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Increasing the General Public's Knowledge of Food Research

Evaluation of Scientific Expert Engagement and
Massive Open Online Courses

October 2020



Norwegian University of
Science and Technology

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Submission date: October 2020

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Abstract

Food-based dietary guidelines (FBDG) are evidence-based recommendations on food and health that have been developed by governments around the world for their populations. FBDG lay the basis for promoting a healthy lifestyle in areas such as education, governmental institutions, and policy development. However, many people still suffer from some form of malnutrition. Furthermore, the general public is frequently presented with sensationalised and misleading news about food and health that are not in line with official recommendations. The scientific community can help by sharing their expertise in food, research, and evidence-based recommendation, and thereby help increase the general public's knowledge that is needed for the population to choose a healthy diet.

A Twitter study was performed to explore the debate around two misleading media headlines concerning the consumption of red and processed meat. This was done in order to confirm the need for better communication from the scientific community. The method had several limitations due to technical difficulties and needs to be further developed in order to draw a final conclusion. However, the results indicated that many people share the sensationalised headlines on Twitter, possibly reinforcing the flow of misleading information.

Two strategies used by scientists to reach the general public have been evaluated. The Speaking up for Science Action Network (SuSAN) initiative encourages experts in the field of food and health to speak up against misleading and unbalanced media reporting. Several issues have been identified in recent years, but public reactions from the SuSAN experts are limited. Other experts have been engaged in debates on Twitter around issues concerning the consumption of red and processed meat. To increase expert engagement could other approaches be further investigated.

Another strategy to bridge the gap between the general public and experts through massive open online courses (MOOCs) was also studied. MOOCs are increasingly popular among learners and educators, giving scientists an opportunity to reach the general public in a new and engaging way. The 'MOOC – Food and nutrition: The truth behind food headlines' has been developed with the aim of presenting scientific facts behind media headlines, introducing different types of research methods and their limitations and advantages and providing practical tools to spot unreliable sources. This is done through engaging articles and videos, and also through more interactive parts such as polls, quizzes and discussions. The MOOC was launched on September 28, 2020, and the final outcome has thus not been evaluated in this thesis. However, a systematic literature review of evaluations, experiences and learning outcomes of similar MOOCs was conducted. This review indicated that MOOCs often have high enrolment rates, but struggle with low retention rates. To keep the learner engagement throughout the course and increase the retention rate, elements such as educators' presence, dividing into groups based on learner profiles and adding gamification elements have shown to be effective and could be considered when developing MOOCs about food and research in the future.

Sammendrag

Anbefalinger om kosthold, ernæring og fysisk aktivitet (FBDG) er evidensbaserte anbefalinger om mat og helse som er utviklet av styresmakter over hele verden for deres befolkning. FBDG legger grunnlaget for å fremme en sunn livsstil på områder som utdanning, statlige institusjoner og politiske beslutninger. Imidlertid lider fortsatt mange mennesker av en eller annen form for underernæring. Videre får allmennheten ofte presentert sensasjonelle og villedende nyheter om mat og helse som ikke er i tråd med offisielle anbefalinger. Forskningsmiljøet kan hjelpe ved å dele sin ekspertise innen mat, forskning og evidensbaserte anbefalinger, og dermed bidra til å øke allmennkunnskapen som er nødvendig for at befolkningen skal velge et sunt kosthold.

En Twitter-studie ble utført for å utforske debatten rundt to misvisende medieoverskrifter angående inntak av rødt og bearbeidet kjøtt. Denne ble utført for å bekrefte behovet for bedre kommunikasjon fra forskningsmiljøet. Metoden hadde flere begrensninger på grunn av tekniske problemer og må videreutvikles for å kunne trekke en endelig konklusjon. Resultatene indikerte imidlertid at mange mennesker deler de sensasjonelle overskriftene på Twitter, noe som muligens forsterker strømmen av villedende informasjon.

To strategier som forskere bruker for å nå ut til allmennheten, er evaluert. Initiativet 'Speaking up for Science Action Network' (SuSAN) oppfordrer eksperter innen mat og helse til å motsi misvisende og ubalansert medierapportering. Flere saker har blitt identifisert de siste årene, men offentlige reaksjoner fra SuSAN-eksperter har vært begrenset. Andre eksperter har vært engasjert i debatter på Twitter rundt inntak av rødt og bearbeidet kjøtt. For å øke engasjementet blant eksperter, bør andre tilnærminger undersøkes nærmere.

En annen strategi for å bygge bro over gapet mellom allmennheten og eksperter gjennom massive åpne nettkurs (MOOC) ble også studert. MOOC-er blir stadig mer populære blant elever og lærere, noe som gir forskere muligheten til å nå allmennheten på en ny og engasjerende måte. 'MOOC - Mat og ernæring: Sannheten bak matoverskrifter' er utviklet med det formål å presentere vitenskapelige fakta bak medieoverskrifter, introdusere forskjellige typer forskningsmetoder og deres begrensninger og fordeler og gi praktiske verktøy for å oppdage upålitelige kilder. Dette gjøres gjennom engasjerende artikler og videoer, og også gjennom mer interaktive deler som avstemninger, spørrekonkurranser og diskusjoner. MOOC-en ble lansert 28. september 2020, og det endelige resultatet er dermed ikke evaluert i denne oppgaven. Imidlertid ble det gjennomført en systematisk litteraturgjennomgang av evalueringer, erfaringer og læringsutbytte av lignende MOOC-er. Denne gjennomgangen indikerte at MOOC-er ofte har høye påmeldingstall, men sliter med lave retensjonsrater. For å holde læringsengasjementet gjennom hele kurset og øke retensjonsraten, har elementer som tilstedeværelse av lærere, inndeling i grupper basert på læringsprofiler og å legge til spillelementer vist seg å være effektive og kan vurderes når man utvikler MOOC-er om mat og forskning i fremtiden.

Preface

This Master's thesis concludes my degree in Chemical Engineering and Biotechnology with specialisation in Biotechnology and Food Science from the Norwegian University of Science and Technology (NTNU), and marks the end of five years as a student in Trondheim. The thesis was written in the 10th semester of the degree in the period of April 1 – October 1, 2020. The work was supervised by Professor Turid Rustad at the Department of Biotechnology and Food Science, NTNU. The thesis had support from the European Food Information Council (EUFIC) and was co-supervised by Senior Manager in Food and Health Science, Dr Joanna Kaniewska. Data collection with Meltwater was supported by Carlos Abundancia and Hannah Bollmann from the Communications Team at EUFIC.

This year has been different and challenging for many people in many ways. I feel lucky to have been (mostly virtually) surrounded by friends and family who have tirelessly supported me and my work. A few people deserve to be especially thanked: Joanna (Asia), who not only gives invaluable input on my work, but also supports my growth as a person – during the writing process, at EUFIC, and beyond. Your encouragement has made this experience both instructive and manageable. I am extremely thankful for having you as a mentor. Turid, who is always positive to my ideas and helps me see them through. Thank you for answering any questions I might have along the way. My parents, who have let me refurnish the house to function as a home office. I am forever grateful for your continued, unconditional flow of support, food and hugs. My friends, Ingrid and Jørgen, who have cheered me on more than anyone could ask for - and especially thank you for adopting the dog Johan, who has brought immense joy the last few months. Also thank you to Ann Kristin, Clara, Vilde, Andrea, Dina and Karina – the core group who made the last weeks in Trondheim possible and unforgettable.

Anna Kristine Auråen
October 1st, 2020

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List of Abbreviations

AR	Average Requirement
DRV	Dietary Reference Value
EIT	European Institute of Innovation and Technology
EUFIC	European Food Information Council
ECT	Expectation-confirmation theory
FAO	Food and Agriculture Organization of the United Nations
MOOC	Massive Open Online Course
NNR	Nordic Nutrition Recommendations
NTNU	Norwegian University of Science and Technology
RCT	Randomised Controlled Trial
RI	Recommended Intake
SRL	Self-Regulated Learning
SuSAN	Speaking up for Science Action Network

1 Introduction

Nutrition research dates back to the 1930s [1]. In 1936, The League of Nations published the first international table of energy and protein requirements, followed by recommendations on macronutrients and some micronutrients by the United States' National Academy of Science in 1941. The first joint official statement on 'Medical aspects of the diet in the Nordic countries' from medical societies in the Nordic countries was published in 1968. It dealt with the correlation between dietary habits and the development of chronic diseases. Since then, recommendations have evolved to not only focus on avoiding deficiencies, but also to concern the reduction of risk of developing overweight, obesity and following lifestyle-related diseases. Today, almost 100 governments worldwide have formed food-based dietary guidelines (FBDG) for their populations [2]. They are science-based recommendations on food and lifestyle and lay the basis for the development of policies and interventions, including meals in governmental institutions, public procurement standards and regulations on food marketing and advertising [3]. The overall intention of FBDG is to promote a diet with nutrient intakes that maximises physiological and mental functions while minimising the risk of developing chronic diseases [1]. However, research on food and nutrition, like any other field, is evolutionary. New scientific data are being published continuously, thus nutrition recommendations need to be updated regularly.

An increasing amount of available information about food and health, from all channels, has not always lead to increased scientific knowledge [4]. To increase the public's knowledge, nutrition information needs to be balanced, based on credible sources and communicated in a way that can be understood by a layperson. Some challenges to overcome are that consumers often want certainty, while uncertainty is unavoidable in nutrition research. There is also a difference between scientists, who want to avoid simplifications and absolutes, and the media, who try to simplify and put things as understandable as possible. Also, as the term 'expert' is not a protected title, it has been widely used and abused, damaging the trust and credibility of all experts in the media [4-6].

In order to increase the scientific knowledge about food and research, with the result of increased questioning of sensationalised and misleading media headlines, two methods are investigated in this thesis; (1) to encourage scientists to speak up against misreporting in the media, which could help the layperson to filter information, and (2) to develop online courses for the general public about food and research, to help them obtain competencies to be critical towards sensationalised news and make informed choices about their own diet and lifestyle.

1.1 Aim of study

Many factors influence an individual's food choices, including access to highly palatable foods, cultural and social pressures, cognitive-affective factors, familial, genetic and epigenetic influences on personality characteristics, and physiological mechanisms that affect hunger and the feeling of satiety [7]. All of these aspects will influence a person's diet. To overcome these challenges and maintain a healthy diet and lifestyle, a basic knowledge of what constitutes a healthy diet is needed. This includes knowledge about food and its components, but it also comes from understanding research and how science-based recommendations are formed. The last issue is the focus of this thesis. It is assumed that a main reason why people do not follow a healthy diet is a lack of knowledge. Only when scientific knowledge is obtained can the discussion about action strategies and overcoming implementation barriers start [8].

This thesis is supported by the European Food Information Council (EUFIC), which is a non-profit organisation that aims to communicate clear and practical information on food and health, based on sound science. EUFIC is involved in two projects where the scientific community can help increase the general public's knowledge of diet recommendations and research, and these are evaluated in this thesis. The SuSAN project aims to encourage experts in food and nutrition to speak up against misreporting in the media, and online courses, such as 'MOOC – Food and nutrition: The truth behind food headlines', can help reach the masses with education about research in food and nutrition. These two projects and strategies are additions to the governments' already existing FBDG. This work will explore a way for better communication from the scientific community, and from different angles, in order to bridge the gap between scientists and the general public. The hypothesis is that when scientists speak up against misreporting in the media (SuSAN) and offer tools to the general public to increase their knowledge about food and research through modern, digital education (MOOC), the scientific community will reach the general public from other angles than the governments' FBDG.

2 Background

Food-based dietary guidelines (FBDG) have been formed by governments worldwide to promote a healthy diet and lifestyle in their populations. However, malnutrition, whether it is due to undernourishment, overconsumption or nutrient poor diets, is still a rising issue [3, 9]. This, combined with an overwhelming amount of information of varying quality and from all channels, highlight the need for better and clearer communication of science-based knowledge about food and health. A way to achieve this is to improve the communication from the scientific community itself towards the general public.

2.1 The history of food-based dietary guidelines

FBDG are developed by governments and give recommendations on how their population should eat and live as healthy lives as possible and, if successfully implemented, will lead to mean population intakes of foods and nutrients closer to the nutrient goal [10]. Despite that it has been several decades since FAO and WHO started giving recommendations on energy, protein and nutrient requirements [11], it is still estimated that around 800 million people worldwide suffer from undernutrition, while on the other hand, there are 1.9 billion people with overweight or obesity [3]. Malnutrition, whether it is from undernutrition, micronutrient deficiencies, obesity or diet-related diseases such as cardiovascular diseases, type 2 diabetes, and certain forms of cancer [9], is a rising global concern. According to the 2017 Global Nutrition Report [12], 1 out of 3 people suffer from malnutrition, and around 88% of countries have populations that significantly suffer from at least two forms of malnutrition. The number of children and adults with overweight or obesity is increasing [12]. It is stated that the economic and health costs related to malnutrition is high, with a return of 16 dollars for every 1 dollar invested. It would thus be a good opportunity for governments and actors from other sectors to invest in proper nutrition.

As the FBDG are developed by individual governments, there are some variations from country to country. Some recommendations are common in almost all FBDG, such as consuming a variety of different foods, some in higher quantities than others, and to consume both fruits and vegetables, legumes, and animal-sourced foods. They recommend limiting sugar, fat, and salt [2]. There are bigger variations between recommendations concerning dairy, red meat, fats and oils, and nuts. More recently, some countries have also started to pay attention to sustainability and sociocultural factors [2].

The dietary guidelines are often accompanied by a graphic, frequently called a food guide, for communication purposes. Some of the most known food guides are pyramids and plates, but more original representations also exist, such as the food pagoda developed for the Chinese population or the food map based on the physical shape of Barbados (Figure 2.1) [13, 14]. Other countries do not have a graphic representation of the dietary guidelines, such as Norway, where the focus is on communicating 12 take-away messages [15].



Figure 2.1: The FBDG of China represented by a food pagoda (left) and the FBDG of Barbados represented by a map of the island (right) [13, 14].

2.1.1 The importance of communicating science-based knowledge

In a report published by the FAO and The Food Climate Research Network at the University of Oxford in 2016, some ways forward for the FBDG are suggested, especially concerning the incorporation of sustainability [3]. It is highlighted that in order for the FBDG to have a real impact on food consumption, they need to be owned by a government, different versions are needed for the general public, health professionals, consumer organisations and those working in the food sector, and there needs to be a clear link to actually implemented food policies in schools, agriculture, hospitals, public procurement, advertising regulations [3, 16]. Finally, the FBDG need to be promoted for the general public to know about them [3]. To achieve this, collaboration between different sectors such as governments, non-governmental organisations, mass media, the private sector and communities [16]. It is important to promote information about FBDG and science-based information about food and health in general. Here, communication from the scientific community itself could be an added resource.

2.2 Experts speaking up against misreporting in the media

Experts are frequently present in the media, where they analyse and explain complex issues. Depending on their background knowledge, laypeople often require expert help when encountering scientific issues [17]. However, the term 'expert' is not a protected title and may therefore be used by or given to anyone presenting information in public. The role of scientists as public experts has been investigated by Peters [8], and is here defined as a scientist sharing knowledge in their field of expertise. As a group, scientists are often given high credibility by the general public, and it comes with a certain level of responsibility to provide information that might affect people's behaviour and decisions and possibly lead to serious consequences [8]. However, a problem arises if individuals who may not have the expertise, are presented as experts and give information that may not be evidence-based [18]. Studies have shown that it is not always the most relevant researcher with the specific expertise who is quoted in the media, but rather individual scientists who are highly prominent, no matter their field of expertise [6, 8].

The [Speaking up for Science Action Network](#) (SuSAN) initiative was started by the European Food Information Council (EUFIC) in collaboration with a group of European organisations and experts in food and health, dedicated to improving the accuracy and balance of science communication in the media. The aim is to facilitate expert reactions to misreporting in the field of food and health, when the media presents stories from their field of expertise. This is done by having the online media headlines screened daily, singling out stories that appear unbalanced or incorrect, and writing summaries of the stories that have hit the news and why they seem inaccurate. The summaries are finally distributed to scientific experts from the field of food, nutrition, health and communication. With this summary, they get a thorough introduction to the issue and can individually decide whether they want to present their point of view and where they want to do it, e.g. via social media or open articles. The news stories will thus get a more balanced representation.

2.3 Enabling self-education via massive open online courses

Another way for the scientific community to help increase knowledge of food and research is through massive open online courses (MOOCs). This is a rapidly growing global phenomenon, where renowned universities and other organisations develop courses that can be followed online, typically over a few weeks with a few hours of study per week and are usually free of charge. The courses can be attended by anyone who wishes to increase their knowledge of a specific topic. Since the first MOOCs began to appear in 2008 they have gained increased popularity [19]. As they are digital and usually free, they reach learners and educators from the far corners of the world in a way that traditional university courses do not [20]. Some of the main MOOC platforms are Coursera (www.coursera.org), EdX (www.edx.org), Udacity (www.udacity.com) and FutureLearn (www.futurelearn.com).

With the overload of information there is in the world of food and health, MOOCs can help provide learners with the reliable information and tools to reflect on their diets and lifestyle. 'MOOC – Food and nutrition: The truth behind food headlines' (available on [FutureLearn](#)) is an EIT-Food funded joint project between the University of Reading, TU München and EUFIC. Its objective is to demonstrate the difference between media's presentation of food and health topics and the peer-reviewed science, and with this, encourage consumers to think critically and objectively. By signing up for the MOOC, participants will

- be presented with the scientific facts behind the headlines,
- get an insight into the psychology of why we are so easily influenced by headlines and different types of biases that lead to misperceiving the credibility of information and sources,
- get an introduction to the main types of research methods used, their advantages and limitations and the necessary scientific terms,
- be provided with practical tools such as questions to ask yourself that will identify unreliable sources and where to find reliable information online.

2.4 Media and social media's role in science communication

Today, most news media consist of both the internet, radio and television, in addition to traditional newspapers. More and more newspapers are also found in digital versions. As of April 2019, the most circulating newspaper in the United Kingdom was the Sun with 1 371 190 circulated copies, followed by the Daily Mail with 1 199 760 circulated copies,

while the Times has 406 280 circulated copies [21]. The Sun is a tabloid newspaper published in the UK and Ireland, mainly covering news, sport, celebrities and gossip. Similarly to the Sun, the Daily Mail covers 'the latest breaking news, showbiz & celebrity photos, sport news & rumours, viral videos and top stories'. The Times is traditionally a broadsheet paper, more focusing on current affairs.

The digital age has opened up for new ways of sharing news stories. Articles shared on social media platforms, such as Twitter (www.twitter.com) quickly reach the audience and invite them to engage. Twitter is a microblogging and social networking platform where users can write short posts ('tweets') of maximum 280 characters and comment, like or share ('retweet') other users' tweets. In the first quarter of 2019, twitter had 330 million monthly active users and 145 million daily active users [22]. 63% of twitter users is between 35 and 65 years old, indicating a more mature user base than other social media platforms such as Instagram (www.instagram.com), where around 70% of the users are between 13 and 34 years old [23].

Social media listening is obtaining data from social media platforms and analysing them. This can give valuable insights into attitudes, knowledge trends, marketing strategies or public health trends [24]. The latter has in recent years been defined as 'infodemiology' or 'infoveillance', which is defined as "the science of distribution and determinants of information in an electronic medium or population which aims to inform public health and public policy" [25]. For researchers, Twitter is a unique real-time big data source that gives access to publicly available information [26]. Therefore, analysing how people search for health information and how they communicate and share this information on Twitter, such as how news stories about food and nutrition are perceived by a lay audience [25]. Digital tools that facilitate social media listening include Meltwater, Twint and Octoparse.

3 Methods

In the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden), the FBDG are based on the Nordic Nutrition Recommendations [1], a report developed as a collaboration between the countries. This report was written as a review of the scientific evidence available, and the arising FBDG are thus based on solid evidence. Exaggerated media coverage of food and research is spotted through the SuSAN initiative, encouraging experts to speak up for a more balanced coverage. The general public can also be encouraged to gain more knowledge through modern, online education tools. Social media listening tools are used to gain insight into the discussion around sensationalised news about food and research on Twitter.

3.1 Development of the Nordic FBDG

Varying methods are used by governments when developing FBDG, but all are based on overall assessments of present scientific knowledge. Here focusing on the Nordic countries; national FBDG in Denmark, Finland, Iceland, Norway and Sweden, are all mainly built on the Nordic Nutrition Recommendations (NNR) [1] in addition to other sources, such as the WHO [27]. The fifth edition of the NNR was written as a regional collaboration in 2012, with an expected update in 2022 [28].

There have been more than 100 scientific experts involved in the revision of the recommendations, reviewing the scientific evidence for setting dietary reference values (DRVs) that will promote optimal nutrition and prevent diet-related diseases [1].

Systematic reviews were conducted by the selected experts. Data from randomised controlled trials (RCTs), prospective cohort studies, and other epidemiological studies were assessed and used in the development of the NNR. In the NNR and FBDG developed by other governments, the approach is to translate nutrient recommendations into available foods, as this is easier to understand and implement by a layperson [11]. The criteria for the systematic review are shown in Figure 3.1, and the method used to set

the dietary reference values, such as the average requirement (AR) and recommended intake (RI), of the NNR is visualised in Figure 3.2.

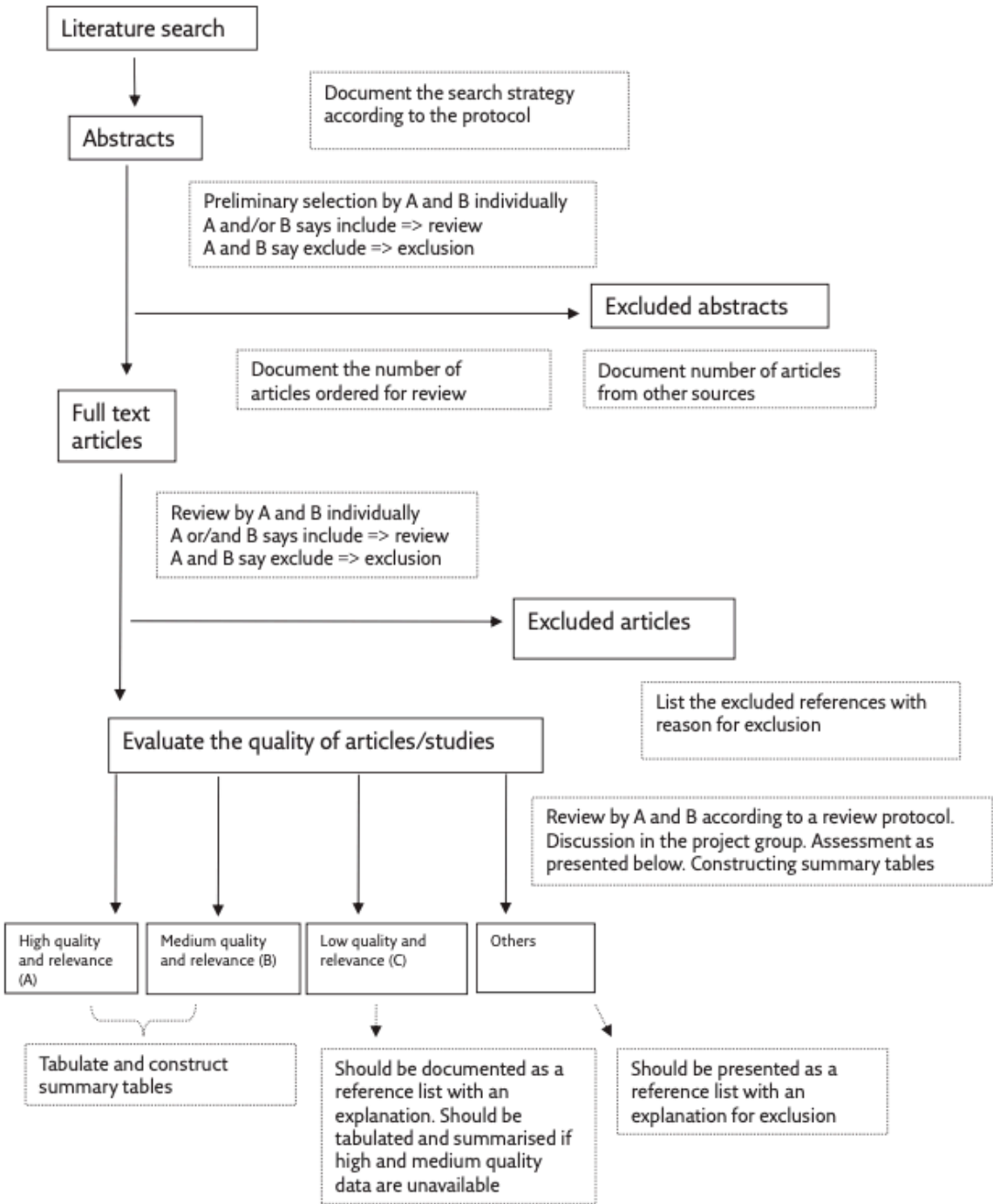


Figure 3.1: From the Nordic Nutrition Recommendations, page 57 [1]: The systematic review approach used in the development of the NNR.

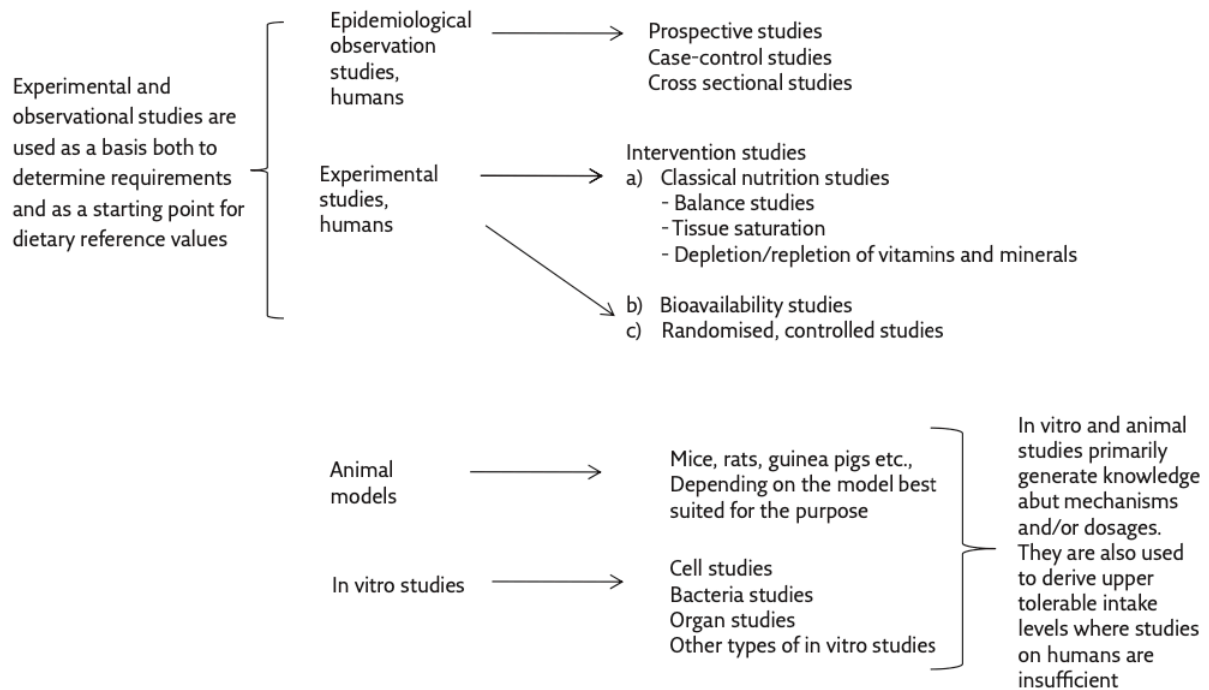


Figure 3.2: From the Nordic Nutrition Recommendations, page 54 [1], page 54: Overview of the types of data used to set the average requirements (AR) and the recommended intake (RI) and of the NNR.

3.1.1 Implementation of FBDG

Even though the FBDG around the world are quite similar, how they are tailored for specific populations and how they are communicated varies and remains a topic of discussion among experts. Draft guidelines are being tested with different consumer groups to ensure that they are being understood and are suited for the situation of the specific country [9].

3.2 Speaking up for Science Action Network

The SuSAN project encourages experts to speak up against misreported, misunderstood or unbalanced media headlines and articles. Data have been gathered by EUFIC since October 2014, however, due to the fast shifting trends in media, only the most recent issues have been studied in this thesis, starting from September 2017. An overview over these issues can be found in Appendix 1.

3.2.1 The process of a SuSAN issue

A SuSAN issue, or headline, is defined as the process of identifying a sensationalised news story, using a decision tree to evaluate the need and urgency for experts to counteract the miscommunication, and based on the resulting score, creating a summary of the story and points of concern which is distributed to selected experts via a digital platform.

3.2.1.1 Identifying exaggerated headlines

Google Alert is set up for a string of keywords covering the area of nutrition and health, from general terms ('food', 'health') to more specific terms ('coffee', 'BPA'). The complete list can be found in Appendix 2. This list has been developed through the years (since

2014) based on what areas and topics are most frequently occurring and miscommunicated in the media.

3.2.1.2 Decision tree

After an issue has been identified and the study source has been read, a decision tree is used to determine whether to proceed with the issue or not. The decision tree was created in the establishment of the SuSAN project as a way of securing objectivity. For each potential issue, seven questions are asked, and a score from 0 to 3 is given. The questions concern the relevance of the communicated message to public health and scientific accuracy, the time when the issue appeared in the media headlines the first time or if it is recurring, the extent of online reporting, the credibility and influence of the source, which media channels have covered the issue and how the community response has been. Based on these scores, it is decided whether to proceed with the issue or not.

3.2.1.3 Distributing summary to the scientific experts in the food and health field

If the news story passes the decision tree as being misrepresented, a summary is prepared and sent to the expert group. A summary includes:

- background information about the story in the news and the report it is based on,
- points of concern: the miscommunicated or overlooked points of the news coverage or performed research, e.g. over-simplification in the media or miscommunicated statistical concepts such as correlation and causation, representative populations and risk communication,
- sources: links to the original paper and media articles,
- list of relevant scientific sources from renowned organisations such as the WHO, the European Food Safety Authority (EFSA) and the International Agency for Research on Cancer (IARC),

Four full summaries are found in Appendix 3, as these will be further explored (Section 3.3 and 3.4). Individual decisions are made by the experts about whether to engage in the media debate or not. The experts are also asked to leave a comment about whether they have chosen to take action or not, and if yes, through which channel (social media, blog, newspaper, online newspaper or scientific publication). The most frequently occurring themes are presented in Table 4.2.

3.3 Creation of a MOOC and systematic literature review

MOOCs may provide an opportunity for scientists to reach learners from across all continents. The 'MOOC – Food and nutrition: The truth behind food headlines' was created by experts in food and nutrition from different European institutions including the University of Reading, the Technical University of Munich and EUFIC. The duration of the online course is three weeks, with an estimated weekly study time of two hours. The course is divided into three main themes; each week includes the perspectives of the reader, the journalist and the scientist. An overview of the course structure can be found in Table 4.3. The focus in this thesis is the science communication section of the course created by EUFIC, as nutrition *per se* and consumer psychology are considered out of the scope of this work.

3.3.1 MOOC and science communication

For EUFIC as the organisation providing science based communication, the main task was selecting news stories and respective headlines to be discussed during the course, in addition to creating a video about how to understand statistical terms, and composing three articles; 'An overview of different types of studies, 'The science behind a headline' and 'How to read a scientific paper' which was divided into 'abstract and introduction', 'methodology and results' and 'discussion and references'.

In order to select stories that illustrate questionable media coverage for the three weeks of the course, headlines from the SuSAN issues (Appendix 1) were selected. By analysing the most frequently recurring subjects (Table 4.2) and frequently recurring scientific terms, the final four headlines were selected.

3.3.2 Approach of systematic literature review

A literature review was conducted to assess the effect of MOOCs on learning outcome, specifically in terms of how experts and universities can reach the general public. Two databases (Web of Science and Scopus) were searched to first collect publications on MOOCs and their outcomes. Three search terms were used in both databases; 'MOOC evaluation', 'MOOC learning outcome' and 'MOOC experience', and the time frame was limited to 2015-2020. Further selection was done by excluding articles that were not directly relevant for the topic in question.

3.4 Twitter analysis

Meltwater is a platform used for media monitoring and social listening and was used to retrospectively monitor the twitter debate around two opposing headlines; 'Red and processed meat and poultry linked with small increased risk of cardiovascular disease' and 'New guidance suggests that people continue current red and processed meat consumption' (Headline 2 and Headline 3, Table 4.4). These headlines about red and processed meat consumption were covered by SuSAN summaries and are discussed in the MOOC 'The truth behind food headlines'. The strings of keywords and timeframe set were

- (("processed meat" AND "cardiovascular disease") OR ("processed meat" AND "heart condition") OR ("processed meat" AND "heart disease") OR ("unprocessed meat" AND "cardiovascular disease") OR ("unprocessed meat" AND "heart condition") OR ("unprocessed meat" AND "heart disease") OR ("red meat" AND "cardiovascular disease") OR ("red meat" AND "heart condition") OR ("red meat" AND "heart disease") OR ("poultry" AND "cardiovascular disease") OR ("poultry" AND "heart condition") OR ("poultry" AND "heart disease") OR ("chicken" AND "cardiovascular disease") OR ("chicken" AND "cardiovascular disease") OR ("chicken" AND "heart condition") OR ("chicken" AND "heart disease")) AND ("Cornell" OR "JAMA" OR "Northwestern" OR "US study") around February 2020,
- (("unprocessed meat" AND "cancer") OR ("processed meat" AND "cancer") OR ("red meat" AND "cancer") OR ("bacon" AND "cancer")) AND "NutriRECS" around October 2019.

Meltwater returned

- the tweets (the hit sentence that corresponded to the keywords),
- the name handle of the user who posted the tweet and their country of residence,

- the reach across the platform (the number of users who might have seen the tweet)
- the sentiment of the tweet (positive, neutral or negative).

The full set of data obtained is found in Appendix 5. Sentiments of the tweets that were automatically attributed by Meltwater but were also manually verified. The automated assignment is based on the overall score of positive, neutral or negative words and sentences [29]. In the manual verification of sentiment, any post that only shared the study findings without any personal comment was marked 'neutral'.

4 Results

4.1 Evidence-based recommendations

The NNR are primarily intended for the general healthy population, so individuals with diseases or special conditions might need their dietary composition to be adjusted accordingly. The NNR are, for instance, meant for sustainable weight maintenance, not for treatment of diseases or significant weight reduction [1]. It is stated that the NNR should not be regarded as definitive due to the evolving nature of scientific knowledge, they give thus recommendations on diet planning based on current conditions. The NNR are suggested to be used as guidelines and tools for assessment of diets, lay a basis for education and policies around food and nutrition and to give guiding values when developing food products. Figure 4.1 shows the final summary of the NNR which lays the basis for the Nordic countries’ own graphic developments.

Increase	Exchange	Limit
Vegetables Pulses	Refined cereals → Wholegrain cereals	Processed meat Red meat
Fruits and berries	Butter → Vegetable oils Butter based spreads → Vegetable oil based fat spreads	Beverages and foods with added sugar
Fish and seafood	High-fat dairy → Low-fat dairy	Salt
Nuts and seeds		Alcohol

Figure 4.1: From the Nordic Nutrition Recommendations [1]: Summary of diet recommendations based on scientific evidence documented in the fifth edition of the NNR.

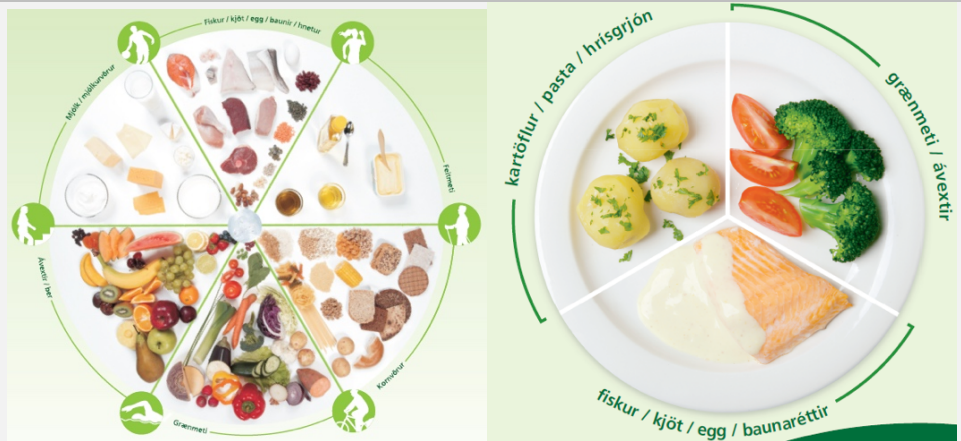
4.1.1 FBDG dissemination tools

Based on the NNR report, FBDG have been developed for the populations in the five Nordic countries. The resulting graphics (food guides), which are meant to summarise the FBDG to the public, are shown in Table 4.1.

Table 4.1: FBDG in the Nordic countries (all images retrieved from the corresponding FAO country overview [30]).

Country	Food guide
Denmark [31]	
Finland [32]	

Iceland [33]



Norway [15]

1. Have a varied diet with plenty of vegetables, fruit and berries, wholegrain products and fish, and limited amounts of processed meat, red meat, salt and sugar.
2. Find the right balance between how much energy you consume through food and drink and how much energy you use by being physically active.
3. Eat at least five portions of vegetables, fruits and berries each day.
4. Eat wholegrain products every day.
5. Eat fish for dinner two to three times a week. Fish is also a great filling in sandwiches.
6. Choose lean meat and lean meat products. Limit the amount of processed meat and red meat you consume.
7. Include lean dairy products as part of your daily diet.
8. Choose cooking oils, liquid margarine and soft margarine over hard margarine and butter.
9. Choose foods with a low salt content and limit the use of salt when preparing food.
10. Limit your consumption of food and drink with a high sugar content.
11. Choose water as a thirst quencher.
12. Engage in physical activity for at least 30 minutes each day.

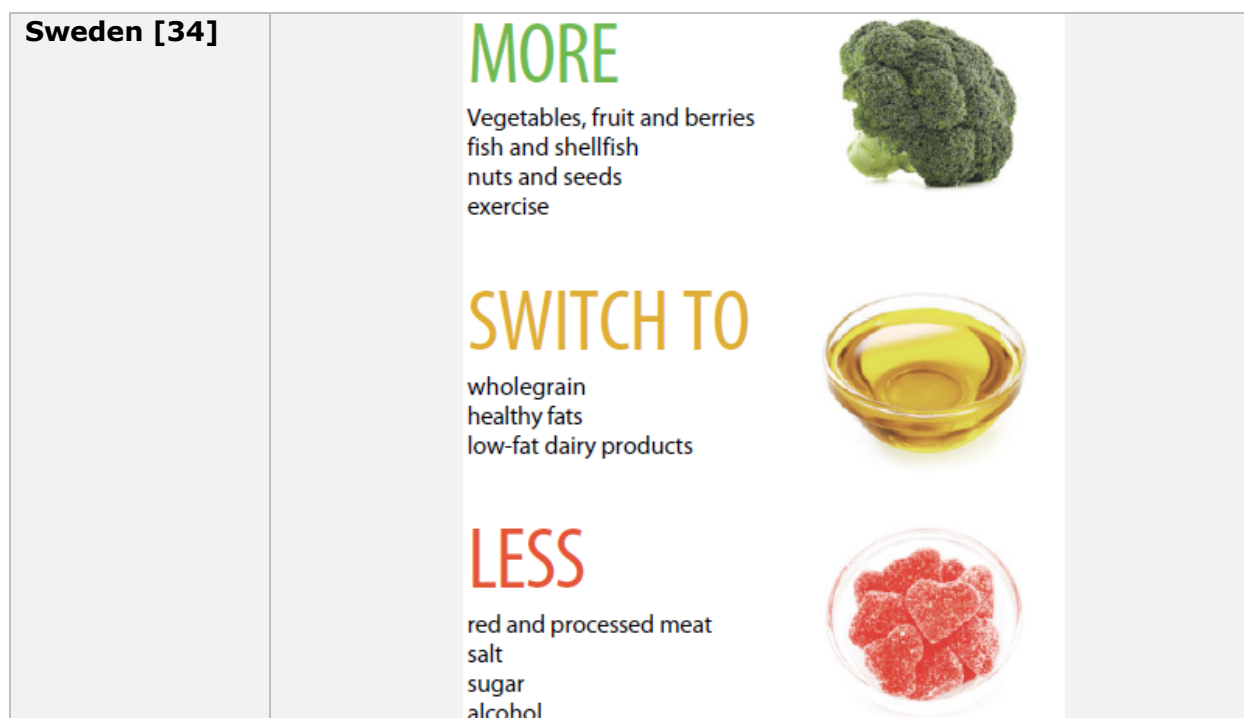


Figure 4.1 shows the summarised NNR that the individual Nordic governments have used as a basis for their FBDG graphics. Table 4.1 shows the four countries food guides (graphic representation of the FBDG). The Danish food guide highlights nine key messages under the general recommendation of eating a variety of foods, not too much, and be physically active. Both the Finnish and the Icelandic food guides visualise a plate with an example of a meal, in addition to a food pyramid (Finland) and a food circle (Iceland) that display food groups. There is no visual food guide developed by the Norwegian government, the focus is instead on 12 key messages. The Swedish food guide is similar to the NNR suggestion (Figure 4.1).

4.2 Expert reactions and frequently miscommunicated topics and scientific terms

Since the SuSAN initiative was started, summaries concerning miscommunicated research in food and health have been sent out to the expert panel. This has resulted in

- 25 issues covered (September 2017 – February 2020),
- A network of 130 experts from fields in science and communication,
- An average of 3 experts exchanging opinions on the platform per summary.

In order to determine which subjects and themes that are most often misreported in the media, the SuSAN issues were divided into categories. The media scanning and resulting headline cases done through the SuSAN project over the past few years give a good indication of the major stories within food and health that have reached the news. Based on their title on the SuSAN network platform, the 25 issues from September 2017 were divided into three main categories; Processed food (including red and processed meat), sugar and sweeteners, specific diets, and one 'other'. The subjects and corresponding number of issues are summarised in Table 4.2. The detailed placement of headlines in categories is listed in Appendix 1.

Table 4.2: Number of SuSAN issues covering three main subjects.

Subject	Number of issues covering the subject
Processed food (incl. red and processed meat)	6
Sugar and sweeteners	6
Specific diets (e.g. Western, low-carb, organic, etc.)	6
Other	7

In addition to giving an insight into which themes within food and health appear in the media most often, the SuSAN issues also give an indication of what specific terms and concepts are misreported or misunderstood. The 'points of concern' of all SuSAN summaries were screened and some of the scientific and statistical terms that appear regularly were:

- Causation and correlation
- Not representative population size
- Relative vs. absolute risk
- Selection bias
- Limitations of different types of studies

4.3 Overview of MOOC structure and headlines

A MOOC about miscommunication of food and research in the media was created by scientists from different fields of expertise, including nutrition, consumer psychology and science communication, and was launched on September 28, 2020.

The duration of the online course 'MOOC – Food and nutrition: The truth behind food headlines' is three weeks with an estimated workload of two hours per week. The course is available on the FutureLearn platform, and the final course structure is presented in Table 4.3.

Table 4.3: Course structure of 'MOOC - Food and nutrition: The truth behind food headlines'. Highlighted parts have been produced by EUFIC and can be found in full in Appendix 4.

	Theme of the week	Question	Summarised description
Week 1	What's behind a headline?	How do we interpret headlines?	<ol style="list-style-type: none"> 1. Discussion – Where do you get your food-related news from? 2. Article – Welcome to the course. 3. Article – Why does the advice keep changing? 4. Video – The relationship between headline and reader. 5. Quiz – How do you judge whether a headline is true?
		How do journalists produce their news?	<ol style="list-style-type: none"> 6. Article – Sources, angles and agendas. 7. Discussion – Explore a headline (Headline 1: Ultra-processed

			<p>foods increase cancer risk and unprocessed foods reduce it).</p> <p>8. Video – How journalists produce their news.</p> <p>9. Article – Two examples of misreporting.</p>
		How is scientific credibility established?	<p>10. Article – Next steps.</p> <p>11. Article: An overview of different types of studies. (Appendix 4)</p> <p>12. Article – The science behind a headline. (Headline 1: Ultra-processed foods increase cancer risk and unprocessed foods reduce it).</p> <p>13. Poll – Do you trust the headline?</p>
Week 2	Influence and interpretation	What bias do readers bring?	<p>1. Article – Educator response: the science behind the headline.</p> <p>2. Video – Reader bias.</p> <p>3. Article – The psychology of influence.</p> <p>4. Poll – compare these headlines.</p> <p>5. Article – How the media influences us.</p>
		What are the statistics behind a headline?	<p>6. Video – How to interpret correlations and population samples.</p> <p>7. Video – How to interpret absolute and relative risk.</p> <p>8. Article – The science behind the conflicting headlines.</p>
		How do you read a scientific paper?	<p>9. Article – Abstract and introduction. (Appendix 4)</p> <p>10. Article – Methodology and results. (Appendix 4)</p> <p>11. Article – Discussion and references. (Appendix 4)</p> <p>12. Poll – Do you believe the headline?</p>
Week 3	Trust	How do you find reliable information?	<p>1. Article – Educator response: behind the headline.</p> <p>2. Discussion - What are the reliable sources of food information in your country?</p> <p>3. Video – Who should you trust?</p> <p>4. Article – Nutrition and health claims.</p>
		How do you check if an	<p>5. Article – Finding the source.</p> <p>6. Article – Checklist for credibility.</p>

	article is credible?	7. Discussion – Your turn. 8. Article – Educator response: credibility checklist.
	How is a scientific study published?	9. Video – The process of publishing a scientific paper. 10. Article – The importance of sharing knowledge.

The course content of 'MOOC – Food and nutrition: The truth behind food headlines' has been developed with the idea of making it appealing, varied and relevant to the learners. It contains several full-text articles and videos covering scientific topics that are likely unknown to many of the learners. These articles and videos have been presented in a simple and engaging language, accompanied by graphics to emphasize the main messages.

Some of the headlines presented to the learners during the course were selected from SuSAN issues with different subjects (Table 4.2 and Appendix 1). In order to select stories with questionable media coverage, SuSAN issues were screened and categorised. The themes 'Processed foods', 'Sugar and sweeteners' and 'Specific diets' have all appeared as media headlines six times between September 2017 - February 2020 (Appendix 1). This led to one headline concerning ultra-processed foods ('Ultra-processed foods increase cancer risk and unprocessed foods reduce it') and one headline concerning a specific diet ('Organic food consumption linked to lower risk of cancer'). Finally, two headlines concerning the same theme but giving opposing conclusions were selected; 'New guidance suggests that people "continue current red and processed meat consumption"' and 'Red and processed meat and poultry linked with small increased risk of cardiovascular disease'.

The four headlines will be referred to as Headline 1 (UPF), 2 (RPMR), 3 (RPMC) and 4 (OFC) throughout this thesis, and are presented with further details Table 4.4. This includes the name of the original SuSAN issue (Appendix 1), the title of the study that the corresponding media coverage was based on, example of headline phrasing in the Daily Mail, and an overview of the points of concern related to the study and the news coverage.

Table 4.4: Overview over the four headlines retrieved from the issues covered by the SuSAN project and presented in 'MOOC - Food and nutrition: The truth behind food headlines'. Further details and relevant links can be found in Appendix 2.

	Name of SuSAN summary (as in Appendix 2)	Title of original study	Corresponding media headline (example from the Daily Mail)	Points of concern presented in the SuSAN summary.
Headline 1 – 'Ultra-Processed Foods (UPF)'	Ultra-processed foods increase cancer risk	Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé	'Processed foods are driving up rates of cancer: Major study	<ul style="list-style-type: none"> The observational nature of the study means we

	and unprocessed foods reduce it.	prospective cohort [35]	reveals the health threat including cereal, energy bars, sausages and chocolate.'	cannot prove cause and effect <ul style="list-style-type: none"> • The participants may not be representative of the general population • Food frequency and health status questionnaires can be inaccurate due to recall bias and under or over estimates of consumption • Only some cancer risk factors were taken into account
Headline 2 – Red and Processed Meat Risk (RPMR)	Red and processed meat and poultry linked with small increased risk of cardiovascular disease.	Associations of processed meat, unprocessed red meat, poultry, or fish intake with incident cardiovascular disease and all-cause mortality [36].	'Red meat IS bad for you: Eating pork or beef twice a week raises the risk of heart disease by up to 7%, according to study of 30 000 people.'	<ul style="list-style-type: none"> • The study cannot prove direct cause and effect. • The risk increase is small. • Estimations of portion size may be inaccurate. • Representation is uncertain
Headline 3 – Red and Processed Meat Continue (RPMC)	New guidance suggests that people 'continue current red and processed meat consumption'.	Unprocessed red meat and processed meat consumption: dietary guideline recommendations from the Nutritional Recommendations (NutriRECS) Consortium [37]	'You DON'T need to cut out red meat: Scientists say official advice on eating less beef, pork and lamb is based on bad evidence and having it four times a week poses 'NO cancer risk'.	<ul style="list-style-type: none"> • The evidence was all assessed to be low or very low certainty • The recommendation does not relate to a particular level of meat consumption. • Even 'a very small' reduction in disease risk could make a

				big difference at the population level.
Headline 4 – Organic Food Consumption (OFC)	Organic food consumption linked to lower risk of cancer.	Association of frequency of organic food consumption with cancer risk [38]	'Organic food lowers blood and breast cancer risk, study finds'.	<ul style="list-style-type: none"> • There may be confounding from other health and lifestyle factors. • Analyses of risk for individual cancers are based on small numbers. • There is potential for inaccuracy around self-reported organic food intake. • Participants may not be representative of the general population.

4.4 Systematic literature review on learning outcomes of MOOCs

Data from 'MOOC – Food and nutrition: The truth behind food headlines' could not be collected and analysed due to the timeframe of this thesis overlapping with the launch of the course. Instead, a systematic literature review was conducted of previous experiences and outcomes with MOOCs in order to identify the strengths, weaknesses and possible improvements for reaching a global audience through online courses. The literature review on the learning outcomes of MOOCs was conducted in a systematic manner. A total of 1006 articles and review articles were found from the keywords in Web of Science and Scopus (437 from Web of Science and 569 from Scopus, duplicates not subtracted). These titles and abstracts were screened, excluding the articles that did not concern the topic specifically. After exclusion, the final number of articles considered in this review was 25.

Reasons for excluding articles included

- that the study focused on e-learning or blended learning and did not describe MOOCs specifically,
- that the MOOC in question was directed at specific groups of learners that could not be generalized (e.g. students already enrolled in a course or individuals with a specific profession),
- that the study was not in English
- the paper focused on learner psychology, such as their behaviours or motivation to join MOOCs.

4.4.1 Common evaluation methods

Since MOOCs started to gain attention around 2010, research in the field is quite new. Some reviews have highlighted the need for common evaluation methods to be able to assess the overall outcomes of MOOCs. In 2016, Veletsianos et al. [39] found that despite the quick increase of MOOCs on the market, there are a number of gaps in the scholarly understanding of MOOCs. Many of the published papers have little impact in terms of citations, and they are mostly published by institutions in North America and Europe. They found, however, that quantitative approaches have been favored.

A systematic review by Alturkistani et al. [40] identified currently used evaluation methods, in order to propose methods to future designers of MOOCs. They confirmed that there are several ways to evaluate a MOOC, but both quantitative and qualitative methods should be used in order to successfully evaluate the outcome. Qualitative methods are needed to help explain why certain outcomes occur.

Zhu, Sari and Lee (2018) [41] also looked at evaluation methods of MOOCs. They found that most used quantitative methods in their evaluations, followed by mixed-methods and qualitative methods. The focus of the evaluations was usually student-based, but also the design, instructor, context and impact of the MOOCs were evaluated. Learner retention and motivation were also mentioned. Zhu, Sari and Lee (2020) [42] further developed the review of methodological approaches, concluding that the quantitative method, and especially surveys, were the preferred evaluation method.

4.4.2 Importance of self-regulated learning (SRL) skills

Alonso-Mencía et al. [43] studied autonomy of MOOC students as self-regulated learning (SRL) through a literature review. SRL involves the ability to face different challenges such as cognitive, behavioural and motivational and still persevere until the finish line. This ability is especially important when the course is taking place online instead of in face-to-face learning environments. They concluded that SRL skills are critical in achieving the learners' goal in MOOCs, due to low interaction with instructors who focus on preparing the content. This is supported by Li [44], who found that having SRL skills increases learning and should be encouraged.

How MOOC participants are able to use SRL skills, which is an important factor of how and when they engage in a course, was studied by Littlejohn et al. [45]. Specifically, how participants in a data science course self-regulated their learning. They found that learners who had a profession related to the course and could directly apply their knowledge scored high on SRL. Learners who scored lower on SRL, often were more interested in achieving a certificate and completing all activities. They also engaged in the course but did not actively apply their new knowledge in a work context. It was thus evident that the learners' reasons for joining a MOOC also determined their ability to self-regulate their level of learning. For MOOC designers, it is critical to support learners with different backgrounds and goals to achieve the goal of open education to all

4.4.3 Heterogeneity of MOOC participants

A MOOC about geodesign was developed by Foster et al. [19]. They found that it was difficult to address the different levels of prior knowledge facing complex processes, and nearly 25% of learners found the pace of the course to be too fast. Three MOOCs about climate change and health where the aim was to increase the knowledge of a global audience were studied by Barteit et al. [46]. One MOOC was in English, targeted at a general audience, one MOOC in French for a general francophone audience focusing on

sub-Saharan conditions, and one MOOC targeted at policy makers. To reach all participants and to measure learning outcome was proven difficult also here, especially for the learners who did not finish the course. However, high enrolment of participants from across the globe was observed, and the MOOC attracted learners from low-resource settings. Also how to reach students with disabilities has been studied by Sanchez-Gordon [47].

That participants' demographics such as age, English language proficiency, level of education, motivation and participation influence their learning [44, 48, 49]. The results of a study performed by Zhang et al. [50] showed that older participants (over 50 years old) were more likely to complete a MOOC, university students are more likely to complete when the MOOC is directly relevant to their academic background. MOOCs from highly renowned institutions also have higher student enrolments. However, demographics such as gender, personal interests, connection with others did not play a significant role in the completion rates. Neither did group activities affect the completion level. This may be due to the heterogeneity in the group of learners.

The issue of heterogeneity could be overcome, for example as described by Alonso-Mencía et al. [43], who also concluded that because of the heterogeneity of MOOC students, it could be valuable to have information about the learners and possibly divide them into groups in order to meet their needs. Students with high SRL thrive in non-linear learning environments, while students with medium SRL have difficulties in these environments as they are given too many options. Also, some participants are *targeted learners*, who are mostly aiming at achieving a certificate, and one with *comprehensive learners*, who are mostly looking to achieve a deeper understanding of the subject.

4.4.4 Key success factors

In order to design an effective learning platform, knowledge about the factors that influence learning and perceptions is needed. According to a paper by Swan [51], the clarity of the design, the level of interaction with the instructors and engagement with other participants, significantly influenced the learning. This should be taken into account when designing an online learning platform. Several other studies have looked at the key success factors of MOOCs [52-55]. Cohen & Holstein [54] concluded that three main elements that were present contributed to a MOOC's success; teaching, social and cognitive, in addition to four main characteristics; teacher, exercise, atmosphere, and workload. It was also shown that the learners could consume the content and activities according to their own preferences. Zhang et al. [52] studied instructor's presence on dropout rates.

Lu et al. [53] used expectation-confirmation theory (ECT) and user experience on the satisfaction of the MOOC. They concluded that usefulness, interest and flow contribute positively to participants' satisfaction with the course based on ECT. In practical terms, MOOC educators and platform should provide interesting contents that can increase the participants' flow experience (not being distracted by disturbances, not giving up due to frustrations, etc.).

Romero-Rodríguez [55] also analysed the effect of expectancy-value and achievement goals as factors that contribute to the higher participant engagement in some MOOCs. They found that the participants that were most likely to finish the course successfully had previously finished more than one MOOC, had taken the MOOC for work purposes and having an underlying interest. To decrease dropout rates and increase the number of

participants that successfully finish, the educators and designers of the MOOC should take the student profiles into account. However, this may show to be difficult, as the content is normally completed before registrations are made.

4.4.5 Innovative ways to improve MOOCs

Davis et al. [56] looked at empirically evaluated active learning strategies in digital learning environments with a focus on scalable learning. They confirm that MOOCs are a new way to reach the masses, but still struggle with keeping the participants attention throughout the courses. The way MOOCs are taught leaves room for passivity, which does not lead to satisfactory learning. They categorised 126 papers and concluded that cooperative learning, simulations and gaming, and interactive multimedia were the most promising strategies for effective learning at scale. López-Goñi et al. [57] found that a way to boost engagement could be done through teaching MOOCs on Twitter.

Antonaci et al. (2018 and 2019) [58, 59] studied how course developers can add gamification elements to MOOCs to improve the learner experience. Gamification is the application of game elements, such as rules, earning points and competing with others, in non-game contexts. By adding gamification to MOOCs, enhanced goal achievement and engagement could be achieved. However, the process of developing gamification is complex and requires expertise from several disciplines, from psychology, learning and game science and design to human-computer-interaction and other advanced technologies.

By applying gamification to MOOCs, individual learners can achieve their own goals, while also appreciating a sense of community that could increase engagement [58]. However, the game elements should be selected carefully in order to be in line with the course content and be perceived as useful for the learners [59]. Gamification of a MOOC was applied in a study by Borrás, Martínez, and Martín [60] and achieved greater engagement than MOOCs without the gamification feature.

4.5 Red and processed meat headlines on twitter

The full set of data on tweets and corresponding reach and sentiment obtained from Meltwater can be found in Appendix 5 and are summarised in Table 4.5 and Table 4.6. The manual verification of assigned sentiment is also included.

Table 4.5 describes the twitter debate around Headline 2 (RPMR), while Table 4.6 concerns Headline 3 (RPMC). The tables show that Meltwater returned twice as many hits for Headline 2 (RPMR) than for Headline 3 (RPMC) (77 versus 31), yet this is still considered to be on the same level (less than 100) and are thus comparable. Using the specific keywords for the names of institutions and publishers ('Northwestern', 'Cornell', 'US study', 'NutriRECS' and 'JAMA') was proven to be necessary, as an attempt without yielded more than 3000 hits. Out of these 3000, a substantial part concerned the theme 'red and processed meat' in general, not the headline cases specifically. The keywords insure thus that the obtained results do concern the specific headlines.

Table 4.5: Data describing the online debate concerning red and processed meat and cardiovascular disease, Headline 2 (RPMR).

Description	Total number	Percentage
Hits	77	-
Nationalities represented	14	-

Total users reached	2 483 746	-
Experts ("dr" included in username)	6	8%
Positive sentiment (Meltwater / manual)	3 / 20	4% / 26%
Neutral sentiment (Meltwater / manual)	41 / 55	53% / 71%
Negative sentiment (Meltwater / manual)	33 / 2	43% / 3%

Table 4.6: Data describing the online debate concerning red and processed meat and cancer, Headline 3 (RPMC).

Description	Total number	Percentage
Hits	31	-
Nationalities represented	4	-
Total users reached	117 385	-
Experts ("dr" included in username)	1	3%
Positive sentiment (Meltwater / manual)	1 / 3	3% / 10%
Neutral sentiment (Meltwater / manual)	19 / 9	61% / 29%
Negative sentiment (Meltwater / manual)	11 / 19	36% / 61%

Table 4.5 and Table 4.6 show that the headlines have reached people worldwide – there were tweets concerning Headline 2 (RPMR) in more than 14 countries, reaching almost 2.5 million users, whereas Headline 3 reached over 100 000 people from at least four different countries. Six experts were involved in the debate around Headline 2 (RPMR), while only one was involved in the other.

Meltwater was also used for sentiment classification. However, a manual verification of the assigned sentiment varied greatly from the automated assignment (Table 4.5 and Table 4.6), especially in the case of Headline 2 (RPMR), where three posts were categorised as positive, while the manual verification resulted in 20. The sentiment of a post was manually categorised as 'positive' when it was positive towards the headline, and similar for 'negative'. 'Neutral' was used in the cases where there was no personal comment that indicated whether the user was positive or negative (e.g. in the cases of just retweeting study findings).

5 Discussion

The process of developing FBDG is long and thorough and includes experts from interdisciplinary fields reviewing the available literature. As the research is evolving, new evidence come up regularly and the FBDG need to be updated frequently. Figure 3.1 and Figure 3.2 show two of the processes involved in the development of the NNR in 2012; the approach used in the systematic literature review and an overview over the types of studies used when determining the AR and RI that lay the basis for nutrient-to-food translation. In both cases, the methods are thoroughly developed, include several types of studies and evaluations in order to conclude on the recommendations. Most importantly, the review is based on an overall assessment of all research and studies and is of the highest level on the hierarchy of scientific evidence. In addition to this, it is tailored for the Nordic populations and environment, and it "should be considered as "optimal" in Nordic countries." [1].

A possible drawback of this thorough process is that for a person that does not have solid knowledge about research, the time it takes for updating recommendations may seem long. Also, when reading media headlines about new research that is miscommunicated or unbalanced, they may get the impression that all research and evidence are equally significant.

The differences in FBDG and food guides between the Nordic countries (Table 4.1) show that even though the same scientific report is the same for all four governments' FBDG, the way they are being communicated varies, even between countries that are close both geographically and culturally. This may appear confusing if not communicated properly. The general knowledge about food recommendations could benefit from a more streamlined communication of FBDG, across borders and from different holds. Communication from the research community itself could be an added resource.

5.1 SuSAN

The SuSAN project was started by EUFIC and included scientific experts in the field of food and health, aiming to encourage them to respond to misreporting of scientific research in the media. The process from detecting a misreported news story to the summary is distributed to the experts is described in Section 3.2.1. To ensure a subjective selection of news stories, problematic headlines are identified through notifications from Google Alert, and the identified headlines are evaluated through a decision tree. The list of keywords (Appendix 2) set up in Google Alert includes both broad terms and more specific terms that will identify most news stories about food and health. However, news stories may be missed if the list of keywords does not cover all aspects of food and health, or if the manual screening of notifications is incomplete due to human errors. The decision tree supports subjectivity by scoring the potential news story, where the score determines whether there will be proceeded with writing a summary to be sent to the experts. However, also the scores given through the decision tree are not subjective. Questions about the relevance of the communicated message to public health or the credibility and influence of the source, will be influenced by the opinion of the analyst. By having two or more analysts evaluating the Google Alert notification, performing the decision tree process and comparing scores, human errors in

the news story identification could be minimised. However, although subjectivity should be worked towards, it may not be crucial for the project at this stage.

Summaries are written for the selected news stories (examples in Appendix 3) and distributed to the expert group. The expert group consists of 130 experts from fields within food science and communication. 25 issues have been identified since September 2017 with an average of three expert comments left on the SuSAN digital platform per issue. Out of the 130 experts, eight of them have left comments on the platform saying that they have taken action and spoken up against one or more of the cases of misreporting. Taking into consideration that SuSAN is a voluntary initiative, any reaction is valuable on the way to a more balanced representation of food and research in the media. The quite low number of actions may simply be due to a lack of time. Scientists are often concerned with increasing knowledge, not with the practical application of it [8]. Going into a public debate may thus feel risky for an untrained scientist, as it can result in negative comments and publicity. With the summaries distributed via the SuSAN initiative, the aim is to lower the threshold for scientists to raise their voice in public, by pointing out the news story and the points of concern and that these are backed by scientific evidence. Social media also offers a way for scientists to get in direct contact with the general public, without being quoted by the media.

5.2 MOOC

To understand and be able to critically evaluate media reporting of scientific studies, consumers should have a basic understanding of scientific research. The aim of the first article, 'An overview of different types of studies' was to bring attention to the hierarchy of scientific evidence. Learners will get an introduction to the limitations and advantages of different types of scientific studies, such as systematic reviews, RCTs and expert opinions. The second article, 'The science behind a headline' concerns Headline 1 (UPF) which is based on media coverage following the research performed by Fiolet et al. [35] that assessed the prospective associations between consumption of ultra-processed foods and risk of developing cancer. Some of the limitations of the study and media coverage were pointed out in the article, to make the learners aware of these and to illustrate them through an example. The last article, 'How to read a scientific paper', highlights the different parts of study reports, to suggest what to expect and pay attention to when reading independently and critically in the future. The selection process of the four headlines that were studied in the MOOC secured both a representation of themes that frequently occur in the media (Table 4.2), and that statistical terms such as causation and correlation, population size and risk evaluations were highlighted and discussed in a context.

A systematic literature review of evaluations, experiences and learning outcomes of MOOCs in general was conducted and showed that MOOCs are still in the infancy compared to face-to-face learning environments. Research on how to increase the completion rate and the importance of SRL skills [43-45], how to engage learners through gamification and instructor presence has been presented [54, 58, 59], yet more research is needed in terms of finding the best evaluation methods [40-42]. The group of learners in a MOOC is normally heterogenic in terms of background knowledge and goals, which is a challenge for course developers. Some learners may choose to finish only one or a few modules that seem relevant to them. This may still be a positive learning outcome although the course as a whole is not completed. Therefore, course completion may not be the best way to evaluate success. To be able to adapt the course to the

individual learner (e.g. via quizzes or feedback) throughout the course could help keep increase retention rates.

The literature review indicated that when a MOOC is developed, instructor presence and creation of course content that seems relevant and appealing to the learner should be considered. Instructor presence can however be difficult to achieve with thousands of learners. Creating relevant and appealing content for all learners with different background is also challenging. Adding gamification elements can improve learner engagement. Dividing learners into groups based on their prior knowledge in the field, their goals and SRL skills can also be considered. In light of these points, 'MOOC – Food and nutrition: The truth behind food headlines' has the benefit of having all instructors present and available during the three weeks of the course to answer questions and moderate discussions. The learners have not been grouped in this course, which could be considered when creating similar MOOCs in the future. Interactive elements have been included, such as discussions, quizzes and polls. Addition of more advanced gamification elements could be considered to further increase learner engagement. Learners who have a scientific background from other fields than food and health may drop out if they find the course content too little challenging. This could possibly also be overcome if the learners were divided into groups and the content was more tailored for these groups.

Some studies have shown that learners who can directly apply the newly obtained knowledge in their work, who have a basic interest or are students in the field, are more likely to finish a MOOC [50, 55]. These groups consist thus of learners who have a basic interest in the topic of the MOOC. For 'MOOC – Food and nutrition: The truth behind food headlines', this could imply that many participants already have a basic knowledge about food and health. Whether the MOOC reaches the whole general public is thus uncertain. Evaluation of the course after its ending could help determine this.

5.3 Debate around headlines on Twitter

The online twitter debate arising from two out of four headlines (Headline 2 (RMPR) and 3 (RPMC), Table 4.4 **Feil! Fant ikke referanseilden.**) was studied. The aim was to retrospectively investigate the online debate around these headlines and observe whether the users were critical towards sensationalised headlines, and whether any experts reacted to the stories. It is likely that there are tweets, retweets and reactions that have not been caught by the chosen strings of keywords. The keywords included the names of institutions and publishers ('Northwestern', 'Cornell', 'US study', 'NutriRECS' and 'JAMA'). As these keywords are very specific, it is probable that there is a substantial number of tweets published that concern the headlines but have not been detected by Meltwater because they have not included the specific keywords.

As an expert was defined as a person with 'Dr' explicitly as a part of their username, whether they have expertise specifically in the field of food and health was not studied. There may also be more experts involved who were not identified (doctors that do not have the title in their username, scientists in the field or professions that do not hold a doctorate degree, such as nutritionists). However, this shows that there are a few experts involved in the debate around these headlines, but the majority are laypeople. More experts speaking up against misreported scientific findings, such as is the case especially for Headline 3 (RPMC), could lead to a more balanced representation. This requires, however, that the person who is presented as an expert, actually has expertise in the subject in question.

There are particularly two limitations in the manual attribution of sentiments:

1. The assigned sentiment is not fully subjective, even when done manually, as sentiments are difficult to assess and vary according to the personal understanding of elements such as humour and irony.
2. Posts that only shared or summarised the study findings were categorised as 'neutral'. This concerned many posts in both headline cases. However, one might believe that a user who shares study findings without contradicting them, is most likely positive to these findings.

The manual classification is still considered to be most reliable and is chosen as a basis in this discussion. The attributed sentiments indicate that a majority of the Twitter users were positive to the news coverage Headline 2 (RPMR), e.g. 'Red meat IS bad for you', while the majority were negative towards Headline 3 (RPMC), e.g. 'You DON'T need to cut out red meat'. As the case of Headline 2 (RPMR) concerns the link between red and processed meat and increased risk of cancer and encourages a lower consumption of these foods, a positive sentiment implies thus that the user likely agrees with this, while a negative sentiment to Headline 3 also agrees with this. As it is generally recommended in the FBDG to limit the amount of red and processed meat consumed [1, 2], a negative sentiment to the news coverage of Headline 3 (RPMC) is in line with the recommendations. A positive sentiment towards Headline 2 (RPMR) also indicates that the user knows that the consumption of red and processed meat should be limited, even though the specific study [36] and following news coverage have some limitations (Table 4.4)

Only 3 out of 31 users were positive towards Headline 3 (RPMR) (e.g. 'You DON'T need to cut out red meat...'), which is the only sentiment that is considered to be directly contradicting the official recommendations. This may indicate that most users are critical towards sensationalised headlines. However, in addition to the limitations mentioned above, there are some essential factors to be considered:

- The low number of hits may not be representative of the entire online debate and information sharing.
- As the keywords included the specific terms 'Northwestern', 'Cornell', 'US study', 'NutriRECS' and 'JAMA', only users who used these in their posts were detected by Meltwater. People from the scientific community are thought to be more interested in the origin of a research paper than the layperson, so the retrieved posts in this study may come from people with a scientific background who are already aware of misreporting of science in the media. In other words, the Twitter users in this study may not be representative of the entire population on Twitter, as there is a chance that this population contains a disproportionately high number of scientists.
- The high numbers of neutral sentiments give rise to high uncertainty of the overall sentiments.

These limitations could have been further investigated by performing another search using other platforms with other search criteria. It was planned to analyse the debate of all four headlines covered by the Sun, the DailyMail and the Times. However, an update of Twitter caused technical difficulties with the analytic tools for this purpose (Twint and Octoparse), and the relevant data could not be obtained.

5.4 Limitations and further work

- Some improvements of the SuSAN initiative could be considered to engage expert reactions to misreporting. This could be by offering media training to the expert group or encouraging the experts to speak up as a network instead of individually, which would possibly help them feel less exposed. This could be further studied.
- In this thesis, the media and journalists' perspective has not been much explored. The journalist often takes the role as mediator between experts and the public. As journalists work in a narrow time frame, the accessibility of an expert statement is an important selection criterion [8]. Studies have shown that there is a discrepancy between scientists and journalists and their perceived roles in communicating science. Journalists often consider themselves as authors of stories, with scientists being their sources. Scientists, on the other hand, think that they are the authors, while journalists are only disseminating their knowledge [8, 61]. The goal – disseminating scientific knowledge to the public – may be quite similar for both groups, although the angles differ. This could also be further explored.
- It has been assumed that the main reason why people do not follow science-based recommendations is that they lack knowledge and trust in them. There are, however, many other reasons why people choose to not follow a healthy diet, and these reasons have not been taken into account.

6 Conclusion

FBDG have been developed by governments around the world to improve the health of their populations. They promote healthy diets and active lifestyles and are implemented in areas such as education and policy development. However, promotion of FBDG and science-based information about food and health in general, from different angles and across sectors, is needed for them to reach their full impact. The impacts of two initiatives from the scientific community were evaluated as additional communication tools; expert reactions to misleading media headlines through the SuSAN initiative and use of MOOCs, such as 'MOOC – Food and nutrition: The truth behind food headlines'.

Through the SuSAN network, experts in food and health are encouraged to speak up against misreporting in their fields of expertise. More than 20 issues have been identified in the past years, but many experts still seem hesitant towards speaking up in a public debate. A study of an online debate on Twitter around two sensationalised headlines showed, however, that some scientists were engaged on this platform.

MOOCs may ultimately be a more suitable way for scientists and experts to share their knowledge. MOOCs are increasingly popular among learners and educators but have high dropout rates that have been widely studied. Many learners sign up, and demographics can partially explain who drops out. It is a platform where scientists can meet the general public, when succeeding to keep the learners' interest throughout the course. However, whether participating learners represent the general public is uncertain, as they are likely to have an initial basic interest and knowledge about food and research. When developing a MOOC, creating course content that seems relevant and appealing to the learner should be in focus. Educator presence may have a positive impact, but can be difficult to achieve with thousands of learners. Creating relevant and appealing content for all learners with different backgrounds and goals is also challenging. Adding gamification elements can improve learner engagement and dividing learners into groups based on their prior knowledge of the field, their goals and SRL skills can also be considered. This could be considered when developing MOOCs about food and research in the future.

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Appendices

Appendix 1: List of SuSAN issues

Appendix 2: Search terms for SuSAN issues

Appendix 3: SuSAN summaries

Appendix 4: Articles produced by EUFIC for 'MOOC – Food and nutrition: The truth behind food headlines'

Appendix 5: Twitter data obtained from Meltwater

Appendix 1: List of SuSAN issues

Table: The most recent SuSAN issues, from September 2017 to February 2020.

Issue title	Sent on	Theme
One week of a 'western-style diet' linked with memory loss	21/02/2020	Specific diet
Red and processed meat and poultry linked with small increased risk of cardiovascular disease	05/02/2020	Red and processed meat
New guidance suggests that people 'continue current red and processed meat consumption'	04/10/2019	Red and processed meat
Soft drinks, including sugar-free versions, linked to earlier death	06/09/2019	Sugar
No proof red wine makes you slim	29/08/2019	Other
Sugary drinks linked with risk of cancer	12/07/2019	Sugar
Ultra-processed food linked with risk of cardiovascular disease and mortality	04/06/2019	Processed foods
Red and processed meat linked to increased risk of colorectal cancer	18/04/2019	Red and processed meat
Can ultra-processed foods effect how long we live?	14/02/2019	Processed foods
Further research shows sweeteners have few health benefits	-	Sugar
Low carb diet suggested to increase long term weight loss	20/11/2018	Specific diet
Organic food consumption linked to lower risk of cancer	24/10/2018	Specific diet
Further research into the potential toxicity of artificial sweeteners on gut health	05/10/2018	Sugar
Moderate dairy intake associated with lower mortality risk	12/09/2018	Other
Moderate carbohydrate diets associated with lower mortality risk	21/08/2018	Specific diet
Healthy foods can still remain the main part of a varied diet	13/08/2018	Other
Fat, not sugar, linked to weight gain	26/07/2018	Sugar
Minimal evidence to show Omega-3 prevents heart disease	19/07/2018	Other
Reports of high levels of zinc in tinned tuna are based on flawed calculations	19/04/2018	Other
Ultra-processed foods increase cancer risk and unprocessed foods reduce it	16/02/2018	Processed foods
Diets low in asparagine linked to reducing progression of breast cancer	12/02/2018	Specific diet
Weight loss success "in the genes"?	08/12/2017	Other
Daily cheese consumption linked with reduced risk of cardiovascular disease	06/12/2017	Other
Sugar metabolism in cancer cells investigated in yeast	19/10/2017	Sugar

Outcome of global study recommending a high fat diet might not be relevant for European population	06/09/2017	Specific diet
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Appendix 2: Search terms for SuSAN issues

The following list shows strings of keywords that have been used to set up Google Alert notifications. This list has been updated continuously since the beginning of the project in 2015.

Food AND toxic OR safe OR chemical

Health AND nutrition or food

Diabetes OR Obesity AND food OR diet

Fat OR Carbohydrates OR Protein OR Sugar OR Salt AND diet OR health

Wine OR Beer OR alcohol AND diet OR health OR safe

Dairy OR Chocolate AND diet OR health OR safe

Fruit OR Vegetable AND diet OR health OR safe

Meat OR Fish OR seafood AND diet OR health OR safe

Vitamins OR minerals OR antioxidants AND diet OR health OR safe

Coffee OR tea AND diet OR health OR safe

Soda OR "soft drink" OR "energy drink" AND diet OR health OR safe

Food AND safe OR contamination OR packaging OR pesticide OR organic

Food allergy OR allergen OR intolerance

Wheat OR gluten OR peanut OR nut

"Heart disease" OR "live longer" OR cancer AND food OR diet

Food AND GMO OR nano* OR technology

Food AND BPA OR endocrine

Appendix 3: SuSAN summaries

16/02/2018

Ultra-processed foods increase cancer risk and unprocessed foods reduce it

(Headline week 1, MOOC 'The truth behind food headlines')

Summary

"Cancer warning over processed foods that make up half of UK diet" reports the Telegraph. The Times also warned that "Eating factory-made food including cornflakes, pizza and chocolate bars every day increases the risk of cancer by a quarter," and speculated that "Additives in ready meals, packaged snacks and shop-bought cakes may combine to trigger the disease".

These headlines follow results from a large French cohort study of 104,980 adults which looked at diet and risk of cancer. Starting in 2009, with data analysed up to January 2017, people filled in online 24-hour dietary questionnaires every six months. The participants also provided background data about their sex, age, health, smoking status, BMI, family history of cancer, socioeconomic status and level of physical activity. Health status was updated annually.

The researchers split the food and drinks into four categories according to the level of processing using the NOVA classification system. The highest level, "ultra-processed" items include mass-produced breads and cakes, snacks and sweets, fizzy drinks, ready meals and reconstituted meat products.

For every 10% increase in the proportion of ultra-processed foods in the diet, the risk of any cancer increased by 12% (hazard ratio (HR) 1.12, 95% confidence interval (CI) 1.06 to 1.18). The risk of breast cancer was also increased by 11% (HR 1.11, 95% CI 1.02 to 1.22), likely due to post-menopausal cancer. There was no increase in risk of colorectal or prostate cancer. "Processed foods" such as canned vegetables with added salt or sugar, meat preserved by salting, cheeses and freshly-made, unpackaged bread and the next level down, "processed culinary ingredients" were not associated with risk of cancer. "Minimally or unprocessed foods" were associated with a lower risk of cancer. For every 10% increase in dietary proportion, there was a 9% reduction in overall cancer risk (HR 0.91, 95% CI 0.87 to 0.95).

Most media reports highlighted the point that we don't know the cause of this increased risk with ultra-processed food, including expert comments about the likely role of confounding factors such as lifestyle. However, the suggestion from the Times that it is because of the foods combining together is pure speculation. They have also used figures from the highest quartile ultra-processed food consumption group to give the most dramatic results.

Source: Srour et al. Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé prospective cohort. *BMJ* 2018; 360 doi: <https://doi.org/10.1136/bmj.k322> (Published 14 February 2018)

Points of concern

- **Study type:** Cohort study
- **The observational nature of the study means we cannot prove cause and effect**

The number and variety of foods considered ultra-processed means it is hard to pin down which element or elements could be responsible for the increased cancer risk. It could be anything from sugar, additives or packaging. It is also possible that higher ultra-processed food consumption is actually indicative of other unhealthy lifestyle choices which were not adequately taken into account over time.
- **The participants may not be representative of the general population**

The average age was 43 at the start of the study, and 78% of participants were women. The low number of male and older participants may have contributed to why the risk of prostate or colorectal cancer was not increased. This cohort had an annual incidence of 786 cancers per 100,000 person-years which is below the French national average of 972. A variety of factors could account for this difference, including selection bias - a younger cohort who are more likely to engage with online studies and people who may be more health conscious.
- **Food frequency and health status questionnaires can be inaccurate due to recall bias and under or over estimates of consumption**

Yearly self-assessment BMI, physical exercise and alcohol consumption may not be truly reflective. Lifestyle and diet fluctuate. Though researchers aimed for people to fill in food diaries on different days of the week or weekends over the course of the study period, these were still just 24-hour snapshots.
- **Only some cancer risk factors were taken into account**

As we do not have a breakdown of the number of each type of cancer, we do not know whether unrecorded risk factors had a role such as sun exposure, environmental carcinogens, radiation and infections including human papilloma virus, hepatitis B and C and Epstein Barr virus.

Source(s)

<http://metro.co.uk/2018/02/15/eating-ultra-processed-foods-like-cakes-sausages-can-give-cancer-7314756/>

http://www.abc.es/salud/habitos-vida-saludable/abci-alimentos-procesados-asocian-mayor-riesgo-cancer-201802151047_noticia.html

<http://www.bmj.com/content/360/bmj.k322>

<http://www.dailymail.co.uk/news/article-5393231/Processed-foods-driving-rates-cancer.html>

http://www.lemonde.fr/planete/article/2018/02/16/les-aliments-ultra-transformes-favorisent-le-cancer_5257759_3244.html

<https://news.sky.com/story/eating-more-processed-food-boosts-cancer-risk-11250934>

<https://www.thetimes.co.uk/article/ready-meals-and-cereals-linked-with-rise-in-cancer-bmsrmx6fc>

Scientific facts

- The WHO European code against cancer recommends avoiding processed meat. They also recommend limiting high calorie foods and those with high fat, sugar or salt content, all of which is likely to be applicable to ultra-processed foods.
- The EFSA have guidelines on recommended nutritional intake in terms of carbohydrates, protein, fats and vitamins. They also recommend consuming five portions of fresh fruit or vegetables every day. They do not set a threshold on an acceptable level of ultra-processed foods.
- As part of The European Food and Nutrition Action Plan 2015 to 2020 to create healthy food and drink environments, food labelling has improved so that consumers can be more aware of complex processed foods.

http://www.euro.who.int/__data/assets/pdf_file/0003/294474/European-Food-Nutrition-Action-Plan-20152020-en.pdf?ua=1

<http://www.euro.who.int/en/health-topics/noncommunicable-diseases/cancer/news/news/2016/02/preventing-cancer-the-european-code-against-cancer>

https://www.efsa.europa.eu/sites/default/files/2017_09_DRVs_summary_report.pdf

02/05/2020

Red and processed meat and poultry linked with small increased risk of cardiovascular disease

(Headline week 2 part 1, MOOC 'The truth behind food headlines')

Summary

'Red meat IS bad for you' the Mail online reported, in reference to controversial guidance produced last year which suggested that red and processed meat perhaps wasn't as bad as previously thought and that reducing intake had minimal effect on risk of cardiovascular disease and cancer. New research seems to counter this, finding that higher intake is associated with increased risk of cardiovascular disease. This time, higher poultry intake has also been associated with risk.

Researchers from the US pooled the findings from 6 prospective cohort studies:

- the ARIC (Atherosclerosis Risk in Communities) study
- CARDIA (Coronary Artery Risk Development in Young Adults) study
- CHS (Cardiovascular Health Study)
- FHS (Framingham Heart Study)
- FOS (Framingham Offspring Study)
- MESA (Multi-Ethnic Study of Atherosclerosis)

They analysed a total 29,682 adults (average 54 years, 44% male) who were free from cardiovascular disease at recruitment, and completed baseline questionnaires that assessed their intake of processed meat, red meat, poultry and fish. One serving was estimated to be a 4oz piece of unprocessed red meat or poultry, a 3oz piece of fish, and for processed meat, 2 slices of bacon, 2 small links of sausage, or 1 hot dog.

Over an average of 19 years of follow-up, there were 6,963 new cardiovascular diagnoses or cardiovascular 'events' and 8,875 deaths from any cause. Adjusting for sociodemographic variables, smoking, alcohol, physical activity and overall dietary quality, consuming 2 servings of processed meat a week (vs none) was linked with 7% increased risk of cardiovascular disease (hazard ratio [HR] 1.07, 95% confidence interval [CI] 1.04 to 1.11). Two servings of red meat was linked with 3% increased risk (HR 1.03, 95% CI 1.01 to 1.06), and 2 servings of poultry with 4% increased risk (HR 1.04, 95% CI 1.01 to 1.06).

In absolute terms, the difference this made to an individual's baseline risk of developing cardiovascular disease over 30 years ranged from a 0.4% risk increase for red meat to a 1.7% risk increase for processed meat.

For all-cause mortality, 2 servings of processed meat (vs none) was linked with 3% relative risk increase (0.9% absolute difference over 30 years) and 2 servings of red meat also with 3% relative risk increase (0.76% absolute difference over 30 years). Poultry intake was not linked with all-cause mortality. Fish intake was linked with neither cardiovascular disease nor mortality.

The study authors suggest their findings 'have important public health implications and should warrant further investigation.'

Points of concern

- **The study cannot prove direct cause and effect.** The researchers have adjusted for various health and lifestyle factors that may be influencing the link. However, as with all observational research it is difficult to ensure that you have fully removed their effect and isolate the direct effect from a single dietary factor.
- **The risk increase is small.** The relative risk increases only just crossed the threshold of statistical significance, particularly for red meat and poultry. Accordingly the difference that this level of intake would make to an individual's baseline risk of cardiovascular disease was small – less than 2% over 30 years. The specific effect of meat may be small alongside other factors that may contribute to your overall cardiovascular risk such as age, genetics, obesity, smoking or alcohol.
- **Estimations of portion size may be inaccurate.** Food frequency questionnaires are a valid way of obtaining dietary information but can introduce inaccuracy, particularly when estimating portion sizes. For example, '2 small links of sausage' may mean different things to different people. Similarly this assessment doesn't account for the quality of meat: a portion of red meat could mean a lean cut or a fatty one, or poultry could mean plain meat or deep-fried.
- **Representation is uncertain.** The dietary assessments were taken only once at study recruitment, which in all of these 6 studies was between 20 and 30 years ago. One-off assessments may not reflect the consistent lifetime eating patterns of these participants, but neither may they be representative of dietary intakes today. Also being US-based we don't know whether the findings can be generalised to other countries.

Source(s)

<https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/2759737>
<https://www.dailymail.co.uk/health/article-7961205/Red-meat-DOES-raise-risk-heart->

[disease-study-finds.html](#)

<https://www.thesun.co.uk/news/10882869/eating-chicken-twice-week-increases-risk-heart-condition/>

Scientific facts:

- The European Society of Cardiology Joint Consensus Guidelines highlights the importance of a healthy diet for cardiovascular disease prevention. They recommend people should consume less than 5g of salt a day, that saturated fats should account for less than 10% of total energy intake while people should have preferably no intake of trans fatty acids from processed food. However, they recommend that people eat fish once to twice a week, one of which should be oily.
- The European Commission's science and knowledge service highlights the wide variation on food-based dietary guidelines across European countries. For example, Germany advises people eat 'no more than 300-600 g of prepared meat and (low-fat) cold cuts per week, with a portion size equivalent to 100-150 g meat, 15-25 g cold cuts'; Denmark recommends 'a maximum 500 g of cooked meat a week from beef, veal, lamb or pork, corresponding to 2-3 dinners per week + some cold cuts.'
- The World Health Organization (WHO) information is predominantly on the established cancer association. WHO advise that processed meat is classed as being carcinogenic to humans, putting it in the same classification Group 1 as tobacco and asbestos. Red meat is classed as Group 2, probably carcinogenic to humans. This classification followed a scientific evidence review by the International Agency for Research on Cancer (IARC) Monographs Programme. The strongest evidence was for an association with colorectal cancer for both red and processed meat, with possible links between red meat and pancreatic and prostate cancer, and processed meat and stomach cancer.

<https://cdn.ymaws.com/www.eas->

[society.org/resource/resmgr/publications/2016_European_Guidelines_CVD.pdf](https://cdn.ymaws.com/www.eas-society.org/resource/resmgr/publications/2016_European_Guidelines_CVD.pdf)

<https://ec.europa.eu/jrc/en/health-knowledge-gateway/promotion->

[prevention/nutrition/food-based-dietary-guidelines](https://ec.europa.eu/jrc/en/health-knowledge-gateway/promotion-prevention/nutrition/food-based-dietary-guidelines)

<https://www.who.int/features/qa/cancer-red-meat/en/>

04/10/2019

New guidance suggests that people 'continue current red and processed meat consumption'

(Headline week 2 part 2, MOOC 'The truth behind food headlines')

Summary

'Is red meat back on the menu? BBC News questioned, while the Mail Online reported that 'Scientists say official advice on eating less beef, pork and lamb is based on bad evidence.' Extensive media sources carried similar headlines on the 'controversial study' that suggests the people don't need to limit red and processed meat as per current recommendations.

The new guidance was produced by an international team of researchers making up the Nutritional Recommendations (NutriRECS) Consortium. The team conducted a series of systematic literature searches to identify clinical trials and observational studies that had assessed whether eating less red or processed meat had an effect on a set of health outcomes including all-cause death, cardiovascular disease and cancer. A reduction of 3 servings per week was considered to be a 'realistic' reduction for the public to make, so they looked for evidence in relation to this amount. They also identified surveys and interviews that had looked at people's preferences and willingness to change.

For red meat, the researchers identified 12 clinical trials (54,000 adults) which found that reducing intake had minimal effect on cardiovascular outcomes, diabetes or cancer. They identified 23 cohort studies which found that reducing red meat intake (by 3 servings a week) would give 'a very small' reduction in the risk of cardiovascular outcomes and diabetes – about 1-6 fewer events per 1000 people. 17 cohorts (2.2 million adults) suggested that reducing red meat consumption would give 'a very small' reduction in lifetime cancer deaths, about 7 fewer deaths per 1000 people.

For processed meat, no clinical trials met their inclusion criteria. 10 cohorts (778,000 adults) suggested that reducing processed meat intake (by 3 servings a week) gave 'a very small' reduction in risk of all-cause mortality, cardiovascular outcomes and diabetes, about 1-12 fewer events per 1000 people. 31 cohorts (3.5 million adults) found that reduced processed meat was linked with 'a very small' reduction in lifetime cancer deaths, prostate cancer deaths, and the development of colorectal, breast and oesophageal cancer – about 1-8 fewer events per 1000.

Meanwhile the researchers concluded from 54 survey and interview studies that people would be overall unwilling to change their meat consumption.

A guideline development panel of 14 people, including research and healthcare experts and members of the general public, reviewed the findings and voted on the final recommendations. The overall graded recommendation was identical for both red and processed meat: 'For adults 18 years of age or older, we suggest continuing current [unprocessed red meat and processed meat] consumption (weak recommendation, low-certainty evidence). Eleven of 14 panelists voted for continuation of current consumption, whereas 3 voted for a weak recommendation to reduce [unprocessed red meat and processed meat consumption].'

Points of concern

- **The evidence was all assessed to be low or very low certainty.** Most of this evidence was observational with highly variable study populations, design, method, risk of bias and findings. The pooled studies may give an unreliable estimate of the effect of red or processed meat consumption. The true effect may be very different these results. Considerable caution needs to be taken when drawing recommendations from such evidence, which is why the recommendation is only 'weak'.
- **The recommendation does not relate to a particular level of meat consumption.** The researchers have looked at evidence on the effect of reducing intake of red or processed meat by 3 servings per week. The resulting recommendation is to 'continue current consumption.' However, there is no baseline level of intake to compare this against. If it is assumed that people are, on average, consuming the recommended limit of 3 servings per week, then this

is no change from current recommendations. What the results do not mean is that there is now good evidence that it is safe to start increasing intake above existing guideline levels.

- **Even 'a very small' reduction in disease risk could make a big difference at the population level.** The researchers report that reducing red or processed meat intake gives only very small reductions in risk of heart attack, stroke, diabetes and cancer at up to 1 fewer event per 100 people. However, this not negligible when considering that these diseases are very common. Reducing consumption could make a large difference at the population level.

Source(s)

<https://annals.org/aim/fullarticle/2752328/unprocessed-red-meat-processed-meat-consumption-dietary-guideline-recommendations-from>

<https://www.bbc.co.uk/news/health-49877237>

<https://www.dailymail.co.uk/health/article-7520483/You-DONT-need-cut-red-meat-scientists-claim-huge-controversial-study.html>

<https://www.independent.co.uk/news/health/red-meat-cancer-processed-study-science-evidence-a9127166.html>

<https://www.mirror.co.uk/science/you-can-now-eat-steak-20358412>

<https://www.telegraph.co.uk/science/2019/09/30/weak-evidence-cancer-link-red-processed-meat-major-review-concludes/>

<https://www.theguardian.com/food/2019/sep/30/research-red-meat-poses-no-health-risk>

<https://www.thesun.co.uk/tvandshowbiz/10040395/anti-vegan-piers-morgan-rejoices-as-its-revealed-meat-doesnt-cause-cancer/>

<https://www.thetimes.co.uk/article/red-meat-may-not-be-so-bad-for-you-but-dont-pig-out-on-it-yet-6tzjdtnd>

Scientific facts

- The World Health Organization (WHO) advises that processed meat is classed as being carcinogenic to humans, putting it in the same classification Group 1 as tobacco and asbestos. Red meat is classed as Group 2, probably carcinogenic to humans. This classification followed a scientific evidence review by the International Agency for Research on Cancer (IARC) Monographs Programme. The strongest evidence was for an association with colorectal cancer for both red and processed meat, with possible links between red meat and pancreatic and prostate cancer, and processed meat and stomach cancer.
- The World Cancer Research Fund (WCRF) advises that red meat is a good source of protein, iron and other micronutrients. They do not suggest completely avoiding red meat, but advise to limit consumption to no more than 3 portions per week. This would be equivalent to about 350-500g cooked weight or 700-750g raw meat. They also recommend people opt for lean rather than fatty cuts where possible. Poultry, fish, eggs and dairy are suggested as valuable alternative sources of protein and macronutrients. WCRF advises that people consume very little, if any, processed meat.

<http://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Red-Meat-And-Processed-Meat-2018>

24/10/2018

Organic food consumption linked to lower risk of cancer

(Headline week 3, MOOC 'The truth behind food headlines')

Summary

Various media outlets have reported that people who eat organic food are 25% less likely to develop cancer, with even greater risk reductions for specific types of cancer like Non-Hodgkin's lymphoma (73% less likely).

This follows a large population-based study from France in which 68,946 volunteers completed online questionnaires. They were asked how frequently they ate 16 different organic products, from fruit and vegetables, dairy and eggs, meat and fish, grains and cereals, to ready-meals, wine, chocolate and coffee. Participants were followed for five years on average to see how many people developed cancer, as verified by medical records. There were 1,340 cases, affecting around 2% of people. When participants were divided into quartiles of organic food intake, those with the highest intake were found to have 24% lower risk of developing cancer compared to those with the lowest intake (adjusted hazard ratio 0.76, 95% confidence interval 0.64 to 0.90). Subanalysis according to type of cancer found significantly reduced risk for lymphomas and non-Hodgkin's lymphoma, specifically.

The cancer link is worthy of further investigation but this single study does not prove that eating organic will reduce your risk of cancer. There are numerous limitations, including potential for confounding and the small numbers in the analysis of specific cancers.

Source: Baudry et al. Association of Frequency of Organic Food Consumption with Cancer Risk. JAMA Internal Medicine. Published online October 22, 2018.

<https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2707948>

Points of concern

- **Study type:** cohort study
- **There may be confounding from other health and lifestyle factors.**
People who ate more organic food had higher educational level or occupational status, did more physical activity and had healthier diets in general. Though the researchers tried to adjust for factors like these that may be having an influence, there could still be residual confounding. It may not be organic food that's directly reducing the risk; it could be the effect of a healthier lifestyle in general.
- **Even if there is a direct link, other factors may still have a greater influence on an individual's cancer risk.**
Even some of those who ate the most organic food still developed cancer. In terms of absolute risk, the difference was small: 2.2% of those who ate the least organic food developed cancer compared with 1.6% of those who ate the most

organic. Even if eating organic offers some cancer protection, the effect could be very minimal compared with other well-established risk factors for cancer, for example hereditary factors, smoking or obesity.

- **Analyses of risk for individual cancers are based on small numbers.**
People with the highest intake of organic food were found to have reduced risk of lymphoma and non-Hodgkin's lymphoma (NHL) compared with those with the lowest intake, but these analyses were based on very small numbers. Only 5 people in the highest quartile of intake developed lymphoma (2 NHL) and 23 in the lowest quartile of intake developed lymphoma (15 NHL). Analyses based on such small numbers are more likely to find chance associations.
- **There is potential for inaccuracy around self-reported organic food intake.**
People self-reported how frequently they consumed the 16 different types of organic food, and they did this once only. There is potential for inaccuracy in estimated consumption frequency across individuals. It's also unclear whether this reflects lifetime patterns or more recent dietary habits.
- **Participants may not be representative of the general population.**
This was an online study about health and nutrition, which recruited people from France who had access to the internet. Participants of this study may not be representative of the general population of France or elsewhere.

Source(s)

http://www.el-nacional.com/noticias/salud/estudio-afirmo-que-riesgo-cancer-reduce-consumidores-bio_256734
<https://edition.cnn.com/2018/10/22/health/organic-food-cancer-study/index.html>
<https://www.20minutes.fr/sante/2359003-20181023-alimentation-bio-fait-baisser-25-risque-cancer-apres-etude>
https://www.lemonde.fr/planete/article/2018/10/22/l-alimentation-bio-reduit-significativement-les-risques-de-cancer_5372971_3244.html
<https://www.nrc.nl/nieuws/2018/10/22/kwart-minder-kanker-bij-bio-voeding-a2752288>
<https://www.thesun.co.uk/news/7559026/organic-food-25-per-cent-less-cancer/>
<https://www.thetimes.co.uk/article/people-who-eat-organic-25-per-cent-less-likely-to-get-cancer-gpdbl82sp>

Scientific facts

- The World Cancer Research Fund reports that "there is currently no strong evidence to support the idea that organic foods can help protect against cancer compared with produce that is grown conventionally." When it comes to cancer prevention they highlight the overall benefit of eating more fruit, vegetables, wholegrains and pulses, limiting consumption of red and processed meat and sugar-sweetened drinks, and avoiding high-calorie processed and fast foods.
- Cancer Research UK highlighted the findings of a 2014 study published in the British Journal of Cancer, which included around 600,000 participants of the Million Women Study. This cohort of women were questioned about their organic food consumption and then followed up for nine years. It found no association between organic food consumption and cancer overall, but similarly found a small

reduction of risk for non-Hodgkin's lymphoma. The current study under review also highlighted this research. This could be a chance finding, but as the association has been found in both studies, it is likely to be an area for further research.

- Cancer Research UK also notes that although high doses of pesticides can cause cancer in animals, the levels found in foods are tightly regulated to ensure that they are below this dose. They report that there is no evidence that eating the small amounts found on the surface of fruit and vegetables will increase cancer risk. Similarly they emphasise that there is no evidence that eating organic – which doesn't usually contain pesticides – will affect cancer risk.

[https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/diet-and-cancer/food-controversies?_ga=2.123297795.944461153.1540302995-](https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/diet-and-cancer/food-controversies?_ga=2.123297795.944461153.1540302995-1883913842.1537530684#food_controversies4)

[1883913842.1537530684#food_controversies4](https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/diet-and-cancer/food-controversies?_ga=2.123297795.944461153.1540302995-1883913842.1537530684#food_controversies4)

[https://www.cancerresearchuk.org/about-us/cancer-news/press-release/2014-03-28-organic-food-doesnt-lower-overall-cancer-](https://www.cancerresearchuk.org/about-us/cancer-news/press-release/2014-03-28-organic-food-doesnt-lower-overall-cancer-risk?_ga=2.64618535.944461153.1540302995-1883913842.1537530684)

[risk?_ga=2.64618535.944461153.1540302995-1883913842.1537530684](https://www.cancerresearchuk.org/about-us/cancer-news/press-release/2014-03-28-organic-food-doesnt-lower-overall-cancer-risk?_ga=2.64618535.944461153.1540302995-1883913842.1537530684)

<https://www.wcrf-uk.org/uk/preventing-cancer/cancer-prevention-recommendations>

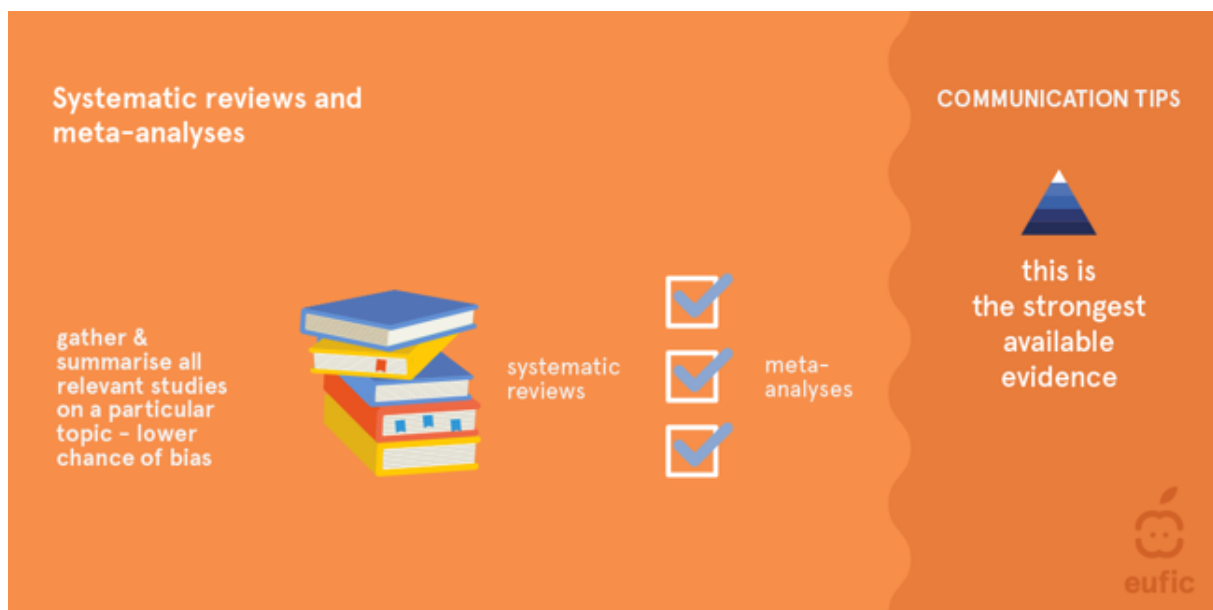
<https://www.wcrf-uk.org/uk/recipes/diet-cancer-myths-debunked>

Appendix 4: Articles produced by EUFIC for 'MOOC – Food and nutrition: The truth behind food headlines'

Week 1.11: An overview of different types of studies

As the examples we've looked at so far show, some of the confusion around what studies prove is down to a lack of understanding of the strength of evidence they convey. The strength of scientific evidence produced by different types of studies such as systematic reviews, meta-analyses, randomised controlled trials, observational research, animal studies, cell studies and expert opinions, can vary. All of them have their advantages and limitations.

Systematic reviews and meta-analysis



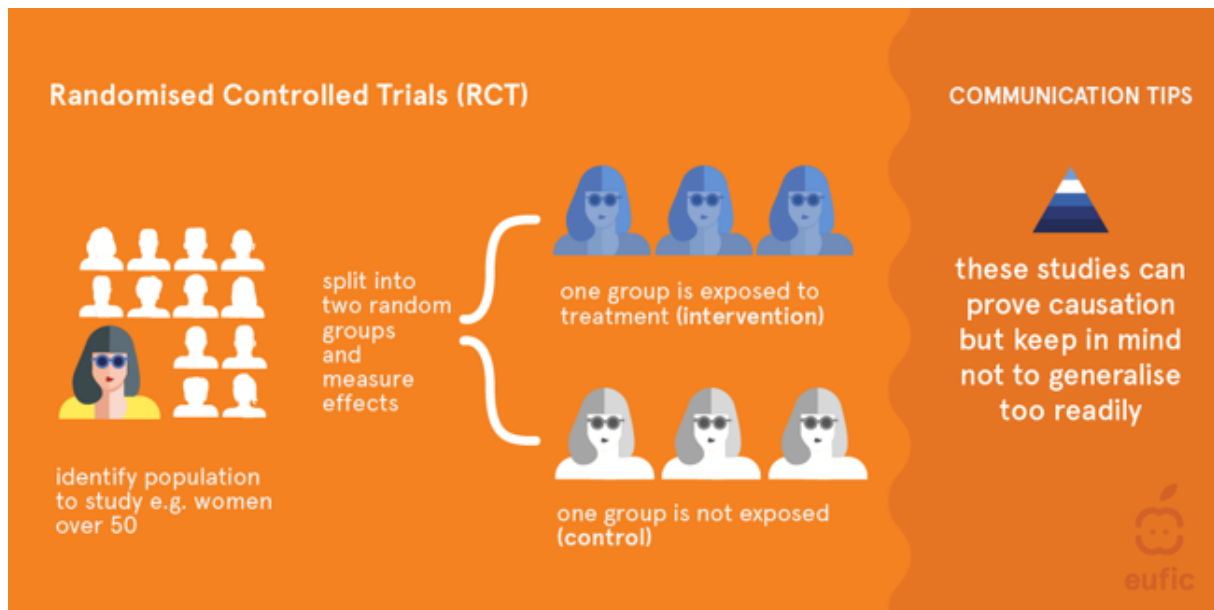
A meta-analysis is a method of combining results from separate studies to get broader overall conclusions about a hypothesis. Meta-analyses are a useful way to reconcile differences of statistical power or sample size between studies, or to aggregate relevant findings across studies.

The procedure is most appropriate when examining studies that look at the same question and use similar methods to measure relevant variables. For example, scientists used a meta-analysis of observational studies to examine the relationship between the consumption of red meat and the risk of bowel cancer. Although individual studies showed different results, pooling the data from 16 similar studies showed significant decreases in the risk of oral cancer with increased intakes of fruits and vegetables.

However, as with every study technique, the meta-analysis is not without its limitations. Data from flawed studies may be included, or the analysis may include data from studies that use different methods to measure variables resulting in a situation where direct comparisons are impossible (you're 'comparing apples with oranges').

Systematic reviews gather together all the studies on a particular subject and present them in one paper, highlighting their strengths and weaknesses as well as any contradictory findings. The aim of a systematic review is not to come to a conclusion but to summarise the evidence to date. On the other hand, a meta-analysis aims to come to a conclusion based on the findings of a wide range of studies.

Randomised controlled trials



Randomised controlled trials (RCTs) can help prove causation. A selected group of people (a population sample) is split into two groups; one intervention group and one control group. The aim is to have different variables, such as gender, age, or lifestyle, equally distributed among the two groups. The intervention group is then given a selected treatment, while the control group does not get any treatment, or they get a placebo/fake treatment. If done correctly, observed differences between these two groups can then be attributed to the treatment investigated.

Uncertainty arises if the controlled trial becomes 'uncontrolled', either because of uneven splitting of groups, or because the people in the groups know which treatment they are getting as this can sometimes be hard to hide.

Observational research



These types of studies identify correlations (links) and develop hypotheses that can be further investigated. In these studies, researchers observe what happens without

intervening. For example, they can observe whether there might be any link between eating eggs and cholesterol levels in a group of people. However, it's important to keep in mind that correlation does not prove causation as other factors might be affecting the outcome.

There are various types of observational study:

Cohort studies: the researchers follow a group of people who often share similar characteristics over a period of time (usually many years), to see if an outcome develops.

Case-control studies: these help determine whether an exposure leads to an outcome, for example a disease. These studies are retrospective as they look at an outcome first and try to trace back to identify the exposure.

Case series: these studies follow people with a known exposure or receiving the same treatment and examine their outcome.

Animal and cell studies

The infographic is set against an orange background. On the left, under the heading "Animal & cell studies", there are two text blocks: "effects in humans and animals are not always the same" and "isolated cells in the laboratory behave differently than cells in the body". To the right of these text blocks are illustrations of three mice and a test tube. In the center is a large illustration of a microscope. On the right side, under the heading "COMMUNICATION TIPS", there is a triangle icon and the text "always keep in mind the limitations of cell and animal research". At the bottom right corner is the "eufic" logo, which consists of a stylized apple icon and the text "eufic".

These studies are similar to the RCTs, but done on animals or on cells in a lab rather than in people. As animals and cells are different from whole human bodies, these types of studies are not considered as strong evidence but they provide indications that can help design further studies.

Expert opinions and anecdotes

Expert opinions & anecdotes

a single person's experience or opinion does not provide an objective picture

anecdotes



COMMUNICATION TIPS



this evidence is too weak to draw conclusions



Personal experiences and statements from experts are rated quite low on the evidence scale in scientific studies. Such statements are not objective. We are all very different, and what worked for one individual will not necessarily work for everyone.

Science is evolutionary, not revolutionary

We've looked at the strengths and limitations of different study designs but it's also important to understand how to interpret the results they produce. The scientific process - how studies are designed, conducted, and reported - frequently generates a great deal of public debate. Tracking the debate is often key to putting new research into context. With that in mind, new research studies published in scientific journals should be viewed as discussions among scientists. In these discussions, almost no one gets to have the final word, as it is rare that a study provides a final, complete answer.

The bottom line is that dialogue characterised by cycles of revision, conjecture, assertion, and contradiction are key to investigating a subject. Although such cycles often frustrate non-scientists and contribute to increasing public scepticism about advice on food and health, it is important to understand that science is evolutionary, not revolutionary. Because scientific research explores the unknown, uncertainty is an unavoidable part of investigations. Only through repeated research and analyses can certainties emerge.

Week 1.12: The science behind Headline A



Now that we've looked at the ways study design affects how to interpret results and considered some examples of cases where results have been inaccurately reported by the media, let's look back at Headline A (Step 1.7), analyse the original science and draw some of our own conclusions.

Eating ultra-processed foods like cakes and sausages can give you cancer

Metro News. Thursday 15 Feb 2018

The context

This headline follows results from a large French cohort study of 104,980 adults which looked at diet and risk of cancer '*Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé prospective cohort. BMJ 2018;360:k322*'. Starting in 2009, with data analysed up to January 2017, people filled in online 24-hour dietary questionnaires every six months. The participants also provided background data about their sex, age, health, smoking status, BMI (Body Mass Index), family history of cancer, socioeconomic status and level of physical activity. Health status was updated annually.

The researchers split the food and drinks into four categories according to the level of processing using the NOVA classification system. The highest level, 'ultra-processed'

items include mass-produced breads and cakes, snacks and sweets, fizzy drinks, ready meals and reconstituted meat products.

The Educator team have provided their analysis below. If you would like to read the study for yourself, you can find a link to the study in the 'See also' section at the end of the article.

The analysis

The observational nature of the study means we cannot prove cause and effect. The number and variety of foods considered 'ultra-processed' means it is hard to pin down which element or elements could be responsible for the increased cancer risk. It could be anything from sugar, additives or packaging. It is also possible that higher ultra-processed food consumption is actually indicative of other unhealthy lifestyle choices which were not adequately taken into account over time.

The participants may not be representative of the general population. The average age was 43 at the start of the study, and 78% of participants were women. The low number of male and older participants may have contributed to why the risk of prostate or colorectal cancer was not increased. This cohort had an annual incidence of 786 cancers per 100,000 person-years which is below the French national average of 972. A variety of factors could account for this difference, including selection bias - a younger cohort who are more likely to engage with online studies and people who may be more health conscious.

Food frequency and health status questionnaires can be inaccurate due to recall bias and under or over estimates of consumption. Yearly self-assessment of body mass index, physical exercise and alcohol consumption may not be truly reflective. Lifestyle and diet fluctuate. Though researchers aimed for people to fill in food diaries on different days of the week or weekends over the course of the study period, these were still just 24-hour snapshots.

Only some cancer risk factors were taken into account. The study showed that for every 10% increase in the proportion of ultra-processed foods in the diet, the risk of any cancer increased by 12%. The risk of breast cancer was also increased by 11%, likely due to post-menopausal cancer. There was no increase in risk of colorectal or prostate cancer.

'Processed foods' such as canned vegetables with added salt or sugar, meat preserved by salting, cheeses and freshly-made, unpackaged bread and the next level down, 'processed culinary ingredients' were not associated with risk of cancer. 'Minimally or unprocessed foods' were associated with a lower risk of cancer. For every 10% increase in dietary proportion, there was a 9% reduction in overall cancer risk.

We do not have a breakdown of the number of other types of cancer. We also do not know whether unrecorded risk factors had a role such as sun exposure, environmental carcinogens, radiation and infections including human papilloma virus, hepatitis B and C and Epstein Barr virus.

Most media reports highlighted the point that we don't know the cause of this increased risk with ultra-processed food, including expert comments about the likely role of confounding factors such as lifestyle. However, the suggestion from The Times that it is because of the foods combining together is pure speculation. Also, only figures from the

highest quartile ultra-processed food consumption group were shown in order to give the most dramatic results.

In the next Step, it's your turn to explore a scientific study.

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Week 2.9-11: How to read scientific papers

Abstract and introduction

To enhance communication among scientists and to make the replication of a study easier, published research generally follows an established format: abstract, introduction, methodology, results, discussion and references (although exactly where information appears in different articles can vary).

At the end of this week, you'll have the chance to read a whole scientific paper and use the skills you've acquired to analyse the main results and conclusion of the study. Before you do this, it's important to understand the different sections of a scientific paper.

Over the next three Steps, you'll look at each section in turn, describe what it is and what it's for, and highlight important information to look for and questions to ask yourself or to pose to experts.

Let's start with the abstract and the introduction.

Abstract

The abstract serves to describe briefly what was studied, how it was done, and the results. It allows readers to make a judgement about whether a study is of interest, without having to read the complete paper. If only we could just skim the abstract and consider our review of the study complete! Unfortunately, that is not the case. Abstracts don't provide sufficient detail to enable readers to assess the validity of a study, or put it into context. Only reading the rest of the paper can do these.

Introduction

The introduction sets the scene. It eases the reader into the research by presenting the issue that the researcher seeks to answer or the problem/hypothesis that the study addresses. It explains *why* the study was conducted which gives the reader an indication of its potential importance. It also expands on *how* the research was conducted.

In some instances you may find that the study doesn't seem to be appropriately designed or conducted to achieve its purpose. For example, the type of study (see [Step 1.11](#)) might not provide the information needed to answer the question the researcher set out to answer, or the population surveyed may not fit the purpose.

Sources of potential bias

NOT TRUE →

-
-
-

Self-reported data, for instance, through the use of food frequency questionnaires, can introduce response bias. People tend to over/under-report, or simply forget.

Read the 'conflicts of interest' section towards the end of the paper to judge if there was any potential bias.

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Here are some key questions to bear in mind when reading an introduction:

What are the limitations of this type of study?

Does the research design fit the stated purpose of the study?

Has the author left anything out of the introduction that could affect the study design or interpretation of the results?

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Methodology and results

Methodology

The key question the methodology addresses is 'How?' This section should enable critical readers to determine whether the research is valid: was the study adequately designed to achieve its purpose? It explains the detail of *how* the research was conducted and to whom or what the study results apply.

The methodology section also provides information about the sampling method and whether subjects were randomly assigned or not (in experimental studies). Pay specific attention to these points, because flaws that occur here can render the results invalid.

Sample

1 HOW LARGE WAS THE STUDY?
The more people involved in a study, the more reliable and representative the results will be of the population.

2 IS THE STUDY POPULATION GENERALISABLE?
If a study was only carried out on a specific group of people (for example, middle-aged women suffering from diabetes), the study may not be applicable to the wider population.

3 HOW WERE STUDY PARTICIPANTS CHOSEN?
Random sampling avoids bias. With this method everyone in a population has an equal chance of being chosen, this ensures a generalisable set of results.

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The infographic features a grid of 12 white human icons on a blue background. One icon in the bottom-left corner is highlighted with a yellow circle and a white border, representing a sample. To the right, three numbered circles (1, 2, 3) are connected by a vertical line, each corresponding to a key question about study methodology.

Methodological limitations

There are all kinds of limitations that make scientific research challenging. External limitations include access to finances and the regulations around ethics of human testing. Internal limitations include gaps in or limits to the current state of knowledge (particularly as it relates to data collection). Any limitations and constraints that affect the results should be discussed in the methodology or discussion sections of the study.

Here are some key questions to bear in mind when reading the methodology:

- Are there any major design flaws in this study?
- Are the data collection measures appropriate to answer the study questions?
- Were methodological limitations acknowledged and discussed?
- What influence might these limitations have had on the results?

Duration



HOW LONG DID THE STUDY LAST?

Short-term studies may not be representative of the long-term effects of dietary patterns and changes. Longer studies will provide more realistic data.

Potential confounding



DID THE STUDY ADJUST FOR POTENTIAL CONFOUNDING EFFECTS?

The result of the study may be affected by hidden factors that researchers did not anticipate. Therefore, the effect of the study may be attributed to the wrong factors/causes.



Results

Few people would deny that reading the first three sections of a scientific study can be difficult and require focus. But then we finally get to the really interesting stuff: the answers. The results section provides the answers in the form of data and statistical analysis. Statistical measures can clearly and accurately describe the existence and strength of relationships observed in the study.

It is easy to get wrapped up in discussions of statistical significance when reading research, but it is important to remember that a statistically significant result does not necessarily mean that the outcomes are important or relevant to the public. And it doesn't guarantee that the research is without bias or confounding factors that could make the statistical value irrelevant.

If the results are not statistically significant, the author may discuss the statistical power of the study. An in-depth discussion of statistical power is complex but such information does help the reader understand whether the study had a chance of finding the answer to the research questions in the first place.

Statistical significance is only part of the picture; to get the whole picture, the reader must consider the context of the study. Some key questions to bear in mind when reading the results are:

- What is the real as well as statistical significance of these results?
- To whom do these results apply?

Discussions and references

Discussion

The discussion section gives the reader some insight into the subject area of the study and can shed new light on the results and their meaning. Alternative explanations for the results and their implications may also be presented.

One of the most frequent errors in scientific research is drawing conclusions that are not adequately supported by the data. This may occur for a number of reasons: collection of insufficient or inadequate data, over-generalisation, methodological problems, or inherent limitations in the study design. This is why it's so important to review the methodology section carefully.

Finally, be wary of absolute conclusions that claim to be the final word on a subject. Good research answers some questions and raises others. A call for more research to investigate particular issues that remain unclear or to replicate the study findings is a frequent conclusion in journal articles.

Here are some key questions to bear in mind when reading the discussion:

- Are the conclusions supported by the data?
- Are the conclusions related to the stated purpose of the study? If not, do the study design and results support the secondary conclusions?
- How do these results compare with those of other studies on the subject?

References

Experts in the subject area assess reference lists to find out if any key studies have been omitted. If this is the case, the researchers may have failed to evaluate prior research in the field that could have benefited their current study. A reference list that includes older as well as more recent papers can reassure the reader that the author has reviewed the entire body of research and has not just considered the last few or first few studies conducted on the topic.

Now you know how to read a scientific paper so whenever you see a newspaper headline that interests you, check to see if there's a link to the original study. Then you can work out for yourself whether or not the headline reflects the science.

You'll have the opportunity to do this in the next Step.

Appendix 5: Twitter data obtained from Meltwater.

Hit Sentence	Country	Reach	Sentiment (by Meltwater)	Sentiment (manual check)
Diet and cardiovascular disease have long been linked. A study was conducted to see how processed meat, unprocessed red meat, poultry, and fish impact risk of CVD. #JAMA #CUinTheLab https://t.co/woW4u7YVGu	Unknown	1	Negative	Positive
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/zrF1v3ICVH	Italy	272	Negative	Neutral
赤い肉は死亡リスクを高めるのソースはこちら。 Study: Red meat, processed meat hike heart disease risk Cornell Chronicle https://t.co/XiQU5M9Zn4	Burkina Faso	3129	Neutral	Neutral
RT @thescpn: Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/amejH8NJbU https://t.co/ASXKrZrZRf	France	2312	Negative	Neutral
Study: Red meat, processed meat hike heart disease risk Cornell Chronicle https://t.co/3aQ4U4aYs6 - Good stuff!	United States	56	Positive	Neutral
RT @thescpn: Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/amejH8NJbU https://t.co/ASXKrZrZRf	Cameroon	74	Negative	Neutral

<p>Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network</p> <p>https://t.co/amejH8NJbU https://t.co/ASXKrZrZRf</p>	United Kingdom	5344	Negative	Neutral
<p>Worst case scenario is to have a long life, but a slow death. Cutting meat is a simple step to avoid this. Study: Red meat, processed meat hike heart disease risk Cornell Chronicle</p> <p>https://t.co/jXLyqs5Uer via @AddThis</p>	United States	160	Negative	Positive?
<p>Cornell University and Northwestern Medicine conducted a study and found that frequent consumption of red and processed meat leads to increased risk of cardiovascular disease and even death.</p> <p>#publichealthvt</p> <p>https://t.co/hSt8nPsXml</p>	Unknown	1	Neutral	Neutral
<p>Cornell University and Northwestern Medicine conducted a study and found that frequent consumption of red and processed meat leads to increased risk of cardiovascular disease and even death.</p> <p>https://t.co/hSt8nPKyKV</p>	Unknown	1	Neutral	Neutral
<p>Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network</p> <p>https://t.co/WoAWfoGhuo</p>	Austria	475	Negative	Neutral
<p>The latest on the back-and-forth scientific dispute about the health risks posed by a meat-heavy diet. A study in JAMA Internal Medicine journal says those eating red meat, processed meat and poultry</p>	United States	129	Neutral	Neutral

have a slightly higher risk of cardiovascular disease. https://t.co/KA2ZgrhviE				
RT @DrDave01: Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine □@MikeAlbertMD□ https://t.co/b2nNczBmjQ	United States	2684	Negative	Neutral
RT @Cornell: Unprocessed red meat and processed meat consumption leads to a slightly higher risk of heart disease, according to a new study from researchers at @CornellCHE. https://t.co/Uc2sIPiBmk	Unknown	199	Neutral	Neutral
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality JAMA https://t.co/eNv9NPHROi	Canada	222	Negative	Neutral
More #fish less #meat may reduce #heart disease Associations of Processed #Meat, Unprocessed #Red Meat, #Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/HBDJnixGGS	Netherlands	170	Neutral	Positive
RT @ihblythe: Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network #meatkills #meatismurder #govegan https://t.co/M0ulwIbwXG	Unknown	66	Negative	Neutral
RT @ihblythe: Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality	Unknown	4180	Negative	Neutral

Cardiology JAMA Internal Medicine JAMA Network #meatkills #meatismurder #govegan https://t.co/M0ulwIbwXG				
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine □@MikeAlbertMD□ https://t.co/b2nNczBmjQ	United States	14925	Negative	Neutral
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network #meatkills #meatismurder #govegan https://t.co/M0ulwIbwXG	Unknown	480	Negative	Neutral
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/On1YnSoMGr	United States	11	Negative	Neutral
@theveganparent @monorchus @Robrt_M_Goldste @CNN The article that was released February 3rd, 2020 in JAMA is entitled Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality by Victor W. Zhong PhD, Linda Van Horn PhD, Philip Greenland MD et al.	United States	77	Neutral	Neutral
Study: Red meat, processed meat hike heart disease risk Cornell Chronicle https://t.co/o4LNaItxuL via @AddThis	Unknown	1974	Neutral	Neutral
"A large, carefully analyzed new study [from @NorthwesternMed	United States	2173	Neutral	Positive

and Cornell University] links red and processed meat consumption with slightly higher risk of heart disease and death." https://t.co/bB9mdLFCMT				
Study: Red meat, processed meat hike heart disease risk Cornell Chronicle https://t.co/IOZYj22maF via @AddThis	Peru	702	Neutral	Neutral
QT @Cornell: @Cornell Posted... https://t.co/qN4EyBmBIS ; Unprocessed red meat and processed meat consumption leads to a slightly higher risk of heart disease, according to a new study from researchers at @CornellCHE. https://t.co/Uc2sIPiBmk	United States	3	Positive	Neutral
RT @Cornell: Unprocessed red meat and processed meat consumption leads to a slightly higher risk of heart disease, according to a new study from researchers at @CornellCHE. https://t.co/Uc2sIPiBmk	United States	239	Neutral	Neutral
RT @Cornell: Unprocessed red meat and processed meat consumption leads to a slightly higher risk of heart disease, according to a new study from researchers at @CornellCHE. https://t.co/Uc2sIPiBmk	Unknown	24	Neutral	Neutral
RT @EcoInternetDrGB: Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality: JAMA Network https://t.co/xQLQzExNIw MORE w/ EcoSearch - news: https://t.co/LBwRYMyyWH web: https://t.co/IYOlgZIngs	Australia	3970	Negative	Neutral
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality: JAMA Network https://t.co/xQLQzExNIw MORE	United States	34282	Negative	Neutral

w/ EcoSearch - news: https://t.co/LBwRYMywH web: https://t.co/IYOlgZlngs				
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/RO5cdNWEvx	Unknown	153	Negative	Neutral
@VeganRecovering The new analysis, published Monday in the journal JAMA Internal Medicine, found a 3% to 7% 🤔 higher risk of cardiovascular disease and premature death for people who ate two servings of red meat and processed meat each week.///// Haha 3-7% rounds off to zero. 🤔	Unknown	223	Neutral	Negative
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/cyPxmBIbRf	Unknown	18	Negative	Neutral
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine Please Forward to Annals of Internal Medicine 🤔 https://t.co/VO5UOkIbaq	United States	145	Negative	Positive
Processed meat, red meat, and poultry increase your risk for cardiovascular disease, according to a study published in JAMA Internal Medicine.	United States	80	Negative	Neutral
Eating red meat and processed meat hikes heart disease and death risk, study finds Northwestern University https://t.co/6qy3uG3llx	Unknown	997	Neutral	Neutral

RT @IvorGoodbody: In this cohort study of 29682 US adults, intake of processed meat, unprocessed red #meat, or poultry was significantly associated with incident cardiovascular disease, but fish intake was not. All meat, but not poultry or #fish, also associated with all-cause mortality. [JAMA] https://t.co/0acHNTDKuH	United States	287	Negative	Neutral
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/RLuOs7wEAv	United States	134	Negative	Neutral
In this cohort study of 29682 US adults, intake of processed meat, unprocessed red #meat, or poultry was significantly associated with incident cardiovascular disease, but fish intake was not. All meat, but not poultry or #fish, also associated with all-cause mortality. [JAMA] https://t.co/0acHNTDKuH	Unknown	2526	Negative	Neutral
Red and processed meat linked to higher mortality risk, study finds: Consumption of red and processed meat has been linked with slightly higher risk of heart disease and death, a major new study has found. The findings from Northwestern Medicine and... https://t.co/jD2uc6kf36 https://t.co/7LzXj2QzbK	Unknown	3081	Neutral	Neutral
Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality Cardiology JAMA Internal Medicine JAMA Network https://t.co/kaKFWdDKvF	Canada	1203	Negative	Neutral
RT @protoninfo: Food for thought Two weekly servings of	Unknown	478	Neutral	Positive

processed meat or unprocessed red meat tied to small increase in mortality, cardiovascular disease risk, research suggests in JAMA https://t.co/tHWEvBbJHg				
RT @protoninfo: Food for thought Two weekly servings of processed meat or unprocessed red meat tied to small increase in mortality, cardiovascular disease risk, research suggests in JAMA https://t.co/tHWEvBbJHg	United States	611	Neutral	Positive
Food for thought Two weekly servings of processed meat or unprocessed red meat tied to small increase in mortality, cardiovascular disease risk, research suggests in JAMA https://t.co/tHWEvBbJHg	United States	58250	Neutral	Positive
QT @chicagotribune: RT @_randuhl: This really wasn't discovered recently. Why do we continually recycle this red meat linked to heart disease headline as if it... ; Researchers at Northwestern say you might want to reconsider that weeknight burger. Their new study found that eating just two servings weekly of red and processed meat is linked to a higher likelihood of heart disease and death. https://t.co/uxjyQkcREa	United States	1349	Negative	Positive
RT @chicagotribune: Researchers at Northwestern say you might want to reconsider that weeknight burger. Their new study found that eating just two servings weekly of red and processed meat is linked to a higher likelihood of heart disease and death. https://t.co/uxjyQkcREa	France	486	Neutral	Positive
RT @chicagotribune: New research from Northwestern found that eating just 2 servings	Italy	141	Neutral	Neutral

a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg				
QT @chicagotribune: RT @RennyRenfro: Looks like heart disease is gonna be how I go out ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	763	Negative	Positive
29 682 People in 6 studies: un/processed /red meat,poultry: significantly linked with incident CVD-fish intake not. Associations of Processed Meat,Unprocessed Red Meat, Poultry or Fish Intake With Cardiovascular Disease & All-Cause Mortality/ JAMA Network https://t.co/NgkFAU95dl	United States	197	Negative	Neutral
QT @chicagotribune: This really wasn't discovered recently. Why do we continually recycle this red meat linked to heart disease headline as if it's not ancient? That's why I'm vegan. ; Researchers at Northwestern say you might want to reconsider that weeknight burger. Their new study found that eating just two servings weekly of red and processed meat is linked to a higher likelihood of heart disease and death. https://t.co/uxjyQkcREa	United States	1212	Negative	Positive
RT @chicagotribune: Researchers at Northwestern say you might want to reconsider that weeknight burger. Their new study found that eating just two servings weekly of red and processed meat is linked to a higher likelihood of heart disease and death. https://t.co/uxjyQkcREa	United States	41	Neutral	Neutral

RT @chicagotribune: Researchers at Northwestern say you might want to reconsider that weeknight burger. Their new study found that eating just two servings weekly of red and processed meat is linked to a higher likelihood of heart disease and death. https://t.co/uxjyQkcREa	Unknown	695	Neutral	Neutral
RT @DrAyala: JAMA Study: People eating 2 servings of processed meat/week had 7% higher risk of heart disease than those who ate none. People eating 2 weekly servings of red meat had a 3% higher risk of heart disease. https://t.co/DbIKP9VrkL #meat #veganism	United States	3994	Neutral	Neutral
RT @chicagotribune: Researchers at Northwestern say you might want to reconsider that weeknight burger. Their new study found that eating just two servings weekly of red and processed meat is linked to a higher likelihood of heart disease and death. https://t.co/uxjyQkcREa	United States	724	Neutral	Neutral
Researchers at Northwestern say you might want to reconsider that weeknight burger. Their new study found that eating just two servings weekly of red and processed meat is linked to a higher likelihood of heart disease and death. https://t.co/uxjyQkcREa	United States	1101864	Neutral	Neutral
QT @chicagotribune: I call this a win-win situation. ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	2983	Neutral	Positive
JAMA Study: People eating 2 servings of processed	United States	8326	Neutral	Neutral

meat/week had 7% higher risk of heart disease than those who ate none. People eating 2 weekly servings of red meat had a 3% higher risk of heart disease. https://t.co/DbIKP9VrkL #meat #veganism				
RT @chicagotribune: New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	46	Neutral	Neutral
RT @chicagotribune: New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	11690	Neutral	Neutral
QT @chicagotribune: #staywoke ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	Unknown	15	Neutral	Neutral
QT @chicagotribune: Looks like I'm dying early, muchachos ! ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	Unknown	508	Negative	Positive
RT @chicagotribune: New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	25	Neutral	Neutral
QT @chicagotribune: shoutout to every time I argued veganism is imperative to stopping climate change my extremely conservative college prof told me	United States	19	Neutral	Positive

he was open to meat as a topping like that idea came from the 4th dimension ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg				
RT @chicagotribune: New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	174	Neutral	neutral
RT @chicagotribune: New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	7746	Neutral	Neutral
QT @chicagotribune: Eesh. Glad I eat fewer than two servings of red meat most weeks... ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	1060	Positive	Positive
QT @chicagotribune: Looks like heart disease is gonna be how I go out ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	Unknown	522	Negative	Positive
New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/URF85cw7kp	Unknown	2064	Neutral	Neutral
QT @chicagotribune: Damn, we're f-ed :/ ; New research	United States	32	Negative	Positive

from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg				
RT @chicagotribune: New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	Unknown	96	Neutral	Neutral
QT @chicagotribune: Can't this bullshit wait until AFTER the coronavirus hysteria has settled down? JFC ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	Unknown	37	Negative	Negative
RT @chicagotribune: New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	Spain	72	Neutral	Neutral
QT @chicagotribune: https://t.co/e10FAghax8 ; New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	Bangladesh	11	Neutral	Neutral
New research from Northwestern found that eating just 2 servings a week of red and processed meat is linked to a higher likelihood of heart disease and death https://t.co/2DyDKKeCTg	United States	1101888	Neutral	Neutral
A new large study from Northwestern University, US, suggests that red and processed meat connected to a higher risk of heart disease and all causes	Finland	4327	Neutral	Neutral

death https://t.co/YWbUB8YYOc https://t.co/Ixj7TQHS7v				
Sorry, meat lovers: New Northwestern research confirms health risks, clashes with last year's optimistic study Eating red and processed meat is linked to higher rates of heart disease and death, says a large new study — a finding that would be me... https://t.co/OeJWIRZzbA #USRC https://t.co/v7nnmkFVFG	United States	83869	Neutral	Positive
Red meat DOES raise your risk of heart disease, study finds: The study by Northwestern University in Chicago found that red meat and processed meat raised the risk of dying prematurely of any cause by three per cent, but poultry and fish did not. https://t.co/ybmJULatNV https://t.co/xxeCL5xyxs	United Kingdom	249	Negative	Positive

Hit Sentence	Country	Reach	Sentiment (by Meltwater)	Sentiment (manually checked)
QT @fleroy1974: The gist of this article is that it's okay to eat red meat. There is no evidence that it is linked to heart disease, hypertension, diabetes, cancer etc. eat on..... https://t.co/5ECn3IN2hO ; John Ioannidis: "This debate offers a nice example of the difference between what we want to believe and what we can really know" (with some input from myself, in support of NutriRECS) https://t.co/2Zbn3CrGpR via @TheWireScience	India	2866	Neutral	Positive
2/2 in combination with our other recommendations, is best for cancer prevention. We believe this NutriRECS publication has the potential to harm public health efforts by confusing the public and downplaying the clear risks that eating too much red and processed meat pose.	Unknown	186	Negative	Negative
RT @MsKymLang: Authority on cancer prevention research @WCRF_UK reiterates that red and processed meat still increase bowel cancer risk, despite the recent NutriRECS study. So stick to max 3 x red meat a week and avoid processed meat and find out more at @bowelcanceruk #bowelcancer	Unknown	1083	Neutral	Negative
RT @MsKymLang: Authority on cancer prevention research @WCRF_UK reiterates that red and processed meat still increase bowel cancer risk, despite the recent NutriRECS study. So stick to max 3 x red meat a week and avoid processed meat and find out more at @bowelcanceruk #bowelcancer	France	106	Neutral	Negative
RT @MsKymLang: Authority on cancer prevention research @WCRF_UK reiterates that red and processed meat still increase bowel cancer risk, despite the recent NutriRECS study. So stick to max 3 x red meat a week and avoid processed meat and find out more at @bowelcanceruk #bowelcancer	Unknown	1947	Neutral	Negative
Authority on cancer prevention research @WCRF_UK reiterates that red and processed meat still increase bowel cancer risk, despite the recent NutriRECS study. So stick to max 3 x	Australia	332	Neutral	Negative

red meat a week and avoid processed meat and find out more at @bowelcanceruk #bowelcancer				
RT @KUSINews: An international group called Nutrirecs published research that says there's no proof that eating excess amounts of red meat causes cancer, diabetes or heart disease. Cardiologist Dr. Kiyon Chung at Scripps Mercy Hospital was at KUSI to discuss. https://t.co/9zrWGHC0eQ	United States	54	Neutral	Neutral
RT @KUSINews: An international group called Nutrirecs published research that says there's no proof that eating excess amounts of red meat causes cancer, diabetes or heart disease. Cardiologist Dr. Kiyon Chung at Scripps Mercy Hospital was at KUSI to discuss. https://t.co/9zrWGHC0eQ	Unknown	79	Neutral	Neutral
RT @KUSINews: An international group called Nutrirecs published research that says there's no proof that eating excess amounts of red meat causes cancer, diabetes or heart disease. Cardiologist Dr. Kiyon Chung at Scripps Mercy Hospital was at KUSI to discuss. https://t.co/9zrWGHC0eQ	United States	2049	Neutral	Neutral
RT @KUSINews: An international group called Nutrirecs published research that says there's no proof that eating excess amounts of red meat causes cancer, diabetes or heart disease. Cardiologist Dr. Kiyon Chung at Scripps Mercy Hospital was at KUSI to discuss. https://t.co/9zrWGHC0eQ	Unknown	416	Neutral	Neutral
RT @KUSINews: An international group called Nutrirecs published research that says there's no proof that eating excess amounts of red meat causes cancer, diabetes or heart disease. Cardiologist Dr. Kiyon Chung at Scripps Mercy Hospital was at KUSI to discuss. https://t.co/9zrWGHC0eQ	United States	1145	Neutral	Neutral
RT @KUSINews: An international group called Nutrirecs published research that says there's no proof that eating excess amounts of red meat causes cancer, diabetes or heart disease. Cardiologist Dr. Kiyon Chung at Scripps Mercy Hospital was at KUSI to discuss. https://t.co/9zrWGHC0eQ	United States	1439	Neutral	Neutral
An international group called Nutrirecs published research that says there's no	United States	69348	Neutral	Neutral

proof that eating excess amounts of red meat causes cancer, diabetes or heart disease. Cardiologist Dr. Kiyon Chung at Scripps Mercy Hospital was at KUSI to discuss. https://t.co/9zrWGHC0eQ				
NutriRECS's own data show that a moderate reduction in red and processed meat consumption within a healthy eating pattern can reduce total mortality by 13%, heart disease mortality by 14%, cancer mortality by 11% and type 2 diabetes risk by 24%,... https://t.co/oZIBFUfd3P	United States	205	Negative	Negative
RT @eatingourfuture: #NutriRECS's own data show that a moderate reduction in red & processed meat consumption within a healthy eating pattern can reduce total mortality by 13%, heart disease mortality by 14%, cancer mortality by 11% & type 2 diabetes risk by 24% [Dr Hu] https://t.co/QgDLD4jjoI https://t.co/3q5o5GQqch	Unknown	2995	Neutral	Negative
via @deanornish on #NutriRECS: They found that ... a moderate reduction in red & processed meat consumption had a 13% lower rate of premature death from all causes, a 14% reduction in cardiovascular disease mortality, an 11% decrease in cancer mortality https://t.co/LW4PyXepfv	United States	659	Negative	Negative
RT @eatingourfuture: #NutriRECS's own data show that a moderate reduction in red & processed meat consumption within a healthy eating pattern can reduce total mortality by 13%, heart disease mortality by 14%, cancer mortality by 11% & type 2 diabetes risk by 24% [Dr Hu] https://t.co/QgDLD4jjoI https://t.co/3q5o5GQqch	Unknown	2530	Neutral	Negative
#NutriRECS's own data show that a moderate reduction in red & processed meat consumption within a healthy eating pattern can reduce total mortality by 13%, heart disease mortality by 14%, cancer mortality by 11% & type 2 diabetes risk by 24% [Dr Hu] https://t.co/QgDLD4jjoI https://t.co/3q5o5GQqch	United States	659	Neutral	Negative
@adil_naki @marionnestle NutriRECS's own data show that a moderate	United States	659	Negative	Negative

reduction in red & processed meat consumption within a healthy eating pattern can reduce total mortality by 13%, heart disease mortality by 14%, cancer mortality by 11% and type 2 diabetes risk by 24%, said Hu. https://t.co/QgDLD4jjoI				
RT @petersliang: Strongly disagree with new #NutriRECS recommendations on red/processed meat consumption: https://t.co/bHPnkTo9Zm 1) Their data shows reduction in red/processed meat leads to 📉 diabetes & CV/cancer death. 7-8 fewer cancer deaths/1000 ppl is NOT trivial on population level!	United States	1086	Negative	Negative
RT @petersliang: Strongly disagree with new #NutriRECS recommendations on red/processed meat consumption: https://t.co/bHPnkTo9Zm 1) Their data shows reduction in red/processed meat leads to 📉 diabetes & CV/cancer death. 7-8 fewer cancer deaths/1000 ppl is NOT trivial on population level!	United States	1320	Negative	Negative
Hi @wcrfint, how is the signing of this statement against the new NutriRECS [red meat] guidelines, which [you] believe are misleading actually limited? i.e. does a digital signature limit it to Top health organisations and global cancer experts? https://t.co/5HrLLgLPpZ	Australia	388	Neutral	Neutral
community members. NutriRECS determined that there's low- to very low-certainty evidence that reducing red and processed meat consumption will reduce the risk for developing heart disease or dying from cancer. The group essentially recommends that adults should (2/3)	United States	55	Negative	Positive
Strongly disagree with new #NutriRECS recommendations on red/processed meat consumption: https://t.co/bHPnkTo9Zm 1) Their data shows reduction in red/processed meat leads to 📉 diabetes & CV/cancer death. 7-8 fewer cancer deaths/1000 ppl is NOT trivial on population level!	United States	604	Negative	Negative
RT @PennylessChurch: @KrHarper7 NutriRECS's own data show that a moderate reduction in red and	United States	5046	Negative	Negative

processed meat consumption within a healthy eating pattern can reduce... Total mortality by 13%, Heart disease mortality by 14%, Cancer mortality by 11% & Type 2 Diabetes risk by 24% Dr. Frank Hu				
QT @AnnalsofIM: Ahh we finally have the climate change deniers of the Health world! @AnnalsofIM is denying the abundance of evidence against eating processed red meat and encouraging people not to worry about the increased #cancer and #cardiovascular disease risk ; Free in Annals today: Unprocessed Red Meat and Processed Meat Consumption: Dietary Guideline Recommendations From the NutriRECS Consortium https://t.co/WQjRkvy31M #redmeat https://t.co/YeE2H9HTKW	United States	9032	Negative	Negative
"The NutriRECS stance contradicts existing guidance by the WHO, the UK's National Health Service, the American Cancer Society and the American Heart Association, to name a few, about the dangers of red and processed meat consumption." https://t.co/CxphaeVcng	Unknown	839	Neutral	Negative
@KrHarper7 NutriRECS's own data show that a moderate reduction in red and processed meat consumption within a healthy eating pattern can reduce... Total mortality by 13%, Heart disease mortality by 14%, Cancer mortality by 11% & Type 2 Diabetes risk by 24% Dr. Frank Hu	United States	5578	Negative	Negative
QT @australian: The WHO International Agency for Research on Cancer has indicated that the consumption of red meat is 'probably carcinogenic' to humans, and that processed meat is "carcinogenic". But the NutriRECS consortium found in its systematic reviews that these conclusions were not sound. ; A major study finds little evidence that eating red meat is linked with cancer, diabetes or heart disease. https://t.co/cHnnOdTNN1	Australia	369	Neutral	Positive
Breaking! NutriRECS Study Claiming That Red & Processed Meat Does Not Contribute To Cancer & Other Diseases Is Misleading; A Plant-Based Diet Is	United States	74	Positive	Negative

<p>The Healthiest Choice https://t.co/hYFgma5cbb</p>				
<p>New nutrition guidelines by NutriRECS: Individuals do not need to eat less red and processed meat to stay healthy 🔴 Controversial guidelines. Diet with 🔴 red & processed meat has been associated with 🔴 colon cancer #Somedocs @AnnalsofIM https://t.co/ASyrtmObG</p>	<p>United States</p>	<p>4237</p>	<p>Neutral</p>	<p>Neutral</p>