



## Data Article

# Changing impact of dietary risk factors on cardiovascular mortality in 46 European countries from 1990 to 2019 by age and sex: A data article of the GBD Study

Theresa Pörschmann<sup>a,b,\*</sup>, Toni Meier<sup>b,c</sup>, Stefan Lorkowski<sup>a,b,\*</sup><sup>a</sup> Institute of Nutritional Sciences, Friedrich Schiller University Jena, Dornburger Straße 25, 07743 Jena, Germany<sup>b</sup> Competence Cluster for Nutrition and Cardiovascular Health (nutriCARD) Halle-Jena-Leipzig, Dornburger Straße 25, 07743 Jena, Germany<sup>c</sup> Institute for Sustainable Agriculture and Food Economics (INL) e.V., Reilstraße 128, 06114 Halle (Saale), Germany

## ARTICLE INFO

## Article history:

Received 22 July 2024

Revised 9 August 2024

Accepted 12 August 2024

Available online 20 August 2024

Dataset link: [Dietary risk-factors on cardiovascular deaths by age and sex in 1990-2019 in 46 WHO European countries \(Original data\)](#)

## Keywords:

Nutrition

Cardiovascular diseases

Public health

Europe

## ABSTRACT

This study aimed to estimate the association between single dietary risk factors and cardiovascular mortality in the WHO European Region, its four subregions and 46 individual countries. For this purpose, data from the Global Burden of Diseases Study (GBD) 2019 iteration were employed and analysed according to age ( $\geq 25$  years) and sex. The comparative risk assessment framework of the GBD was utilized in order to estimate the number of cardiovascular deaths that could be attributed to 13 dietary risks. The study period spanned from 1990 to 2019. Between 1990 and 2019 the absolute number of diet-related cardiovascular deaths (DRCDs) in the WHO ER decreased from 1.69 to 1.55 million deaths. Moreover, a decline in the absolute number of deaths was observed in two subregions and 27 countries. In 2019, the number of deaths was almost equally distributed between women and men. This distribution has undergone only slight temporal changes. The number of cases for men were found to be higher in three subregions and in 30 countries. The majority of DRCDs in the WHO ER were attributable to 'a diet low in whole grains', which was also the primary risk factor in three subregions and 29 countries. The next

\* Corresponding authors.

E-mail addresses: [theresa.poerschmann@uni-jena.de](mailto:theresa.poerschmann@uni-jena.de) (T. Pörschmann), [stefan.lorkowski@uni-jena.de](mailto:stefan.lorkowski@uni-jena.de) (S. Lorkowski).

most-common risk factor was 'a diet low in legumes', followed by 'a diet high in sodium'. In particular, the risk factor 'a diet high in sodium' was a significant contributing factor in Central Europe. In addition, the risk factor 'a diet high in red meat' was more pronounced in Western Europe than in the other regions and slightly more influential in the group of women across all regions. For men 'a diet high in sodium' was more prominent than for women. In essence, slight changes in the influence of individual risk factors were observed across the different age groups. The datasheets enable the observation of changes within the dietary risks over time, their distribution by age and sex, and differences between regions and individual countries in detail. This allows for an individual assessment of the problem situation for each country, the subregions and the European Region as a whole, with the aim of developing solution strategies based on this assessment. Dietary interventions can focus on the relevant food and target groups in order to support a health-promoting diet.

© 2024 The Author(s). Published by Elsevier Inc.

This is an open access article under the CC BY-NC license

(<http://creativecommons.org/licenses/by-nc/4.0/>)

---

## Specifications Table

Subject	Health and Medical sciences
Specific subject area	An estimation of the association between dietary risk factors and cardiovascular mortality in the WHO European Region, four subregions and 46 countries between 1990-2019.
Type of data	Estimated numbers of deaths by sex, age and year, visualized by figures. Tables, Figures (.xlsx format)
Data collection	Analyzed The analysis based on the Global Burden of Diseases Study data; raw data was used from the 'Global Health Data Exchange' website. Data were analysed for countries of the WHO European Region and the four WHO Regions Central Asia, and Central, Eastern and Western Europe. Countries (n=46) with total diet-related cardiovascular deaths <2,500 cases in 2019 were excluded. 13 dietary risk factors were analysed and adjusted for multiplicity. The distribution of deaths by age (>25 years) and sex and their change between 1990-2019 were analysed. Absolute death numbers and the proportion of deaths in the related age group were calculated, summarised in datasheets and used to generate figures.
Data source location	Analysed data: Friedrich-Schiller-University Jena, Jena, Germany. Raw (primary) data: Global Burden of Diseases Study (GBD), which were provided by the Institute for Health Metrics and Evaluation (IHME) at University of Washington, Seattle, USA.
Data accessibility	Repository name: Open Science Framework (OSF) Data identification number: <a href="https://doi.org/10.17605/OSF.IO/KC9U8">DOI 10.17605/OSF.IO/KC9U8</a> Direct URL to data: <a href="https://osf.io/8tkgc">https://osf.io/8tkgc</a>
Related research article	Pörschmann T, Meier T, Lorkowski S (2024) Cardiovascular mortality attributable to dietary risk factors in 54 countries in the WHO European Region from 1990 to 2019: an updated systematic analysis of the Global Burden of Disease Study. <i>Eur J Prev Cardiol.</i> <a href="https://doi.org/10.1093/eurjpc/zwae136">https://doi.org/10.1093/eurjpc/zwae136</a> .

---

## 1. Value of the Data

- A healthy diet is essential to prevent premature death throughout the WHO European Region. The country-specific factsheets highlight the key food groups that should be prioritized at the national level, allowing a clear and effective focus on dietary improvements.
- The changes in the dietary risk over the period, their distribution by age and sex as well as differences between regions and single countries can be considered in detail.
- This enables an individual assessment of the problem situation for each country, the subregions and the European Region as a whole. This allows the development of solution strategies based on this assessment. Dietary interventions can focus on the relevant food and target groups in order to support a health-promoting diet.

## 2. Background

Cardiovascular diseases (CVD) are the leading cause of death. Ischaemic heart disease accounts for the largest share of CVD [1–3]. In 2019, one-third of all deaths worldwide were attributed to CVD. Diet-related risks were the second most important risk factor for CVD, alongside 'high blood pressure' [4].

In the WHO European Region (WHO ER), diet-related cardiovascular deaths (DRCDs) account for a significant proportion of CVD deaths, namely 36.7 %, and 16.4 % of total deaths. Diet, along with other behavioural risks, is undoubtedly one of the most important factors in preventing premature death in the WHO ER [5]. The absolute numbers and the changes of DRCDs in the individual countries between 1990 and 2019 have been presented in detail by Pörschmann et. al (2024). The changes in dietary risk over this period and their distribution by age and sex have not yet been considered in detail for the WHO ER, its subregions and respective countries.

## 3. Data Description

### 3.1. DRCDs absolute numbers

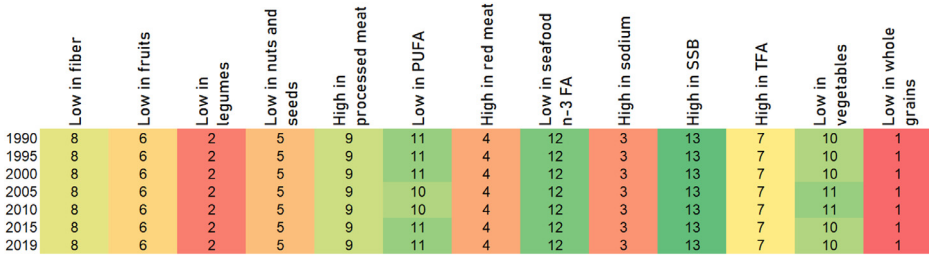
#### 3.1.1. By regions and countries

The absolute numbers of DRCDs in the WHO ER declined from 1.69 to 1.55 million deaths between 1990 and 2019. The highest value was observed in 1995, with nearly 1.9 million deaths. While the absolute number of deaths decreased in Western and Central Europe, an increase was observed in Eastern Europe and in Central Asia. In Central Asia the highest rate was observed in 2005, while the lowest was recorded in 1990. In Central Europe, the majority of deaths occurred in 1995, with the lowest number occurring in 2015. In Eastern Europe, the DRCDs increased until 2005, reaching their highest rate, and subsequently decreased. In Western Europe, the highest rate was observed in 1990, while the lowest was recorded in 2010. At the national level, 27 countries exhibited a reduction in the DRCDs between 1990 and 2019, while 19 countries experienced an increase.

#### 3.1.2. By sex

In 2019, the overall mortality distribution in the WHO ER was slightly higher for females than for males, with the proportion of female deaths amounting to 50.2 %. During the period under analysis, the distribution changed slightly. While the proportion of women was 50.8 % in 1990, it fell to 48.9 % by 2005 and has since risen.

Although the number of cases among women in the WHO ER was slightly higher in 2019, the proportion of men exceeded that of women in three of the subregions in that same year. In Central Asia, the proportion of males consistently exceeded that of females. In 2000, the figures for men were the lowest (52.6 %), while in 2015 and 2019 they were the highest (54.6 %). In Central



**Fig. 1.** Heat map of numbers of death by dietary risks from 1990 to 2019 in the WHO ER (ranked from highest numbers by death to lowest).

Europe, the proportion of men has been declining consistently since 1990 (53.8 %), resulting in a near-equalisation of the proportions in 2019 (male: 50.6 %, female 49.4 %). The lowest proportion of men for all regions was observed in Eastern Europe, at 47.0 %. However, this figure has risen significantly since the low point observed in 1990 (43.8 %). In 2005, the proportions were almost equal and slightly exceeded that of women (male: 50.4 %, female 49.6 %). In Western Europe, the highest proportion of women was in 2000 (49.9 %) and the lowest in 2015 and 2019 (48.5 %).

An analysis of the individual countries reveals that the lowest proportion of women was identified in Mongolia in 2019 (39.7 %). Estonia exhibited the highest proportion, at 58.2 %. Turkey demonstrated the lowest proportion of women throughout the entire period under review in 1990, at 37.1 %. Ukraine exhibited the lowest proportion of men (40.9 %) in 1990. Notably, in only 16 countries did the proportion of women predominate. In the remaining 30 countries, however, the number of deaths was higher among men.

### 3.2. Ranking of dietary risks

#### 3.2.1. By regions and countries

'A diet low in whole grains' was identified as primary cause of DRCs (326,755 deaths, 21.1 %) in the WHO ER in 2019. The next most prevalent cause was 'a diet low in legumes', which was responsible for 232,918 deaths (15.0 %). With 193,713 deaths (12.3 %) 'a diet high in sodium' ranked third. For all other dietary risks, the attributable share was less than 10 % in each case. 'A diet high in red meat' (138,312 deaths; 8.9 %) and 'a diet low in nuts and seeds' (117,460 deaths; 7.6 %) ranked fourth and fifth respectively. The lowest share was observed for 'a diet high in SSB' (32,948 deaths; 2.1 %) (Fig. 1). As illustrated in Fig. 1, no substantial alterations in the ranking of the risk factors were identified between 1990 and 2019 in the WHO ER.

Developments in the four regions can be summarised in a similar way. The ranking of the most influential factors remained largely unchanged throughout the study period. 'A diet low in whole grains' was identified as the primary risk factor in three of the four regions and was the second most important risk factor in Central Europe. 'A diet low in legumes' was identified as the second-most significant risk factor in Central Asia, Eastern Europe and Western Europe. In Central Europe 'a diet high in sodium' was identified as the primary risk factor, while 'a diet low in legumes' was ranked third. In the remaining regions, the third most influential factor was 'a diet low in nuts and seeds' (Eastern Europe), 'a diet high in sodium' (Central Asia) and 'a diet high in red meat' (Western Europe). The least influential factor in three of the four regions was 'a diet high in SSB'. In Central Asia, 'a diet low in vegetables' ranked last.

The following picture emerged at the country level in 2019: 'a diet low in whole grains' was identified as the main risk factor in 29 of the 46 countries, the second most important risk factor in 16 countries and ranked third only once. In terms of absolute numbers 'a diet low in legumes' was identified as the primary risk factor in four countries, the second most important risk factor

**Table 1**

Top 3 risk factors in the relative proportions of age groups in the WHO ER and the subregions in 2019.

Age		WHO ER		Central Asia		Central Europe		Eastern Europe		Western Europe	
		Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
25-49 years	1.	WG	WG	WG	WG	REDM	SOD	WG	WG	REDM	REDM
	2.	LEG	LEG	LEG	LEG	WG	WG	LEG	LEG	WG	WG
	3.	REDM	REDM	SOD	SOD	FRU	REDM	REDM	FRU	FRU	LEG
50-69 years	1.	WG	WG	WG	WG	SOD	SOD	WG	WG	WG	WG
	2.	LEG	LEG	LEG	LEG	WG	WG	LEG	LEG	REDM	LEG
	3.	REDM	SOD	REDM	SOD	REDM	LEG	REDM	SOD	LEG	REDM
>70 years	1.	WG	WG	WG	WG	SOD	SOD	WG	WG	REDM	REDM
	2.	LEG	SOD	LEG	LEG	WG	WG	LEG	LEG	WG	WG
	3.	SOD	LEG	REDM	REDM	LEG	LEG	NUT	SOD	FRU	LEG

FRU = a diet low in fruits, LEG = a diet low in legumes, NUT = a diet low in nuts and seeds, REDM = a diet high in red meat, SOD = a diet high in sodium, WG = a diet low in whole grains

in 26 countries and ranked third 14 times. The risk factor 'a diet high in red meat' was, on average, ranked third, but in the different countries the factor ranked from first to ninth place, thereof twelve times third place. The risk factor 'a diet high in sodium' was only ranked fourth on average, as well as down to ninth place. However, in all 13 countries in Central Europe, it was identified as the primary risk factor. Albania, Finland, Ireland, Portugal, Sweden and Turkey showed particularly strong or many changes within the rankings.

### 3.2.2. By age and sex

Looking at the datasheets [6] for countries and regions, there is a general increase in deaths with age across all individual risk factors. This results from a shift in the number of cases from the lower to the higher age groups over the period. In particular, the age group >80 accounted for a large proportion of the deaths, irrespective of the dietary risk factor. This is especially pronounced for women. Among the regions, only Central Asia stands out as an exception, where middle-aged men also exhibit high case numbers.

In addition, the percentage of deaths caused by each risk factor in each age group in relation to total diet-related deaths was analysed. As can be seen from the figures in the datasheets [6], the percentage of total deaths attributable to each age group tends to decrease in almost all countries and for all dietary factors. However, the risk factor 'a diet high in sodium' is an exception in many countries. Especially in Central Europe, an increase in the proportion can be observed, at least in the interim period. For the risk factor 'a diet high in red meat' in particular, the percentages decrease across the age groups. This applies mainly to Western European countries. For the factor 'a diet low in fibre', the percentages first decrease in most countries and then increase again from the middle age groups onwards.

Slight changes in the influence of individual risk factors were observed between the different age groups. Table 1 shows the three most important risk factors in relation to their percentage share in each age group. It can be observed how the influence of different diets changed across the age groups. While in the WHO ER, Central Asia and Eastern Europe the diets 'low in whole grains' and 'low in legumes' ranked first and second in all three age groups (except for men >70 years), there were clear deviations in Central and Western Europe. The risk factor 'a diet high in red meat' played a much more important role in Western Europe. In addition, the 'a diet low in fruits' group also appeared twice among the women. In contrast, sodium played a much more dominant role in Central Europe, as the absolute values already showed.

It can also be seen that the factor 'a diet high in red meat' was slightly more important for women in all regions. For men, on the other hand, 'a diet high in sodium' was slightly more relevant. In Western Europe, 'a diet low in fruits' only appeared in the women's group and was less important in the men's group. In Central Europe, the factor was also found once among women (25-49 years), but not among men. 'A diet high in SSB' accounted for the lowest proportion in all three age groups in the WHO ER, and there were no differences between women and men. The same was observed for Eastern Europe. In Western Europe, 'a diet high in SSB' was the factor with the least influence in the middle and older age groups. However, in the 25-49 age group, it was the factor 'a diet low in PUFA' for both sexes. In Central Asia and Central Europe, the risk factor 'a diet low in vegetables' took this place in all age groups and sexes, except for the group > 70 years in Central Europe.

In 2019, the highest proportion of women for 'a diet low in whole grains' was observed in Latvia (58.2 %), while the highest proportion of men was noted in Mongolia (62.3 %). When the entire observation period is taken into account, the highest values for women were recorded in 1990 in Ukraine (59.6 %), while for men the highest values were observed in 1990 in Turkey (62.7 %). For 'a diet low in legumes' the highest proportion of women was observed in Estonia (58.2 %) in 2019, while the highest proportion of men was recorded in Mongolia (63.4 %). A review of the entire period reveals that the highest values for women were observed in 1990 in Ukraine (57.9 %), while the highest values for men were observed in 1995 in Turkey (73.2 %). In 2019, the highest proportion of women for 'a diet high in red meat' was in Latvia (58.4 %), while the highest proportion of men was noted in Mongolia (60.0 %). Throughout the entire study period, the highest values for women were observed in 2019, while for men the highest values were observed in 1990 and 1995 in Turkey (61.4 %). For 'a diet high in sodium' the highest proportion of women in 2019 was 54.3 % in Lithuania, while the highest proportion of men was 72.4 % in Ireland. When the entire observation period is taken into account, the highest values for women were observed in 2019 and for men in 2005 in Latvia (75.0 %).

## 4. Experimental Design, Materials and Methods

### 4.1. Materials

Deaths by CVD were attributed to 13 dietary risks for the years 1990 to 2019. This analysis is based on data from the Global Burden of Diseases Study (GBD), which was calculated using the conceptual framework of comparative risk assessment (CRA) developed by Murray and Lopez [7]. The raw data were obtained from the 'Global Health Data Exchange' website, which is provided by the Institute for Health Metrics and Evaluation (IHME; University of Washington, Seattle, Washington, USA).

### 4.2. Methods

#### 4.2.1. Selection of countries analysed

Although the WHO ER included 54 countries at the time of publication of the GBD data, only 46 countries were included in this analysis. To avoid the potential for uncertainty in the estimates, countries with total DRCs below 2,500 cases in 2019. i.e. Andorra, Iceland, Luxembourg and Cyprus were excluded from the analysis.

#### 4.2.2. Selection of dietary risks analysed

While 15 diet-related risk factors are considered in the GBD-CRA framework, only 13 of these are relevant for CVD. As the risk factors 'a diet low in milk' and 'a diet low in calcium' are only available for the cause group 'neoplasms', they were not included in the calculations. The dietary risk factors employed in the analysis presented here are a diet low in fibre, fruits, whole grains,

legumes, vegetables, nuts and seeds, polyunsaturated fatty acids (PUFA) and seafood omega-3 fatty acids (seafood n-3), as well as a diet high in sodium, processed meat, sugar-sweetened beverages (SSB) and trans fatty acids (TFA). The data were adjusted for the multiplicity of dietary factors.

#### 4.2.3. Adjusting the nutritional risk data for multiplicity

Some of the diet-related risks are not mutually exclusive, and thus there may be overlaps between the risks. Therefore, the individual risks must be adjusted for multiplicity when calculating the overall reduction in disease burden from all dietary risk factors. All figures and data in this study are based on a combined realisation of all risk factors mentioned. Further information can be found in the GBD capstone papers [3,8].

#### 4.2.4. Data analysis

Data were analysed for adults aged 25 years or older and calculated for 46 countries of the WHO ER as well as the four subregions Central Asia, Central Europe, Eastern Europe and Western Europe of the WHO ER. For this purpose, the distribution of deaths by age and sex for all risk factors and their change between 1990 and 2019 were analysed separately for each country. In addition to the absolute number of deaths, the proportion of deaths in the corresponding age group in relation to the total DRCs was calculated. The resulting data were employed to generate figures for each risk factor, illustrating the absolute age- and sex-specific mortality of DRCs and the proportion of DRCs by age group. These were compiled in datasheets for each country, with the most relevant findings presented in brief descriptions.

## Limitations

The outcomes of individual countries are influenced by the quality, quantity, and timeliness of the health data collected within that country. As the data on dietary intake is derived from a variety of sources, it exhibits a range of characteristics and degrees of uncertainty. Limitations of the data collection and calculations, as well as the methods employed to address these uncertainties, have been described in detail [4,9]. Furthermore, data are not available for all risk-outcome pairs (diet-CVD pairs), which is likely to influence the results. For example, there are values for all CVD types only for the risk factor 'a diet high in sodium'. It was not possible to mitigate this limitation in the present study.

Moreover, some of the figures analysed are relatively small, meaning that differences in the calculation model may be inaccurate, particularly over time. To mitigate this limitation, only countries with a minimum of 2,500 total deaths attributable to diet-related CVDs have been included in the analysis.

## Ethics Statement

This work meets the requirements of ethics as stated in (<https://www.elsevier.com/journals/data-in-brief/2352-3409/guide-for-authors>) and (<https://www.elsevier.com/about/policies/publishing-ethics#Authors>). This work also does not involve studies with animals and humans.

The authors have read and followed the ethical requirements for publication in Data in Brief and confirm that the current work does not involve interventions with human subjects, animals experiments or any data collected from social media platforms.

## CRedit Author Statement

**Pörschmann:** Conceptualization, Methodology, Formal analysis, Investigation, Data Curation, Writing - Original Draft, Visualization; **Meier:** Conceptualization, Methodology, Formal anal-

ysis, Data Curation, Writing - Review & Editing, Supervision, Project administration support; **Lorkowski**: Writing - Review & Editing, Supervision, Project administration.

All gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

## Data Availability

[Dietary risk-factors on cardiovascular deaths by age and sex in 1990-2019 in 46 WHO European countries \(Original data\)](#) (Open Science Framework).

## Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

- **Lorkowski** reports grants or contracts from dsm-firmenich (formerly DSM Nutritional Products); consulting fees from Danone, Novartis Pharma, and Swedish Orphan Biovitrum (SOBI); payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from AMARIN Germany, Amedes Holding, Amgen, Berlin-Chemie, Boehringer Ingelheim Pharma, Daiichi Sankyo Deutschland, Danone, Hubert Burda Media Holding, Janssen-Cilag, Lilly Deutschland, Novartis Pharma, Novo Nordisk Pharma, Roche Pharma, Sanofi-Aventis, and SYNLAB Holding Deutschland; participation on a data safety monitoring board or advisory board with Daiichi Sankyo Deutschland, and Novartis Pharma; outside the submitted work.
- **Pörschmann** and **Meier** have nothing to declare.

## References

- [1] G.A. Mensah, V. Fuster, C.J.L. Murray, et al., Global burden of cardiovascular diseases and risks, 1990-2022, *J. Am. Coll. Cardiol.* 82 (2023) 2350-2473, doi:[10.1016/j.jacc.2023.11.007](https://doi.org/10.1016/j.jacc.2023.11.007).
- [2] N. Townsend, D. Kazakiewicz, F. Lucy Wright, et al., Epidemiology of cardiovascular disease in Europe, *Nat. Rev. Cardiol.* 19 (2022) 133-143, doi:[10.1038/s41569-021-00607-3](https://doi.org/10.1038/s41569-021-00607-3).
- [3] GBD 2019 Risk Factors Collaborators, Global burden of 87 risk factors in 204 countries and territories, 1990-2019: a systematic analysis for the global burden of disease study 2019, *Lancet* 396 (2020) 1223-1249, doi:[10.1016/S0140-6736\(20\)30752-2](https://doi.org/10.1016/S0140-6736(20)30752-2).
- [4] G.A. Roth, G.A. Mensah, C.O. Johnson, et al., Global burden of cardiovascular diseases and risk factors, 1990-2019: update from the GBD 2019 study, *J. Am. Coll. Cardiol.* 76 (2020) 2982-3021, doi:[10.1016/j.jacc.2020.11.010](https://doi.org/10.1016/j.jacc.2020.11.010).
- [5] T. Pörschmann, T. Meier, S. Lorkowski, Cardiovascular mortality attributable to dietary risk factors in 54 countries in the WHO European Region from 1990 to 2019: an updated systematic analysis of the global burden of disease study, *Eur. J. Prev. Cardiol.* (2024), doi:[10.1093/eurjpc/zwae136](https://doi.org/10.1093/eurjpc/zwae136).
- [6] T. Pörschmann, Dietary Risk-factors on Cardiovascular Deaths by Age and Sex in 1990-2019 in 46 WHO European Countries, *OSF*, 2024, doi:[10.17605/OSF.IO/KC9U8](https://doi.org/10.17605/OSF.IO/KC9U8).
- [7] C.J.L. Murray, M. Ezzati, A.D. Lopez, et al., Comparative quantification of health risks: conceptual framework and methodological issues, *Popul. Health Metr.* 1 (2003) 1, doi:[10.1186/1478-7954-1-1](https://doi.org/10.1186/1478-7954-1-1).
- [8] GBD 2017 Risk Factor Collaborators, Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017, *Lancet* 392 (2018) 1923-1994, doi:[10.1016/S0140-6736\(18\)32225-6](https://doi.org/10.1016/S0140-6736(18)32225-6).
- [9] GBD 2017 Diet Collaborators, Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the global burden of disease study 2017, *Lancet* 393 (2019) 1958-1972, doi:[10.1016/S0140-6736\(19\)30041-8](https://doi.org/10.1016/S0140-6736(19)30041-8).