



Perspectives for nutrition research 2022

Position of the German Nutrition Society (DGE)

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Abstract

Nutrition is a central aspect of current societal challenges – from the climate crisis, the SARS-CoV-2 pandemic, and the obesity pandemic to global hunger. To successfully address these challenges innovative and interdisciplinary nutrition research that generates and evaluates new approaches to solutions is needed. This Germany Nutrition Society position statement identifies pressing research issues and emerging topics in the field of nutrition. It is intended to inform those active in research funding and stimulate calls for research proposals across the identified thematic areas. In view of the enormous importance of nutrition for health and sustainable development, the need for vision, resources, and concerted action is more urgent than ever to promote and strengthen nutrition research.

Keywords: societal challenges, nutrition research, research funding, health, sustainable diet

Introduction

Nutrition science considers and analyses the process of nutrition in its biological, health, sociocultural, behavioural and economic dimensions – from the individual to society, in all of its diversity – and within the given limits of ecosystems. Before considering the influence of socially accepted values and goals on our diet, the foundation must be built upon scientifically validated knowledge and concepts. Our nutrition faces numerous challenges. Not only should it provide adequate amounts of energy and nutrients while supporting the prevention of diseases but should also be compatible with the climate and environment, taking ethical aspects into account and enabling social participation [1, 2]. Nutrition is thus an essential part of the sustainable development goals formulated by the United Nations [3]. Successful transformation towards a health-promoting and more sustainable diet requires adapted and culturally accepted dietary recommendations as well as personalized nutrition concepts [4, 5], modern food technologies [6], health-promoting and fair food environments¹ and sustainable food value chains [1, 2]. Demographic changes further increase the urgency of implementing health-promoting diets to curb the prevalence of diet-related diseases [7].

Some of the objectives mentioned can be achieved through sociopolitical measures based on the current state of knowledge. Other objectives require new solutions that are developed and validated through research initiatives. Translating new concepts into practice to improve population diet quality must be evidence-based and evaluated.

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¹ The term "fair food environment" includes all dimensions of a more sustainable diet (health, environment, animal welfare, and social; defined in the "German Nutrition Society position statement on a more sustainable diet" [2]).



The task of the German Nutrition Society is to identify nutrition research needs [8]. Therefore, this German Nutrition Society position statement aims to identify urgent and emerging nutrition research topics. It is meant as a source of ideas for national and international research funders and third-party funders, as well as for politicians and stakeholders. Moreover, this position statement is intended to be a compass for developing and formulating forthcoming calls for funding programs. Due to the interdisciplinary nature of nutrition-related research topics, the German nutrition research landscape is fragmented and lacks visibility compared to the international community. The reasons for this are multifactorial and are primarily manifested in insufficient human and financial resources as well as poor research capacity pooling and sharing of competencies [9]. Given the enormous importance of nutrition for individual health, society, and sustainable development, there has never been a more urgent call for vision, resources, and concerted action to strengthen nutrition research.

Important topics in nutrition research

The following passage provides an overview and rationale for nutrition-related research topics considered most important and relevant by the German Nutrition Society. Examples are provided for selected topics considered to be particularly important; however, the focus and level of detail between the individual topics may differ considerably.

a. Further development of dietary recommendations

The most important basis for deriving measures to improve nutrition are evidence-based (i) nutrient intake reference values and (ii) food-based dietary guidelines.

Given scientific developments and societal changes, ongoing review and further development of dietary recommendations and their implementation for all population groups is critical. Dietary guidelines must take the goals of a health-promoting and more sustainable diet into account and should be implemented based on fair food environments. Relevant individual characteristics should be considered when developing and implementing personalized dietary recommendations. Moreover, it is

Overview of selected topics

- a. Further development of dietary recommendations
- b. New technologies and data science in nutrition science
- c. Food components and food processing
- d. New approaches in dietary behaviour research
- e. Health-promoting and fair food environments
- f. Monitoring and surveillance in the field of nutrition
- g. Physiological aspects of nutrition on different levels

essential that measures taken to implement dietary recommendations into practice are evaluated.

- Further developing methods for deriving Food-Based Dietary Guidelines (FBDG) – both generally and in specific situations
- (Further) Developing dietary guidelines for plant-based diets
- Identifying relevant genetic and metabolic parameters to develop specific nutrient reference values; developing methods for deriving more individualized food and nutrient intake recommendations (i.e. personalized nutrition).
- (Further) Developing dietary recommendations to prevent certain chronic diseases that have not been the focus of research thus far, e.g. neurodegenerative, respiratory, autoimmune and mental health diseases
- (Further) Developing dietary recommendations to ensure optimal immune system functioning and thus contribute to the prevention of communicable diseases
- Investigating the effects of different diets, meal structure, chronobiological aspects of the diet, frequency of out-of-house meal consumption, portion sizes and energy/nutrient density on metabolism, body weight and disease risk. Moreover, taking the heterogeneity of these effects into account depending on the characteristics of the individual
- Evaluating the effectiveness of interventions aimed at implementing dietary guidelines in practice, both on the individual level and in different settings

b. New technologies and data science in nutrition science

Innovative technologies have enabled the generation of extensive nutrition research data. This data must be systematically recorded and evaluated using new methods. Knowledge of a wide range of nutrition science issues, such as (patho-)physiological processes, systems biological approaches, the inclusion of sustainability aspects and the development of personalized strategies can thus be greatly expanded and specified by adapting and employing data science methods and artificial intelligence.

- Employing omics techniques to investigate the effect of nutrition factors on the gut microbiome, metabolome, immune system and epigenetics as well as their interactions



- Implementing systems biological approaches to integrate multidimensional omics data for describing the preventive potential of nutrition
- Applying new methods for combining personal characteristics such as age, (consumption) habits, omics data, medication intake, chronic diseases etc. to comprehensively characterize a person (i.e., personalized nutrition).
- Adopting innovative technologies and data science for research questions in behavioural science, public health research and epidemiology
- Research on a sustainable diet and developing a valid, integrated open-access database for environmental indicators (e.g., the "German Sustainability Database")
- Creating a "Digital Ecosystem of Nutrition" in which digital applications and opportunities for promoting a healthy and more sustainable diet can be developed and translated into practice
- Research in digital services and applications: acceptance and effectiveness of digital applications among stakeholders and in the general population

c. Food components and food processing

In addition to essential nutrients, foods provide a broad profile of other nutritive and non-nutritive components whose occurrence and physiological effects are insufficiently researched. Knowledge of the composition of traditional and especially new and novel foods is incomplete. In terms of a more sustainable diet, these foods are of great interest. However, there is a lack of knowledge on the possible physiological effects on food undergoing emerging processing technologies or combinations of different technologies.

- Conducting studies on physiological and molecular effects and mechanisms of food products that have been insufficiently researched so far, such as dairy products, legumes, polyphenol-rich foods, etc. and their components
- Reviewing the potential health risks of increased consumption of highly processed foods, including the underlying mechanisms of action
- Investigating the dietary quality and health effects of new and novel foods (e.g., insects, and in-vitro meat); evaluating plant-based alternatives to animal products including novel protein substitutes
- Investigating how food components are metabolized by endogenous enzyme systems and the intestinal microbiota; investigating the metabolites formed in the process, including their bioactivity
- Performing intervention studies to evaluate new and novel foods
- Conducting studies on the use of convenience foods, processed and highly processed foods in private households and commercial kitchens

d. New approaches in dietary behaviour research

Modifying dietary habits is the key for long-term improvement in nutrition. New methods for describing behaviour and related factors must be further developed, tested, adapted and validated. Communication strategies and interventions need to be rethought in order to bring about tailored, lasting and thus effective behavioural changes.

- Developing and validating methods for multidimensional recording of eating behaviour at the time of consumption (in-situ) ("behavioural signatures" e.g. what, how much, when, how long, and where) using digital technology
- Investigating social factors that influence individual dietary behaviour over time (exposure, access, choice, and consumption)
- Developing and evaluating effective interventions for the reception and acceptance of dietary recommendations and guidelines as well as for behavioural change among people in varied settings and from different age, social, and cultural groups
- Investigating the effectiveness of nutrition education interventions
- Utilizing digital services to develop and evaluate effective communication channels for delivering nutrition information to different target groups
- Identifying determinants of food perception and their influencing factors (e.g., systematic studies on olfactory changes over the life course)

e. Health-promoting and fair food environments¹

The impact of a health-promoting and fair food environment on consumer dietary behaviour has been historically underestimated in Germany. Measures to create a fair and sustainable food environment for all, including vulnerable groups, organizational settings (e.g. schools, companies, and hospitals), municipalities, and nationally are still in its infancy compared to the international community. These actions should be developed using evidence-based nutrition concepts, regularly evaluated and continuously reviewed and adapted.

- Developing and regularly evaluating evidence-based concepts for creating fair food environments in terms of food exposure, access, selection and consumption in all population groups and for all lifestyles, including at-home food preparation
- Developing and evaluating the preventive potential (i.e., efficacy, cost-effectiveness, and feasibility/acceptability) of nutrition interventions to change food environments and dietary behaviour (e.g., nudging) in "field tests" (e.g., community catering or model regions)
- Evaluating the effectiveness of nutrition policy measures that are already implemented (e.g., health claims, food labelling,



reformulation strategies, and voluntary labelling systems) or not yet implemented (e.g., taxes, reduced portion sizes, retail regulations, regulations in out-of-house consumption, mandatory labelling systems, and regulation of food marketing)

- Research on any undesirable effects/consequences resulting from measures to create health-promoting and fair food environments (e.g. undesirable side effects of salt reduction, switching to organic foods, unintentional discrimination against selected population groups due to nutrition policy measures)

f. Monitoring and surveillance in the field of nutrition

A thorough understanding of the current nutrition status, both in the general population and in population subgroups, is a prerequisite for sound planning of nutrition policy measures. Likewise, measures to improve overall nutrition status must be evaluated in order to analyse and assess their effectiveness. Monitoring and surveillance studies in the field of nutrition are currently lacking nationwide, are rudimentary or are conducted too infrequently. Investigating a "more sustainable diet" needs to be newly established and is particularly necessary for monitoring measures aimed at sustainable diet implementation and monitoring fundamental changes in the food system. The consequences of the SARS-CoV-2 pandemic also include an increase in food insecurity and food poverty in the general population, although exact figures do not yet exist in Germany.

- Monitoring and surveillance of nutrition (and health) at the national level, in the federal states, and in all relevant population subgroups; monitoring dietary quality and catering in important institutions (e.g., daycare centres, schools, universities, workplaces, hospitals, retirement/nursing homes, etc.)
- Monitoring of the extent and causes of food poverty and developing strategies to reduce food poverty
- National reporting on a "more sustainable diet"; monitoring of food waste in private households, the retail sector and catering establishments
- Monitoring of food choices (incl. portion sizes) and their placement in the retail sector and out-of-house settings
- National reporting on nutrition education and monitoring measures applied to formal nutrition education

- (Further) Developing the use of digital methods for the collection of nutrition data
- Identifying new and/or combined biomarkers to measure food intake, identify dietary patterns and use these for diet monitoring

g. Physiological aspects of nutrition on different levels

A basic knowledge of the physiological effects and mechanisms of foods and dietary components at the molecular, cellular, and clinical functional levels is imperative for understanding the causality of nutrition on the salutogenesis and pathogenesis of human disease. In this regard, the effects of targeted nutrition interventions on the entire human organism, particularly in vulnerable populations, are also of primary interest. This knowledge is a prerequisite for formulating evidence-based dietary recommendations for nutrients and foods as well as developing effective preventive and therapeutic approaches. Currently, there is a lack of data on absorption rates, kinetics and metabolism of many nutrients and food ingredients as well as knowledge of nutritional endogenous (e.g. genetics, epigenetics, and gut microbiome) and exogenous (e.g. other lifestyle factors) modulating factors, all of which contribute to the high variance of individual metabolic responses to nutrition. These knowledge gaps also limit the development of personalized nutrition approaches, the assessment of the safety of food ingredients and the understanding of the interactions between the food environment and individual biological influences (e.g. age, obesity, hormones, genetics, epigenetics, and microbiome).

- Physiological studies in humans as well as cellular and molecular studies in animal models and cells to elucidate specific mechanisms of action of essential and non-essential nutrients
- Investigating interactions between macronutrients, vitamins, minerals, phytochemicals and food additives in intestinal absorption and on metabolism
- Nutrigenomics and nutri(epi)genetics studies to investigate individual metabolic responses to changes in energy and nutrient intake
- Studies on the modulation of the pathogenesis of immunological and neurological diseases by nutritional factors (food and its components)
- Investigating the interaction between nutritional factors and intestinal microbiome (e.g. composition, metabolic activity and functionality)
- Transfer of basic scientific findings into applied research

Explanations

The topics outlined by the German Nutrition Society reflect the nutrition challenges of our time and their importance for nutrition research in Germany. In particular, the climate crisis, the SARS-CoV-2 pandemic, global hunger and the obesity pandemic have forced the nutrition science community to rethink and act. There is a great opportunity to meet these challenges with constructive approaches and innovation. It involves changes at various points in the food system, which are socially and politically possible and



must be designed in a way that leads to significant improvements in human health and environmental sustainability as a result of healthier population diets. The nutrition science community must work on these challenges scientifically, for instance by developing new concepts, facilitating their implementation into practice and evaluating their effectiveness.

Our knowledge of the general population's current dietary behaviour is rudimentary. A regular and more detailed monitoring is important and was therefore listed as a priority research area. New (digital) methods for collecting nutrition data will be further developed and used for this purpose.

Digital innovations also enable major advances in the field of dietary behaviour research. Digital information about the consumer's process of making food decisions (from purchase to consumption) allows comprehensive insights and, at the same time, opportunities for intervention. With simultaneously optimized food environments, improvements on individual nutrition towards health promotion and sustainability is achievable.

The food supply is changing rapidly, especially due to the reduction of animal-based food consumption. Novel foods must be evaluated and their impact on the daily diet must be identified. The possibilities and opportunities of optimized nutrition geared toward the individual (personalized nutrition), as well as necessary adaptations of food environments must also be scientifically investigated and evaluated.

New technologies are available for research: in laboratory analytics (e.g., omics techniques), via digital possibilities for data acquisition and processing, applying new algorithms for using data (e.g., data science and artificial intelligence) and communication. The scientific use of new technology to elucidate molecular and physiological processes, and subsequently evaluate the influence of nutritional factors on health and disease is also a great opportunity. In particular, research on the prevention of diseases that have not been in focus so far, such as neurodegenerative diseases, is urgently needed.

Of course, only a selection of nutrition research topics are presented here, and interdisciplinary topics in particular are neglected. For example, a deeper understanding of the sustainability of the current food system provides the basis for the formulating concrete goals to bring about the necessary changes. The consequences of dietary changes on the value chain can be investigated in model calculations (e.g., food system research). In this way, the full consequences of implementing a health-promoting and more sustainable diet can be presented. The international perspective is essential in this context, as consequences for health and resource consumption must always be seen and evaluated in an international context (i.e., global health). Expertise in these areas in the German nutrition research community is lacking and should be expanded.

It is also evident that some of the major challenges in the field of nutrition can only be optimally addressed by interdisciplinary teams. Close cooperation with related scientific fields, such as agricultural science, food technology, environmental science, psychology, and medicine is required to co-develop better solutions. Research funding organisations should recognise this need and potential barriers to investigating nutrition-related research topics should be reduced. Nutrition research is dependent on third-party

funding and thematically adapted funding instruments. Individual funding alone is inadequate, especially for working on complex topics. Therefore, funding for collaborative research should be encouraged and enabled. The time component of research funding should also be adapted to the topics and projects. Long-term observational nutrition studies and multicentre nutrition intervention trials require flexible time-frames and sufficient possibilities for long-term funding.

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Conflict of Interest

Position papers and statements reflect viewpoints and assessments – i.e. also the interests – of the organization(s) named in the author line. The authors declare that there are no further conflicts of interest in connection with the contents of this publication.

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