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Research Article

Nutrition and Food Safety

Siniša Franjić*

Faculty of Law, International University of Brcko District, Brcko, Bosnia and Herzegovina

***Corresponding Author:** Siniša Franjić, Faculty of Law, International University of Brcko District, Brcko, Bosnia and Herzegovina.

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Abstract

Nutrition is the applied natural science of food and its effect on the human body. Nutrition research has an important role to play in understanding many of the processes involved in eating and the onset of diseases and disorders, but also in understanding the role of nutrition in modulating an individual's genetic potential. Therefore, nutritionists today have an increasingly important role to play, not only as researchers, but also as persons who transmit scientific knowledge to a general and targeted population in order to preserve health and improve their existing condition.

Keywords: Nutrition; Food; Health

Introduction

Nutrition exists when food security is combined with a sanitary environment, adequate health services, and proper care and feeding practices to ensure a healthy life for all household members [1]. Despite increased attention to undernutrition, it remains a devastating multi-faceted problem for infants, young children, and women around the world, resulting in increased morbidity, mortality, and long-term disability. Undernutrition can also lead to poor health into adulthood, which affects social and economic development of nations. On the other end of the malnutrition spectrum, overweight and obesity are growing problems, linked to changing diets and activity patterns, which also lead to serious health problems and impact the economies of nations. External pressures, such as climate variability and population growth, that tax these systems are discussed, as well as the globalization of our food system and why that has shifted dietary patterns and nutrition and health status trends. The multi-sectoral integration of food and health systems and its importance to improve nutrition is demonstrated through three models.

Historically, nutrition science came into being because of the discoveries of the roles of certain nutrients in disease development [2]. Examination of the early medical literature is especially revealing in this respect. The Egyptian papyri, the early Greek writings, the monastic scripts, and even passages of the bible describe the role of food in the prevention or treatment of diseases. For example, ox liver was frequently prescribed for anemia. Those early physicians did not know what ox liver actually did, but they knew that the pale and listless people who came to them for help would improve if they consumed this food item. Later, as humans became more adventurous and left the shores of their homelands to explore the world in ships, other diseases became apparent. Through astute observations, a number of physicians/scientists found that simple diet modifications could prevent or cure these disorders. Through the years these diseases have become uncommon in today's world. They have not disappeared, however, because whenever a population faces a food crisis, be it due to war or crop failure or financial collapse, nutrient deficiencies will appear and have adverse effects on health. They also appear in people who, through ignorance of the importance of consuming a wide variety of foods, select foods that do not provide sufficient amounts of the micronutrients. These people may be of normal weight or even overweight yet they may be inadequately nourished with respect to one or more of the essential vitamins and minerals. As scientists became aware of this problem within an ostensibly well-nourished group of people, they developed techniques that would sensitively detect marginal or in-

adequate intakes of specific nutrients. This work is ongoing and is the basis for nutrition assessment. Through work with animals that develop analogous deficiency symptoms, these techniques or tests of intake adequacy were related to particular biochemical functions of the individual micronutrients. These then, became the tools for assessment of the nutritional status of humans.

Children

What children eat between being weaned and starting school is important [3]. Food habits are established in this phase of life. They are less under parental control than they used to be. Mothers often go out to work, the toddler eats at a child care centre or preschool. Food companies make some products specially for this age group and young children are targeted by advertisements on television. Young children have different taste perception from adults. They prefer sweeter foods, dislike bitter tastes, and often object to vegetables of the cabbage family.

After having a reliable appetite for their first twelve months, some children aged 1-3 go through a phase of poor eating, which can make parents anxious or even exasperated. Children are less enthusiastic about eating and refuse foods that the rest of the family eat, especially vegetables.

One reason for this is that growth slows at around twelve months. This can be seen in the changes in gradient of normal weight for age, and height for age curves. It is even more obvious in weight and height velocity curves, which descend to about a quarter and a half, respectively, of the values in early infancy. Energy intake can be very variable from time to time in toddlers. Other things are also happening. Children are discovering their independence and testing their choice in food selection. Once they have some control over what is offered, foods that they find unattractive are displaced by those they think delicious: cakes, biscuits, chocolate, crisps, ice cream, etc.

The role of high fat foods in the epidemic of overweight is generally known, and realised among schoolchildren themselves, though cheese or biscuits may not be recognised as high fat. Another contributor to overweight, more recently revealed, is the widespread consumption of sugar-sweetened soft drinks. It is sometimes hard to visualise how much sugar and calories are in these liquids.

Energy expenditure has fallen in young people. Many do not participate in sport, are driven to school and spend hours everyday looking at television or a personal computer. Children who watch more TV have higher BMIs and most of the food adverts they see are for fast foods, high in fat, sugar or salt.

Teenagers are not fed; they eat. For the first time in their lives they assume responsibility for their own food intakes. At the same time they are intensely involved in day-to-day life with their peers, and preparation for their future lives as adults. Social pressures thrust choices at them: to drink or not to drink, to smoke or not to smoke, to develop their bodies to meet sometimes extreme ideals of slimness or athletic prowess. Few become interested in foods and nutrition except as part of a cult or fad such as vegetarianism or crash dieting.

As well as overweight youngsters there are adolescent girls of normal weight modifying their diet because they are not as thin as they or their peers think they should be. Some may fast and binge alternately. With a smaller energy intake they are more likely not to reach their requirements for iron and other essential nutrients. In a small minority this social dieting goes on to anorexia nervosa (incidence in some places as high as 1% of middle class girls aged 15-25) or bulimia. Treatment of anorexia nervosa is best handled by a specialised team of psychiatrist and dietitian. The general practitioner's main role is to recognise the early case. The longer the duration the worse the prognosis. A young woman whose weight goes below a body mass index (weight (kg)/height(m)2) of 17 should be warned, with her parents, that her thinness is unhealthy and referred for treatment if she cannot put on weight. By contrast, adolescent boys are more likely to worry that they are not growing tall enough or not developing enough muscles.

Adults

Adults should eat enough of the essential nutrients by eating a healthy varied diet [3]. This is more difficult to achieve if people have a low energy intake and if much of their diet consists of fats, alcohol, and sugar, which provide empty calories but little or no protein, or micronutrients.

The food guide plate, with pictures of real foods, shows the four groups of foods that should between them provide enough of all the essential nutrients and the fifth group that provides mostly energy. The areas indicate relative amounts, so that people can see they should eat plenty of vegetables and fruit, plenty of cereal foods, and potatoes; moderate amounts of meat, fish and alternatives, and of dairy foods. The fifth group, "fatty and sugary foods", are foods and drinks on which to go easy. Other countries have food guides rather like this but use different shapes.

In developing countries children suffer most of the malnutrition. In developed countries it is the elderly who are most at risk of nutritional deficiency, though this is usually mild or subclinical

and often associated with other disease(s). But it is very misleading to lump everyone over 65 together and expect them all to show the same problems and diseases. Healthy older people who are socially integrated are no more likely to get into nutritional trouble than anyone else.

For the majority people most of their life after 65 should be healthy and enjoyable. This "third age" is a time when people want to look after their health. They can now give more attention, time and money to getting and keeping healthy. They can take plenty of gentle exercise, have none of the stress of the workplace, few deadlines, and plenty of rest, and have time to choose food carefully and prepare it nicely. The dietary guidelines for younger adults all apply after retirement.

Vegetarians

People who live on a diet totally devoid of animal products are known as vegans and are rare in the western world [3]. Much more common are those who eat milk, milk products and eggs in addition to plant foods: they are known as lacto-ovovegetarians, or vegetarians for short.

Vegetarians are not, of course, a homogeneous group and among them are people who further restrict their diets in various ways. Some of these extra restrictions may be harmless, although they may make it very difficult to devise a nutritionally adequate diet; some of the extra restrictions, on the other hand, can be actually harmful. When considering the health of vegetarians in comparison with the health of the omnivorous general population it needs to be remembered that vegetarians often vary markedly from the general population in their use of alcohol, tobacco and other drugs and in their attitude to a healthy way of life.

Are vegetarians more healthy or less? The answer depends first on the degree of vegetarianism [4].

Vegans, who eat no animal products, are at risk of vitamin B-12 deficiency. Supplements are essential during pregnancy and for infants of vegans. Vegans lack the best dietary sources of calcium—milk, yoghurt, and cheese.

Lacto-ovo-vegetarians have no absolute nutritional risk. They miss the best absorbed form of iron in the diet, haem iron, but may largely compensate because ascorbic acid enhances the absorption of non-haem iron.

The other determinant is the reason for the vegetarianism. People belonging to long traditions of vegetarianism have the necessary recipes to prepare vegetarian centres for their dishes, using legumes (including soya) and nuts, and so have a good protein intake. It is new vegetarians, some of whom simply remove meat from the centre of the plate, who may eat inadequately.

Vitamins

Vitamins are a large group of potent organic compounds necessary in minute amounts in the diet [2]. They are usually divided into two classes based on their solubility characteristics. The watersoluble vitamins are soluble in water and usually function as coenzymes in the metabolism of protein, fats, and carbohydrates. The fat-soluble vitamins are not usually soluble in water but are soluble in one or more solvents such as alcohol, ether, or chloroform.

Each of the vitamins has a specific chemical structure and many can be synthesized rather inexpensively. Thus, multivitamin supplements can be purchased in drugstores for a modest price. While specific vitamins can cure specific deficiency diseases, the use of supplements by people consuming a wide variety of raw and cooked foods may be unnecessary.

Before the vitamins were chemically isolated and described, scientists began naming the compounds. In some instances, different research groups were studying the same compound and unwittingly gave different names to the same vitamin. This contributed confusion to the identity of vitamins. Frequently, the name chosen described the food source or the deficiency symptom. Thus, for years thiamin was known as the antiberiberi factor, vitamin K was known as the coagulation factor, and vitamin E as the wheat germ factor or the antisterility factor. As nutrition scientists began publishing their findings, it became important to establish a uniform nomenclature and one based on the alphabet was devised. Compounds having vitamin activity were alphabetized in order of their discovery. Now, however, information about the vitamins has expanded to such an extent that this nomenclature system is outmoded. Chemically descriptive terms are now being used that more correctly identify the vitamin in question. Nonetheless, alphabetical designations are still being used and the reader will encounter some of these in this text.

As scientists learned more about the vitamins they began to reclassify them according to function rather than solubility. Thus, we have vitamins that serve as membrane stabilizers, as coenzymes, or that have antioxidant properties and/or that act at the genomic level. Some vitamins fall into more than one category. For example, ascorbic acid serves as a general antioxidant, as a redox agent (as a substrate being oxidized to dehydroascorbic acid), and yet also

acts at the levels of transcription and translation for the protein, procollagen. Vitamin A is another one that is multifunctional. It has a direct role in the visual cycle, is an antioxidant, stimulates the RNA transcription for the retinoic acid receptor, and when bound to this receptor serves as a transcription factor for the transcription of numerous mRNAs.

Food

All living things on this planet require nourishment to fuel and support vital operations [5]. For instance, plants get water, minerals and nitrogen from the soil and produce their own carbohydrate, protein, and fat. Meanwhile, animals consume other forms of life, such as plants and animals or their products, in order to survive. For humans, we consume animals and their products (for example, milk, eggs) and/or plants and their products (fruits, vegetables, cereal grains). Even eating some forms of microbes (or microorganisms) such as yeast and some bacteria can help us survive and promote vitality. Humans exist at the upper end of the food chain, meaning that a large variety of life-forms are food to us, but we are not regular food for other life-forms. Plants, on the other hand, maintain a position at the other end of the food chain as they are food for many life-forms, including insects, fish, and mammals.

Numerous compounds found in small amounts in food products have been indicated to influence substantially the state of human health [6]. The detection of harmful compounds in food plays an important role in the food industry. The determination of toxicity of these substances enables to establish the potential adverse effects on heath and consumer safety. At the turn of many years, the food industry has changed in terms of number of compounds used for production and as a consequence quality of products. Foods used at early times were mostly without additives, hence they also had a short period for consumption. Nowadays, food without additives is virtually nonexistent. It is extremely important to increase the nutritional value of foods (vitamins, mineral compounds, amino acids, and their derivatives), the sensory properties (pigments, flavoring components, or flavor enhancers), and the shelf life of foods (antimicrobial additives and buffer additives). Additives or their degradation products generally remain in food. Although, in some cases, they can be removed during processing it is generally assumed that applied doses of food additives and their degradation products should be nontoxic. This also applies to both acute and chronic toxicity and is extremely important for compounds with teratogenic, mutagenic, or carcinogenic effects.

Unsafe food

Food service directors have a responsibility to ensure that their operations serve food that is safe and free of contamination [7]. The most frequently reported causes of food-borne illnesses are improper cooling of food, a lapse of 12 or more hours between preparation and consumption, infected persons handling food, inadequate reheating, improper hot holding of food products, contaminated prepared food and raw ingredients, and contaminated food preparation surfaces. Other causes include food from unsafe sources, improper cleaning of equipment and utensils, and cross-contamination of raw and cooked food. These causes illustrate that most food-borne illness can be prevented if food sanitation practices and temperature controls are an integral component of a continuous quality improvement program.

Health care food service operations should take particular caution to prevent food-borne illness caused by microbial (biological), chemical, or physical hazards. Certain consumers are among the high-risk populations for contracting food-borne illness, whereas healthy individuals are at less risk. At-risk groups—immune-compromised persons who cannot tolerate even small levels of microorganisms—include infants, fragile elderly, pregnant women, inpatients, malnourished individuals, those with controlled physical and metabolic disorders such as diabetes mellitus and high blood pressure, and persons with immune disorders.

Contamination is the presence of substances or conditions in food that can be harmful to humans. Bacteria and viruses pose the greatest safety challenges for all food establishments. Contaminants cannot be seen with the naked eye. Many types of food contamination can cause illness without a change in appearance, odor, or taste of the food. Cross-contamination happens when germs are transferred from one food item to the other, usually from raw food to ready-to-eat foods, by contaminated hands, equipment, or utensils.

Microbial (biological) hazards cause the greatest number of outbreaks of food-borne illness and are the most difficult to control because they involve microorganisms. Microorganisms are microscopically small living creatures that multiply rapidly given the right environment and are the most common type of food contamination. These microorganisms are classified into four major groups: bacteria, viruses, parasites, and fungi (specifically, yeasts and molds). Familiarity with each of these organisms and how they can lead to food-borne illness is essential to a food service director.

Toxicity

Anyone consuming food in a well-organised developed country in which they have lived long enough to have acquired immunity to the main local microorganisms is usually confident that the food is safe [3]. If they have any qualms, it is most likely to be about food additives, even though these have been thoroughly tested for toxicity. Apart from the rare people who may be allergic to a particular food additive, these substances present the least threat to health. Everyday food may, however, cause trouble from time to time, most often mild though occasionally serious or even fatal, the toxicity arising from natural poisons in the food or from contamination. The contamination may be with microbes because of poor standards of hygiene, or, far less commonly, some poisonous material may have accidentally entered the food. The purposeful adulteration of food with a harmful material in well-organised countries is now extremely rare.

Many ordinary foods contain some naturally-occurring toxic substances but they are very unlikely to cause harm. This may be because the toxic materials are present in very small amounts, or are not sufficiently well absorbed into the blood, or because they are quickly neutralized by the liver and then excreted in the bile or in the urine. The body's protective mechanisms can, of course, be overwhelmed if the intake of toxic material is large, or if the liver and kidneys are not working adequately.

Very few of the foods that we commonly eat have been subject to any toxicological testing and yet they are generally accepted as being safe to eat [8]. However, all chemicals, including those naturally found in foods, are toxic at some dose. Laboratory animals can be killed by feeding them glucose or salt at very high doses, and some micronutrients such as vitamin A and selenium can be hazardous at intakes only a few times greater than normal human requirements. Toxicity testing of a food or ingredient can tell us what the likely adverse effects are and at what level of consumption they may occur, but by itself this does not tell us whether it is safe to eat in normally consumed amounts.

Three general classes of hazards are found in foods: (1) microbial or environmental contaminants, (2) naturally occurring toxic constituents, and (3) those resulting from intentional food additives or new biotechnologies such as genetically modified foods. The most dangerous contaminants are those produced by infestations of bacteria or moulds in food, which can produce toxins that remain in the food even after the biological source has been destroyed. Other contaminants, such as pesticide residues or heavymetals, are usually well controlled in modern food supplies but can be significant hazards in particular localities. Naturally occurring toxic constituents can be considered normal and unavoidable. They are usually present in doses that are too small to produce harmful effects when foods are eaten normally, except in the cases of atypical consumers who may be allergic to individual ingredients. Food additives are generally the least dangerous hazards because their toxicology is well studied and the levels of use are tightly controlled.

Conclusion

Nutrition or food science is the applied natural science which studies the relationship between man and food and the implications that arise from that relationship and which are reflected in a sociological, psychological, physiological and biochemical aspect. It is based on the basic principles of chemistry and biochemistry, biology and microbiology, physiology and anatomy, and genetics. In practice, it also covers the principles of scientific disciplines such as agriculture, food technology, biotechnology, anthropology, medicine, sociology, psychology and economics. Nutrition research has a leading role in understanding the many processes involved in eating and the appearance of diseases and disorders, but also in understanding the role of nutrition in modulating an individual's genetic potential.

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