percentage of food waste by consumers in industrialized countries is very high (222 million ton) and is almost comparable to the

total net food production in sub-Saharan Africa (230 million ton).

As mentioned before, significant losses of edible food occur through the entire food supply chain. During the primary production losses appear, mainly due to mechanical damage or spillage within harvesting operations like threshing or fruit picking. Sorting of crops out post harvest are also a significant cause of food loss. For food of animal origin like bovine, pork and poultry meat, losses refer to animal death during breeding. For milk, losses refer to decreased milk production, due to dairy cow sickness (mastitis). Post-harvest handling operations including storage of food lead to further loss of edible food due to spillage and degradation during handling, storage and transportation between farm and distribution. At the production and processing level loss may be caused by the poor quality of raw materials (rejection of improper quality raw materials within the initial internal control), further loss of food due to inadequate food storage conditions, and then by production and processing operations like – washing, peeling, slicing and boiling or during process interruptions and accidental spillage. Losses and waste of food may appear also during distribution/retail stage. Usually such losses or waste are due to the end of products' shelf-life, their damage or packaging damage and spillage of foodstuffs. Inappropriate storage conditions, mainly keeping inconstant temperature of cool and frozen foodstuffs play also an important role in food waste production. Consumption of food in household is essential in production of losses and waste. Consumers often do not plan shopping, buy too much food, which subsequently become expired. Losses also arise during the preparation of

meals – while washing, peeling, cooking and improper storage (2). Table 1 shows percentages of food waste for each group of foodstuffs through the whole food supply chain, in Europe including Russia.

EUROPEAN PARLIAMENT RESOLUTION OF 19 JANUARY 2012 ON HOW TO AVOID FOOD WASTAGE: STRATEGIES FOR MORE EFFICIENT FOOD CHAIN IN THE EU (36)

In response to the problem of food loss and food waste, on 19th of January 2012, the European Parliament adopted resolution called „How avoid food waste: strategies for more efficient food chain in the EU“. This document underlines that food security is a basic human right. Therefore, the Council, the Commission and Member States and all players in the food supply chain are called to address the problem of food waste and to devise guidelines for improving the efficiency of the food supply chain, as well as to take concrete steps to reduce it. The resolution calls on the Commission to raise awareness of the ongoing work in both the High Level Forum for a Better Functioning Food Supply Chain and the European Sustainable Consumption and Production Roundtable, including with regard to recommendations on how to tackle food waste.

The resolution notes that reducing food wastage is a significant preliminary step in combating hunger in the world and improving people's nutritional states. It underlines, that in developed countries, threat to food security is more often accompanied by obesity, cardiovascular illnesses and cancers arising from a diet over rich in fats and proteins, the result being that the world's overweight and obese population numbers are as many as the undernourished/malnourished.

Table 1. Percentages of food waste for each group of foodstuffs through the whole food supply chain, in Europe including Russia (source: Gustavson J, Cederberg Ch, Sonesson U, van Otterdijk R, Meybeck A: Global Food Losses and Food Waste. FAO 2011-2012).

Groups of foodstuffs	Agricultural production (%)	Postharvest handling and storage (%)	Processing and packaging (%)	Distribution: supermarket retail (%)	Consumption (%)
Cereals (excluding beer) ¹	2	4	0.5, 10	2	25
Roots and Tubers ²	20	9	15	7	17
Oilseeds and Pulses (including nuts) ³	10	1	5	1	4
Fruit and Vegetables (including bananas) ⁴	20	5	2	10	19
Meat ⁵	3.1	0.7	5	4	11
Fish and seafood ⁶	9.4	0.5	6	9	11
Dairy products ⁷	3.5	0.5	1.2	0.5	7

Explanatory notes to the table:

¹Cereals (excluding beer) include: wheat, rice (milled), barley, maize, rye, oats, millet, sorghum, other Cereals.

²Roots and Tubers include: potatoes, sweet potatoes, cassava, yams, other roots.

³Oilseeds and Pulses (including nuts) include: soybeans, groundnuts (shelled), sunflower seeds, rape and mustard seed, cottonseed, coconuts (incl. copra), sesame seed, palm kernels, olives, other oil crops.

⁴Fruit and Vegetables (including bananas) include: oranges and mandarins, lemons and limes, grapefruit, other citrus, bananas, plantains, apples (excl. cider), pineapples, dates, grapes (excl. wine), other fruit, tomatoes, onions, other vegetables.

⁵Meat include: bovine meat, mutton/goat meat, pig meat, poultry meat, other meat, offals.

⁶Fish and seafood include: freshwater fish, demersal fish, pelagic fish, other marine fish, crustaceans, other mollusk, cephalopods, other aquatic products, aquatic mammal meat, other aquatic animals, aquatic plants.

⁷Dairy products include: milk.

Document points out that food waste has a number of causes, which first is overproduction, second – faulty product targeting (unadapted size or shape), third – deterioration of the product or its packaging, fourth – marketing rules (problems of appearance or defective packaging), and finally – inadequate stock management or marketing strategies.

Member States call for retargeting of the support measures at EU level, according to distribution of food products, to the poorest citizens of the Union, Community support for the supply of milk and milk products in schools, as well as programmes to encourage the consumption of fruit in schools, with a view to preventing food waste. They also call on the Commission to consider possible amendments to the public procurement rules on catering and hospitality services to make possible redistribution of food free of charge to the poorest citizens of EU. The Commission and Member States are asked to encourage the exchange of best practices and promote awareness-raising campaigns to inform the public of the value of food and agricultural produce, the causes and effects of food waste and ways of reducing it, thereby fostering a scientific and civic culture guided by the principles of sustainability and solidarity. Members maintain that investing in methods leading to a reduction in food waste could result in a reduction in the food losses by agri-food businesses and, as a consequence, in a decreasing food prices, and finally improving the access to food by poorest segments of the population. The resolution calls also for establishing measures to reduce food waste such as dual-date labeling – “sell by” and “use by” or “best before”, and the discounted sale of foods being close to their expiry date and of damaged but safety foodstuffs. Finally, Members call on the Member States to support initiatives of stimulating sustainable small- and medium-scale production linked to local and regional markets and consumption. Members persuade the Council and the Commission to designate a year of 2014 as the European Year against Food Waste (36).

HOW TO REDUCE FOOD LOSS AND FOOD WASTE IN HOUSEHOLDS

The fundamental reason why household food is wasted in developed countries, mainly relates to consumer behavior and his lack of awareness of the scale of the problem. There are some simple guidelines how to prevent wastage of food in households, which first is insufficient shopping planning. Assessment of necessary quantities of food is underlying in preventing of food wastage. From the point of view of rational management of food, it is recommended to buy it, as far as possible, on an ongoing basis. Consumer should pay attention to the expiry dates on labels for dual reasons – due to the food safety and planning of food preparing (eg. when preparing of food is plan to be postpone). Frozen foods should be purchased in isothermal bags which prevent products' thawing. It is also worth to choose vacuum-packed products because of their extended shelf-life.

Ensuring adequate storage conditions, reduces food becoming inedible and thrown away. Food being stored undergoes different transformations – microbiological, biological and chemical, including enzymatic and physical changes. Therefore, keeping food in adequate food storage conditions (in accordance with the manufacturer's instructions on the label) provides its proper quality, both organoleptic (flavour, colour) and health (nutrient content, microbial quality and physicochemical stability – slows down the process of creating undesirable compounds). Foodstuffs requiring cold storage, must be kept in the refrigerator, usually at temperature not higher than 4°C depending on the product type. Frozen foodstuffs supposed to be stored in freezer at temperature not higher than – 18°C (38). The rest groups of products, for which the producer did not specified specific storage requirements, might be placed in ambient temperatures, but in cool, dark and dry room. These products include, among others, cereal, bakery, olive oils, some concentrates and beverages.

Having regard the aim of reducing wastage of food, a rotation on the basis “first in – first out” is worth to be used. That means, that in order to prepare meals in households, foodstuffs of the same category, which were purchased earlier (with shorter expiry date) must be used at first.

Preparation of raw materials, including sorting, thorough washing, peeling, etc. is very important due to safety of food, but usually involves a significant loss of food. Thorough separation of edible from inedible parts of food is crucial due to prevention of wastage, thus the loss of the edible parts should be reduced.

Adequate technique of thawing of frozen foodstuffs supposed to be undertaken to avoid excessive loss of nutrients. Frozen fruit and vegetables are recommended to be cooked directly without thawing, likewise small pieces of meat can be fried without previous thawing. A microwave oven is also a good tool to use for thawing of larger pieces of frozen food due to rate of process, keeping of high nutritional value and a good quality of thawed fish and fish fillets.

In order to maintain a high quality of food, including minimizing the loss of nutrients, fruit and vegetables (excluding intensive green vegetable) are recommended to be start cooking from boiling water, covered and in little quantities of water. Steaming process, comparing to standard water cooking, allows to remain more nutrients. Starting the process at high temperatures favors the retaining of nutrients and color of food, and in the case of meat dishes it increases their efficiency (39).

In many available publications on reducing wastage of food, freezing process of raw food material, as well as, previously cooled ready-to-freeze dishes is often recommended. Freezing process it is a good manner to prolong a shelf-life of foodstuffs. Unless it reduces vegetative microorganisms, it must be remembered that food being frozen like “home method” loses

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