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Promoting and disseminating consistent and effective nutrition messages: challenges and opportunities

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Nutrition messages are a central part of policy making as well as communication via product information, advertising, healthcare advice and lifestyle campaigns. However, with amplified information (and misinformation) from a growing number of sources, inconsistent and conflicting food landscapes, and limited engagement from the public, nutrition messaging tensions have become more accentuated than previously. In this review, we focus on the challenges facing those wishing to effect dietary change through communication; and identify opportunities and future research questions. Beginning with a new working definition and taxonomy for the term ‘nutrition message’, we consider the evolution of public health nutrition messages from the past century and discuss which types of messages may be more effective. We then turn to the challenges of implementation and highlight specific barriers to recipients’ understanding and change. While the evidence has many gaps and there is a need for systematic evaluation of nutrition messages, research indicates that recipients are more likely to act on fewer messages that provide clear benefits and which resonate with their perceived health needs, and which are relatively straightforward to implement. Effectiveness may be improved through consideration of how nutrition messages can be designed to complement key non-health drivers of food choice (taste, cost) and societal/cultural norms. Consistency can be achieved by aligning the wider food and messaging environment to desired public health actions; that is by ensuring that retail settings provide and signpost healthier choices, and that mass media nutrition messages work with, not against, public health advice.

Nutrition communication: Public health: Effectiveness: Compliance: Barriers to change

The aim of nutrition science is its application to the maintenance of human and animal health as stated in the mission statement of the Nutrition Society and, more recently, in alignment with planetary health. A major step in this journey from research to implementation is the development of effective nutrition messages

and their communication to recipients, particularly the general public, with the objectives of improving well-being and preventing future disease.

In a 1999 editorial, Ruxton⁽¹⁾ asked: ‘Why is so much good dietary advice being ignored?’ and lamented the lack of public compliance with evidence-based nutrition

Abbreviations: FSS, Food Standards Scotland; NDNS, National Diet and Nutrition Survey; RPM, red and processed meat.

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advice, such as 5-a-day⁽²⁾. The article proposed that the most effective advice is simple, actionable, consistent, from trusted sources, and linked with personal benefits that resonate with the public. More than two decades later, the same appears to be true with little significant movement in the nutritional intake of British adults and children despite years of consistent messaging to reduce sugars, saturated fat and salt and to eat more fruit, vegetables and fibre.

This review will examine different types of nutrition messages communicated in the UK and assess their impact on population behaviour. It will provide examples of nutrition messages which appear to have worked better than others and postulate why this may be so. Finally, it will summarise research opportunities for improving the consistency and effectiveness of future messaging, given the additional complexity of including advice on sustainability and food-related environmental issues.

Exploring nutrition messages

Nutrition messages come in many forms, are aimed at different recipients for different objectives, originate from both public and private sources, and vary in quality, validity and reliability. Nutrition messages may focus on individual dietary components, such as 5-a-day, or be more complex, such as food-based dietary guidelines (FBDG), which include the UK's Eatwell Guide.

Definition

There is no universally agreed definition of the term 'nutrition message'. Therefore, for the purposes of this review, we define a nutrition message as any communication, in any format or medium, intentionally made available to a recipient, containing information about: (a) diet, (b) food(s), (c) nutrients, (d) food-derived compounds, (e) diet-related attitudes, intentions, behaviours or practices, or (f) resources, processes, systems or technologies related to any of that afore-mentioned.

Nutrition messages are the practical component of dietary guidelines, nutrition education, product information and nutrition-related marketing. They are also an area of concern when used as a vehicle for spreading false nutrition and health information, either inadvertently (misinformation) or intentionally (disinformation) – whether originating from public or private sources.

Table 1 presents a proposed classification for nutrition messages by source and intended recipients in the population. For example, the source of public nutrition messages may be the WHO at an international level or Public Health Scotland at local level, with the intended recipients being the general public or population sub-groups.

Importance: global to local

Currently, diet is the number one modifiable behavioural risk factor predicting all-cause mortality risk worldwide, with more annual deaths attributed to it than to tobacco, pollution and insufficient physical activity⁽³⁾. Dietary

risks account for approximately 8 million annual deaths globally, and this figure excludes alcohol use (attributable to an additional 3.3 million annual deaths), with a total of 11.3 million preventable deaths related to eating and drinking behaviours each year^(3,4). The impact of dietary factors extends beyond the burden of disease, with direct implications for planetary health and resource sustainability^(5,6). Human and planetary health are interdependent, thus changes in dietary patterns and in food, energy and water systems are seen as pivotal to the global One Health cause⁽⁷⁾.

Sustainability has been incorporated into the suite of nutrition messages in recent years as a consequence of academic research on the planetary impact of certain dietary behaviours and international lobbying, such as by the EAT-Lancet Commission which proposed the Planetary Health Plate⁽⁸⁾. These developments have led to the concept of healthier and more sustainable diets being reflected in public health policy⁽⁹⁾, impacting on the evolution of dietary guidelines around the world^(10–12). However, without far-reaching and effective nutrition messages that translate planetary objectives into local actions, population habits are unlikely to change in the short term.

Evolution of messages in the UK

In the two decades following the Second World War, necessity and limited availability were the key drivers of dietary habits in the UK⁽¹³⁾; with public nutrition messages focusing on adequate protein, vitamins and minerals, and meeting energy needs⁽¹⁴⁾. In the 1940s, expenditure on food was significant yet austere, accounting for around a third of household income. This can be compared with just 11 % of mean household income (15 % in lower income households) in 2019/20^(13,15), in part due to the gradual shift towards the mass production of lower cost, processed foods with longer shelf lives^(16,17).

Demand for easier, quicker and cheaper meals grew in the 1960s and, by the end of the 1970s, most British families owned a fridge, with the preference for convenience foods driving increases in fat and sugar consumption and decreases in fibre intake⁽¹⁸⁾. In 1976, while highlighting the rapid expansion of lifestyle-related diseases, a Department of Health and Social Security report⁽¹⁹⁾ placed the responsibility for appropriate dietary choices on the individual and urged nutrition messages which focused on self-control. This has been superseded in recent years by a shift towards controls on the food environment, especially food manufacture and retailing⁽²⁰⁾.

In 1983, the National Advisory Committee on Nutrition Education called for the translation of the recommended intake limits in fat, sugar and salt into 'simple and clear messages for the public' which illustrated 'spoonfuls of sugar, rashers of bacon, and helpings of mashed potatoes' rather than nuanced dietary percentages⁽²¹⁾. In fact, many years passed before the complexities of the dietary reference values⁽²²⁾ were visualised and communicated to lay audiences. The first food-based dietary guideline in the UK, 'The Balance of Good Health', was launched in 1994, followed by the 'Eatwell Plate' in 2007 and the 'Eatwell Guide' in

Table 1. Classification of nutrition messages by source and intended recipients in the population

Nutrition message types	Sources	Recipients	Examples
Public health messages	WHO, SACN, NHS, DHSC, EC, Parliament (via laws)	General public	Policies, guidelines, campaigns, regulation: (1) Diet (e.g. FBDG, energy reduction) (2) Food environment (e.g. marketing/advertising restrictions, school food regulations, nutrient profiling, SDIL) (3) Foods (e.g. 5-a-day, oily fish, meat reduction) (4) Single nutrients (e.g. sugar, salt, vitamin D) (5) Non-nutrients (e.g. fibre, contaminants)
Food product messages	Private sector via advertising, packaging, physical food retail, digital food retail Regulatory bodies (e.g. EFSA, FSA, FSS)	Consumers	Labelling (e.g. ingredients, nutrients, allergens, traffic light coding) Nutrition and health claims (e.g. 'low fat', 'high fibre', 'rich in calcium', 'free from', 'supports normal function of') Packaging design, images and symbols (e.g. plant leaf, crossed-grain, 5-a-day symbol) Endorsements (e.g. celebrities, experts, cartoon characters) Promotional deals (e.g. 'buy one, get one free', seasonal offers) Digital food retail (e.g. personalised algorithm-based product displays, pop ups) Media (e.g. adverts, pop ups, advertorials, inserts)
Media-generated messages	Traditional print and broadcast media, social media, mobile apps, Internet	Users of the medium	News items, features, shows, editorials, posts, MMORPGs, alerts (e.g. food recalls), crowd text messages, mass mailers
Interventional messages	Nutrition and health professionals, medics, unregulated health advisors	Individual clients, patients, service users	Advice given face-to-face or remotely (e.g. chats, video calls, interactive apps) – either one-to-one or in small group settings

DHSC, Department of Health and Social Care; EC, European Commission; EFSA, European Food Safety Authority; FBDG, food-based dietary guidelines; FSA, Food Standards Agency; FSS, Food Standards Scotland; NHS, National Health Service; SACN, Scientific Advisory Committee on Nutrition; SDIL, soft drink industry levy; MMORPG, massive multiplayer online role-playing games.

2016⁽²³⁾. This latter version introduced sustainability into the model by promoting meat and dairy alternatives and removed discretionary foods from the central display of food groups.

Individual nutrition messages have been promoted in parallel, such as '5-a-day' introduced in 2003 to echo the WHO recommendation to consume a minimum of 400 g/d of fruit and vegetables⁽²⁴⁾. Widely discussed in the mass media, the Carbohydrates and Health report issued in 2015 halved the free sugars limit from 10 to 5 % of dietary energy, while advising an increase in dietary fibre to at least 30 g/d⁽²⁵⁾. Public health messaging for the free sugars target was developed by Public Health England⁽²⁶⁾, resulting in the translation of the advice into sugar cubes and teaspoons.

The '5-a-day' and 'sugar-limit' messages made it to food labels and packaging, but whether consumers are receptive of these remains under investigation. To discourage high-fat, high-sugar and high-salt choices, a voluntary colour-coded traffic light labelling system has been used in the UK since 2006, where the colours red, amber and green respectively represent 'high', 'medium' and 'low' amounts of less favourable nutrients⁽²⁷⁾. In subsequent years, additional nutrition messages have been introduced onto product packaging, including claims, images and symbols, with limited evidence that these

influence attitudes or purchasing intentions⁽²⁸⁾. Digitalisation of the food environment provides abundant opportunities for manufacturers, retailers and public health bodies to address nutrition messages to consumers. However, there is still much to be done to achieve success in food environment interventions which seek to alter purchasing and consumption behaviours (for a review, see Evans⁽²⁰⁾).

Do we eat what we are advised to eat?

The simple answer to this question is 'not really' but, to investigate this, one may consider data from dietary surveys, such as the National Diet and Nutrition Survey (NDNS)⁽²⁹⁾, as well as consumer surveys. The latter are viewed as less robust in scientific terms but can play a role alongside empirical evidence since they explore attitudes, knowledge and understanding – information which can be missing from observational studies.

Dietary assessment and trends

A secondary analysis of the diets of 5747 individuals aged ≥ 5 years from waves 5–9 of the NDNS examined compliance with the nine individual recommendations

promoted in the Eatwell Guide⁽¹¹⁾. Only 0.1% of the population achieved all nine recommendations, 18% achieved 5–9 recommendations, 44% achieved 3–4 and 38% achieved 0–2. As illustrated in Fig. 1, the recommendations most likely to be met related to total fat, salt, red and processed meat (RPM) and saturated fat. Those least likely to be met were for fibre and oily fish. Given the positive framing of the 5-a-day message ('eat more') and its longevity, it is disappointing that only 26% of the UK population, on average, were eating the recommended servings of fruits and vegetables⁽¹¹⁾.

The same study also examined the potential health impact of the Eatwell Guide recommendations, based on a secondary analysis of three prospective cohort studies⁽¹¹⁾. A statistically significant 7% risk reduction in total mortality was associated with compliance with five or more recommendations, but this fell to 4% for compliance with 3–4 of these. When individual recommendations were examined, the greatest impact (10% risk reduction in mortality) was associated with 5-a-day, followed by saturated fat (5% risk reduction) and oily fish (3% risk reduction). No other recommendations were individually associated with mortality risk. This suggests that some dietary targets may be more important than others for lowering disease risk, and there could be a hierarchy of recommendations – something which should be investigated using UK cohort studies. The Global Burden of Disease database reported that the dietary risk factors most associated with mortality and disability-adjusted life-years during 1990–2019 were high sodium and low intakes of whole grains and fruits⁽³⁰⁾.

The NDNS is a repeated cross-sectional study, and therefore examination of trends is possible from an analysis of successive waves of data collection. A trend analysis was performed across years 1 to 11 (2008/2009 to 2018/2019) revealing significant reductions over time in the consumption of sugar-sweetened beverages, RPM, confectionery (in children only) and free sugars⁽³¹⁾. However, intakes of other foods and nutrients did not make progress towards targets including fibre, saturated fat, fruits and vegetables, while others went in the wrong direction including reductions in the proportion of individuals meeting recommendations for vitamin A, iron and folate.

Trend analysis was also performed by a team examining data on Scottish consumers from the Living Costs and Food Survey (2001–18)⁽³²⁾. This survey collates annual information on UK household food consumption minus waste over a 2-week period, enabling researchers to estimate food and nutrients consumed per head of population. The results highlighted a static picture of consumption for most foods and nutrients between 2001–2003 and 2016–2018, with very little progress towards Scottish dietary goals⁽³³⁾. Exceptions were free sugars and RPM, which declined; although, in the case of sugar, intakes still exceeded the population goal of 5% energy by two and a half times⁽³²⁾.

Consumer research

With these empirical data in mind, it is interesting to examine what consumers think and understand about

dietary recommendations. Both Food Standards Scotland (FSS) and the Food Standards Agency conduct regular tracking surveys of consumers recruiting 1000–1500 people at a time, mostly aged 16 years and over.

The 2021 tracking survey (n 1009)⁽³⁴⁾ found that 43% of Scottish consumers aged over 16 years had seen the Eatwell Guide, while 35% of this group had used it. The resource was likely to have been noticed by women (52%), 16–34-year-olds (66%) and those with children at home (64%), with the most common settings for engagement being healthcare, schools or the Internet. Encouragingly, 89% said they understood the Eatwell Guide fairly or very well.

Delving into this concept further, a survey commissioned by the Proprietary Association of Great Britain (personal communication, 2021) asked consumers (n 1110) to select the answer which best articulated the key message of the Eatwell Guide. Almost half (48%) admitted that they did not know, while 33% chose the correct answer of 'fruit, vegetables, starchy carbohydrates and a little meat/dairy'. The remainder chose options relating to vegan/vegetarian diets, portion sizes or limiting discretionary foods. Hence, asking about general understanding may be insufficient, and further studies should probe consumers' perceptions of what food-based dietary guidelines are trying to communicate.

The apparent disconnect between awareness, understanding and implementation of food-based dietary guidelines was highlighted by a review of twenty-eight studies which suggested that consumers may not accept that they need to follow official guidelines to eat healthily, or could be unconsciously adopting guidelines⁽³⁵⁾. Indeed, one consistent finding from surveys is the degree to which people believe that they are already following a healthy diet. In the afore-mentioned FSS survey, 61% said the foods they tended to eat were very or quite healthy, which is similar to how 65% of 16–75-year-olds living in England, Wales and Northern Ireland (n 1916) responded in the 2021 Food Standards Agency tracker survey⁽³⁶⁾.

Another reason for the disconnect may be recipients' difficulties in translating advice into practical application. In a randomised controlled trial, an *ad libitum* buffet model was used to investigate how adults' (n 187) perceptions of habitual *v.* healthy diets compared⁽³⁷⁾. Diets identified as healthier were significantly lower in saturated fat and higher in protein and fibre yet did not comply with Swiss dietary guidelines. However, levels of energy and other nutrients, notably sugars and salt, were similar between the habitual and healthier diets. The authors concluded that the public likely lack information about portion sizes, and levels of salt and sugars in processed foods. While perceived healthier diets differed from habitual diets, they nevertheless failed to comply with dietary targets.

Sugars and red meat

As mentioned earlier, the two notable exceptions to the overall lack of dietary progress are free sugars and RPM. What has brought about these successes?

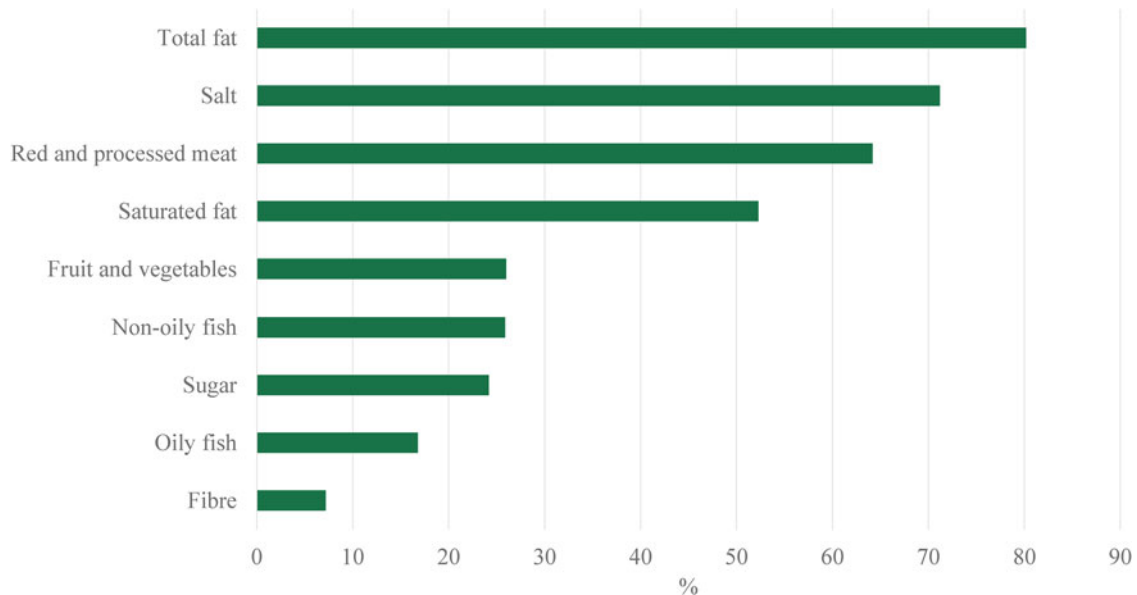


Fig. 1. Percentage of UK population achieving individual dietary recommendations from the Eatwell Guide. Source: Figure based on Scheelbeek *et al.*⁽¹¹⁾ *n* 5747 individuals aged ≥ 5 years from waves 5–9 of the National Diet and Nutrition Survey.

Per the NDNS⁽³¹⁾, free sugars intakes reduced by 2–4 percentage points between 2008 and 2019 to deliver intakes of about 10% energy in adults and 12% energy in children. This was matched by a steady decline in sugar-sweetened beverage consumption equivalent to a third of a can daily, with a 20% fall in the proportion of adults consuming these drinks (34% fall in 1.5–18-year-olds)⁽³¹⁾. While the soft drinks industry levy introduced in 2018 undoubtedly helped, the gradual decline in sugar intake started prior to its introduction.

One explanation may be the mass media coverage of sugar over several years which reached its apogee in 2015 following publication of the Carbohydrates and Health report⁽²⁵⁾ and associated policy announcements. These included lay communication of maximum teaspoons of sugar for adults and children⁽²⁶⁾, industry targets for sugar reduction in products, and plans for a soft drinks industry levy⁽³⁸⁾. Some of the media coverage was driven by campaign groups, such as Action on Sugars and National Obesity Forum, which pressed for ambitious industry targets and faster reformulation.

In the case of RPM, between 2008 and 2019, average total meat intake reduced by 17 g daily and the proportion of meat consumers fell by 3%, accompanied by a switch from RPM to white meat⁽³⁹⁾. Data on Scottish consumers (2001–18) revealed a decrease in RPM consumption from a mean of 65 to 55 g daily, which complies with the 70 g recommendation⁽³²⁾. As with free sugars, the decline in red meat consumption predates current messages about planetary diets.

Interestingly, the Scottish data indicate a drop in mean RPM intake from 61 to 56 g daily during 2013–14, which coincides with the ‘horsemeat scandal’, a Europe-wide food fraud episode which resulted in significant media

attention⁽⁴⁰⁾. The NDNS data cover a broader period but, nevertheless, suggest a similar trend with mean daily RPM falling from 60 to 53 g between 2012–14 and 2014–16⁽³¹⁾. The statistical significance of this trend needs to be verified.

For both sugar and RPM, new product development activity in the food industry has led to more reduced sugar and meat-free products, and a higher profile and visibility of these in retail and out-of-home settings. In several categories, such as cordials, mixers, baked beans, yogurts and breakfast cereals, sugar reduction has been applied to standard products rather than to new launches or niche brands. Retailers’ ‘own brand’ products have also been the target of significant reformulation⁽⁴¹⁾. Both retail and out-of-home sectors are continuing to develop and promote meat-free and vegan ranges, including large chains such as Marks & Spencer, Morrison’s, Lidl, McDonalds, Burger King, Starbucks and Greggs, which serve many millions of customers.

Hence, we propose four common factors which may explain the apparent success of sugar and RPM reduction compared with other dietary targets:

- (1) Clear government targets and policy development
- (2) Extensive media coverage, including social media
- (3) Active high-profile campaigning groups
- (4) Alternative products offered by mass retail and out-of-home sectors.

Future research should investigate whether this type of ‘360-degree approach’ to fibre and 5-a-day targets would help drive better compliance, for example by stimulating media coverage, campaigning for reformulation targets or clearer food labels, and improving the availability and visibility of new or renovated products containing more fibre, fruit and vegetables.

Horses for courses: which message for whom?

With so many options available for nutrition messaging beyond the core message itself, it is important to take a systematic approach when planning the creation and implementation of nutrition messages.

A good starting point is the 'communication for behavioural impact toolkit'⁽⁴²⁾ which proposes a seven-step approach comprised of: (1) identifying the preliminary behavioural objectives, (2) conducting a rapid situational analysis, (3) refining the behavioural objectives and stating the communication aims, (4) designing the communication strategy, (5) preparing the implementation and monitoring plans and budget, (6) implementing and monitoring the strategy while identifying trends and adapting it as necessary and (7) evaluating the outcomes. WHO's 'strategic communications framework for effective communications' goes further by including guiding elements for the health message itself, namely that it should be: accessible, actionable, credible and trusted, relevant, timely and understandable⁽⁴³⁾.

General, segmented and individual messages

One of the first decisions for implementation is to determine whether nutrition messages are more appropriate for an individual or a group. For this to be done appropriately, it is worth making a distinction between their 'promotion' (i.e. the act of supporting, encouraging or advocating) and their 'dissemination' (i.e. the act of spreading widely). These two terms are not interdependent or inclusive of each other.

For example, specific nutrition messages may be promoted by a nutrition professional as part of their provision of personalised advice to a patient but without the need to disseminate it given that it would not be relevant to other individuals. Conversely, public health nutrition messages are designed to reach as many people as possible since a wider reach is desirable. This distinction allows us to compare variations in message reach, channel and cost of delivery, content nature and perceived relevance by the recipient.

Fig. 2 illustrates a comparison between general, segmented and individual dietary advice messages in relation to their intended reach. Using the example of free sugars reduction, general guidance for the public assumes an average population intake and associated health risk, whereas personalised advice is based on individual dietary assessment. Segmented advice, conversely, is typically aimed at specific groups based on sociodemographic characteristics and consumption trends, such as campaigns to reduce sugar-sweetened beverage consumption in teenagers.

Traditional health communication models have attempted to improve and refine these messages for enhanced effectiveness, largely by focusing on a recipient's beliefs, attitudes, personal motivators and other individual-level constructs that influence behavioural change. However, less attention has been paid to macro-level influences such as communities, culture or society⁽⁴⁴⁾.

Persuasive message framing

The anatomy of a typical health message at the turn of the new millennium had the following characteristics:

- (1) a message recipient
- (2) threats to health
- (3) actions to be performed to reduce the threat
- (4) benefits achieved from performing the actions⁽⁴⁵⁾.

However, the persuasive effects of fear-based, health-threat messaging have been questioned by health psychologists as being insufficient for generating intrinsic motivation to change^(46,47). It has been suggested that the inclusion of information about the possible health outcomes (gain or loss) from either engaging in or repressing a behaviour might be more persuasive than remaining silent about these. However, gain (rather than loss) frames that align with the recipients' motivations or intentions may make a nutrition message more likely to influence behavioural change^(46,48,49). Based on regulatory focus theory and prospect theory, gain-framed messages allude to the benefits of changing behaviour⁽⁵⁰⁾. These typically include the promotion of a rewarding outcome (e.g. 'Eating your 5-a-day can help you feel healthier') or the prevention of an adverse outcome (e.g. 'Eating your 5-a-day can mitigate your disease risk').

The jury is still out in terms of the effectiveness of loss-framed nutrition messages. These messages focus on the detriments of either engaging in an undesirable behaviour (e.g. 'Eating too much sugar increases your risk for dental caries') or not engaging in a desirable behaviour (e.g. 'If you do not eat enough fruits and vegetables, your disease risk will be higher'). Studies indicate that when recipients are first presented with health risk information, they are primed for loss-framed nutrition messages, making these more effective for eliciting changes in intention⁽⁵¹⁾. That said, loss framing may fall short when recipients are already well aware of the negative impact of their eating behaviours, so making them feel guilty is unlikely to work⁽⁵²⁾. This contradicts suggestions that recipients with higher levels of health literacy and detailed knowledge are more susceptible to fear-based, loss-framed messages⁽⁴⁷⁾.

Compelling messaging design

Using fear or reward appeals is not limited to oral or written nutrition communications. Numerous graphical and visual strategies have been evaluated in persuasion research. A wordy message about vitamin D supplementation, such as that meticulously stated by the NHS in 2020: 'everyone (including pregnant and breastfeeding women) should consider taking a daily supplement containing 10 micrograms of vitamin D during the autumn and winter'⁽⁵³⁾ may be harder to process and be less compelling than a short, gain-framed statement accompanied by a graphical illustration of cheering sunrays coming from a vitamin D tablet on a dark background representing the colder months, such as the advertisement promoted by FSS for the 'sunshine vitamin'⁽⁵⁴⁾.

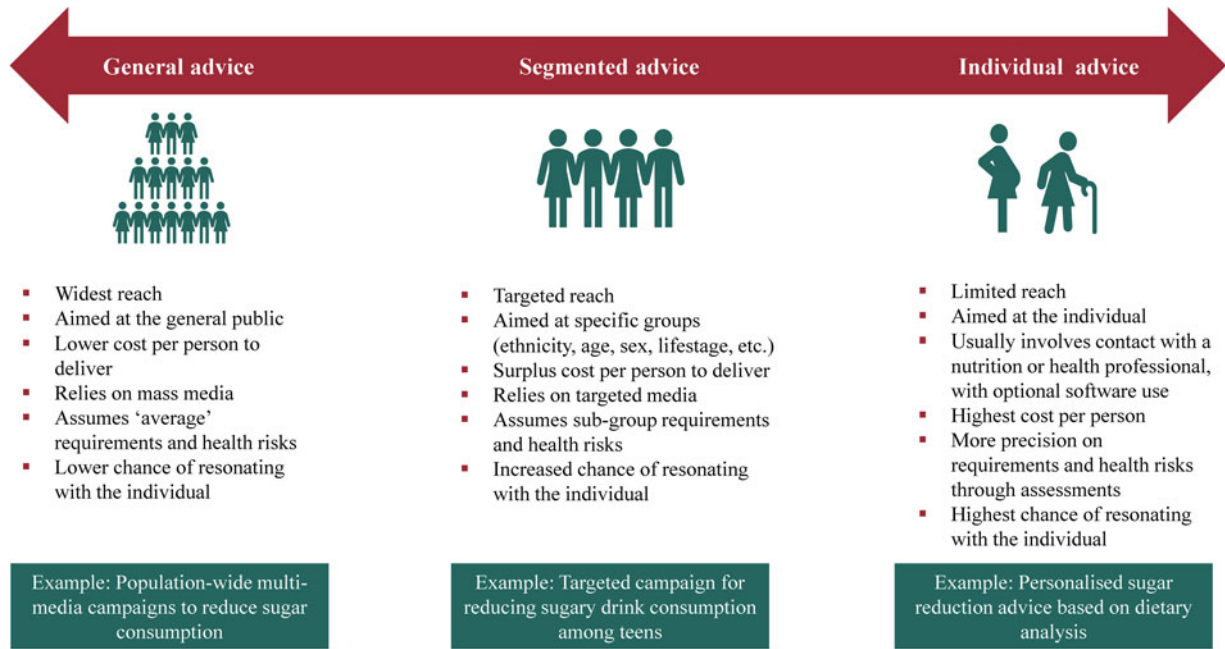


Fig. 2. Differences in nutrition messages depending on the target audience.

Diet contains many different components and is, therefore, complex. Hence, it has been postulated that: 'simple public health messages can never convey a full understanding of how to construct a healthy diet'⁽⁵⁵⁾. As a result, practitioners must decide whether a nutrition message should specify a course of action or simply offer general guidelines, with some researchers hypothesising that the former may be more effective⁽⁵⁶⁾. An example is indicating types and quantities of food to eat, as opposed to messages that leave room for personal interpretation or complex calculations.

Recipient factors considered in nutrition message design models also include personal health and nutrition priorities (e.g. How relevant is this dietary issue to me personally? How much should I care? Am I motivated enough to pay attention?) as well as different tonal executions for the same recommendation based on recipient preferences⁽⁵⁷⁾ (e.g. Am I more likely to react to authoritative or to empathic reasoning? Am I more inclined to act on affinity-driven discourse that 'speaks my language' using peer slang? Do I need practical, solution-based ideas with demonstrations or swap ideas so I can choose healthier options?). For an example of the latter, see the FSS Eat Well Your Way resource⁽⁵⁸⁾.

The perceived and actual diet quality of recipients should not be ignored. The afore-mentioned Food Standards Agency survey⁽³⁶⁾ revealed that 65% of consumers think their diet is already fairly or very healthy whereas the reality is different with 15–35% of energy coming from discretionary foods⁽⁵⁹⁾, and alcohol contributing 10% of calories among drinkers⁽⁶⁰⁾. Therefore, effective design should make allowances for the reality of eating habits in the target population; that is, by not setting the behavioural change bar too high.

One or many messages?

The inclusion of one *v.* several recommendations at the same time has also been examined. While it may be tempting to give multiple points of advice when the opportunity arises, this can be counterproductive. A meta-analysis of 150 research reports comparing the magnitude of change following different numbers of concurrent recommendations concluded that two or three recommendations at a time was associated with stronger outcomes than either one or 4+ recommendations⁽⁶¹⁾. This observation may be explained by the number of recommendations being low enough to avoid overload and disengagement, but high enough to challenge receivers with the right level of motivation and effort. Whether or not the grouped recommendations are closely aligned may also impact effectiveness, regardless of the number. In one study, sugar reduction was not maintained when this advice was accompanied by recommendations to also reduce fat and energy⁽⁶²⁾.

Artificial intelligence, algorithm-based predictive behaviour models and multi-factorial message framing analyses can all be used for more impactful and compelling messaging. For example, multi-level or complex messages can be broken down into smaller, individual and more practical pieces then spread across multiple channels – such as product packaging, advertising, public health websites, diet apps and digital food retail. This can amplify reach and effectiveness since using multiple channels to deliver the same message in different formats results in superior outcomes⁽⁶³⁾. Moreover, technological advancements for the personalisation of public health messages in the digital era provide opportunities for optimised segmentation and tailoring of nutrition communications for greater engagement with recipients⁽⁶⁴⁾.

The importance of evaluation

In recent years, evaluation has fortunately become part of the process of designing and implementing nutrition messages and policies. This is important, as it helps society determine which interventions work and which do not. It also flags up unintended consequences or the potential for entrenching health disparities, such as when better educated groups of people are more likely to act on a health message and reap the health rewards.

Objective criteria for the evaluation of nutrition messages may include communication type, format and medium, source, intended recipient, content, tone, framing, length, complexity, objective, reach and accessibility, timing and context; whereas subjective criteria may include perceived message quality, validity, relevance, comprehension, credibility, trustworthiness, reliability, intrinsic and extrinsic consistency (i.e. consistency with itself or with external information), usability and effectiveness. While these elements are interrelated, emphasis may be placed on one or more aspects when evaluating a message or policy.

Research on nutrition messages is now wide-ranging and multi-disciplinary, with opportunities for collaboration between different actors to harmonise applicable concepts and taxonomy, and to develop a more consistent framework for evaluation.

Barriers to effectiveness

Even in the case of a perfectly crafted nutrition message, there remain barriers to effectiveness which may include consumer taste preferences, low motivation for change, food costs (perceived or real), low health literacy, competing messages, trust in the messenger, cultural barriers and health expectations. Believing in the benefits and wanting to change are only half the battle. External contextual factors outside the recipient's control may result in discouragement or confusion.

Personal barriers

Competing drivers including appetite, internal and external cues, habits, traditions, self-efficacy, liking and taste can overwhelm even the most compelling dietary messages. Health is just one reason why people choose particular foods or diets and is typically not the primary one. A survey of 2531 consumers in Great Britain aged 16 years and over⁽⁶⁵⁾ found that taste was the most important driver of food choice by far (51%), with health (24%) just above cost (18%). The influence of taste and health rose with age, while the influence of cost fell.

There is a perception that healthier diets are more expensive, and cost is cited as a major reason for failing to comply with dietary targets. In the FSS consumer tracker⁽³⁴⁾, 45% agreed with the statement that 'healthy eating is too expensive', while 33% surveyed by the Food Standards Agency said cost was a barrier to eating a healthier diet (a similar proportion to those who said cost prevented them from eating more sustainably)⁽³⁶⁾. However, the perception may be true according to a

secondary analysis of the NDNS combined with food price data which found that meeting recommendations for fruit and vegetables, oily fish, non-milk extrinsic sugars, fat, saturated fat and salt was 3–17% more expensive than less healthy diets⁽⁶⁶⁾. Diets that met six or more recommendations were 29% more expensive than isoenergetic diets not meeting any recommendations. The only target that went in the opposite direction was RPM, which lowered dietary cost by 4% when less than 70 g daily was consumed, while meeting the fibre recommendation was cost neutral.

Competing messaging

Public nutrition messages are rarely delivered in isolation and their context may send a parallel, unspoken message of its own. The food environment can be the source of implicit nutrition messages whereby intention and meaning are implied from a context but not explicitly communicated. These tacit, inferential messages can be at odds with those messages being explicitly promoted⁽⁶⁷⁾. Examples include the greater variety and availability of less healthy foods combined with their lower relative cost; the easy accessibility of 'fast foods' through delivery apps; in-store promotions and multibuy offers applied disproportionately to discretionary food products than to healthier options; and the built-in societal and cultural biases towards energy-dense, high-sugar, high-fat foods as the correct options for occasions or reward. These circumstantial factors can weaken even the most robust nutrition message for healthier and more sustainable eating. No matter how intrinsically persuasive and compelling the nutrition message may seem, external visible and invisible forces may cause it to land on deaf ears. Therefore, for effective behavioural impact, the modelling of these contexts and the application of ecological techniques should be part of messaging strategies⁽⁴⁴⁾.

Literacy, misinformation and trust

Besides implicit messages from ecological contexts conflicting with public nutrition messages, other inconsistencies, such as misinformation exposure and nutrition literacy challenges, may leave recipients confused and less likely to act on advice^(68,69). It has been suggested that recipients' nutrition confusion (defined as the perceived ambiguity or lack of certainty about reported research findings and resulting nutrition messages) and nutrition backlash (defined as negative beliefs about nutrition recommendations and research) may also contribute to greater reluctance to follow official dietary guidelines⁽⁶⁸⁾. In a review of qualitative research from the mid to late twentieth century, Moseley⁽¹⁶⁾ quoted one shopper who puzzled over the meaning of polyunsaturated margarine by saying: 'I understand that poly means many and unsaturated means not chock full of something, so what is margarine poly unsaturated with or not with?' Apparently, she had asked 'many a shopper' but no-one seemed to know.

Science is an ongoing process, rather than a compilation of facts. Food and nutrition sciences are relatively new disciplines compared with natural sciences such as



Table 2. Five factors to consider when designing and implementing nutrition messages

Factors	Justification	Research questions
Talk about food rather than nutrients, using positive/gain-framed messages	<ul style="list-style-type: none"> ● People eat foods and meals, not nutrients ● Fear/loss-framed messages are less effective, especially when the topic is not new to the recipient 	<ul style="list-style-type: none"> ● How can behavioural strategies be incorporated into diet advice, such as making healthier choices more convenient and appealing than less healthy choices?
Consider whether taking a 'good, better, best' approach may encourage small, sustainable steps between current consumption and the desired outcome	<ul style="list-style-type: none"> ● Current diets are far from ideal, and little progress has been made over the past decade. Hence, messages and practical examples need to be relevant and achievable ● Taste is often prioritised over health in determining dietary choices 	<ul style="list-style-type: none"> ● How can we nudge the public along a path towards better food choices? ● What are the steps, and are these collectively more effective than promoting ideal outcomes?
Engage wider stakeholder alignment in nutrition messaging, e.g. government, civil society, industry, health professionals	<ul style="list-style-type: none"> ● The examples of red meat and sugar reduction appeared to benefit from an alignment between government targets/policy, extensive media coverage, active campaigning groups and alternative food and beverage products to purchase 	<ul style="list-style-type: none"> ● How can societal alignment in messaging be improved to encourage better compliance with messages relating to 5-a-day, fibre and oily fish? For example, would mandatory inclusion of fibre on food labels encourage fibre intake? ● Which inconsistencies in the food environment are acting as barriers to the uptake of public nutrition messages?
Segment to enable the message to resonate better with the target group	<ul style="list-style-type: none"> ● Advantaged groups of people are more likely to respond to nutrition messages, indicating a need for targeting to avoid entrenching of dietary and health inequalities ● The concerns of message recipients may be at odds with those of health educators (e.g. cost versus healthiness) 	<ul style="list-style-type: none"> ● In which population sub-groups would the greatest health benefit be realised? ● Which are the most effective channels for engaging the target audience? ● How can the message be best phrased to ensure relevance?
Mitigate any mixed messages in the food environment	<ul style="list-style-type: none"> ● Messages to reduce consumption of certain foods are likely to be ineffective when these foods are cheap and widely available in large portions ● The reformulation of foods currently viewed as 'treats' may appear inconsistent with public nutrition messaging ● Portions in out-of-home settings are larger than those chosen in the home 	<ul style="list-style-type: none"> ● Where are the mixed messages in the food environment, and how do they influence consumers? ● Which policies could be implemented to effectively limit mixed messages? ● How might restrictions to availability, marketing of foods or pricing support message harmonisation?

physics⁽¹⁷⁾. Because research in food and nutrition is evolving at a rapid pace, with the daily publication of divergent evidence, conclusions may be premature when they are disseminated in the mass media. Results can subsequently be disproven or found not to be replicable, particularly when there is an over reliance on observational studies⁽⁷⁰⁾. Meanwhile, the ideas generated through such premature conclusions or arising during the knowledge-construction process may persist in the minds of the public, adding to their confusion about appropriate dietary choices^(71–73).

Another issue arises when communicators – whether in the public or private sector – have invested in a specific ideological position and omit dissenting evidence or disseminate information that does not faithfully reflect antagonising or incompatible research. This can lead to messaging biases and distortion, with the potential to stimulate a nutrition backlash when revealed^(68,70). Therefore, we argue that higher levels of transparency, ethics and message quality are critical elements for nutrition message effectiveness. Because conflicts of interest are not always appropriately disclosed, discrepancies

among nutrition messaging actors can occur and this calls for better monitoring and accountability at professional and organisational levels.

Finally, trust in the communicator is essential. A 2017 consumer survey (*n* 2000) commissioned by the British Dietetic Association⁽⁷⁴⁾ found that 80–85% of adults would trust dietary advice given by a dietitian, nutritionist or general practitioner. However, a significant proportion (35–59%) would also trust potentially unqualified sources of information such as family and friends, personal trainers and even TV chefs. In contrast, 22–25% would trust journalists or bloggers. Perceptions about the attitudes or personal dietary compliance of communicators can impact on how well their nutrition messages are trusted. An intervention study⁽⁷⁵⁾ exposed 186 adult participants to an online meat reduction message promoted by a meat-eating or vegetarian advocate. In addition, the message used either inclusive language ('we can eat less meat') or personal language ('you can eat less meat'). Participants were more likely to perceive the message as inconsistent when the advocate was a meat-eater unless they used inclusive language. Interestingly, if participants

identified less strongly as ‘meat eaters’, they were more likely to take on board the message from a vegetarian. In a similar way, adults (n 2100) surveyed by the Royal Society for Public Health⁽⁷⁶⁾ were six times more likely to listen to diet or exercise advice delivered by a normal weight general practitioner compared with one who was themselves overweight.

Opportunities for better messaging

Given the available evidence, consideration of five factors may help nutrition messages to be more consistent and effective. These are summarised in [Table 2](#) alongside potential research questions.

Conclusions

Nutrition messages are not straightforward and a systematic, evidence-based approach is needed for their creation, targeting, implementation and evaluation. The available evidence suggests that recipients are more likely to respond to fewer messages that provide clear benefits which resonate with their own perceived health needs, and which are relatively straightforward to implement. Effectiveness may be improved by considering how nutrition messages can be designed to complement key non-health drivers of food choice (taste, cost) and societal/cultural norms. Consistency can be achieved by aligning the wider food and messaging environment to desired public health actions; that is, by ensuring that retail settings provide and signpost healthier choices, and that mass media nutrition messages work with, not against, public health advice.

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Conflict of Interest

C. H. S. R. is a Trustee of the Nutrition Society and a Board member of Food Standards Scotland. She also works on a freelance basis with: BBC Radio Scotland, British Egg Industry Consortium, European Fruit Juice Association, Ferrero UK, innocent, Proprietary Association of Great Britain, UK Tea and Infusions Association, Yakult. None of these companies/organisations contributed to this paper or endorse it. C. E. L. E. is a Council member of the Nutrition Society. M. A. R. is a Director of The Health Sciences Academy and doctoral researcher at University College London. None of these organisations contributed to this paper or endorse it.

Authorship

Project direction, C. H. S. R.; conceptualisation, investigation and original draft preparation, C. H. S. R. and M. A. R.; review and editing, C. H. S. R., M. A. R.

and C. E. L. E.; visualisation, C. H. S. R. and M. A. R. All authors have read and agreed to the published version of the manuscript.

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