Journal of Environmental Management 397 (2026) 128185

Contents lists available at ScienceDirect

Journal of Environmental Management

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

Research article

How has the cost-of-living crisis impacted the transition to healthy diets from sustainable food systems?

Susan E. Lee [a], C. William Young [b], Ralf Barkemeyer [c,*]

[a] ESRC Consumer Data Research Centre/School of Geography & Leeds University Business School, University of Leeds, Leeds, LS6 1AN, UK
[b] ESRC Consumer Data Research Centre/School of Earth and Environment & Sustainability Research Institute, University of Leeds, LS2 9JT, UK
[c] KEDGE Business School (Bordeaux), 680 Cours de la Libération, 33405, Talence, Cedex, France

ARTICLE INFO

Keywords:
Environmental impact price index
Inflation
Healthy and sustainable diets
Nutrition price index
Sustainable consumption
Sustainable food systems
Sustainability transition

ABSTRACT

The need for a transition towards healthy diets from sustainable food systems links into a multitude of accelerating social and environmental grand challenges including climate emergency, biodiversity loss and obesity. Governance for sustainable food systems is dominated by market-based approaches focusing on incremental change and centred on the idea of nudges, i.e., behaviour change interventions to promote pro-environmental minority behaviours. Yet, product price is often the primary driver for consumers, especially considering a highly volatile market environment, with a succession of major disruptions that have put additional strains on global food systems and have triggered Cost-Of-Living (COL) crises in many economies. This raises the question whether relative price increases have incentivized sustainable food consumption, or whether they have effectively served as a barrier for the transition to sustainability. Hence, we track prices of food products included in the UK consumer price inflation basket over a nine-year period. We develop two indices: the Environmental Impact Price Index and the Nutrition Impact Price Index to monitor the affordability of a healthy and sustainable diet. The indices provide a means of assessing the impact of changing prices on the nutritional value and sustainability of different food products. We select the food products found in the standard UK Consumer Price Index basket used to calculate inflation. We find the COL crisis period (2021–23) to have nudged UK consumers towards healthy and sustainable diets, but this is embedded in a long-term trend that has disincentivized healthy and sustainable food consumption.

1. Introduction

There is an urgent need for a transition to healthy diets from sustainable food systems which will lead to fewer deaths, and longer lives with better quality of life, as well as living within safe planetary boundaries (Willett et al., 2019; Springmann et al., 2018, Tilman and Clark, 2014). Food safety risks arising from climate change will also be minimized (Varzakas and Smaoui, 2024). The desired transition takes place in an increasingly volatile market environment, characterized by a recent succession of major disruptions such as Covid-19, large-scale violent conflicts and energy and food price inflation leading to the Cost-Of-Living (COL) crisis. Consumers are highly price-sensitive (Yue et al., 2024; Marian et al., 2014, Völckner and Hofmann, 2007), constituting an important barrier to the mainstreaming of sustainable food consumption (Simon et al., 2023; Leal Filho et al., 2019; Melovic et al., 2020). Lewis et al. (2024) and Fishlock et al. (2025) argue that low-income households are especially price sensitive with dependency on limited state welfare and are more in need of healthier diets due to higher diet-related diseases. A shift to healthier diets that is lower in overall cost will help these households (Bai et al., 2025). We investigate the impact of the COL crisis on UK food prices and examine whether relative price increases of healthy and sustainable diet alternatives have nudged consumers towards or away from sustainable food consumption.

For systemic change towards a more sustainable society that includes tackling some of the most pressing environmental problems such as climate change or biodiversity loss, there is need for a multi-level socio-ecological transition (Geels, 2011) through robust global frameworks (Goh et al., 2024). In the context of agri-food systems, according to leading theorists, this requires changes of “technology, policy, markets, consumer practices, infrastructure, cultural meaning and scientific knowledge […] by firms and industries, policy makers and politicians, consumers, civil society, engineers and researchers” (Geels, 2011 p.24). Others argue that children and adolescents should be key actors in this

* Corresponding author.
E-mail address: ralf.barkemeyer@kedgebs.com (R. Barkemeyer).

https://doi.org/10.1016/j.jenvman.2025.128185
Received 21 May 2025; Received in revised form 2 October 2025; Accepted 28 November 2025

Glossary

Environment
Environmental Impact Price Index (EIPI)
(Aggregated EIS for (i, t+1)/Aggregated EIS for (i, t))* 100.
Environment Impact Score (EIS)
$EIS_{i,\,t}$ Environment Impact Score for item i, at time t
Total Environment Score (TES)
TES_i Total Environment Score for item i

Nutrition
Nutrition Impact Price Index (NIPI)
(Aggregated NIS for (i, t+1)/Aggregated NIS for (i, t))* 100.
Nutrition Impact Score (NIS)
$NIS_{i,\,t}$ Nutrition Impact Score for item i, at time t
Total Nutrition Score (TNS)
TNS_i Total Nutrition Score for item i

transition for sustained change (Varela et al., 2024). One proposed systemic change is the transition to "healthy diets from sustainable food systems" as recommended by the EAT–Lancet Commission (Willett et al., 2019). The proposed diet is mainly plant-based where wholegrains, fruits, vegetables, nuts, and legumes dominate with meat and dairy playing a small part. The environmental and nutritional impacts of all kinds of food have been quantified through studies such as Poore and Nemecek (2018) and Harrington et al. (2019), with Li et al. (2024) finding that a reduction of 32.4 % of global carbon emissions by half of the overconsuming population could be achieved by this dietary shift. A comprehensive study of the environmental and nutritional implications of 57,000 UK food products by Clark et al. (2022) found that many nutritious foods are also environmentally sustainable.

Even though a transition of this magnitude requires decisive action by a range of governance actors (Geels, 2011), recent governance for sustainable food systems has been dominated by market-based approaches, with consumers playing a pivotal role in the transition towards sustainable food production and consumption modes (Springmann et al., 2021). They are expected to drive the demand for more sustainable food products and to incentivize companies to lower the environmental impacts associated with large-scale food production. The general idea is that of a transition characterized by incremental change to the range of available products with gradual mainstreaming of sustainable product alternatives, moving market participants towards more sustainable modes of production and consumption (Springmann et al., 2021; Vogel, 2005). Shoppers are becoming increasingly aware of the sustainability issues associated with their weekly shop and some more affluent shoppers have started to change their purchasing habits (Springmann et al., 2021).

Studies that focused on prices of retail food products have produced conflicting evidence on the link between price, environmental and nutritional impacts. Martinez et al. (2024) reviewed 181 countries but did not review nutritional implications found that more expensive foods have higher environmental footprints. On the other hand, a Swedish study found that the cost of nutritious diet had not increased between 1980 and 2012 (Håkansson, 2015). More recently, Mendoza-Velázquez et al. (2023) focusing on price inflation impacts on nutrition between 2011 and 2022 in Mexico showed that higher prices have an impact on healthy food affordability.

Overall, this raises a question as to how the prices of sustainable and non-sustainable food products are evolving, whether these changes incentivize more sustainable food consumption and how the COL crisis period impacted the transition to sustainable food systems. This is where our study is positioned. Utilizing a recent comprehensive dataset on the nutrition value and environmental impacts of UK food products (Clark et al., 2022) and combining it with real UK market price developments, we investigate how UK food prices have changed over the last decade. Our focus on consumers' shopping baskets and relative price increases in relation to (a) environmental impacts and (b) nutritional value allows us to explore the role of product price as a driver or barrier for the desired transition towards healthy diets from sustainable food products.

This paper is structured as follows. The next four sub-sections review how disruption events impact on food systems and how price indices can provide insights into the influence of such events (1.1); they also include further details about the definition of environmental sustainability (1.2) and healthy diets (1.3) as well as the policy instruments available to implement sustainable food consumption (1.4). Section 2 describes the data sources and calculations used to determine the two indices: Environmental Impact Price Index (EIPI) and the Nutrition Impact Price Index (NIPI). Section 3 presents results showing the changes in inflation over the nine-year study period (Jan 2015 to Dec 2023) together with price changes for individual price items within the Consumer Price Index (CPI) food basket and changes in different food categories during this time. Section 4 discusses the results and potential applications of the indices followed by our conclusion (Section 5) which summarises our work and highlights areas for further research.

1.1. Disruption events and Price indices

From both a UK and, in fact, a European perspective, recent years have been characterized by the co-occurrence of major disruptions such as Brexit, the Covid-19 pandemic and the Russia-Ukraine war, and a resultant rise in energy prices leading to the COL crisis (Table S1 shows the dates of these events). These crisis events have put additional strains on global food systems (Davies, 2020; Pörtner et al., 2022) and directly impacted food security in parts of the world (Mehrabi et al., 2022; Gaupp, 2020). Beyond food security, they can be expected to also have impacted the transition towards sustainable food systems. This study focuses on the COL crisis period (2021–23) as it may have unfolded a number of contradictory impacts on the uptake of healthy diets from sustainable food systems. On the one hand, consumer interest may have shifted from concern for the environment towards product affordability and, in turn, accelerated consumption of unsustainable product alternatives. Along similar lines, governance measures aimed at lowering the socioeconomic burden for low-income groups may have had the same effect (Zhong et al., 2025). On the other hand, the COL crisis may also have reduced food waste, increased interest in short food supply chains and more sustainable lifestyles and, hence, supported the transition to healthy and sustainable food systems (Grunert et al., 2023; Rodgers et al., 2020).

Price indices such as the CPI produced by the (ONS, 2023a) provide useful insights about the movement of prices over a given time frame and enable comparisons between different types of household items as well as food and drinks. Such indices are used to assess changes in the COL and help to inform monetary policy as well as assisting in the design of support policies for those in lower socio-economic groups (Grigoli and Pugacheva, 2024).

1.2. Environmental sustainability

There has been considerable discussion and debate as to what is considered a 'healthy and sustainable' diet. This is due, in part, to the definition of what 'sustainable' means in this context (FCRN, 2014). From an environmental perspective there are a range of impacts to consider including land use, greenhouse gas emissions, freshwater use, biodiversity loss, food waste, soil health, eutrophication potential, fertilizer use and pollution (Goss and Sherwood, 2024; Sharma et al., 2024; Şimşek et al., 2024; Zhang et al., 2022).

There are other factors to consider when deciding on what is deemed a 'sustainable solution'. For example, reduced land use through intensive livestock systems causes concern about animal welfare. There is also discussion about grass-fed animals being considered more sustainable than grain-fed (LIM et al., 2024; Magnusson et al., 2003, Sitienei et al., 2020; Stampa et al., 2020; Yiridoe et al., 2005) although Tilman and Clark (2014) show that grass-fed beef needs more land and produces similar GHG emissions as grain-feed beef. There is also confusion in terms of transportation where local reared animals are deemed preferable to imported meat. The main issue should be focussed on the animal rearing and feeding together with the land they live on. In terms of greenhouse emissions, transport contributes very little to the overall emissions total, with the bulk of these emissions coming from the animals themselves (methane) and the production of agricultural fertilisers to improve pastureland for these animals.

Organic production is not necessarily beneficial as more land is required to produce a given amount of food (Hodgson et al., 2010). There is considerable variation across the world between countries that have strict regulations on pesticide use (e.g. UK) and those that do not (e.g. China), so the differentials between the benefits of organic farming would be smaller in the UK than China (FCRN, 2014). From the nutritional perspective, there are very few studies that demonstrate organic foods' benefits though it is generally agreed that they have less pesticide residues or do not contain antibiotics in the case of organic beef. However, the wider adoption of regenerative agriculture practices can help soil health, increase biodiversity and mitigate climate change (Sher et al., 2024; Sharma et al., 2024; Garbisu et al., 2025).

1.3. Healthy diets

A further topic of discussion concerns the term 'healthy' and what this means in terms of nutrition (FCRN, 2014). There are a variety of views on what is deemed to be the optimum diet across the world and can vary with cultural preferences, local food availability as well as considerations as to whether the focus should be on vulnerable individuals or an average for a country's population. From other studies, it is evident that healthier food items tend to be more expensive (Hoenink et al., 2024; Rao et al., 2013; Rydén and Hagfors, 2011; Cade et al., 1999). It is not always clear why this is the case and further insights are needed in this area of research. According to Rao (Rao et al., 2013) who reviewed healthier foods and dietary patterns, part of the reason could be attributable to the existing food system whereby the focus, since WWII, has been on the production of cheap and high-volume food goods which tend to be highly processed, as well as availability and cultural acceptability of such foods. The relatively higher costs of healthy foods are a barrier to healthier eating especially amongst the poorest in society. There are also arguments that environmental sustainability and affordability should be added to dietary guidelines (Cai et al., 2024).

1.4. Policy instruments

From the policy point of view, there are potentially four types of policy instruments: market-based, information-based, regulatory, and nudging (Ammann et al., 2023) to ensure sustainable food consumption. These first two categories are often voluntarily implemented by food retailers including through multi-stakeholder initiatives (Ammann et al., 2023, Young et al., 2017). Economic incentives (such as price discounting and loyalty cards), as well as behavioural nudges (Thaler and Sunstein, 2008; Mertens et al., 2022), are playing an increasingly central role in attempts to change consumer behaviour (He and Li, 2025; Rai and Narwal, 2025). The information-based policy instrument is where product ecolabels and site-specific information (near product shelf in store, or as product information online) provide visual and textual cues to sustainability attributes compared to products without ecolabels. This may be the greenhouse gas emissions of the food product and can be effective (Sun et al., 2024; Wojnarowska et al., 2021). Alongside this, is the education of consumers on sustainability aspects of products.

In addition, the framing of marketing campaigns is often viewed differently by retailers and experts. For example, retailers interpret healthy and sustainable diets as being exclusive of meat and promote meat alternatives rather than reducing meat sales (Ytreberg et al., 2023; Trewern et al., 2021). Eco-labelled products and meat-free alternative products tend to be more expensive than conventional alternatives. As such, few retail food categories are dominated by eco-labelled products with a few notable exceptions such as eggs (free-range) and fish products (Marine Stewardship Council (MSC)) (Chintakayala et al., 2018, Young et al., 2017). Although plant-based diets overall are less expensive than meat heavy diets (Springmann et al., 2021), product price of individual food items continues to be of paramount importance when aiming to reach mainstream consumers.

Two regulatory policy instruments available to Government are taxes or subsidies, and the regulation of food products. These concern the governance of sustainable consumption except perhaps animal welfare standards. In terms of moving towards healthy diets from sustainable food systems they may include meat and dairy tax, and subsidies on fruit, vegetables, and pulses. Even a recent industry-led report on the transition of the food system to net zero, advocates that industry and government need to work together to agree a position on how to achieve significant reductions in red meat and dairy consumption (IGD, 2024).

The fourth category on behavioural nudges is often implemented by food retailers using tools commonly used for selling more products such as moving products to eye level or end-of-aisle or offering discounts. Nudges (also referred to as choice architecture interventions) (Mertens et al., 2022) move people through the design of specific choice environments towards a socially desirable behaviour and to promote pro-environmental minority behaviours (Lehner et al., 2016; Thaler and Sunstein, 2008; Demarque et al., 2015, Campbell-Arvai et al., 2012). More direct approaches include reformulation of product ingredients, only stocking products with third party ecolabels, or placing more sustainable products with conventional products.

Despite this diversity of possible interventions, market-based approaches have become increasingly dominant in the governance of sustainable food systems (Ammann et al., 2023; Springmann et al., 2021). Even though all these instruments arguably have a role to play in the transition to healthy and sustainable food systems, the overall picture remains incomplete if the impact of product price developments is not accounted for. Product price can be expected to play a pivotal role for the uptake of sustainable food consumption (Marian et al., 2014; Melovic et al., 2020), in particular for price-sensitive consumers (Bai et al., 2025; Fishlock et al., 2025).

To date, few studies offer comprehensive insights into the development of prices for healthy and sustainable food products, and offer somewhat conflicting findings. Whilst longer-term trends observed in the Swedish context might be somewhat encouraging in that the cost of a nutritious diet was found to remain stable between 1980 and 2012 (Fishlock et al., 2025), more recent years have been characterized by a multitude of large-scale disruptions and the resultant COL crisis, necessitating an updated analysis that also includes the environmental sustainability of food products. Utilizing a recent comprehensive dataset on the nutrition value and environmental impacts of UK food products (Clark et al., 2022), and combining it with real UK market price developments, our analysis sheds light on how prices for healthy and sustainable food prices have developed over time when compared to other product alternatives.

2. Data and methods

2.1. Study data

To establish UK price trends for the period 2015 to Dec 2023, we collected data from two main sources: ONS UK CPI data (ONS, 2023b; ONS, 2023c), together with the Retail Price Index (RPI) (ONS, 2023b), for all food items. For the purposes of this paper, we extracted the food and non-alcoholic drinks items (146 in total) and their respective prices.

We used the weights and sizes of these food items from the *UK Shopping Price Comparison Tool* (SPCT) (ONS, 2023d) (See Tables S2, S3 and S4 for the item weights, and adjustments for missing weights). The basket of goods used by the ONS, which changes slightly each year, can be found within its Appendix A (ONS, 2023). To account for the environmental sustainability and nutritional value of these food items we used data from the Clark et al. (2022) paper and combined these data with the retail price and consumer price indices to determine the change in sustainability over the period 2015 to 2023.

Our research setup is similar to e.g. Martinez et al. (2024) who have combined environmental impact data (using Petersson et al.'s (2021) dataset) and World Bank price data in order to explore pricing strategies of food retailers. However, we add to this body of research by exploring trajectories of food price categories during the Cost-of-Living crisis. Using Clark et al.'s (2022) environmental impact data also allows us to take a more comprehensive perspective on environmental sustainability, given that Petersson et al. (2021) restricted their assessment to two dimensions (carbon and water footprint). In addition, engaging with the UK context as one specific geography allows us to develop a more precise understanding of the actual price implications for typical mainstream consumers in this context, as proxied by the UK ONS CPI food basket.

Our underlying rationale for developing these indices is to more transparently monitor the affordability of a healthy and sustainable diet given that product price constitutes an important barrier to sustainable consumption (Marian et al., 2014; Melovic et al., 2020). The two indices we propose – Environmental Impact Price Index (EIPI) and the Nutrition Impact Price Index (NIPI) – therefore have the potential to prompt governance for sustainable food systems to pay more attention to product price as a driver of healthy and sustainable food consumption. If the price of products in a healthy and sustainable diet decreases relative to other food items included in the basket, then consumers will be incentivized to purchase these products because they are cheaper relative to conventional product alternatives.

There is considerable diversity in index measures, especially in the context of sustainability (Böhringer and Jochem, 2007; Ness et al., 2007). For the purposes of our study, and following the general principle of "less may be more" (Hsu et al., 2013), we developed a relatively simple measure consisting of environmental/nutrition value and product price. In a wider sense, our indices reflect an eco-efficiency rationale (Schmidheiny and Stigson, 2000). They also align with Oebel et al. (2024) study in which the authors applied hypothetical Value Added Tax levels to create 'true' food prices and showed how demand would shift towards organic food if organic food purchasing was incentivized by way of lower VAT. There are different methods for indices (Nardo et al., 2008, Guo et al., 2015). For the purposes of this study, we chose a relative measure, i.e. the percentage of differences over consecutive periods in line with Nardo et al. (2008). This choice was deemed appropriate as we were interested in price signals and relative progress compared to January 2015 as our benchmark. This also means that our two indices do not allow conclusions regarding actual sustainability per se and/or a certain threshold below which sustainability was to be achieved. We normalize using the same unit per CPI and env impact/nutrition value, respectively. Hence, the weighting of components is not necessary (but see appendix of Clark et al. (2022) for the weighting of environmental and nutrition dimensions applied in their dataset, which is also implicit in our data).

2.1.1. UK consumer Price indices and RPI data (ONS, 2023c)

We extracted CPI and RPI values from the ONS UK Consumer Price dataset for the period Jan 2015 to Dec 2023. This is a database of time series covering measures of inflation data including CPIH (Consumer Prices Index including owner occupiers' housing costs), CPI and RPI. Full details about each of these indices can be found in (ONS, 2023a). We downloaded data from the Consumer price inflation time series (ONS, 2023c) and extracted one of the following: the CPI Index; RPI: food; or RPI: Average price values; for each of the food items listed in the Shopping Price Comparison Tool. In all cases, the category in the dataset that provided the closest match to a given product was selected to extract price data. Preference was given to CPI Index data. The data extracted can be found within Supplementary Information file S2 (see *Prices* worksheet). This database contains all the index values and price values for the period Jan 2015 to Dec 2023. It lists each food item in the SPCT (ONS, 2023d) with its Consumer Price Index value for the period Jan 2015 to Dec 2023.

Note the COICOP (Classification of Individual Consumption According to Purpose) reference value was determined for each food item from the metadata worksheet contained within the data download file for the SPCT by matching the *item_ID* with the COICOP reference number. To track UK price levels, we extracted and plotted monthly ratio values, calculated from the totalled monthly indices for all food items relative to the totalled value for Jan 2015. Purchasing power is the inverse of these values. The results are shown in Fig. 1 (see Supplementary Information File S2 *Prices*. To determine price changes for each food item between the 2015 to 2023 period under study, we averaged the monthly index values for Jan 2023 to Dec 2023 and divided them by the average value for the Jan 2015 to Dec 2015 period, to obtain a ratio value. This value was then ranked to highlight food items with the greatest change in price during the study period (se Supplementary Information File S2 *Top-Bottom Prices*). In addition, we calculated a ratio value for all the CSI food basket items within each COICOP3 food category (see details about COICOP in the following section), as well as calculating a six-month moving average for each of the eight food categories (See Supplementary Information file S2 *Prices*).

2.1.2. COICOP matching

The United Nations (UN) references specific household expenditure items, including food, through its international Classification of Individual Consumption According to Purpose (COICOP) classification scheme (UN, 2018). This scheme allocates specific items a COICOP number, at up to five levels with increasingly detailed information. Within the CPIH classification file (ONS, 2023b) the COICOP reference numbers for COICOP level 4 (*coicop4_id*) and level 5 (*coicop5_id*) are listed together with the *item_id* used in the Shopping Price Comparison Tool (SPCT) (ONS, 2023d) for individual food items. COICOP is particularly useful for grouping different food items into one category. Food (Division 01), which includes food (01.1) and non-alcoholic beverages (01.2) also contains food items grouped by source (e.g., cereal, meat, seafood). Raw primary commodities are at the top of the hierarchy within each group, followed by processed commodities and preparation of composites. A new class for ready-made food and other food goods not elsewhere classified (*n.e.c.*) has also been introduced to Division 01. In this paper, and following on from the ONS, we use COICOP levels, COICOP3 (class) and COICOP4 and COICOP5 (subclasses) within the food division COICOP1. We use this *item_ID* to allocate COICOP reference numbers to the food items in the SCPT and to enable us to group these items under COCIOP4 which we simplified for data analysis to eight different food categories (Confectionary, Dairy, Fish, Fizzy Drinks, Fruit. Meat, Vegetables, and Other). Note that potatoes and pulses are included in *Vegetables* and olive oil, ready meals, baby powder and protein powder in *Other*. For further details see next section, 2.1.3.

2.1.3. UK Shopping Price Comparison Tool (SPCT) (ONS, 2023d)

The full CPI dataset contains more than 500 items currently in the consumer prices basket used to capture inflation. The SPCT is based on a selection of food items from this dataset. These items are representative of foods bought in the UK which influence the inflation indices. The SPCT uses the latest available inflation indices to show price movements of individual items in the consumer price basket and is updated monthly. The items themselves are updated in March each year to reflect the annual revisions in the inflation basket. Detailed information about the SPCT can be found from the ONS (ONS, 2023d). We identified all the

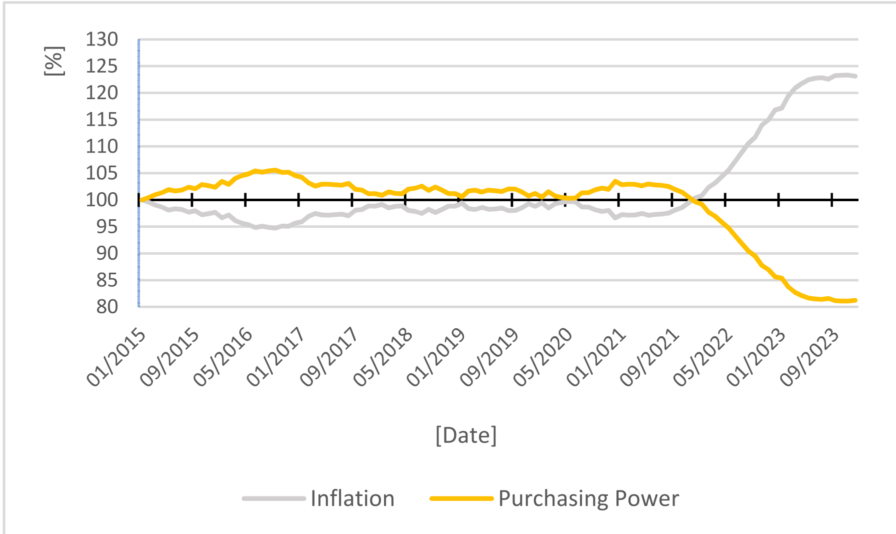

Fig. 1. Tracking the UK inflation basket (January 2015 = 100). Tracked is the aggregate of all 146 food items included in the UK Office of National Statistics Consumer Price Inflation basket.

food and drinks items, and their associated weights and sizes used by the ONS (see Table S2) for the SPCT by using the selection box on the web site. Table S3 shows the procedures to calculate the weights when no size or weight information was provided. Table S4 shows the weight calculations for bread rolls, sponge cake and individual cakes. It was also possible to determine the *Item_Id* values of these items, and these were matched with the COICOP reference numbers, *coicop4_id* (class) and *coicop5_id* (subclass), listed within the CPI classification dataset (ONS, 2023b). We used the COICOP4 categories to group the food items into 11 categories.

We used the data download facility on the SCPT website to download all items (including food and drink) used by ONS for the CPI. We then extracted all the food and non-alcoholic drink items using the Excel *data filter* option on the COICOP2 *Food and non-alcoholic beverages* column; COICOP 4 contains the following ten categories: *Bread and cereals; Coffee, tea and cocoa; Fish; Fruit; Meat, Milk, cheese and eggs; Mineral waters, soft drinks and juices; Oils and fats; Sugar, jam, syrups, chocolate and confectionery; Vegetables including potatoes and tubers* together with *Food products (nec)*. For our analysis, and to highlight changes in specific food categories (e.g. fruit, vegetables and meat), we simplified these headers into eight food categories: *Confectionary*, *Dairy*, *Fish, Fizzy Drinks (soft drinks), Fruit, Meat, Vegetables, Other* (See Table S5).

2.2. Data calculations

2.2.1. Inflation calculation

A price index can be used to measure inflation in several ways; the most common is to look at how the index has changed over a year, which is calculated by comparing the price index for the latest month with the same month a year ago. In this case, we are interested in monthly inflation changes relative to the start of the period: Jan 2015. We divide the total price index value ($TotPI_{(t+1)}$) for the 146 food items for the current month by the total price index value for January ($TotPI_1$). January 2015 is set to 100 (ONS, 2019; Ons, 2023a; ONS, 2023c; ONS, 2024).

Total price indices, at time, *t*, ($TotPI_t$) = sum of the Price Index values extracted from the ONS (CPI or RPI): ($PI_{i,\,t}$), where $i = 1$ to 146, and t = 1 (Jan 2015) to t = 108 (Dec 2023);

$$\text{For Jan 2015}, t = 1, i = 1 \text{ to } 146, \quad TotPI_1 = \sum_{i=1}^{i=146} PI_{i,1} \tag{1}$$

Inflation, Inf_t = total price indices for time (t+1)/total price indices at time (t) × 100 for all food items.

$$\text{Jan 2015}, t = 1, \mathrm{Inf}_1 = 100 \tag{2}$$

$$\text{Feb 2015}, t = 2, \mathrm{Inf}_2 = \frac{TotPI_2}{TotPI_1} \times 100 \tag{3}$$

2.2.2. Purchasing power calculation

Purchasing power (PP_t) is the inverse of price levels. As price levels increase then purchasing power decreases.

Purchasing power (PP_t) = total price indices at time (t)/total price indices for time (t+1), × 100 for all food items

$$\text{Jan 2015}, t = 1, \mathrm{PP}_1 = 100 \tag{4}$$

$$\text{Feb 2015 } t = 2, PP_2 = \frac{TotPI_1}{TotPI_2} \times 100 \tag{5}$$

2.2.3. Calculation of price changes between Jan 2015 and Dec 2023

To determine the price changes (ΔP) between the start (Jan 2015) and end of the study period (Dec 2023), for each product the average price index for the period Jan 2023 to Dec 2023 was divided by the Jan 2015 to Dec 2015 average price index. The results are shown in supplementary file: Supplementary Information file S2 *Prices* and summarised in Table 1.

$$\Delta P = \frac{AvPrice(Jan2023 - Dec2023)}{AvPrice(Jan2015 - Dec2015)} \tag{6}$$

2.2.4. Calculation of six-month moving averages of the price indices for the eight food categories

We calculated the six-month moving average for each of the eight food categories (see Table S5 for food items included in each category): *Confectionary, Dairy, Fish, Fizzy Drinks, Fruit, Meat, Vegetables and Other* for the period Jul 2015 to Dec 2023. We did this to ensure that we were able to discern general patterns over time and between product categories. For example, the inflation value for July 2015 was calculated as the monthly average inflation values from January to June 2015. For each food category, *Dairy* for example, the total price indices for food items in this category were totalled for each month and adjusted for inflation ($\mathrm{DairyInf}_t$ where t = 1 to 108). This figure was multiplied by 100.

Table 1
Products with highest/lowest price increases (2015–2023).

Top 10		
01	Olive oil	+94.4 %
02	Baked beans	+82.7 %
03	Frozen breaded/battered white fish	+68.6 %
04	Dairy-free spread/margarine	+67.6 %
05	Granulated white sugar	+65.7 %
06	Frozen beef burgers	+65.7 %
07	Individual cakes	+64.7 %
08	Dairy spread/margarine	+63.9 %
09	Plain biscuits	+59.9 %
10	Semi skimmed milk	+59.7 %
Bottom 10		
137	Sweet potato	+5.0 %
138	Fresh boneless chicken breast	+4.4 %
139	Bacon	+3.7 %
140	Beef mince	+2.8 %
141	Microwavable rice	−2.9 %
142	Self-raising flour	−4.5 %
143	Baking potatoes	−5.4 %
144	White potatoes	−9.1 %
145	Whole rotisserie chicken	−13.6 %
146	Carrots	−14.1 %

Source: UK Office of National Statistics, Consumer Price Inflation (ONS, 2023b)

$$DairyInf_t = \frac{TotD_{(t=1,108)}}{TotD_1} \times 100 \quad (7)$$

where $TotD_t$ is the total of the price indices for food items within the Dairy category at time t

$DairyInf_1 = 100$

To allow for inflation for all food items these values were deducted from the total inflation for that month, Inf_t (Note that Jan 2015 = 100)

$$\text{For Feb 2015, } DairyInf_2 - Inf_2 \quad (8)$$

The six-monthly average value for Dairy items is calculated for t = 7 to t = 109

$$\text{For } t = 7, \text{ Average } (DairyInf_t - Inf_t) \text{ for } t = 1 \text{ to } 6 \quad (9)$$

$$\text{For } t = 8, \text{ Average } (DairyInf_t - Inf_t) \text{ for } t = 2 \text{ to } 7 \quad (10)$$

2.2.5. *Extraction of total environmental impact score and nutriscore from Clark et al. (2022)*

We used the weights (mass in grams or kilograms; millilitres or litres) and sizes (packets, number of items) of the CPI food items (see Table S1) to evaluate their environmental sustainability and nutritional content, using *the scaled environmental impact score* and *scaled nutriscore* values calculated by (Clark et al., 2022). These values were then multiplied by the appropriate price index ($PI_{i,t}$), for each month to provide an indicator as to how price fluctuations influence the overall sustainability and nutritional values over the study period. Further details about the calculations are provided in the following sections.

2.2.6. *Calculation of Total Environmental score (g/ml) for each CPI food item*

Total Environmental score (TES_i) for a CPI food item mass (g) (i),

$$TES_i = ES_i/100^* M_i \quad (11)$$

where, Environment score for 100g of food item, i, (value from Clark et al. (2022)) = ES_i; mass of CPI food item, i (g/ml) = M_i

A high score depicts an item that is deemed to have a low sustainability value, and a low score depicts a highly sustainable item.

2.2.7. *Calculation of the Environment impact score and Environment impact Price index*

The Environment Impact Score (EIS) determines the monthly changes in sustainability influenced by the price indices from the value set in Jan 2015. We assume that the product amount in Dec 2023 is the same as in Jan 2015.

For the period Jan 2015 to Dec 2023, we calculate the Environment impact score (EIS) for each food item, i, for time-period, t (t = 1, Jan 2015, t = 108, Dec 2023)

$$EIS_{i,t} = TES_i \times (Price_{i,(t+1)} / Price_{i,t}) \quad (12)$$

where $Price_{i,1}$ = Price of item, i, in base period (t = 1)

where $Price_{i,t+1}$ = Price of item, i, in period t+1.

The aggregated $EIS_{146,t}$ for all food items for a given time period, t, which in this case is monthly is:

$$\sum_{i=1}^{i=146} EIS_{i,t} \quad (13)$$

Environmental Impact Price Index for time, t, for time, t, for all food items is adjusted relative to January (=100)

(i = 146, t = 0 to 108), EEIS $_{146,t}$

$$EIS_{146,t} = \sum_{i=1}^{i=146} EIS_{i,t+1} \Big/ \sum_{i=1}^{i=146} EIS_{i,t} \text{x } 100 \quad (14)$$

2.2.8. *Calculation of Total Nutrition score (g/ml) for each CPI food item*

Total Nutrition score (TNS_i) for a CPI food item mass (g) (i),

$$TNS_i = NS_i/100^* M_i \quad (15)$$

where, nutrition score for 100g of food item, i, (value from Clark et al. (2022)) = NS_i; mass of CPI food item, i (g/ml) = M_i

A high score depicts an item that is deemed to have a low nutritional value, and a low score depicts a highly nutritional item.

2.2.9. *Calculation of nutrition impact score*

The Nutrition Impact Score (NIS) determines the monthly changes in nutrition influenced by the price indices from the value set in Jan 2015. We assume that the product amount in Dec 2023 is the same as in Jan 2015.

For the period Jan 2015 to Dec 2023, we calculate the NIS for each food item, i, for time-period, t (t = 1, Jan 2015, t = 108, Dec 2023)

$$NIS_{i,t} = TNS_i \times (Price_{i,t+1} / Price_{i,t}) \quad (16)$$

where $Price_{i,1}$ = Price of item, i, in base period (t = 1)

where $Price_{i,t+1}$ = Price of item, i, in period t+1

where *TES* $_i$ = Total environmental score for food item, i, in CSI food basket.

The aggregated NIS $_{146.,t}$ for all food items for a given time period, t, which in this case is monthly:

$$\sum_{i=1}^{i=146} NIS_{i,t} \quad (17)$$

Nutrition impact score for time, t, for time, t, for all food items is adjusted relative to January (=100)

(i = 146, t = 0 to 108), $NIS_{146,t}$

$$NIPI_{146,t} = \sum_{i=1}^{i=146} NIS_{i,t+1} \Big/ \sum_{i=1}^{i=146} NIS_{i,t} \text{x } 100 \quad (18)$$

2.2.10. *Statistical analysis*

To calculate the variance between the different food groups in the period before COVID-19, during COVID-19 and for the COL period, we divided the whole price dataset (Jan 2015 to Dec 2023) into 3 periods and applied z-scores (*see SPSS output Kruskal-Wallis.pdf*). We conducted

Kruskal Wallis statistical tests to examine whether there were significant differences in median values between the three periods for either EIPI or NPI values. We chose non-parametric tests due to the non-normal distribution of our data. We compared pre-Covid-19, and COL, pre-Covid-19 and Covid-19 and the COL and Covid-19 (See Tables S6 and S7 for a summary of the statistical results for EIPI and NIPI respectively). The results are discussed in Section 3.

3. Results

3.1. Tracking UK inflation over time (2015–2023)

A first look at the data reveals that inflation has been skewed towards the latter end of the review period (Fig. 1). Prices remain largely stable until mid-2021, when a steep increase can be observed before a plateau is reached from early 2023 onwards. Overall inflation based on the CPI basket reaches 23.1 % by December 2023, which is the equivalent of a 19 % reduction in purchasing power throughout the review period. However, overall trends at the level of the CPI basket mask very heterogeneous price developments for individual products included in the basket. Prices for olive oil and baked beans have almost doubled between 2015 and 2023, whereas prices for carrots and whole rotisserie chicken have reduced in absolute terms by more than 10 % (Table 1). Prices for 140 out of 146 have increased within the review period.

Very different patterns and trajectories can also be observed at the level of product categories (Fig. 2). Shown is the extent to which selected COICOP product categories (see section 2.3) diverge from price developments of the overall CPI basket. A positive (negative) value denotes higher-than-average (lower-than-average) inflation level for a product category. There are three product categories that largely show lower-than-average inflation rates throughout the entire review period. Out of these, meat – as the product category associated with by far the highest environmental impacts – shows a continuous downward trend from mid-2016 onwards. Prices for vegetables generally fluctuate more, briefly reach a peak that aligns with overall inflation levels in mid-2019, and then start levelling off in the second half of the review period. Inflation levels of dairy products remain below the overall average until late 2022, but then show a marked increase and higher-than-average inflation compared to the overall basket throughout 2023. Fruit shows clear seasonal cycles and highest increase in terms of price development, before dropping off and reaching lower-than-average inflation for the first time in late 2023. Finally, fish shows relatively steady and higher-than-average price increases over time.

Comparing the trajectories of these product categories, these visibly volatile price changes are likely to trigger price-sensitive shoppers to incentivize a meat-heavy diet as fruit and fish have become relatively more expensive compared to 2015.

3.2. The environmental and nutritional impacts of different food products

There are marked differences in the environmental impacts associated with the different products included in the CPI basket; likewise, products differ significantly in their nutrition scores (Table 2). To take the example of beef mince as a product associated with a particularly high environmental impact: given that prices for beef mince only increased by 2.8 % between 2015 and 2023 – compared to an overall price increase of 23.1 % across all CPI items over the same period – this is likely to incentivize more purchases of beef mince relative to other CPI products and, in turn, increase overall environmental impacts of food shopping.

3.3. The environmental and nutritional impact of changing prices over time (2015–2023)

Along the same lines, consumer demand for products with a high nutrition value (and, hence, a low NutriScore in Table 2) will be moved

Table 2
Environmental scores and Nutrition Scores of selected CPI basket items.

CPI Item	Unit	Total environmental score	Total Nutrition score
Cereal bar	42 g	0.74	0.89
New potatoes	1000 g	2.85	10.67
Regular cola drink	2 L	4.52	69.80
Ice cream	1 L	16.58	34.20
Peanut butter	350 g	30.65	6.33
Fresh white fish fillets	1000 g	60.97	18.49
Cheddar cheese	1000 g	125.70	40.13
Whole milk	4 pints	127.02	62.40
Pork sausages	454 g	130.95	45.74
Beef mince	1000 g	630.02	20.00

CPI Item = Consumer Price Inflation basket item.
EnvScore = Environmental score per product unit where a lower score is more sustainable (data sourced from Clark et al. (2022)).
NutriScore = Nutrition score per product unit where a lower score is healthier (data sourced from (Clark et al., 2022)).

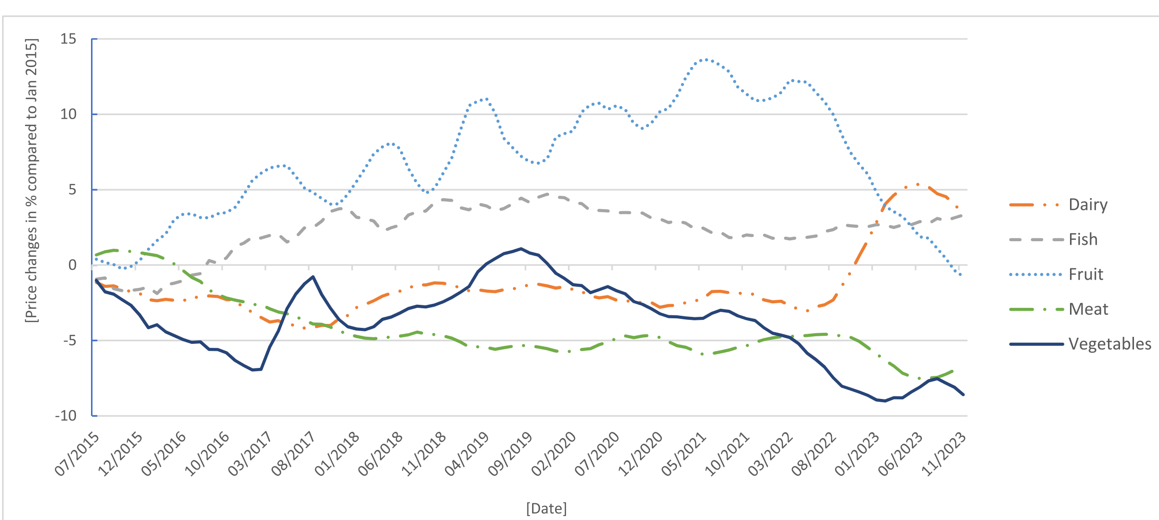

Fig. 2. Inflation at the level of COICOP product categories compared to overall CPI basket (January 2015 to December 2023). Price changes at the level of COICOP product categories are more volatile; for this reason, prices are shown as 6-month moving averages.

towards a more nutritious diet if price changes for these products remain below average inflation levels for the overall CPI basket. Conversely, consumers will be discouraged from having a more nutritious diet if nutritious products become relatively more expensive when compared to the overall CPI basket. We plotted the Environmental Impact Price Index and Nutrition Impact Price Index for the study period: January 2015 to December 2023. The results are shown in Figs. 3 and 4, respectively.

The overall trend of the Environmental Impact Price Index is a steady increase until Spring 2021, before levelling off alongside the unfolding COL crisis (Fig. 3). However, the Index score remains in positive territory even after this levelling-off effect, with a value of 103.8 in December 2023. The upward trend in EIPI is mainly driven by low meat prices, whereas the decrease in EIPI from Spring 2021) is mainly triggered by both falling prices for fruit and vegetables as well as price increases for dairy products.

In comparison to the Environmental Impact Price Index scores, changes in our Nutrition Impact Price Index scores over time are more modest (Fig. 4). Between 2015 and early 2022, the overall picture is one of stability, with scores close to 100. As the COL crisis unfolds, Nutrition Impact Price Index scores dip into negative territory and reach a level of 98.4 in December 2023. As such, price developments throughout the COL crisis may have functioned as a push towards healthier diets. Overall, however, prices for healthy and unhealthy food products have largely moved in parallel between 2015 and 2023.

From our statistical analysis, the groupwise comparisons performed between pairs of the three time periods, showed there was a significant difference between each pair of distributions for the EIPI. The results (Table S8) showed that over the longer term the EIPI is significantly higher in the COL crisis than the pre-Covid-19 period ($P = .008$) suggesting higher relative prices of sustainable items may have led to less incentive for consumer purchase. However, in the COL crisis period it is significantly lower than in the Covid-19 period ($P < .001$) which may have led to more sustainable products being attractive to price sensitive consumers Looking at the NIPI values for the whole period, the distribution of the index also differed across the categories with a slightly different trajectory to the EIPI. The COL crisis also has a positive impact but the overall trend is different to the EIPI in that the first two periods are very similar, ($P = .001$, $P = .0007$), then the index score falls away in last period ($P = .797$) where less nutritious items have come more expensive. These results are summarised in Table S9.

4. Discussion

Moving heavy meat eaters over to healthier and more sustainable diets would save 32.4 % of global emissions (Li et al., 2024). Despite concerns regarding their effectiveness (Buckley, 2020; Hummel and Maedche, 2019), nudges are commonly discussed as market-based incentives for healthier and more sustainable diets as part of the transition to sustainable food systems (Thaler and Sunstein, 2008; Lehner et al., 2016; Demarque et al., 2015, Campbell-Arvai et al., 2012). Yet, product price is often the primary driver for consumers, alongside quality and taste as well as habitual behaviours (Machín et al., 2020), for purchasing a particular food item (Steenhuis et al., 2011). For example, the high price of organic food is often seen as a barrier to purchase (Kushwah et al., 2019) and the sugar tax in the UK has moved consumers away from sugar-sweetened drinks (Fearne et al., 2022). The COL crisis has only increased the importance of price for consumers with reduced purchasing power, raising the question whether this will affect the ability of consumers to move to more healthy and sustainable diets.

Throughout the COL crisis in 2021–2023, prices of healthy and sustainable diet products have become relatively cheaper (Fig. 3) which is a positive incentive for price sensitive consumers to have healthy and sustainable diets. However, this is set against a very negative long-term trend that sustainable food products have experienced a marked price increase between 2015 and 2023 relative to non-sustainable product alternatives, which may be a disincentive for price sensitive consumers. This is likely to continue to be the case as the EIPI shows an upward trend.

The picture looks less bleak from a nutrition point of view, where prices for healthy and unhealthy food products have largely moved in parallel between 2015 and 2023 (Fig. 4) but remain expensive due to the COL price increase (Hoenink et al., 2024). This trend is comparable to Sweden (Håkansson, 2015) but a more recent study by Mendoza--Velázquez et al. (2023) in Mexico showed that COL higher prices have an impact on healthy food affordability. This will contunue to be have a bigger impact on lower income households as shown in Austriailian studies (Lewis et al., 2024; Fishlock et al., 2025) such as having less or more energy dense food (Robinson, 2023). The overall trends are largely driven by the fact that prices for meat products have decreased in

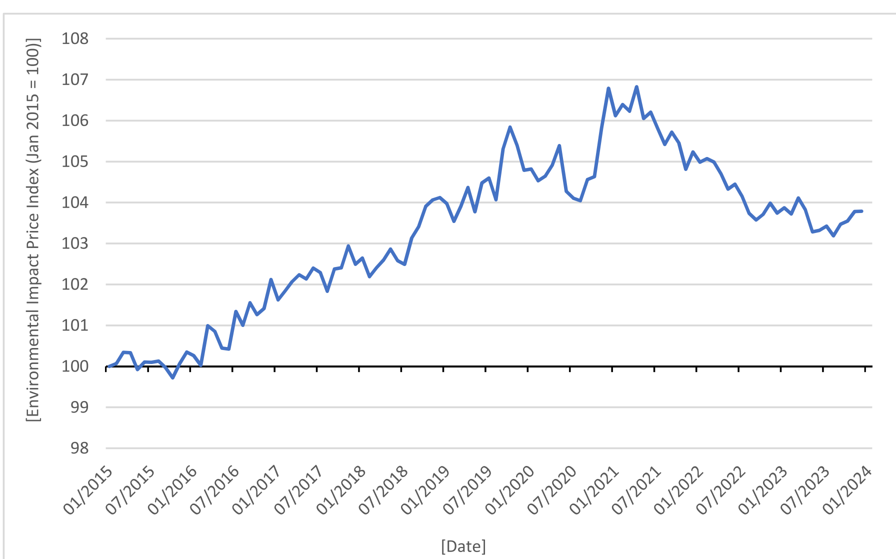

Fig. 3. Environmental Impact Price Index (January 2015 = 100). The Environmental Impact Price Index tracks price development of food products in relation to the overall CPI basket. An Environmental Impact Price Index score of above 100 indicates that products associated with high environmental impacts have become relatively cheaper when compared to the overall CPI basket, moving consumers away from sustainable food consumption.

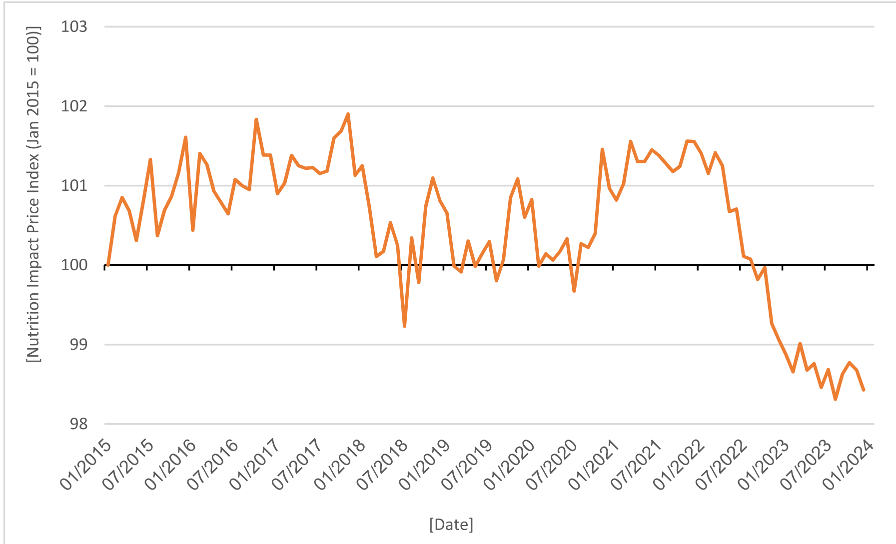

Fig. 4. Nutrition Impact Price Index (January 2015 = 100). The Nutrition Price Index tracks price development of food products in relation to the overall CPI basket. A Nutrition Price Index score of above 100 indicates that products associated with low nutritional value have become relatively cheaper when compared to the overall CPI basket, nudging consumers away from healthy and nutritious diets.

relative terms whereas prices for fruit and fish have experienced above-average price increases throughout the analysis period. Any meaningful transition towards healthy diets from sustainable food systems will inevitably need to entail a move away from meat-heavy towards more plant-based diets to help mitigate greenhouse emissions as well as to increase water quality and reduce land degradation.

Price alone cannot move consumers to cheaper vegetarian and vegan diets (Springmann et al., 2021) with still only 8 % of UK consumers who would classify themselves as such (Raven, 2022). However, meat-free alternatives and eco-labelled products tend to be more expensive than meat products. This illustrates the strong impact of habitual behaviours in the context of food consumption (Machín et al., 2020). Consumers suffering reduced purchasing power because of the COL crisis unfortunately have been found to consume less fruit and vegetables (Grunert et al., 2023), tallying with the general patterns identified in our study.

5. Conclusion

Extant research into nudges has highlighted the potential role of behavioural incentives to promote pro-environmental minority behaviours as part of the transition towards healthy diets from sustainable food systems (Lehner et al., 2016; Demarque et al., 2015, Thaler and Sunstein, 2008; Campbell-Arvai et al., 2012). Yet, it is important to note that beyond behavioural incentives, product price arguably continues to be of paramount importance when aiming to influence consumer behaviour. In other words, product price has the potential to be the most effective nudge in the toolset for a market-based transition to sustainable food systems especially for low income households (Bai et al., 2025).

Hence, in this study, we have explored UK price trends for the period January 2015 to December 2023, focusing on the 146 food items that are included in the UK consumer price inflation basket. Tracking relative price increases of healthy and sustainable diet alternatives has allowed us to examine whether consumers have been nudged towards or away from sustainable food consumption over this period.

From a sustainability point of view, we have found a modestly positive impact of the COL crisis (a fall of 2 points in the EIPI and 1 point in the NIPI), in fact nudging consumers towards sustainable food products. However, this is embedded in a markedly negative longer-term trend, showing that, sustainable food products have experienced a clear price increase between 2015 and 2023 relative to non-sustainable product alternatives (4 points rise in EIPI.) From a nutrition point of view, the overall picture is one of stagnation, both during the COL crisis and as a longer-term trend, where prices for healthy and unhealthy food products have largely moved in parallel between 2015 and 2023. In both cases, the overall trends are largely driven by a relative price decrease for meat products and a relative price increase for fruit and fish. These trends and patterns put prior literature on nudging (He and Li, 2025; Rai and Narwal, 2025) into perspective, showing that price developments for healthy and sustainable food products relative to non-sustainable product alternatives constitute a significant barrier for the desired transition to healthy diets from sustainable food systems.

Our study contributes in three main ways. First, we contribute to the relatively limited body of empirical research into price developments of healthy and sustainable food products (Håkansson, 2015; Martinez et al., 2024; Mendoza-Velázquez et al., 2023), by adding a recent UK perspective that integrates both nutrition value and environmental impacts of food products. Second, by doing so we provide a more balanced – and sobering – view of the effectiveness of market-based approaches in the transition towards healthy diets from sustainable food systems. As a third, applied contribution, we propose two indices (EIPI and NIPI) that allow for the monitoring of the affordability of a healthy and sustainable diet and, thus, have the potential to inform governance for sustainable food systems.

There are several implications from our results on the impact of crisis events on the transition toward sustainable food systems. Firstly, disruptions that cause the price of food to become volatile or to increase have primarily been restricted to fruit and vegetables. Hence strategies on the supply and retailer/consumer side of the supply chain should focus on these product categories. Secondly, behaviour change interventions to move consumers towards healthier and more sustainable diets should focus on price as a longer-term tool. This is especially acute when the wider COL crisis limits the purchasing power of consumers. Thirdly, the domestic strategy for growing fruit and vegetables as well as the subsidies to meat, needs to change to being more favourable. Finally, proactive policies are needed such as category-wide environmental labelling showing meat and dairy products as high impact and fruit and vegetables as low impact (e.g. see work of IGD Environmental Labelling (IGD, 2023) and Defra Food Transparency Data Partnership (Government, 2024)) and even a meat tax that had first been discussed in the late 1990s.

From a methodological point of view, the two indices presented in our study, the Environmental Impact Price Index, and the Nutrition Impact Price Index, provide policymakers and retailers with a simple and transparent measure for our attempts to move towards healthier and more sustainable food systems. These tools could also be used by current industry and pressure group behaviour change initiatives to encourage consumers to move towards healthier and more sustainable diets. It is worth noting that many prior initiatives have only been effective during the period of the campaign without any lasting impact except where price reductions were used (Thomas et al., 2023).

We are aware of several limitations to our research design. First, the price-demand relationship will not always be linear as has been assumed in our analysis. This may potentially restrict the predictive utility of the indices but this would require further testing. Hence, actual consumer purchases may not necessarily follow the patterns identified in this study. Nevertheless, we argue that relative price changes can be expected to prompt equivalent changes in consumption behaviour. Secondly, whilst we track price changes over time, we have treated nutrition and environmental impact scores as static, not accounting for possible changes in environmental impacts or nutrition scores throughout the period of analysis. Thirdly, we are restricted by the food items within the CPI basket which have been specifically selected to be representative of UK food purchases. It could be that these are not representative in terms of their environmental impacts. Finally, the data used for this study represents the UK context and may not be generalizable to other geographies. They are based on purchases for the home but other food outlets such as restaurants and sandwich bars supply food that have not been investigated here.

Our findings give rise to a number of promising avenues for future research building on our current study. First, more fine-grained analyses, e.g. distinguishing between eco-labelled and conventional product alternatives within the same product category, could help to shed further light on the role of product price in the sustainability transition. Second, the analysis should be extended to other geographies and (non-food) product categories in order to corroborate the findings reported in our study. Third, furtherwork needs to be undertaken to assess the validity of the indices and their accuracy in reflecting likely market pressures. If possible, this type of analysis should be complemented with real-life retail sales data in order to get a better understanding of consumer responses to both product price development as well as other nudging strategies.

CRediT authorship contribution statement

Susan E. Lee: Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **C. William Young:** Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Ralf Barkemeyer:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This work was supported by the Consumer Data Research Centre, an ESRC Data Investment CDRC ES/S007164/1; ES/L011891/1.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvman.2025.128185.

Data availability

Data will be made available on request.

References

Ammann, J., Arbenz, A., Mack, G., Nemecek, T., El Benni, N., 2023. A review on policy instruments for sustainable food consumption. Sustain. Prod. Consum. 36, 338–353.
Bai, Y., Martinez, E.M., Yamanaka, M., Rissanen, M., Herforth, A., Masters, W.A., 2025. Climate impacts and monetary costs of healthy diets worldwide. arXiv preprint arXiv:2505.24457.
Böhringer, C., Jochem, P.E., 2007. Measuring the immeasurable—A survey of sustainability indices. Ecol. Econ. 63, 1–8.
Buckley, P., 2020. Prices, information and nudges for residential electricity conservation: a meta-analysis. Ecol. Econ. 172, 106635.
Cade, J., Upmeier, H., Calvert, C., Greenwood, D., 1999. Costs of a healthy diet: analysis from the UK Women's cohort study. Public Health Nutr. 2, 505–512.
Cai, H., Talsma, E.F., Chang, Z., Wen, X., Fan, S., Veer, P.V.T., Biesbroek, S., 2024. Aligning health, environment, and cost aspects of diets: identifying sustainable dietary patterns in China. Environ. Impact Assess. Rev. 106, 107531.
Campbell-Arvai, V., Arvai, J., Kalof, L., 2012. Motivating sustainable food choices: the role of nudges, value orientation, and information provision. Environ. Behav. 46, 453–475.
Chintakayala, P.K., Young, W., Barkemeyer, R., Morris, M.A., 2018. Breaking niche sustainable products into the mainstream: organic milk and free-range eggs. Bus. Strat. Environ. 27, 1039–1051.
Clark, M., Springmann, M., Rayner, M., Scarborough, P., Hill, J., Tilman, D., Macdiarmid, J.I., Fanzo, J., Bandy, L., Harrington, R.A., 2022. Estimating the environmental impacts of 57,000 food products. Proc. Natl. Acad. Sci. U. S. A. 119.
Davies, A.R., 2020. Toward a sustainable food System for the European union: insights from the social sciences. One Earth 3, 27–31.
Demarque, C., Charalambides, L., Hilton, D.J., Waroquier, L., 2015. Nudging sustainable consumption: the use of descriptive norms to promote a minority behavior in a realistic online shopping environment. J. Environ. Psychol. 43, 166–174.
FCRN, 2014. *What is a sustainable healthy diet? A discussion paper* [Online]Food Climate Research Network. Available: https://fcrn.org.uk/sites/default/files/fcrn_what_is_a_sustainable_healthy_diet_final.pdf. (Accessed 23 July 2020).
Fearne, A., Borzino, N., De la Iglesia, B., Moffatt, P., Robbins, M., 2022. Using supermarket loyalty card data to measure the differential impact of the UK soft drink sugar tax on buyer behaviour. J. Agric. Econ. 73, 321–337.
Fishlock, K., Gibbons, S., Walton, K., Kent, K., Lewis, M., Charlton, K.E., 2025. Affordability of habitual (unhealthy) and recommended (Healthy) diets in the illawarra using the healthy diets ASAP protocol. Int. J. Environ. Res. Publ. Health 22, 768.
Garbisu, C., Unamunzaga, O., Alkorta, I., 2025. Generating regenerative agriculture. Front. Sustain. Food Syst. 9, 2025.
Gaupp, F., 2020. Extreme events in a globalized food System. One Earth 2, 518–521.
Geels, F.W., 2011. The multi-level perspective on sustainability transitions: responses to seven criticisms. Environ. Innov. Soc. Transit. 1, 24–40.
Goh, E.V., Sobratee-Fajurally, N., Allegretti, A., Sardeshpande, M., Mustafa, M., Azam-Ali, S.H., Omari, R., Schott, J., Chimonyo, V.G.P., Weible, D., Mutalemwa, G., Mabhaudhi, T., Massawe, F., 2024. Transforming food environments: a global lens on challenges and opportunities for achieving healthy and sustainable diets for all. Front. Sustain. Food Syst. 8, 2024.
Goss, M.A., Sherwood, J., 2024. An absolute environmental sustainability assessment of food. Food Frontiers 5, 855–866.
Grigoli, F., Pugacheva, E., 2024. COVID-19 inflation weights in the UK and Germany. J. Macroecon. 79, 103543.
Grunert, K.G., Chimisso, C., Lähteenmäki, L., Leardini, D., Sandell, M.A., Vainio, A., Vranken, L., 2023. Food-related consumer behaviours in times of crisis: changes in the wake of the Ukraine war, rising prices and the aftermath of the COVID-19 pandemic. Food Res. Int. 173, 113451.
Guo, D., Defrancia, K., Chen, M., Filiatraut, B., Zhang, C., 2015. Assessing Sustainability: Frameworks and Indices (White Paper #3).
Håkansson, A., 2015. Has it become increasingly expensive to follow a nutritious diet? Insights from a new price index for nutritious diets in Sweden 1980-2012. Food Nutr. Res. 59, 26932.
Harrington, R.A., Adhikari, V., Rayner, M., Scarborough, P., 2019. Nutrient composition databases in the age of big data: foodDB, a comprehensive, real-time database infrastructure. BMJ Open 9, e026652.
He, A., Li, A., 2025. Intervention policies for promoting green consumption behavior: an interdisciplinary systematic review and future directions. J. Environ. Manag. 373, 123917.
Hodgson, J.A., Kunin, W.E., Thomas, C.D., Benton, T.G., Gabriel, D., 2010. Comparing organic farming and land sparing: optimizing yield and butterfly populations at a landscape scale. Ecol. Lett. 13, 1358–1367.
Hoenink, J.C., Garrott, K., Jones, N.R.V., Conklin, A.I., Monsivais, P., Adams, J., 2024. Changes in UK price disparities between healthy and less healthy foods over 10

years: an updated analysis with insights in the context of inflationary increases in the cost-of-living from 2021. Appetite 197, 107290.
Hsu, A., Johnson, L., Lloyd, A., 2013. Measuring Progress: a Practical Guide from the Developers of the Environmental Performance Index (EPI). Yale Center for Environmental Law & Policy, New Haven.
Hummel, D., Maedche, A., 2019. How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. J. Behav. Exp. Econ. 80, 47–58.
IGD, 2023. Environmental labelling for the UK food industry [Online]. Available: https://www.igd.com/Social-Impact/Sustainability/Reports/Environmental-labelling-for-the-UK-food-industry/32858. (Accessed 11 December 2023).
IGD and WRAP, 2024. Overview: a net zero transition plan for the UK food System [Online]. Available: https://www.igd.com/Social-Impact/Sustainability/Reports/Net-Zero-Transition-Plan-for-the-UK-Food-System/53058. (Accessed 12 November 2024).
Kushwah, S., Dhir, A., Sagar, M., Gupta, B., 2019. Determinants of organic food consumption. A systematic literature review on motives and barriers. Appetite 143, 104402.
Leal Filho, W., Skouloudis, A., Brandli, L.L., Salvia, A.L., Avila, L.V., Rayman-Bacchus, L., 2019. Sustainability and procurement practices in higher education institutions: barriers and drivers. J. Clean. Prod. 231, 1267–1280.
Lehner, M., Mont, O., Heiskanen, E., 2016. Nudging – a promising tool for sustainable consumption behaviour? J. Clean. Prod. 134, 166–177.
Lewis, M., Nash, S., Lee, A.J., 2024. Cost and affordability of habitual and recommended diets in welfare-dependent households in Australia. Nutrients 16, 659.
Li, Y., He, P., Shan, Y., Li, Y., Hang, Y., Shao, S., Ruzzenenti, F., Hubacek, K., 2024. Reducing climate change impacts from the global food system through diet shifts. Nat. Clim. Change 14, 943–953.
Lim, K.H., Nayga, R.M., Yang, W.E.I., 2024. Were consumers of plant-based beef substitutes buyers of organic or grass-fed beef? Insights from correlations in willingness to pay. J. Clean. Prod. 452, 142176.
Machín, L., Curutchet, M.R., Gugliucci, V., Vitola, A., Otterbring, T., DE Alcantara, M., Ares, G., 2020. The habitual nature of food purchases at the supermarket: implications for policy making. Appetite 155, 104844.
Magnusson, M.K., Arvola, A., Hursti, U.-K.K., Åberg, L., Sjödén, P.-O., 2003. Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour. Appetite 40, 109–117.
Marian, L., Chrysochou, P., Krystallis, A., Thøgersen, J., 2014. The role of price as a product attribute in the organic food context: an exploration based on actual purchase data. Food Qual. Prefer. 37, 52–60.
Martinez, E.M., Blackstone, N.T., Wilde, P.E., Herforth, A.W., Masters, W.A., 2024. Environmental impacts, nutritional profiles, and retail prices of commonly sold retail food items in 181 countries: an observational study. arXiv preprint arXiv: 2401.13159.
Mehrabi, Z., Delzeit, R., Ignaciuk, A., Levers, C., Braich, G., Bajaj, K., Amo-Aidoo, A., Anderson, W., Balgah, R.A., Benton, T.G., Chari, M.M., Ellis, E.C., Gahi, N.Z., Gaupp, F., Garibaldi, L.A., Gerber, J.S., Godde, C.M., Grass, I., Heimann, T., Hirons, M., Hoogenboom, G., Jain, M., James, D., Makowski, D., Masamha, B., Meng, S., Monprapussorn, S., Müller, D., Nelson, A., Newlands, N.K., Noack, F., Oronje, M., Raymond, C., Reichstein, M., Rieseberg, L.H., Rodriguez-Llanes, J.M., Rosenstock, T., Rowhani, P., Sarhadi, A., Seppelt, R., Sidhu, B.S., Snapp, S., Soma, T., Sparks, A.H., Teh, L., Tigchelaar, M., Vogel, M.M., West, P.C., Wittman, H., You, L., 2022. Research priorities for global food security under extreme events. One Earth 5, 756–766.
Melovic, B., Cirovic, D., Dudic, B., Vulic, T.B., Gregus, M., 2020. The analysis of marketing factors influencing consumers' preferences and acceptance of organic food Products—Recommendations for the optimization of the offer in a developing market. Foods 9, 259.
Mendoza-Velázquez, A., Guzmán-Rodríguez, M., Lara-Arévalo, J., Drewnowski, A., 2023. The Nutrient Rich Food Price Index: a nutrition-relevant adaptation of the Laspeyres price index to track the cost of affordable nutrient density. Front. Nutr. 10, 1107573.
Mertens, S., Herberz, M., Hahnel, U.J.J., Brosch, T., 2022. The Effectiveness of Nudging: a meta-analysis of Choice Architecture Interventions Across Behavioral Domains, 119. Proceedings of the National Academy of Sciences, e2107346118.
Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A., Giovannini, E., 2008. Handbook on Constructing Composite Indicators and User Guide.
Ness, B., Urbel-Piirsalu, E., Anderberg, S., Olsson, L., 2007. Categorising tools for sustainability assessment. Ecol. Econ. 60, 498–508.
Oebel, B., Stein, L., Michalke, A., Stoll-Kleemann, S., Gaugler, T., 2024. Towards true prices in food retailing: the value added tax as an instrument transforming agri-food systems. Sustain. Sci. 1–18.
ONS, 2019. Consumer prices indices technical manual, 2019 [Online]. Available: https://www.ons.gov.uk/economy/inflationandpriceindices/methodologies/consumerpricesindicestechnicalmanual2019. (Accessed 3 May 2023).
ONS, 2023a. Consumer Price inflation (includes all 3 indices – CPIH, CPI and RPI) QMI [Online]. Available: https://www.ons.gov.uk/economy/inflationandpriceindices/methodologies/consumerpriceinflationincludesall3indicescpihcpiandrpiqmi. (Accessed 15 May 2023).
ONS, 2023b. Consumer price inflation item indices and price quotes [Online]. Available: https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceindicescpiandretailpricesindexrpiitemindicesandpricequotes. (Accessed 9 August 2023).
ONS, 2023c. Consumer price inflation time series [Online]. Available: https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceindices. (Accessed 9 August 2023).
ONS, 2023d. Shopping price comparison tool [Online]. Available: https://www.ons.gov.uk/economy/inflationandpriceindices/articles/shoppingpricescomparisontool/2023-05-03. (Accessed 19 July 2023).
ONS, 2023. Consumer price inflation basket of goods and services: 2023 [Online]. Office for National Statistics. Available: https://www.ons.gov.uk/economy/inflationandpriceindices/articles/ukconsumerpriceinflationbasketofgoodsandservices/2023. (Accessed 12 March 2023).
ONS, 2024. Consumer price inflation, UK: december 2023.Price indices, percentage changes, and weights for the different measures of consumer price inflation [Online]. Available: https://www.ons.gov.uk/economy/inflationandpriceindices/bulletins/consumerpriceinflation/latest. (Accessed 7 February 2024).
Petersson, T., Secondi, L., Magnani, A., Antonelli, M., Dembska, K., Valentini, R., Varotto, A., Castaldi, S., 2021. A multilevel carbon and water footprint dataset of food commodities. Sci. Data 8, 127.
Poore, J., Nemecek, T., 2018. Reducing food's environmental impacts through producers and consumers. Science 360, 987–992.
Pörtner, L.M., Lambrecht, N., Springmann, M., Bodirsky, B.L., Gaupp, F., Freund, F., Lotze-Campen, H., Gabrysch, S., 2022. We need a food system transformation - in the face of the Russia-Ukraine war, now more than ever. One Earth 5, 470–472.
Rai, S., Narwal, P., 2025. Behavioral insights into sustainable food consumption: a perspective from self-determination theory, theory of reasoned action, and environmental engagement. J. Environ. Manag. 380, 125077.
Rao, M., Afshin, A., Singh, G., Mozaffarian, D., 2013. Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis. BMJ Open 3, e004277.
Raven, P., 2022. How many Britons will attempt a vegan diet and lifestyle in January 2023? [Online]. yougov.co.uk. Available: https://yougov.co.uk/society/articles/44871-how-many-britons-will-attempt-vegan-diet-and-lifes. (Accessed 9 December 2024).
Robinson, E., 2023. Obesity and the cost of living crisis. Int. J. Obes. 47, 93–94.
Rodgers, R.F., Lombardo, C., Cerolini, S., Franko, D.L., Omori, M., Fuller-Tyszkiewicz, M., Linardon, J., Courtet, P., Guillaume, S., 2020. The impact of the COVID-19 pandemic on eating disorder risk and symptoms. Int. J. Eat. Disord. 53, 1166–1170.
Rydén, P.J., Hagfors, L., 2011. Diet cost, diet quality and socio-economic position: how are they related and what contributes to differences in diet costs? Public Health Nutr. 14, 1680–1692.
Schmidheiny, S., Stigson, B., 2000. Eco-Efficiency: Creating More Value with less Impact. World Business Council for Sustainable Development.
Sharma, P., Sharma, P., Thakur, N., 2024. Sustainable farming practices and soil health: a pathway to achieving SDGs and future prospects. Discover Sustainability 5, 250.
Sher, A., Li, H., Ullah, A., Hamid, Y., Nasir, B., Zhang, J., 2024. Importance of regenerative agriculture: climate, soil health, biodiversity and its socioecological impact. Discover Sustainability 5, 462.
Simon, X., Copena, D., Pérez-Neira, D., 2023. Assessment of the diet-environment-health-cost quadrilemma in public school canteens. an LCA case study in Galicia (Spain). Environ. Dev. Sustain. 25, 12543–12567.
Şimşek, E.K., Kara, M., Kalipci, M.B., Eren, R., 2024. Sustainability and the food industry: a bibliometric analysis. Sustainability 16, 3070.
Sitienei, I., Gillespie, J., Scaglia, G., 2020. U.S. grass-fed beef producers: goal structure and reasons for enterprise selection. J. Agric. Appl. Econ. 52, 78–95.
Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., De Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M., Jonell, M., Troell, M., Declerck, F., Gordon, L.J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, H.C.J., Tilman, D., Rockström, J., Willett, W., 2018. Options for keeping the food system within environmental limits. Nature 562, 519–525.
Springmann, M., Clark, M.A., Rayner, M., Scarborough, P., Webb, P., 2021. The global and regional costs of healthy and sustainable dietary patterns: a modelling study. Lancet Planet. Health 5, e797–e807.
Stampa, E., Schipmann-Schwarze, C., Hamm, U., 2020. Consumer perceptions, preferences, and behavior regarding pasture-raised livestock products: a review. Food Qual. Prefer. 82, 103872.
Steenhuis, I.H.M., Waterlander, W.E., De Mul, A., 2011. Consumer food choices: the role of price and pricing strategies. Public Health Nutr. 14, 2220–2226.
Sun, X., Wang, R., He, P., Liu, B., 2024. Effects of environmental and nutritional labels on the dietary choices of consumers: evidence from China. Environ. Impact Assess. Rev. 105, 107407.
Thaler, R.H., Sunstein, C.R., 2008. Nudge: Improving Decisions About Health, Wealth, and Happiness. Yale University Press, New Haven, CT, US.
Thomas, M., Moore, J.B., Onuselogu, D.A., Dalton, A., Rains, T., Lowry, E., Sritharan, N., Morris, M.A., 2023. Supermarket top-up of Healthy Start vouchers increases fruit and vegetable purchases in low-income households. Nutr. Bull. 48, 353–364.
Tilman, D., Clark, M., 2014. Global diets link environmental sustainability and human health. Nature 515, 518–522.
Trewern, J., Chenoweth, J., Christie, I., Keller, E., Halevy, S., 2021. Are UK retailers well placed to deliver 'less and better' meat and dairy to consumers? Sustain. Prod. Consum. 28, 154–163.
UN, 2018. Classification of individual consumption according to purpose (COICOP) 2018 [Online]. Available: https://unstats.un.org/unsd/classifications/unsdclassifications/COICOP_2018_-_pre-edited_white_cover_version_-_2018-12-26.pdf. (Accessed 20 July 2023).
UK Government, 2024. Food data transparency partnership [Online]. Available: https://www.gov.uk/government/groups/food-data-transparency-partnership. (Accessed 9 December 2024).
Varela, P., De Rosso, S., Ferreira Moura, A., Galler, M., Philippe, K., Pickard, A., Rageliene, T., Sick, J., Van Nee, R., Almli, V.L., Ares, G., Grønhøj, A., Spinelli, S., Van

Kleef, E., 2024. Bringing down barriers to children's healthy eating: a critical review of opportunities, within a complex food system. Nutr. Res. Rev. 37, 331–351.
Varzakas, T., Smaoui, S., 2024. Global food security and sustainability issues: the road to 2030 from nutrition and sustainable healthy diets to food systems change. Foods 13, 306.
Vogel, D.J., 2005. Is there a market for virtue? The business case for corporate social responsibility. Calif. Manag. Rev. 47, 19–45.
Völckner, F., Hofmann, J., 2007. The price-perceived quality relationship: a meta-analytic review and assessment of its determinants. Mark. (Lond.) 18, 181–196.
Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., Declerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., DE Vries, W., Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Srinath Reddy, K., Narain, S., Nishtar, S., Murray, C.J.L., 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. Lancet 393, 447–492.
Wojnarowska, M., Sołtysik, M., Prusak, A., 2021. Impact of eco-labelling on the implementation of sustainable production and consumption. Environ. Impact Assess. Rev. 86, 106505.
Yiridoe, E.K., Bonti-Ankomah, S., Martin, R.C., 2005. Comparison of consumer perceptions and preference toward organic versus conventionally produced foods: a review and update of the literature. Renew. Agric. Food Syst. 20, 193–205.
Young, W., Russell, S.V., Robinson, C.A., Barkemeyer, R., 2017. Can social media be a tool for reducing consumers' food waste? A behaviour change experiment by a UK retailer. Resour. Conserv. Recycl. 117, 195–203.
Ytreberg, N.S., Alfnes, F., Van Oort, B., 2023. Mapping of the digital climate nudges in Nordic online grocery stores. Sustain. Prod. Consum. 37, 202–212.
Yue, M., Jin, S., Tindale, S., Vicario-Modroño, V., Sánchez-Zamora, P., Gallardo-Cobos, R., Newell-Price, P., Frewer, L.J., 2024. Segmenting consumers of meat and dairy products from five European countries: implications for promoting sustainable food choices. Sustain. Prod. Consum. 47, 47–58.
Zhang, Q., Dhir, A., Kaur, P., 2022. Circular economy and the food sector: a systematic literature review. Sustain. Prod. Consum. 32, 655–668.
Zhong, Y., Hu, Y., Wang, L., Jiang, F., Cui, S., 2025. The short-term impacts of the COVID-19 pandemic on takeaway dietary pattern, its environmental footprints, and nutritional quality. J. Environ. Manag. 380, 124823.