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Dimensions, domains and principles of the new nutrition science

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Abstract

Objective: Following the agreed principles, definition and dimensions of the new nutrition science, to elaborate its overall guiding principles, to propose some domains of its biological, social and environmental dimensions, and to propose a series of principles to govern and guide these dimensions and domains. This paper, part of *The New Nutrition Science project*, is initial work in progress towards a comprehensive typology of the science, and is designed to stimulate further work.
Method: A review that takes into account the discussions of the Giessen workshop on the new nutrition science, and in particular the workshop agreement as expressed in *The Giessen Declaration*. Three outlines of the evolutionary, historical and ecological general principles to guide the new nutrition science are given in boxed texts. The suggested specific principles, taken mostly from 14 associated papers and workshop discussion, are an informal supplement to the Declaration. They are presented as further work in progress, to be developed, revised and agreed at future meetings designed to develop the new nutrition science.
Conclusion: An essential aspect of the theory and the practice of the new nutrition science – in common with any scientific discipline and indeed any ordered human activity – is a specification of its dimensions and their domains, with definitions; and also considered and agreed principles to govern and guide its work.

Keywords
Conceptual framework of nutrition
Nutrition and ethics
Nutrition and evolution
Nutrition and history
Nutrition and ecology
Principles of nutrition
Dimensions of nutrition
Domains of nutrition

How will the new nutrition science work? *The Giessen Declaration*[1], and supporting and explanatory papers[2,3], define and specify the science and its overall principles. These need further processes of discussion and elaboration to be fully operational. This paper gives some further specification to the evolutionary, historical and ecological principles that will guide the science, and to its overriding ethical principle; and also suggests a series of principles to govern and guide the dimensions and domains of the science, in addition to those already agreed[1]. No attempt is made to be comprehensive.

Background

The main papers in this special issue of *Public Health Nutrition*[2–15] were circulated in draft to all participants in the Giessen workshop, for presentation, examination and discussion at the workshop, and subsequent review and revision for publication. The papers also formed the principal basis for successive drafts of *The Giessen Declaration* developed and then agreed at the workshop in its final form.

The pre-workshop draft of this paper proposed that the new nutrition science should be seen as multi-dimensional, and proposed a total of 12 dimensions: evolution; history; resources (physical, living, human); ecology and environment; food systems and agriculture; tradition, culture and cuisine; technology and industry; physical health (living and human); mental, emotional and spiritual health; equity (including poverty); economics and politics; and philosophy and ethics. The draft also proposed that the science should follow overall principles, and also specific principles to be applied to all these dimensions. One of the papers prepared for the workshop applies this conceptual framework to multi-dimensional work now being carried out in South Africa[13].

On examination and after discussion, the workshop participants agreed that while the new nutrition science should indeed include all these areas, and more, this framework should not be used. First, 12 dimensions are too many. Second, and on the other hand, many more areas could and should be specified: for example, within 'classic' biological nutrition science, the disciplines of physiology, biochemistry, pathology and genomics with all its aspects need to be reflected; as should other social and environmental areas such as geography, ethnology, archaeology, and so on.

The workshop participants agreed that nutrition science should have three dimensions. Whereas current conventional nutrition is a biological science, the new nutrition science has three dimensions: biological, social and environmental. In the words of the conclusion of *The*

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Box 1 – The evolutionary principle

Evolution is the study of the origin, development and adaptation of all life forms, and in particular of the environmental and other influences that enable the appearance and differentiation of living things. It is concerned with primordial and later forces that account for the relative success or failure of species.

Built-in hungers

Understanding of evolution, likely to be 'far more responsive to immediate environmental forces' than has been supposed[1], is vital to nutrition science[2].

One explanation for the current vast increase in prevalence of chronic diseases relies on an evolutionary hypothesis. The human species has an in-built taste for three edible substances valuable or scarce in nature: sugar – sweetness in fruits and other plant foods signals ripeness and safety; salt – sodium can be scarce in foods found in nature; and fat – the usual human condition has been food-insecure, and fat from food is most readily stored as body fat[3,4]. 'Inherent demand for sugary, salty and fatty foods . . . seems to stem from the evolutionary need to benefit from small amounts of these formerly scarce resources'[5].

So humans will, when they can, tend to overconsume foods that are sugary, salty and/or fatty, many of which are energy-dense. This apparently trite perception has profound implications. It implies that hunger is not just for energy from food. It explains why food manufacturers make more money when they include more and more of these substances in their products. It also implies that consumption of excess and pathogenic amounts of sugar, salt and fat is not just a matter of individual choice or voluntary behaviour.

When food insecurity is a major public health issue, consumption of a lot of fat and sugar can be seen as good. But now most populations are becoming increasingly overweight; and in middle- and even low-income countries obesity and diabetes even in early life are now projected as massive epidemics[6]. The evolutionary approach suggests that the only effective policies and programmes are those that alter the nature and quality of food supplies, by fiscal and other mechanisms that affect price and availability.

A general theory of the origins of chronic diseases

Following this, big-picture scientists are now assembling a general theory of the fundamental cause of obesity and its related chronic diseases, also known as the 'metabolic syndrome'[7].

The proposal is that humans have evolved to respond to times of energy restriction as if these are periods of scarcity or famine, by mechanisms that, after restriction ends, trigger hunger, inhibit satiety and preferentially conserve body fat. Indeed, it is hard to see how *Homo sapiens* could have evolved and survived without some such adaptive mechanisms? 'From an evolutionary point of view it makes sense that the body energy stores are defended during times of famine. . .and that in times of food surplus the essential requirements of the body can be met rapidly'[8].

This is why infants frugally nourished in the womb and so born small, then fed *ad lib* energy-dense foods, tend to become unusually fat children and adults[9]. This is why chronic diseases, at first more prevalent among the lower social classes in high-income countries, are now increasing explosively in middle- and low-income countries.

The evolved drive to store excess fat becomes pathogenic, and thus in effect maladaptive, most of all after *in utero* energy restriction, when babies, children and adults have plenty of readily available food to consume; especially when the food and drink is energy-dense; and most of all within sedentary populations whose energy balance is unnaturally low. It is only recently that these three conditions have often been met, but they are now the typical human condition in most parts of the world outside Africa and Asia.

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Giessen Declaration[1]: 'There remains much work to be done in the biological dimension of nutrition science. Much other important work now has to be carried out also in the social and environmental dimensions: this will require a broad, integrated approach. This Declaration emphasises that the most relevant and urgent work to be done by professionals working in nutrition science and in food and nutrition policy is in its three biological, social and environmental dimensions all together'.

Some of the other areas initially proposed as dimensions, such as ethics and ecology, are best seen as principles. Others are domains within the three dimensions: thus, culture, tradition and cuisine are domains of the social dimension, as are economics and politics; and resources of all types are environmental domains.

The workshop participants also agreed that principles should be applied to the dimensions and the domains of nutrition science. But in the time available, it was agreed to focus on the first principles, shown in Box 2. This paper here takes the thinking of the workshop further; it is designed to develop and be consistent with the workshop discussion, and is the responsibility of its authors.

Discussion

No science, and indeed no organised human activity, makes sense unless it is governed and guided by principles; these should be explicitly stated and subject to examination in the light of experience. The sentence before this one is itself an example of a principle.

Principles demonstrate context, structure and meaning. They are not 'truths', they are not forever right or wrong; rather, they are more or less relevant. They live and evolve; they make sense in some circumstances and not in others, and should be periodically reviewed. They answer 'why?' and 'what for?' questions. They give purpose to research and practice. They can be discussed and challenged at any time. Collected together, they should be one theme of congresses at which practitioners meet together to progress their work. A science with no stated principles is liable to become arcane, captured by what has been called 'the conventional wisdom of its dominant group', who act like high priests.

The 'vision' and 'mission' statements now widely adopted and published by government, industry and civil society organisations are examples of dynamic principles. Thus Ricardo Uauy, as President of the International Union of Nutritional Sciences (IUNS) 2005–2009, has proposed draft vision and mission statements for IUNS for the first decade of the twenty-first century and beyond[15].

One of these, an expression of the human rights domain of the social dimension of nutrition, is: 'To live a life without malnutrition is a fundamental human right... Nutrition improvement anywhere in the world is not a charity but a societal, household and individual right'.

As another example, the obsolete paediatric principle that accelerated growth in early life is the measure of good health, also known as the 'bonny bouncing baby' principle, made sense in its original historical context, of widespread deficiency diseases among the European lower classes in the period of rapid industrialisation. The principle gained inexorable momentum once nutrition scientists found out how to push human growth with infant formulae and diets high in energy and protein[16]. But now that machines have replaced the need for muscle power, and the proportion of middle-aged and old people in most populations has absolutely and relatively greatly increased, the context and so the rationale for this principle has disappeared.

Principles

Ethical

The Giessen Declaration states[1]: 'The overall principles that should guide nutrition science are ethical in nature'.

Box 2 – Principles, dimensions and purpose of the new nutrition science

The Giessen Declaration[1] specifies the principles, dimensions and purpose of the new nutrition science as follows. 'The overall principles that should guide nutrition science are ethical in nature. All principles should also be guided by the philosophies of co-responsibility and sustainability, by the life-course and human rights approaches, and by understanding of evolution, history and ecology.

'The biological dimension should...be one of the three dimensions of nutrition science. The other two dimensions are social and environmental.

'Nutrition science is defined as the study of food systems, foods and drinks, and their nutrients and other constituents; and of their interactions within and between all relevant biological, social and environmental systems.

'The purpose of nutrition science is to contribute to a world in which present and future generations fulfil their human potential, live in the best of health, and develop, sustain and enjoy an increasingly diverse human, living and physical environment.

'Nutrition science should be the basis for food and nutrition policies. These should be designed to identify, create, conserve and protect rational, sustainable and equitable communal, national and global food systems, in order to sustain the health, well-being and integrity of humankind and also that of the living and physical worlds.'

Reference

1 The Giessen Declaration. *Public Health Nutrition* 2005; **8**(6A): 783–6.

Box 3 – The historical principle

History discerns the significance of processes, phenomena and people in the recent or earlier past in the context of their times, or as relevant to the present and future. The quality of civilisations and the meaning of sciences increase as a function of applied knowledge of their history.

Why so much milk and meat?

History explains why meat and cow's milk are still emphasised as of special value for human health, including in regions of the world whose food cultures include little meat and little milk other than human breastmilk, and whose land is not suited to cattle farming. The 'Basic Four' food groups were promoted by the US and UK governments between the 1950s and 1970s. Two of the four were milk and meat (and their products). This made sense in a period of massive over-production of beef, milk and dairy products, itself a response to the mistaken idea of the dominant nutrition scientists that protein consumption should be boosted and that protein of animal origin is superior[1,2].

Versions of the 'Basic Four' food groups continue to influence official dietary guidelines throughout the world, and facilitate what remains booming global business in beef, pork, milk and dairy products[3].

Why white bread?

History also explains why degraded[4] white wheat bread is replacing other starchy staples made from rice, corn, oats, cassava and other grains and roots, throughout the world. It is a legacy of a time when nutrition science was dominated by the UK and the USA under the pressure of war and post-war recovery, a time of confluence between government, industry and nutrition scientists. In the late 1940s the British 'national loaf' was brown. Wartime governments accepted that whole-grain and brown bread is more nourishing. But the big millers and bakers wanted to be able to sell bran as animal feed, and germ as human 'health food', and to eliminate the essential and other fats in germ that become rancid and reduce the 'shelf life' of bread[5].

In 1946, in response to industrial pressure on government, Robert McCance and Elsie Widdowson were funded by the British Medical Research Council to determine what type of bread is nutritionally superior[6]. They did this by experiments on German foundlings. In Wuppertal and Duisburg, children were segregated according to what type of bread they were fed, and were also given potatoes, plenty of vegetables, vegetable soups, some meat and milk, and supplements of calcium and vitamins A, D and C.

The regime of the children was more than adequate and amply varied. So all groups of children were found to be equally healthy, judged by the principle that fast growth means health; a telling phrase was: 'their heights and weights went up faster than those of American children'[5]. As a result, the British government in the mid-1950s abandoned support of brown bread, and allowed industry to flood the market with the 'fortified' white bread that suited them best.

In the historical context of post-war Britain and Europe this all made sense. Minimum nutrition standards had to be set. At times of scarcity and insecurity it is essential to use cheap available staples. And McCance and Widdowson, who went on to have a dominant influence on British nutrition science up to the 1980s[7], supported and were supported by the UK government and also by the UK bread and flour manufacturers.

History comes to life

How can the Wuppertal Experiment be judged today? Professor McCance and Dr Widdowson, intractable biological scientists, were wrong to deride the concept that the human species is evolved to eat foods in relatively whole form[5]. They ignored the likelihood that a policy favouring British milling and baking oligopolies would lead to domination of grains by wheat and the destruction of thousands of small farms and businesses. And they did not mention that mass-manufactured white bread is disgusting unless eaten with fats and sugars spread on it.

The experiment was bad biological science and bad integrated science. It was the scientific rationale for mass-produced white bread made from wheat flour. It has shaped modern food systems that are deleterious to human health, and that impede varied and diverse food systems suited to climate and terrain.

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Ethics is concerned with the values and moral purpose of human conduct: not with description but with types of judgement, not with 'is' but with 'should'. When the members of the Commission on the Nutrition Challenges of the 21st Century stated[17]: 'The persistence of malnutrition, especially among children and mothers, in this world of plenty is immoral', they were making a striking ethical judgement. They were saying not just that an estimated 790 million people in poor countries have inadequate access to food, but that this and other information describes a world that has gone wrong.

Philosophy itself, of which ethics is one branch, is the study of meaning, knowledge and judgement. Until the early nineteenth century scientists were known as natural philosophers; aptly so, because characteristically they were concerned with the broader meanings of their work. Ethical issues are 'transcendent'[18]; they may be well grounded in evidence, but by nature they are above and beyond experiment, and so are literally metaphysical. In the modern convention, ethical questions are usually not addressed by physical, chemical or biological scientists when at work, unless the consequences of scientific advances are so awesome (use of nuclear fission to make bombs being an obvious example) that most people including scientists cannot sustain a value-free attitude.

Introducing ethics as the overall guiding principle of nutrition science, and to food and nutrition policy, means that judgement of what is right and what is wrong, and acting accordingly, should be part of its work. Nutrition scientists should accept that ethical values are professionally relevant, as they are in any science with social and environmental dimensions.

The principles suggested below identified in 'bullet points' are mostly taken from the papers as revised for publication after the Giessen workshop[2–15], or from workshop discussion. They are not comprehensive, and there are gaps and overlaps. Some are broad general statements capable of refinement into principles. They are designed to frame nutrition science so that it can be most effective in action, and are meant to engage nutrition scientists as citizens as well as professionals. They are offered for further discussion, revision and agreement on other occasions, as part of the continuing process of *The New Nutrition Science project*, and indeed should be a fruitful basis for another workshop building on that held at Giessen. First, ethical principles:

- The overriding responsibility of nutrition science is to work to handing on to future generations an improved human, living and physical environment: healthy people, healthy populations and a healthy planet.
- Animals are not merely human resources. They should be able to develop and live a proper life before they serve as our food. The industrial production of animals for human consumption is immoral.

Next, here are some suggested evolutionary, historical and ecological principles.

Evolution

- All nutritional theory, policy and practice should take into account the diet-related evolutionary pressures that shaped the biological evolution of the hominid line and, eventually, *Homo sapiens*.
- The human species is uniquely evolved to grow slowly and mature late. Policies and practices designed to accelerate human growth and sexual maturity are a mistake from the biological, social and environmental points of view.

History

- We can properly understand the food and nutrition issues that face us now and for the foreseeable future only by examination of the historical decisions that have shaped the world's food systems.
- Food and nutrition practices consistently followed in different cultures in history are probably valid – though not necessarily for the reasons given. They do not require proof to be accepted, but disproof to be rejected.

Ecology

- To achieve a world nutritional state that is health-supporting, equitable and sustainable, it is necessary to understand the interplay between evolutionary, environmental and ecological dimensions and domains.
- All relevant sciences, including that of nutrition, should be mainly concerned with the cultivation, conservation and sustenance of human, living and physical resources all together, and so with the health of the biosphere.

Next, some suggested principles for the three dimensions of nutrition science, and for some of the domains of these dimensions.

General

- We are moving out of the era in which human activity has been mainly concerned with exploitation, production, consumption, into a new era in which the main human concerns are of preservation, conservation, sustenance.
- Nutrition science should follow ethical, evolutionary and ecological principles, respect history, culture and tradition, affirm human rights, and be committed to preserve and protect the human, living and physical worlds, all together.
- The responsibility of nutrition science now is to be concerned with the human world (personal, community and population health) and also with the whole living and natural world (planetary health).
- Nutrition science should contribute to a world in which all people are able to fulfil their human potential, to live

Box 4 – The ecological principle

Ecology is the study of the environment as a whole system. The ecological approach to food and nutrition considers food systems as a whole, prefers variety and biodiversity, and is concerned with the impact of food systems and dietary patterns on other aspects of life and the whole living and physical world.

Econutrition and nutrition ecology

Everything has a context, and the context for food is the environment. Historically, mainstream nutrition has not been much concerned with ecological aspects of food systems. More recently though, an increasing number of nutrition scientists have identified the need for conjunction between nutrition as a biological and environmental science, with reference to indigenous and traditional food systems that make sustainable use of local climate and terrain, and to food variety and biodiversity.

The ecological approach examines systems as a whole and places human health in a wider context. Ecological nutrition, or 'econutrition' has already been advocated[1].

A broader concept, 'nutrition ecology', includes social as well as environmental with biological science, and covers: 'total food quality, ecologic balances, and life-cycle assessments; the influence of nutrition systems on climate, world nutrition, and food prices; and a comparison of different diets and agricultural, environmental, and consumer policies'[2]. Both these approaches are moves towards the new nutrition science.

Food systems

The concept of 'food systems'[3] is an outstanding example of an ecological approach: it relates the human species to the living and physical world. Food systems are developed to sustain life at all levels, from global to national, communal and individual.

A food chain ('from plough to plate') is a static mechanical concept, as used by engineers. A chain is linear; it exists in space but does not change in time without external intervention; and without any link it breaks. By contrast food systems, and their expression in food culture and cuisine, have social and economic significance and are expressions of communal, regional or national identity.

Food systems are dynamic and organic, naturally understood by farmers, constantly evolving over space and time, and when healthy, spiral in nature – progressing ever on, around and up. They include the planting and breeding, production, harvesting and slaughter, storage, preservation and transport of food, and also its manufacture, processing, packaging, trade, distribution, sale and preparation, as well as its composition, consumption and metabolism, and also interrelated processes flowing within the contexts of evolution, history, resources, environment, tradition, culture, cuisine, health, technology, economics and politics. Compared with the 'chain' metaphor, food systems are obviously a more attractive, accurate and useful model of complex reality.

Traditional food systems necessarily make use of available resources adapted to local climate and terrain. The longest evolved food systems best known in the North are that of the Mediterranean littoral, from southern Spain, France and Italy, to Greece and Turkey, Lebanon, Palestine and Egypt, and the other Maghreb countries of North Africa. Derived from Persian, Egyptian, Greek, Roman, Arab and other cultures, the Mediterranean food systems have a history of over 3000 years, and in their ancient and modern forms are celebrated by nutritional and culinary authorities[4,5].

The natural context of food

Subsistence farming, with its systems of barter and little use of money, has been the basis of the economies of pre-industrial societies for many thousands of years, and agriculture as now developed by family and small farming communities still remains the basis of the economies of many countries. But agriculture is not merely a business. It sustains rural populations, and is a basis for national identity and culture[6].

Understanding of the patterns of disease in any part of the world, and over any period of time, requires study of the ecology of agriculture and of its impact on the nutritional quality of the food produced. Thus, the nature and quality of any plant food is affected by the quality of the soil in which it is grown, and of any animal food, by the feed eaten by the animal and the conditions in which it lives.

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in the best of health, and develop, sustain and enjoy increasingly diverse human, living and physical environments.

Biology

- Nutrition defined as a biological science cannot make much difference to mass epidemics of any type of disease, because the social and environmental determinants of epidemic disease are outside its scope.
- The biological effects of food on the human body are part of a process involving microbial ecosystems within the gastrointestinal tract which, while composed of many thousands of other species, amount to a vital organ of the body.
- The biological impact of a food is greater than the sum of its parts. It includes the bioavailability of its components, their interaction in the gut, and its overall effect on the function of vital organs and the organism as a whole.

Health (physical)

- The single nutritional factor that most protects human health lifelong is extended exclusive breastfeeding. The practice of breastfeeding is also emotionally vital, socially valuable and environmentally sound.
- All nutritional recommendations designed to improve human health should be consistent with and not contradict the need to sustain living and physical resources and to protect the environment.
- The prevention of malnutrition – most of all of women and children – by dietary means in deprived populations will work only if people have access to foods that are adequate both in quantity and quality.

Health (mental, emotional, spiritual)

- Nutrition science should once again be concerned with well-being and health in the broadest sense. For humans, mental, emotional and spiritual health are as important as physical health.
- The best nutrition is from food eaten as shared meals. Good company and surroundings increase enjoyment and well-being, and enhance the meals' nourishment of physical and all other aspects of human health.

Society

- Understanding the vast and rapid recent social as well as nutritional and epidemiological changes, and their basic driving forces, is essential for sustained prevention of disease and sustenance of human well-being and health.
- Choices made by communities, families and individuals play a part in shaping food systems. But social factors, including technological development and economic and political policies and practices, are more powerful.
- The main solutions to nutritional problems lie less in unlocking biological pathways, and more in creating healthy societies and also environments. Change unhealthy societies and maintain healthy societies, and nutrition will follow.

Food systems

- Food and nutrition policies should identify, create, conserve and protect rational, sustainable and equitable food systems, to sustain the health, well-being and integrity of humankind and also that of the living and physical worlds.
- Food systems that are biodiverse are superior to those that reduce biodiversity. Biodiverse systems also protect against environmental disasters, as well as providing the most healthy food supplies.

Technology

- Available technologies determine the nature of food systems. Nutrition scientists should examine all relevant technologies to ascertain that, in use, they benefit human health and welfare and that of the living and natural world.

Tradition

- Nutrition policies should take into account that almost all the great cuisines of the world are high in staples (cereals, pulses, tubers), make maximal use of available vegetables and fruits, and are sparing in their use of meat.
- Indigenous and traditional food systems, when these are known or reliably considered to be beneficial to human health, and which have light environmental impact, should be preserved, reinstated and developed.

Culture and cuisine

- Nutrition scientists and allied professionals should understand and respect the traditional, cultural, religious and other social factors that drive people's food and health beliefs and practices.
- There is an absolute one-to-one correspondence between good husbandry, sound nutrition and great gastronomy. Traditional cooking, rooted in the home, supplies good nutrition, agreeable social life and autonomy.

Economics

- New economic models are needed. Progress and development should not be equated with more industrialisation and urbanisation and more use of money, but personal fulfilment within agreeable and just societies.
- Food subsidies in rich countries, and tariffs imposed on agricultural products from poor countries, damage human health, social fabric and the environment, and are a key basic cause of intractable epidemic diseases.

Politics

- Nutrition science has never been neutral. Its advances have been made in engagement with society's

leaders. Nutrition scientists now should become more organised, more active, and more engaged.
- The basic causes of epidemics now include the results of decisions increasingly taken beyond democratic process. Action to control and prevent disease requires new structures of governance at international and global levels.

Environment

Resources (living, physical)

- Industrial food production – amplified by need to earn foreign exchange, and the growing consolidation and power of the food-producing industry – is doing increasing damage to the natural resource base.
- The only rational food and nutrition policies are those that take account of global renewable and non-renewable resources, designed to sustain renewable resources and not to continue to rely on non-renewable resources.
- Priority should be given to renewable sources of energy that do not create problems of safety and waste, for food systems. These include solar energy, wind power, geothermal energy and tidal energy.

Agriculture

- Monocultural farming systems can be sustained – though not for ever – in rich countries whose people buy imported foods; but in poor countries they cause food insecurity, and increase poverty and instability at all levels.
- Mixed farming systems suited to climate and terrain that support the natural fertility of the soil by sustainable methods, and make minimal use of chemical inputs, are ecologically and environmentally sound.

Conclusion

The general statements set down here amount to a first rough draft of a series of principles to govern and guide the new nutrition science, which supplement the finished and agreed statements made in *The Giessen Declaration*. These should be developed, revised and completed at further meetings designed to shape the science and make it most effective in meeting the opportunities and challenges of the twenty-first century.

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