
DTU

Reflexions on future development and challenges of Risk-Benefit

Parma Summer School June 11-13 2019
Morten Poulsen, Head of research group
Research Group for Risk-Benefit Assessment
National Food Institute, Technical University of Denmark
morp@food.dtu.dk

Outline

1. Status of RBA
2. Challenges
3. Future developments
4. Take-home message

Risk-benefit assessment

Can be common sense…

But sometims more complicated than that!

RBA status Today

We can do it!

Models and methods has been developed

More case studies needed to tackle present and future challenges

Lack of data and too many data!

Good international network

RBAs are performed to…

- …provide the public or authorities with information on the health impact of (current or future) dietary choices
- …evaluate proposed interventions
- The aim of any RBA is stated and reflected in the problem definition (or Terms of Reference) EFSA (2010)
- The RB problem must be formulated in close collaboration with the stakeholder (e.g. risk-benefit manager)

RBA status

Health effect identification and selection is probably the most time-consuming step in RBA

… But probably the most important!

Multiple frameworks available within the individual fields, but no clear-cut guidance available for evidence integration in RBA

Almost impossible to perform perfectly – and therefore be transparent

Risk-benefit assessment is a powerful tool…

…BUT there is a challenge of comparing risks and benefits:

- Risk assessment and benefit assessment are different by nature
- Risk should be prevented
  - Conservative estimates
  - Worst case scenarios
  - Precautionary principle
- Benefits should be proven

RBA vs RA

Risk and benefit assessment has been known for a long time,

but Risk-benefit assessment (RBA) is something different

The purpose of a Risk Assessment of chemicals is to provide evidence to ensure a high level of protection of human health - conservative, worst case

Burden of foodborne chemicals provide evidence of the current impact that exposure to a given chemical has on public health

Workshop Report

Risk-Benefit Assessment Expert Workshop
Copenhagen, May 2017

DTU Food
National Food Institute

Food Research International xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Review

Risk Benefit Assessment of foods: Key findings from an international workshop

Sara M. Pires[a,*], Géraldine Boué[b], Alan Boobis[c], Hanna Eneroth[d], Jeljer Hoekstra[e], Jeanne-Marie Membré[b], Inez Maria Persson[a], Morten Poulsen[a], Juliana Ruzante[f], Jacob van Klaveren[a,e], Sofie T. Thomsen[a], Maarten J. Nauta[a]

[a] *Division of Diet, Disease Prevention and Toxicology, National Food Institute, Technical University of Denmark, Lyngby, Denmark*
[b] *SECALIM, INRA, Oniris, Université Bretagne Loire, Nantes, France*
[c] *Faculty of Medicine, Department of Medicine, Imperial College London, United Kingdom*
[d] *Department of Risk Benefit Assessment, The National Food Agency, Uppsala, Sweden*
[e] *National Institute for Public Health and the Environment, Bilthoven, The Netherlands*
[f] *RTI International, Research Triangle Park, North Carolina, United States*

Trends in Food Science & Technology 76 (2018) 90–100

Contents lists available at ScienceDirect

Trends in Food Science & Technology

journal homepage: www.elsevier.com/locate/tifs

Review

Meeting the challenges in the development of risk-benefit assessment of foods

Maarten J. Nauta*, Rikke Andersen, Kirsten Pilegaard, Sara M. Pires, Gitte Ravn-Haren, Inge Tetens, Morten Poulsen

Research Group for Risk-Benefit, National Food Institute, Technical University of Denmark (DTU), Kemitorvet, 2800 Kgs. Lyngby, Denmark

ABSTRACT

Background: Risk-benefit assessment (RBA) of foods aims to assess the combined negative and positive health effects associated with food intake. RBAs integrate chemical and microbiological risk assessment with risk and benefit assessment in nutrition.

Scope and Approach: Based on the past experiences and the methodological differences between the underlying research disciplines, this paper aims to describe the recent progress in RBAs, identifying the key challenges that need to be addressed for further development, and making suggestions for meeting these challenges.

Key Findings and Conclusions: Ten specific challenges are identified and discussed. They include the variety of different definitions and terminologies used in the underlying research disciplines, the differences between the "bottom-up" and the "top-down" approaches and the need for clear risk-benefit questions. The frequent lack of data and knowledge with their consequential uncertainties is considered, as well as the imbalance in the level of scientific evidence associated with health risks and benefits. The challenges that are consequential to the need of considering substitution issues are discussed, as are those related to the inclusion of microbiological hazards. Further challenges include the choice of the integrative health metrics and the potential scope of RBAs, which

A summary of the challenges in risk-benefit assessment as discussed in this paper, with a brief indication of the proposed way forward.

Topic	Challenge	Suggested way forward
Definitions	Definitions of basic concepts differ between disciplines underlying RBA.	Create awareness and reach consensus.
Top-down versus bottom-up	Risk and benefit assessments can be based on top-down human observational evidence or bottom-up risk assessment approaches, which may provide different health effect estimates of food compounds or contaminants.	Perform studies that combine the two approaches to compare potential bias and uncertainties, either by case studies or simulation studies.
Risk-benefit question	A wide and confusing range of questions is possible, which may require different methods.	Define the risk-benefit question in close collaboration with risk-benefit managers. Categorise questions and frame the risk-benefit question schematically.
Lack of data and knowledge; uncertainty	Missing data and knowledge can lead to large uncertainties attending RBA.	Identify, characterise and communicate uncertainties; fill up the crucial identified data gaps.
Imbalance of level of evidence	The level of evidence required for benefits is usually larger than for risks, hence risks are more likely to be included in RBAs.	Put emphasis on the size of the health effect rather than on the presence or absence of the health effect.
Substitution	When an alternative intake scenario implies a change in consumption of one food product, it will have consequences for others. There can be many options for substitution.	Find a comparable food product and include it in the analysis, use isocaloric alternatives, or compare several scenarios.
Quantitative metrics	Qualitative and quantitative approaches can be used and various health metrics can be selected. They can be applied both at population level and individual level.	More than one metric can be useful, quantitative assessments can be preferable even if the risk-benefit balance is clear. Well balanced choices for the metrics applied have to be made when the risk-benefit question is defined.
Including microbiology	Microbiology is not well integrated in current RBA methods, definitions and concepts may be different. Yet it is an intrinsic part of food safety with significant health implications and therefore it should be included in RBAs.	Perform more RBAs that include microbiological hazards, take advantage of experience in disease burden estimation and risk ranking.
Scope	The scope of RBAs can be extended beyond health concerns, for example by including costs and environmental sustainability.	Develop methods and metrics to do this further, integrate methods such as LCA and MCDA into RBAs.
Application	The (Quantitative) RBA methodology has not yet been applied much, it is unclear to what extent the developed methods are practically applicable.	With case studies, show how useful the RBA can be in different areas and discuss experiences.

A summary of the challenges in risk-benefit assessment as discussed in this paper, with a brief indication of the proposed way forward.

Topic	Challenge	Suggested way forward
Definitions	Definitions of basic concepts differ between disciplines underlying RBA.	Create awareness and reach consensus.
Top-down versus bottom-up	Risk and benefit assessments can be based on top-down human observational evidence or bottom-up risk assessment approaches, which may provide different health effect estimates of food compounds or contaminants.	Perform studies that combine the two approaches to compare potential bias and uncertainties, either by case studies or simulation studies.
Risk-benefit question	A wide and confusing range of questions is possible, which may require different methods.	Define the risk-benefit question in close collaboration with risk-benefit managers. Categorise questions and frame the risk-benefit question schematically.
Lack of data and knowledge; uncertainty	Missing data and knowledge can lead to large uncertainties attending RBA.	Identify, characterise and communicate uncertainties; fill up the crucial identified data gaps.
Imbalance of level of evidence	The level of evidence required for benefits is usually larger than for risks, hence risks are more likely to be included in RBAs.	Put emphasis on the size of the health effect rather than on the presence or absence of the health effect.
Substitution	When an alternative intake scenario implies a change in consumption of one food product, it will have consequences for others. There can be many options for substitution.	Find a comparable food product and include it in the analysis, use isocaloric alternatives, or compare several scenarios.
Quantitative metrics	Qualitative and quantitative approaches can be used and various health metrics can be selected. They can be applied both at population level and individual level.	More than one metric can be useful, quantitative assessments can be preferable even if the risk-benefit balance is clear. Well balanced choices for the metrics applied have to be made when the risk-benefit question is defined.
Including microbiology	Microbiology is not well integrated in current RBA methods, definitions and concepts may be different. Yet it is an intrinsic part of food safety with significant health implications and therefore it should be included in RBAs.	Perform more RBAs that include microbiological hazards, take advantage of experience in disease burden estimation and risk ranking.
Scope	The scope of RBAs can be extended beyond health concerns, for example by including costs and environmental sustainability.	Develop methods and metrics to do this further, integrate methods such as LCA and MCDA into RBAs.
Application	The (Quantitative) RBA methodology has not yet been applied much, it is unclear to what extent the developed methods are practically applicable.	With case studies, show how useful the RBA can be in different areas and discuss experiences.

Definitions

The different approaches used in the disciplines contributing to RBA apply different terminology or may apply the same terminology in a different way

Dissimilar definitions can lead to confusion and lack of understanding of the risk-benefit question

Applies to concept like “Hazard, Risk, Benefit”

Top-down versus bottom-up

The approaches are characterised by their different starting point

Top-down: starts with the incidence of a health outcome in the consumer taken from epidemiological studies. Estimation of metrics such as the odds ratio or the relative risk

Advantage: based on actual health effects, measured in specified populations.

Weaknesses: observed associations are not a proof of causation and many data are required if the health effect of interest is small

Bottom-up: starts with the food product, food compound or contaminant, followed by an exposure assessment and a dose-response model (The risk assessment approach)

Advantage: a direct causal link between intake of the food product or food compound (or contaminant)

Disadvantage: uncertainty regarding the dose-response and extrapolation from animal studies

Top-down versus bottom-up

Both approaches can be used in the same RBA

Choice of approach is depending on the availability of data (feasibility of acquiring the requested data and the quality of the studies providing the data)

Studies that combined and compared bottom-up and top-down approaches may help clarify how the two methods can be integrated in RBA

Risk-benefit question

The RB-question/Problem formulation is essential to specify the benefit–risk problem that will be investigated

It describes the purpose, scope and limitations of the assessment to ensure that the outcome is relevant

Make the RBQ in close collaboration with the risk-benefit manager if the outcome of the assessment is intended for political initiatives

To clarify the elements in the risk-benefit question a schematic framing of the risk-benefit question can be used

Lack of data and knowledge; uncertainty

The need for data in RBA are large and diverse and we often face data gaps and lack of knowledge (lack of human data, information on dose-response and intake levels for specific population groups)

This is also faced in other assessments (such as risk assessments)

Due to limited data and lack of knowledge the uncertainty may be large, and characterising this uncertainty is crucial in the risk-benefit assessment

The identified uncertainties should be explicitly addressed and characterized in the assessment and clearly communicated

RBA models can identify the most important data gaps and crucial lack of knowledge. Thus guide future data generation and research

Imbalance of level of evidence

The level of scientific evidence needed for identifying negative and/or positive health effects of a food compound, food or diet is not consistent

For health claims, a nutritional benefit needs to be scientifically substantiated with convincing evidence of the cause and effect relationship, before it can be accepted

The scientific evidence needed for identifying risks or negative health effects may be small, as only an indication of a risk is sufficient for the scientific substantiation

Therefore, risks are more likely to be included in an RBA than benefits, thus leading to a potential bias in the RBA

A paradigm shift from the RBA as a sum of risk and benefit assessment to the RBA as a well-integrated risk-benefit assessment is needed

Substitutions

RBA compares two or more intake scenarios, defined by a specified changes in the amount or type of food consumed

However, these specified changes in intake may also change the intake of other food products to compensate for the part of the diet that is deleted or added

Despite this “substitution” is rarely included in RBA

DTU has now developed a substitution model (deterministic and probabilistic)

Quantitative metrics

The DALY is increasingly used for risk ranking and in burden of disease studies as a population metric

Other metrics can be used, such as monetary integrated metrics like the

Cost-of-illness, which aims to calculate the direct and indirect monetary costs to society related to disease and death

or Willingness-to-pay

The use of the DALY is an established choice in RBAs, but is difficult to communicate

Communication

How would you communicate the following:

”The RBA showed that the net DALY calculated from a reference (0 g salmon/week) and alternative scenario (200 g salmon/week) in Denmark was -15.8 DALY/100.000”

Microbiology

Microbiology are not well-presented in the performed RBA

Despite it seems (GBD) that the disease burden related to the exposure to microorganisms may be larger than that for chemicals

Where do you see the challenges in RBA?

- 1) for those RBA already made?
- 2) For those RBA you have to do yourself?

Future developments of RBA

In RBA research the end-point is the human health impact of food intake scenarios, but..

RBA based only on health will not be sufficient to address risk management and societal questions, and including non-health factors is inevitable and necessary

Need to consider and balance the health impacts of changes in food intake with effects on other factors such as **sustainability, consumer preferences, the economy, and societal values**

The question whether other disciplines should be included in the RBA must be included in the risk benefit question

Future developments of RBA

An integrated approach requires an interdisciplinary procedure as well as exchange of data from the different disciplines involved

However, adding such factors makes the analysis more complex, potentially less transparent and more difficult to update

Also, it increases the number of stakeholders involved, and requires a methodology in which those effects can be transparently weighted and compared

Multi-Criteria Decision Analysis (MCDA) has been designed to address such complex decision problems, while making the analysis transparent and systematic

Future developments of RBA

MCDA is a robust decision analysis tool that integrates different factors (i.e. criteria), while considering the preference and values of policy makers as well as stakeholders

MCDA has been used to balance risk and benefits of pharmaceutical drugs, emerging technologies, and in a framework that could be applied to foods

The challenges associated with incorporating other factors relevant to policy decision besides the typical RBA will not be the application of MCDA, but rather with the different magnitudes of uncertainty and the data available

Future developments of RBA

Sustainability is not easily quantified by a single indicator. Several indicators in the area of food exist, such as greenhouse gas emission, water use, biodiversity, and others

The choice for the most suitable indicator and/or weighing between them must be made depending on the assessment and the question asked

Sustainability is not the only issue when it comes to the actual behavioral motives related to food. Consumer motives like convenience, enjoyment and cost also play a role

Further prosperity motives like employment and export and ethical issues like animal welfare are also involved

Future developments of RBA

Could you think of other parameters that could be included in a broad RBA?

Take home messages

- RBA is relevant because most foods we consume impact health in both positive and negative directions.
- The RBQ may be formulated from either of the 3 levels of aggregation, but it is only a RBA if health is impacted in opposite directions.
- DALY is the common health metric most often applied in RBA, but it might have limitations or can be accompanied/supported by other metrics.
- There is a challenge in comparing risks and benefits due to the inherent difference in the purpose of each research discipline
- Benefits should not be an excuse to introduce risks, but it may be a reason to accept risks.

Eager to learn more about Risk-Benefit?

8-day intensive course

Risk-benefit assessment of foods:
methods for quantifying health effects
5-14 November 2019
DTU Campus, Kongens Lyngby, Denmark

The course description can be found at http://www.kurser.dtu.dk/2019-2020/23839.aspx.

For more information and registration, please contact Maarten Nauta, senior scientist at the Risk-Benefit Research Group, maana@food.dtu.dk