



**FIRST STEPS
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Ultra-processed foods (UPF) in the diets of infants and young children in the UK

WHAT THEY ARE, HOW THEY HARM
HEALTH, AND WHAT SHOULD BE
DONE TO REDUCE INTAKES



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What they are, how they harm health, and what needs to be done to reduce intakes

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FOREWORD

By Dr Chris Van Tulleken

At its heart, this report proposes something very simple: that young children should mainly eat real food rather than the ultra-processed milks, pastes, pouches, purées and snacks that presently make up a significant proportion of their diet.

The formal definition of ultra-processed food (UPF) is extremely long because it encompasses such a wide range of processing techniques and additives. But the most important part of the definition is the purpose of the food: profit.

Of course, making food for money is ancient, but the companies that now manufacture food for our children are obliged to make not just profit but to generate relentless growth for their owners, typically huge investment funds. This places a commercial pressure on these companies to design products using the cheapest possible ingredients, and that are engineered for excess consumption.

It's no surprise that these products are strongly associated with weight gain. This is why we find ourselves in the midst of a child health emergency, with UK children heavier on average than in almost any other country.

But weight gain is not the only way in which eating large amounts of UPFs harms children's bodies. As this report explains, these products also change children's long-term food preferences and have a huge range of effects on their bodies, including malnutrition and stunting: many children in the UK aren't just heavy for their age, they are also short.

No doubt the food industry will respond to this report. 'Industry' includes the companies themselves but also their representative bodies, plus the charities, scientists and doctors they fund, often opaquely. They'll say that more research is needed, that we cannot be sure about every product. They'll stall any policy that seeks to recommend reducing UPF intake with lawsuits. They'll continue to publish research that locates the problem elsewhere.

In doing this, they are behaving exactly like the tobacco industry – delaying, denying and claiming that they can be part of the solution.

They cannot be, because a reduction in UPF intake is an existential threat to the companies who manufacture these products.

The evidence around UPF is robust. It's not just a couple of trials, but hundreds of papers including prospective epidemiological studies, as well as other high-quality data showing wide-ranging harms using population data plus a vast and growing body of laboratory and clinical evidence.

The recommendation to feed children diets based on whole and minimally processed food is uncontroversial. Food made by diffusely owned transnational companies for the purpose of profit affects our eating habits and health in a very different way to food made at home for the purpose of love and nourishment. That will be an intuitive, self-evident truth to many people, and we now have the evidence to back it up.

Nevertheless, the recommendations of this report – though obvious steps in the right direction – will still be hard for both individuals and policy makers to implement. Thanks to the marketing efforts of the companies making these products, we have seen high UPF intakes for several generations in this country – to such an extent that it defines our food culture. Additionally, UPFs are typically cheap and quick. Many families will struggle with the increased demands on time, costs, equipment and skills that a switch to minimally processed foods will require.

The implications of this report will also be hard for policy makers to act on because of the tangled web of financial conflicts influencing our food system. Until all those who seek to reduce rates of diet-related disease refuse money from all institutions that profit from disease-inducing products, i.e. UPF manufacturers, the problem will not go away.

At the moment, UPF manufacturers have near total dominance over the entire food policy ecosystem in the UK. We need a revolution in terms of what our children consume, and this can only be achieved when we disentangle ourselves from the industry that profits from harming them. This doesn't mean that we stop speaking to industry or that we stop trying to understand them... but we can't take their money.

Instead, we urgently need to see policy makers engage fully with the wealth of evidence around UPF, and tackle the problem head-on, starting with reforming UK dietary recommendations, especially for babies and young children. The health of future generations demands urgent action now.

TERMINOLOGY USED IN THIS REPORT

HFSS: Commercially produced products defined as high in fat, salt and sugar according to the FSA Nutrient Profiling Model (developed for the media and communication regulator Ofcom, to inform broadcast advertising restrictions).

NOVA: A classification system for commercially-available foods and drinks based on level of processing. It was created in 2010 by the Brazilian academic Carlos Monteiro. For more detail, see page 20.

Ultra-processed food (UPF): Ultra-processed foods and drinks are the fourth category in the NOVA classification.

Breastmilk substitute: Any formula or milk drink marketed or presented as a total or partial replacement for breastmilk for feeding infants and children from birth to three years of age. This term can potentially and misleadingly imply that such products are equivalent to breastmilk.

Commercial milk formula: An alternative term to 'breastmilk substitute'.

Infant formula: Designed for healthy infants from birth to one year, meeting their nutritional needs in the first six months of life, and in the second six months alongside complementary foods. Products marketed as infant formula are subject to compositional, safety and marketing regulations for infant formula.

Follow-on formula: Milks marketed for feeding infants from six months to a year. Products marketed as follow-on formula are subject to compositional and safety regulations for follow-on formula.

Growing-up and toddler milks: Many infant formula companies extend their product range into the second and third year of life by marketing products as 'growing-up' and 'toddler' milks labelled as stage 3 and stage 4 'formula'. There are no specific compositional, marketing or labelling regulations for these products, which are considered unnecessary.

Marketing: Includes product promotion, distribution, selling, advertising, product public relations, and information services (WHO, 1981).

ACRONYMS

DHSC	Department of Health and Social Care	NPM	Nutrient Profile Model
DNSIYC	Diet and Nutrition Survey of Infants and Young Children	NSS	Non-Sugar Sweeteners
EFSA	European Food Safety Authority	PHE	Public Health England, a former executive agency of the DHSC which was dissolved in October 2021. Its health improvement functions were transferred to OHID (below)
FSA	Food Standards Agency	OHID	Office for Health Improvement and Disparities, part of DHSC
HFSS	High in fat, salt and sugar	SACN	Scientific Advisory Committee on Nutrition
NDNS	National Diet and Nutrition Survey	UPF	Ultra-processed food and drink
NPPM	Nutrient and Promotion Profile Model. Created by the WHO's Collaborating Centre in Nutritional Epidemiology at the University of Leeds, the tool checks commercial baby foods against WHO recommendations	WHO	World Health Organization

OVERVIEW

In 2018, the UK Government committed to halving childhood obesity by 2030 (DHSC, 2018). However, this target will most likely be missed due to a lack of consistent funding, the absence of evidence-based policy-making and increasing unchecked barriers to eating well. Simply put, the current Government approach is failing.

This policy report focuses on the extent to which the persistently high prevalence of childhood obesity is driven by ultra-processed foods (UPF). It builds on our 2021 report *Enabling children to be a healthy weight: What we need to do better in the first 1000 days*, and draws on our previous work on commercial baby foods and on additives.



CHILDHOOD OBESITY IN THE UK

Though obesity prevalence figures have fallen somewhat since their peak in 2020, they remain unacceptably high – nearly a quarter of children in England are already living with obesity or overweight by the time they start school (NHS Digital, 2022). Added to this, huge inequalities exist: in the most deprived areas, the prevalence of childhood obesity at age four to five (13.6%) is double that of the least deprived (6.2%). The situation appears even more concerning in Scotland and Wales (comparable data are unavailable for Northern Ireland).

Percentage of four- to five-year-olds living with obesity or overweight¹

22.3%
IN ENGLAND

24.1%
IN SCOTLAND

33%
IN SWANSEA
BAY UNIVERSITY
HEALTH BOARD,
WALES

¹ Figures for four- to five-year-olds in England, Scotland and parts of Wales (in the absence of national data) for the 2021/22 school year: England: living with obesity 10.1%, overweight or living with obesity combined 22.3% (NHS, Digital, 2022); Scotland: living with obesity 11.7%, overweight or living with obesity combined 24.1% (Public Health Scotland, 2022); Wales, Swansea Bay University Health Board: living with obesity 17.6%, overweight or living with obesity combined 33.0%; Wales, Aneurin Bevan University Health Board: living with obesity 18.3%, overweight or living with obesity combined 32.5% (Public Health Wales NHS Trust, 2022). No comparable data is available for Northern Ireland, however in 2019/2020, 6.9% of two-10-year-olds were living with obesity, and overweight or living with obesity combined was 25.2% (Department of Health, 2020).

Objective

To date in the UK, there has been no scrutiny of the extent to which foods and drinks given to infants and young children are processed, and the implications of ultra-processing on their diets and health. This report aims to address this knowledge gap and inform policy makers, politicians and peer organisations working in the field of infant and young child nutrition and health.

We hope our findings highlight the shortcomings of the current UK dietary guidelines – which focus on food groups

and nutrients but lack a clear steer on processing – and will help create consensus that the NOVA classification is an important complementary tool to evaluate the healthiness of our children's diets. We argue that, alongside food and nutrient-based approaches, NOVA should inform dietary guidelines for the early years, public health initiatives to reduce diet-related ill-health, as well as practical support for families in complementary feeding and helping their children to learn to eat well for life.

WHAT IS ULTRA-PROCESSED FOOD (UPF)?

UPF is the fourth category of the **NOVA classification** of commercial foods and drinks, created by Brazilian academic Carlos Monerrio and colleagues in 2010 and widely recognised by scientists and public health

authorities around the world.

NOVA groups foods according to the extent and purpose of industrial processing, and its four groups indicate progressive processing. It defines UPF as

“formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes, many requiring sophisticated equipment and technology” (Monteiro et al, 2019).

Summary of findings

How and what infants and young children are fed sets the trajectory for life-long health. Yet, for many, their diets are suboptimal; dominated by commercial milk formulas, commercial baby and toddler foods, and treat and snack foods, including products marketed for pre-school children using cartoons, bright colours, toys and promotions.

It is already agreed that the vast majority of these commercial products do not support public health recommendations for feeding in the early years, as shown in section 1. For commercial baby and toddler foods, this is in large part due to excessive free sugars and sweet taste, poor variety in texture and inappropriate and misleading marketing. Many products aimed at pre-school children are high in fat, salt and sugar.

As set out in section 2, new research now sheds light on the extent to which many of these products are also ultra-processed: all formulas are ultra-processed, and a high proportion of baby ‘finger foods’/snacks and baby cereals. However, UPFs exist across all commercial baby and toddler food categories and the extent of ultra-processing is underestimated due to reliance on looking at product labels for ingredient markers of ultra-processing.

UPFs marketed for infants and young children are ubiquitous, and they are also widely consumed, meaning the scale of the problem is large, as shown in section 3. Consumption typically starts in the first weeks and months of life, because the UK has a formula feeding culture. Thereafter, the frequent consumption of ultra-processed commercial baby and toddler foods is now normal across socio-economic groups. By aged two to five, UPFs account for nearly two thirds (61%) of the total mean energy intake of UK children – a higher proportion than their peers in the United States and Australia. And given the National Diet and Nutrition Survey data on which this estimate is based is at least a decade old, this could even be an underestimate.

The reasons why we should all be concerned about high levels of UPF consumption in the early years are discussed in section 4. A large and growing body of evidence now consistently links UPF-rich diets to a range of negative health outcomes, from infancy through to adulthood. What a mother eats and drinks while she is pregnant and breastfeeding, and what a child eats and drinks from birth, impact on the child's immunity, development and health, and can shape lifelong taste preferences and dietary habits. >

> The evidence implicating UPFs in ill-health is strongest for obesity and intermediate markers of obesity. It is largely observational but includes a very large number of longitudinal cohort studies which have adjusted for confounding factors, and some studies show a dose-response relationship. A tightly controlled randomised trial provides evidence of a causal association between UPF consumption and excess calorie intake and subsequent weight gain.

Multiple studies show that UPF-rich diets are linked to negative health outcomes independently of their poor nutrient profile and contribution to nutritionally imbalanced diets. It is likely that several overlapping and interacting mechanisms are at play, including that UPFs cause overconsumption, disrupt taste preferences in the early years, displace minimally and unprocessed foods needed for optimal growth, health and development, encourage unnecessary snacking, interfere with the healthy development of the gut microbiota, and have harmful effects due to containing certain additives and contaminants.

Along with health implications, the negative impacts of diets rich in UPF on infants and young children include avoidable damage to the environment which they are born into and will grow up in, as we highlight in section 5.

Section 6 explores the drivers of high UPF consumption by the UK's infants and young children, which reflects wider population-level shifts towards diets dominated by highly palatable, highly processed foods and drinks. Ultra-processed commercial baby and toddler foods are ubiquitous, hyper-palatable (linking to the known issues with their nutrition composition and ingredients) and convenient. They often imitate ultra-processed family foods and snacks, and may be cheap or perceived as cost effective.

A number of these drivers are even more pertinent given the current cost of living crisis faced by UK families.



Aggressive and misleading marketing overshadows all of the above, as companies position themselves as trusted experts on infant and young child feeding, whilst preying on parents' anxieties and exploiting weak or non-existent legal restrictions.

Lastly, in the context of all of the above factors promoting UPF consumption, the absence of explicit public health recommendations relating to UPF in the diets of infants and young children is of serious concern. What is more, efforts to reduce population-level consumption of high fat, salt, sugar foods inadvertently promote consumption of UPF.

THE COST OF LIVING CRISIS

We acknowledge that our call for urgent Government action on high UPF consumption comes in the midst of an unprecedented cost of living crisis, with the ability to afford food being a real concern for many families with young children.

However, it is not a straightforward case that UPFs are cheaper than nutrient-rich, less processed foods. Commercial baby and toddler foods commonly consumed in the early years are typically more expensive. We discuss this further in section 6. And instead of supporting the status quo – with children in the most deprived households left to consume the cheapest foods – we believe it is the Government's responsibility to ensure that all infants and young children have access to nutrient-dense diets that support their health and development. The Healthy Start and Best Start Foods schemes are directly relevant in that regard (see recommendation 4).

Despite ample evidence of the health and environmental harms of high levels of UPF consumption, the UK currently lacks a clear position on UPF. However, as shown in section 7, at least 10 countries around the world have recently updated their national dietary guidance to try to reduce UPF consumption. Guidance from Brazil, Mexico, Israel and France includes specific recommendations to reduce UPF consumption among young children.

The UK Government could learn from these nations, and could make use of the recently launched WHO Europe Nutrient and Promotion Profile Model tool which has the potential to prevent the inappropriate marketing of UPFs for the under-threes.



Conclusion and recommendations

The dominance of UPF in the diets of the UK's infants and young children is ultimately a food system issue, and should be tackled by the UK Government as part of a cohesive food policy that addresses the whole food system, encompassing poverty, inequalities, and access to healthy and sustainable diets.

However, specific actions focused on the early years are also warranted, and therefore we make the following seven recommendations to the UK Government. These take into account some of the likely drivers of high UPF consumption, draw on what other governments are doing, make use of available opportunities and existing initiatives, and build on our earlier recommendations for enabling children to be a healthy weight.

In our view, these seven actions (set out in further detail from page 77) would improve the food environment in which parents/carers are making decisions about when, what and how to feed their babies and young children, so that they are enabled to reduce their UPF intakes.

SUMMARY OF RECOMMENDATIONS TO THE UK GOVERNMENT:

- 1 Acknowledge the NOVA classification and update public health recommendations on infant and young child feeding to explicitly address food processing.
- 2 Regulate and enforce the composition, labelling and marketing of commercial baby and toddler foods and drinks, utilising the WHO Europe Nutrient and Promotion Profile Model.
- 3 Ensure parents/carers have easy access to independent information and practical guidance and support on complementary feeding, and feeding from one to five years of age. This requires proper investment in the health visiting service and Family Hubs (or equivalent services).
- 4 Ensure parents/carers on low incomes can afford to feed their infants and young children nutritious diets based on minimally processed foods and drinks by reforming the Healthy Start scheme for England, Wales and Northern Ireland.
- 5 Enable women who want to breastfeed by following through on existing commitments to increase access to breastfeeding support, extending that support universally, and upgrading and enforcing the UK law in line with the International Code of Marketing of Breastmilk Substitutes.
- 6 Invest in research on UPF consumption in the early years, including regular collection of comprehensive data on maternal, infant and young child feeding, and focused research on additives in commercial baby and toddler foods.
- 7 Acknowledge and promote the environmental benefits of diets based on minimally processed foods.

1 Feeding infants and young children: public health recommendations versus common practices

The first years of life set a child's growth and development trajectory, and have an impact on life-long health. This makes what and how infants and young children are fed critical for their health and development in both the short and long term.

This section summarises the UK's current public health recommendations in relation to feeding babies and young children up to age five, and examines the available data on what and how, in practice, this age group is being fed. Our analysis reveals that common feeding practices are suboptimal for many, with widespread use of commercial foods which do not align with public health recommendations, including many marketed for infants and young children.

1.1 Public health recommendations

MILK FEEDING

Infants have unique nutritional requirements because of their small size and rapid growth and development. In addition, their immature immune systems make them vulnerable to infections. Breastfeeding protects infant health (reducing risks of infectious diseases, diabetes, heart disease, asthma and obesity), and also maternal health (as mothers' risk of ovarian cancer, breast cancer and heart disease is reduced by breastfeeding) (Victora et al, 2016; Rollins et al, 2016; Horta et al, 2015). For these reasons, the UK's public health recommendations on infant feeding (SACN, 2018) mirror those of the WHO (WHO, 2023), promoting breastfeeding as optimal in infancy and beyond.

Where breastfeeding is not possible or desired, the only suitable alternative is infant formula until 12 months of age. Infant formula can meet an infant's nutritional requirements for adequate growth and development, but does not impart the immune benefits of breastmilk.

COMPLEMENTARY FEEDING, AND FEEDING ONE- TO FIVE-YEAR-OLDS

Recommendations on complementary feeding (i.e. the foods given alongside breastmilk or infant formula) and feeding children up to five years of age take into account their high energy and nutrient requirements relative to their size and rate of growth, which requires that they are fed nutrient-dense foods in small amounts

frequently, compared to older children and adults (see **box 1**¹).

These recommendations also acknowledge that eating skills and taste preferences develop during this period. Cultivating appropriate eating habits in the early years is important as they influence later food preferences (Schwartz et al, 2011; Golley et al, 2013). From the age of two, the population-level dietary recommendations outlined in the Eatwell Guide apply (PHE, 2016), but these are not appropriate in the first two years of life, when a diet initially based on breastmilk will be higher in some macronutrients which are needed for this period of rapid growth and development.

“Giving your baby a variety of foods, alongside breast or formula milk, from around 6 months of age will help set your child up for a lifetime of healthier eating. Gradually, you'll be able to increase the amount and variety of food your baby eats until they can eat the same foods as the rest of the family, in smaller portions.”

(NHS, 2022)

¹ SACN published draft guidance on feeding children aged 1-5 years in 2022 and this report is currently being finalised following public consultation (SACN, 2022). This means the current guidance summarised here will likely change in 2023, although not substantially.

BOX 1

UK PUBLIC HEALTH RECOMMENDATIONS FOR FEEDING INFANTS AND YOUNG CHILDREN¹

INFANTS

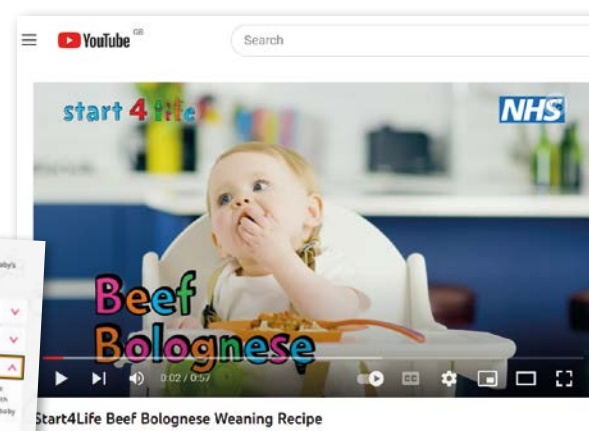
(birth to one year) (SACN, 2018; NHS, nd, a)

- Breastfeed exclusively until around six months of age and continue alongside solid foods when these are introduced (infant formula is the only suitable alternative to breastmilk for babies under one year of age)
- Offer a wide variety of solid foods (including iron-containing foods) in age-appropriate form at around six months, when the infant shows signs of developmental readiness
- Offer only breastmilk or infant formula and water to drink after six months of age, and encourage drinking from a free-flowing cup
- At first, offer single foods like vegetables and fruits (including those with bitter flavours), or baby rice with breastmilk/infant formula, once a day. Move towards three meals a day from seven to nine months onwards
- Do not provide snacks between meals; offer usual milk feeds instead
- Gradually diversify the diet, flavour and texture, including foods from all the food groups – vegetables, fruits, starchy foods (including whole grains), protein foods (including pulses) and dairy – in increasing amounts, offering a diverse range on multiple occasions to gain acceptance
- Offer finger foods to help baby get used to different textures and develop coordination
- Avoid adding salt and sugar.

YOUNG CHILDREN

(one year and up) (NHS, nd, b; NHS, 2019)

- Offer three meals a day and two healthy snacks, including a wide variety across the food groups. Offer one or two portions of protein-rich foods each day, some wholegrain starchy foods and include vegetables and fruit in every meal
- Offer the same foods as the rest of the family, in smaller portions and prepared age-appropriately
- Continue avoiding adding salt and sugar
- Continue to breastfeed for as long as desired
- Whole milk (or a suitable milk alternative) and/or breastmilk should be the main drinks, with water offered too. Infant formula is not necessary after the age of one, and 'growing-up' or 'toddler' milks are also unnecessary. Feeding from a bottle is discouraged. Limit consumption of 100% fruit/vegetable juices/smoothies to 150ml a day (dilute if given). Do not give squashes, flavoured milk and juice drinks, 'diet' and no added sugar drinks, fizzy drinks, tea and coffee
- From age two, gradually introduce more wholegrain foods, lower-fat dairy products and cut down fat in other foods.



RECOMMENDATIONS ON FOOD PROCESSING

These current public health recommendations focus on food groups and are largely nutrient-oriented. They do not include explicit advice to consider the level of processing when making food choices. Presumably this is mainly because the NOVA classification (see **section 2.1**) is relatively new and because, until very recently, limited evidence existed on the health effects of ultra-processing. Nonetheless, the recommendations imply a preference for minimal processing through the images used and suggested recipes and meal ideas. Commercial foods and drinks aimed at babies, toddlers and young children are not featured in the recommendations.

1.2 Common practices

It is likely that the current diets of many infants and young children in the UK fall short of public health recommendations for optimal feeding in a range of different ways. However, the true picture is unclear as much (but not all) of the nationally representative data² on the diets of the UK's infants and young children is now quite dated, especially with respect to the current product ranges being marketed at and for this demographic.

MILK FEEDING

Most mothers in the UK would like to breastfeed, but for various reasons most do not manage to do so for as long as they had wanted, or as is ideal (McAndrew et al, 2012), meaning the UK has a formula-feeding culture (see **figure 1**). The reasons for the steep drop-off in breastfeeding in the first weeks after birth are complex, but likely include a lack of support for breastfeeding at a societal level, as well as from family, peers and healthcare professionals (Wray and Garside, 2018), and inadequate legal protections and policies including maternity protections, workplace policies, and laws preventing misleading marketing of commercial milk formulas, bottles and teats (WHO and Unicef, 2022; Hastings et al, 2020). In addition, there is a socio-economic gradient in milk feeding practices, whereby breastfeeding is less common among younger white women, those in routine and manual occupations or those who have never worked (McAndrew et al, 2012).

Whilst infant formula is recommended for non-breastfed or mixed-fed infants, and only to one year of age, data from the UK Diet and Nutrition Survey of Infants and Young Children (DNSIYC) in 2011 reported that 18% of 12-18-month-olds were being given a 'growing-up' milk marketed for use from 12 months and up, and 16% were still being given 'follow-on formula' marketed for use from 6-12 months of age (Lennox et al, 2013).

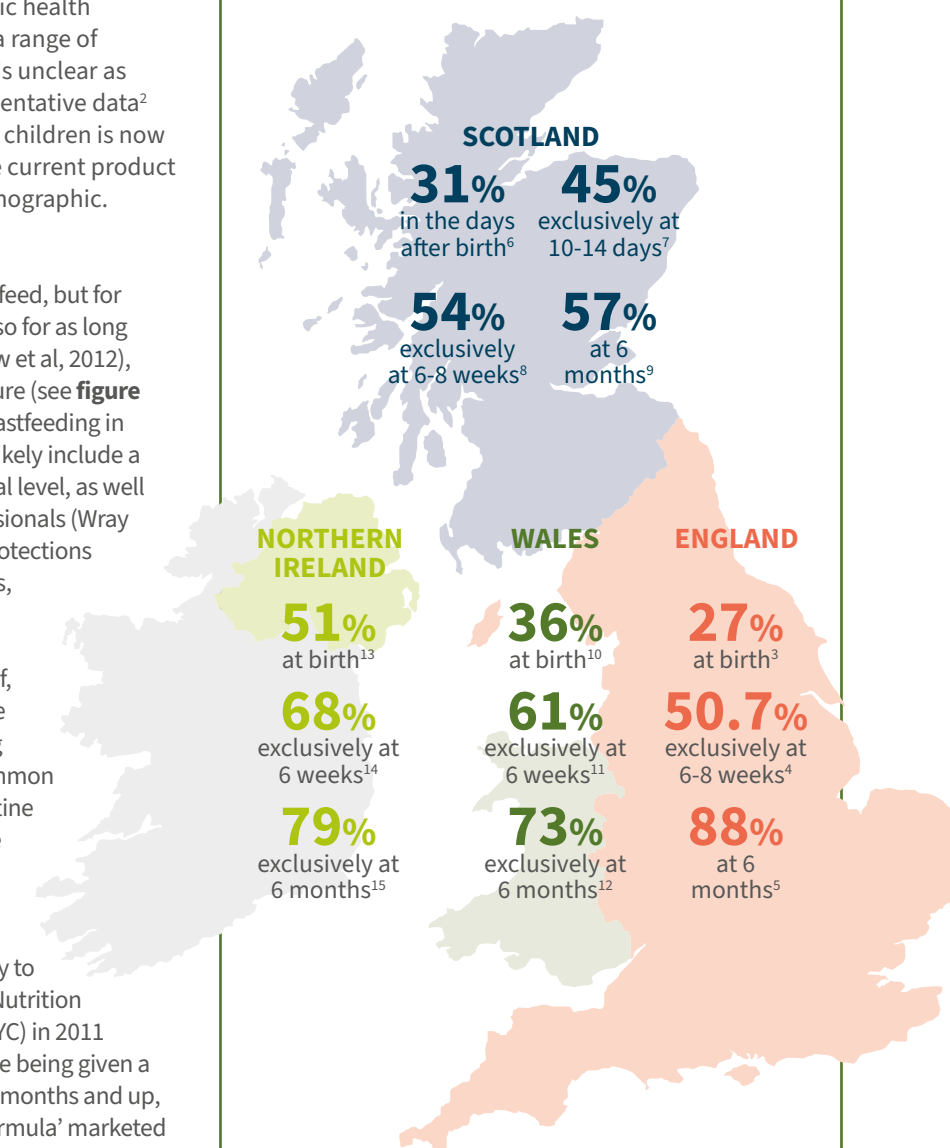
Box 2 outlines the main types of commercial milk formula on the UK market. More recent National Diet and Nutrition Survey (NDNS) data and market survey data also indicate unnecessary use of commercial milk formulas by some into the second, third and even fourth years (SACN, 2022; Mintel 2022). We explain what the NOVA classification means for commercial milk formulas in **section 2** and explore what is known about their consumption in **section 3**.

² The two key data sources are the last UK Infant Feeding Survey conducted in 2010 (reporting data on feeding from birth to 10 months) (McAndrew et al, 2012) and a one-off survey, the UK Diet and Nutrition Survey of Infants and Young Children (reporting data on feeding from 4 to 18 months) (Lennox et al, 2013) conducted in 2011. However, a 2017 maternal and infant feeding survey from Scotland (reporting data from the antenatal period to 12 months) (Scottish Government, 2018), UK market survey data (Mintel, 2022) and some limited but up-to-date national data on infant milk feeding (NHS Digital, 2023; OHID, 2023; Public Health Scotland, 2022; Welsh Government, 2023; HSC Public Health Agency, 2021) suggest persisting poor dietary practices. The National Diet and Nutrition Survey (NDNS), a continuous cross-sectional survey in children aged 18 months plus (Bates et al, 2020) also provides some information on young children's diets, which has recently been further analysed by SACN (SACN, 2022).

FIGURE 1

FORMULA-FEEDING TRENDS IN THE UK'S FOUR NATIONS

Percentages of babies likely fed with formula, inferred from the latest available breastfeeding statistics.



³ In November 2022 (NHS Digital, 2023), ⁴ In 2021/2022 (OHID, 2023), ⁵ In 2010 (McAndrew et al, 2012), ⁶ In 2017 (Scottish Government, 2018), ⁷ In 2021/22 (Public Health Scotland, 2022), ⁸ In 2021/2022 (Public Health Scotland, 2022), ⁹ In 2017 (Scottish Government, 2018), ¹⁰ In 2021 (Welsh Government, 2023), ¹¹ In 2021 (Welsh Government, 2023), ¹² In 2021 (Welsh Government, 2023), ¹³ In 2020 (HSC Public Health Agency, 2021), ¹⁴ In 2020 (HSC Public Health Agency, 2021), ¹⁵ In 2020 (HSC Public Health Agency, 2021)

BOX 2

COMMERCIAL MILK FORMULAS ON THE UK MARKET¹⁶

1 Infant formulas are designed for healthy infants from birth to one year, meeting their nutritional needs in the first six months of life, and in the second six months alongside complementary foods. These products are subject to nutrition composition, safety and marketing regulations (see **annex 1**). Products that adhere to the legislation are judged to be safe and able to sustain adequate growth and development.

2 Follow-on formulas are marketed for feeding healthy infants from six months to a year; however, the NHS recommends that formula-fed babies are given infant formula until 12 months of age, rendering these products discretionary. These products are subject to nutrition composition and safety regulations (see **annex 1**).

3 Growing-up milks/toddler milks are commercial milk formulas marketed as alternatives to whole cows' milk for children over one year old. They were created by industry to extend infant formula product ranges into the second and third year of life. However, they are not recommended by the NHS, which advises: *"There's no evidence to suggest that these products provide extra nutritional benefits for young children"* (NHS, 2023a). There are no specific nutrition composition, marketing or labelling regulations for these products. They can contribute substantial amounts of free sugars¹⁷ to the diet and accustom young children to the sweet taste and a flavour profile dissimilar to cows' milk (First Steps Nutrition Trust, 2021).



¹⁶ A fourth category comprises specialised infant milks for non-breastfed babies with medical conditions for whom infant formula is inappropriate. These milks can meet their nutritional needs in the first six months of life, and in the second six months alongside complementary foods and are regulated and marketed as foods for special medical purposes. These products are not for healthy infants and should be used under medical supervision, so are not discussed further in this report.

¹⁷ For the definition of free sugars see (Swan et al, 2018)

COMPLEMENTARY FEEDING

Many families introduce complementary foods before six months, contrary to public health recommendations. And many use commercial baby foods which are marketed from four months plus. Households from all socioeconomic groups buy commercial baby foods (PHE, 2019).

Commercial 'baby foods' are those marketed for infants (defined as under 12 months) and young children (defined as aged one to three years), making them subject to specific legislation (see **annex 1**), which in practice means products which include a suggested age for use on their labelling.

Section 1.3 describes the types of commercial baby and toddler foods and drinks on the UK market and summarises prior research exposing some of the ways in which they are unsuitable for their target consumers. In **section 2** we consider the extent to which these products are ultra-processed, in **section 3** the extent to which they are consumed and in **section 4** the health concerns of high levels of UPF consumption.

A recent survey by Office for Health Improvement and Disparities (OHID) among first-time mothers in England reported that 41% had already introduced solid foods by the time their baby was five months old (OHID, 2022). In the UK in 2010, 57% of mothers gave their baby 'baby rice' among their first taste of solids, 12% gave 'ready-made baby food' and 10% gave rusks (McAndrew et al, 2012).

"Households from all socioeconomic groups buy commercial baby foods"

(PHE, 2019)

The proportion giving the latter two product types increased to 44% and 14% respectively between the ages of eight and ten months (McAndrew et al, 2012), when adapted family foods are recommended. Data from Scotland indicate that commercial baby foods remain popular: in 2017, 87% of mothers of babies 8-12 months of age reported feeding them commercial baby foods, 41% at least five days a week (Scottish Government, 2018).

The use of commercial baby snack foods (described in **section 1.3**) is also commonplace, as well as giving other snack foods, despite all snacks being unnecessary for infants. Over a third (34%) of babies aged four to six months in the UK in 2011 were consuming commercial infant snacks, rising to 62% at age 7-9 months and remaining similar at 60% for babies aged 10-11 months (Lennox et al, 2013). In Scotland in 2017, nearly three quarters (74%) of 8-12-month-old babies were given one or more 'snack' or

'treat' foods daily, including chocolate buttons, ice cream, crisps or cheese puffs (Scottish Government, 2018).

These types of foods are not explicitly marketed for infants and young children (i.e. are not labelled with an age for use, which exempts them from complying with baby food legislation), but likely include products marketed at pre-school children through use of cartoons, toys and promotions. **Section 1.4** summarises the research we could find which exposes the issues with these types of products aimed at pre-school children in the UK. As for commercial baby and toddler foods and drinks, in **section 2** we explore the extent to which these products are ultra-processed. There is a lack of data to be able to describe the extent to which they are consumed, as explained in **section 3**.



41% of first-time mothers in England introduce solid food by five months

44% of babies in the UK aged between eight and ten months are given 'ready-made baby food'



34% of babies in the UK aged four to six months are given 'baby' snacks

74% of eight- to 12-month-old babies in Scotland are given 'snack' or 'treat' foods daily



FEEDING CHILDREN AGED ONE TO FIVE

Among young children in the UK in 2011, 40% were being given commercial infant snacks at 12-18 months and a third (32%) were given adult ready meals (Lennox et al, 2013). Among these children, commercial toddler foods and drinks contributed a similar proportion to their average total dietary energy intake as ‘biscuits, buns, cakes, pastries, pies and puddings’ (SACN, 2022). More recent NDNS data collected between 2016 and 2019 indicate that ‘biscuits, buns, cakes, pastries, pies and puddings’, ‘sugars, preserves and confectionery’, and ‘crisps and savoury snacks’ all contribute an increasing proportion of average daily total dietary energy intake as UK children age between one and five years (SACN, 2022). As above, these food categories are known to include specific products marketed to appeal specifically to pre-school children (see **section 1.4**).

Sweet drinks are consumed by many children from a young age. Close to half (46%) of children aged 12-18 months in the UK in 2011 were consuming low calorie (artificially sweetened) soft drinks and a quarter (26%) sugar sweetened soft drinks (Lennox et al, 2013). NDNS data from 2008 to 2017 revealed that, among the 65% of children aged 18 months to three years old who drank a low-calorie (artificially sweetened) soft drink during the four-day recall period, median consumption was 330g/day; which is equivalent to one whole can of soft drink (Bates et al, 2019). Comparable statistics for sugar-sweetened drinks were that 33% of 18-month to three-year-olds were consuming these, and the median intake was 134g/day.



1.3 Commercial baby and toddler foods and drinks on the UK market and how they are at odds with public health recommendations

The broad range of foods and drinks marketed for infants and young children can be classified in to three main categories (PHE, 2019) (the proportion of product types within are shown in **figure 2**):

BABY MEALS
including main meals, dry cereal/foods, desserts and breakfasts, fruit and vegetable first foods, soups and sauces, plus ‘others’, e.g. stocks



BABY FINGER FOODS,
including sweet, savoury and fruit and vegetable-based finger foods



BABY DRINKS,
including fruit juice drinks, smoothies and squash



These products are subject to legislation governing the use of specific ingredients and levels of certain nutrients and nutritional substances (though not nutrition composition), safety and some elements of labelling (see **annex 1**). However, the current regulations do not align with public health recommendations, and also allow the marketing of products in ways which challenge public health advice.

In 2019, Public Health England (PHE) published an analysis of sales and nutrition data for the UK baby food and drink market collected in 2017/2018¹⁸ (PHE, 2019). Their findings, and that of preceding research by us and others, highlight how the variety of available products and their market share poorly reflect public health recommendations for infant and young child feeding¹⁹.

Key issues relate to their nutrition composition and certain ingredients (in particular high free sugar content), taste (predominantly sweet), texture (many smooth), packaging (e.g. in pouches and for snacking) and labelling and marketing (including as healthier than their nutrition composition indicates). These issues are further described by product category below.

Whilst the PHE analysis did not consider the extent to which these products are processed or the impact of processing, our prior work has touched on this. We build on this work in **section 2** of this report, where we consider the extent to which commercial baby and toddler foods are ultra-processed.

BABY MEALS (76.1% market share)

- 36% of these products are marketed at children under six months (PHE, 2019), despite public health recommendations to introduce solids at around six months.
- Most are smooth, or smooth with lumps (Crawley and Westland, 2017) despite public health recommendations to introduce babies to varied textures.
- Many are packaged in pouches with nozzles. Sucking from pouches may harm teeth and encourage over-consumption (Westland and Crawley, 2018).
- Product names are often misleading regarding the range and balance of ingredients, including suggesting the product is savoury when the main ingredient is sweet (PHE, 2019).
- Fruit and vegetable-based first foods are typically high in free sugars (puréeing releases intrinsic sugars from the plant cell wall) giving them a sweet taste (Crawley and Westland, 2017; PHE, 2019; BDA, 2022). Only 15% comprise single vegetables or fruits (PHE, 2019), with sweeter fruits and vegetables often used to improve palatability (Garcia et al, 2013; 2015; Crawley and Westland, 2017), despite public health recommendations to introduce single fruits and vegetables when starting solids, starting with vegetables that are less sweet.

flavour biscuits, biscotti, wafers and rice cakes) have an average sugar content of 17g/100g due to the use of ingredients such as fruit juices, purées, concentrates and added sugar. PHE’s analysis revealed that, on average, sweet finger foods provide 12.8% of the estimated average energy requirement for a one-year-old, higher than the 10% recommended for snacks for children from one year and up.

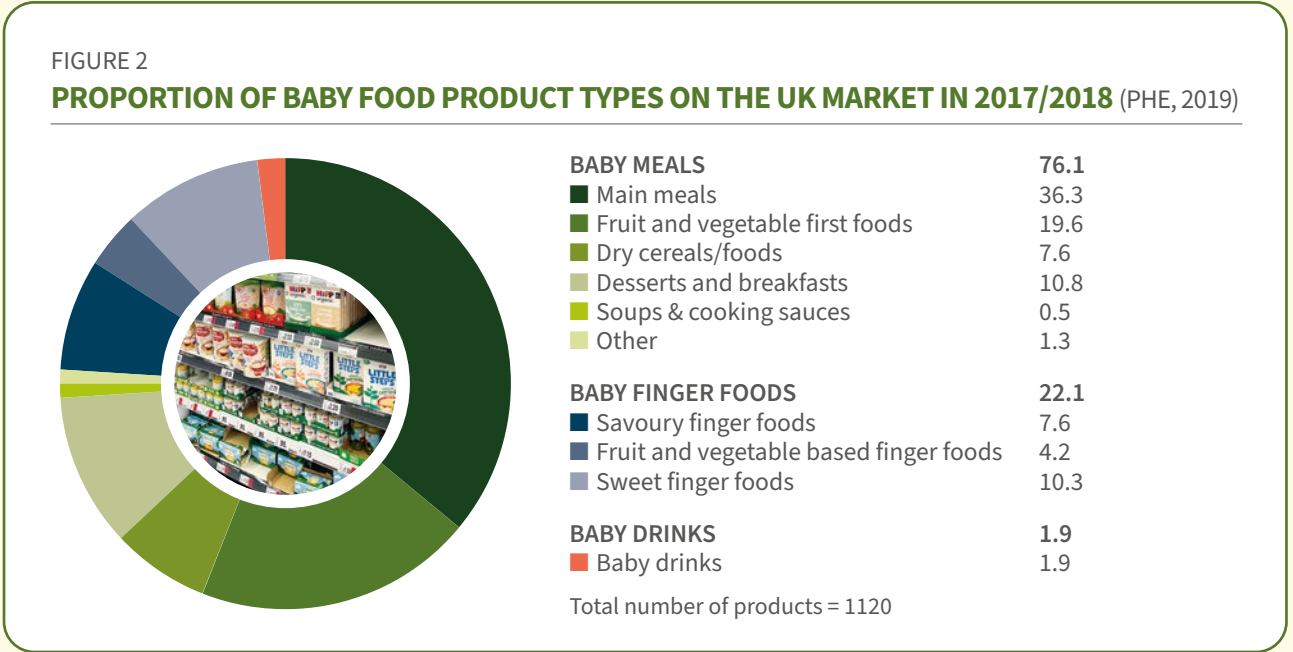
- Savoury finger foods (7.6% product share, includes puffs, breadsticks, rice cakes, biscuits, wafers and crisps) have the highest energy (441kcal/100g) and salt (0.35g/100g) of all the baby food categories.
- Fruit and vegetable-based finger foods (4.2% market share, includes vegetable-based crisps or puffs, or fruit-based finger foods such as bakes, bites or shapes) have the highest average sugar content of all the baby food categories, at 47.5g/100g (PHE, 2019). Processed dried fruit-based snacks marketed as fruit-equivalent may have sugar content similar to confectionery and are also at odds with public health recommendations to avoid dried fruit between meals (Sparks and Crawley, 2018).

BABY DRINKS (1.9% market share)

- Nearly three-quarters of fruit juice-based baby drinks are marketed for use under one year, despite advice to offer only breastmilk, infant formula or water as drinks from 6 to 12 months of age (PHE, 2019). The proportion of fruit juice in commercial baby drinks is between 15 and 50%, despite public health advice to dilute any fruit juice given to children aged 1-5 years to 10% juice.

FINGER FOOD²⁰ (22.1% market share)

- Often marketed as snacks and cultivating a snacking culture (PHE, 2019), despite the public health recommendation not to give infants snacks.
- Sweet finger foods (10.3% market share, includes fruit-



¹⁸ Products in the ‘baby’ aisle of retailers, plus some chilled/frozen products.

¹⁹ In 2019 WHO Europe published a study examining the commercial baby food products for sale in Bulgaria, Israel, Hungary and Austria which revealed many range of issues (WHO Europe, 2019). This is relevant as the majority of baby foods on the UK market are imported from European countries (FAO, 2021).

²⁰ It is our view that the term ‘finger foods’ used in public health recommendations has been co-opted by industry and these products would be more accurately defined as snacks.

1.4 Commercial foods and drinks marketed at pre-school children and how they are at odds with public health recommendations

A separate category of food and drink products featuring in the diets of pre-school aged children but also at odds with public health recommendations comprises products not labelled with a suggested age, but marketed to imply the target demographic, by using animated characters and child-friendly images, puzzles, games or activities, and/or the words 'kids/children'. This category is poorly defined and not subject to specific regulation – two probable reasons why it has not been subjected to the same level of scrutiny as commercial baby and toddler foods and drinks.

A survey conducted by Action on Salt and Action on Sugar in 2019 revealed that 51% of 526 foods and drinks marketed using cartoons could be classified as 'unhealthy' according to the Ofcom Nutrient Profile Model (DoH, 2011), being high in saturated fat, salt or sugar (Pombo-Rodrigues et al, 2020). Most commonly, levels of sugar were the issue, and three quarters of products were food categories that, according to the Eat Well guide, should be eaten less often and in small amounts, including biscuits, cakes, chocolate, confectionery and desserts.

Another survey of 332 food products for sale in the UK was conducted in 2017/2018 (including cereals/cereal bars, fruit snacks, fruit-based drinks, dairy products and ready meals), aimed at children from one year through a range of child-friendly themes and presented as healthy (through, for example, a claim on the label) (Garcia et al, 2019).

Most products were sweet: the fruit snacks, cereal bars and cereals were found to have high sugar content; and 41% of the surveyed products could be classified as 'unhealthy' according to the Ofcom Nutrient Profile Model (DoH, 2011). This is despite public health recommendations to avoid added sugar and salt in the diets of young children (Garcia et al, 2019). This study assessed the use of processed fruit ingredients which would classify products as ultra-processed, and the results are reported in **section 2**.

51% of foods and drinks featuring cartoons are 'unhealthy'



41% of products aimed at children and that claim to be healthy are in fact 'unhealthy'



“Cartoon animation and characters, which appeal to children, are being used by food manufacturers and retailers to sell unhealthy foods which are high in fat, salt and/or sugar. The majority of food and drink featuring this type of packaging come from categories that would not be recommended for frequent consumption.”

(POMBO-RODRIGUES ET AL, 2020)

2 Ultra-processed foods marketed for infants and young children



Section 1 showed how common feeding practices are suboptimal for many infants and young children in the UK. Widespread use of commercial milk formulas in place of breastfeeding undermines the unequivocal health benefits breastmilk provides; the use of commercial foods and drinks marketed for babies and toddlers does not align with public health recommendations and many young children are fed ‘family foods’ like chocolate, crisps and ice cream, some of which may be marketed to appeal to pre-school children through the use of cartoon characters, toys and promotions.

The suitability of commercial baby and toddler foods has been evaluated and found to be problematic in large part due to excessive free sugars and sweet taste, poor variety in texture, and

inappropriate and misleading marketing (which we examine more in section 6). Less attention has been paid to foods marketed for pre-school children, although available analysis indicates that these too are likely to be inappropriate in young children’s diets.

However, to date in the UK there has been no scrutiny of the extent to which foods and drinks given to infants and young children are processed, and the implications of ultra-processing on their diets and health. This section explains the NOVA classification, and the processes and ingredients used in the manufacture of ultra-processed foods. It reveals that a significant proportion of foods marketed for infants and young children in the UK can be classified as UPF.

2.1 What are ultra-processed foods (UPF)?

Ultra-processed foods (UPF) are foods and drinks in the fourth category in the NOVA classification of commercially-available foods and drinks. NOVA was created in 2010 by the Brazilian academic Carlos Monteiro and his colleagues (Monteiro et al, 2010). It groups foods according to the extent and purpose of industrial processing; its four groups indicate progressive processing (see **figure 4**) (Monterio et al, 2019).

The NOVA classification was designed in response to epidemiological data showing increased obesity and type 2 diabetes at population level even when purchases of dietary fat and sugar were decreasing (Monteiro et al, 2010). NOVA is recognised as a valid tool for public health and nutrition research and policy by the Food and Agricultural Organisation of the United Nations and the Pan American Health Organisation (Rauber et al, 2019). A number of food classifications systems based on food processing (González-Castell, et al, 2007; Asfaw, 2011; Eicher-Miller, et al, 2012) have been reviewed (Moubarac et al, 2014), but NOVA has been most widely applied in the scientific literature (Lawrence and Baker, 2019).

An increasing body of evidence linking high UPF intake with negative health outcomes has since resulted in 10 countries recommending the reduction of UPFs in their dietary guidelines. However, as highlighted in **section 1**, the classification of products as ultra-processed is not yet recognised nationally in the UK, including in guidance from the Scientific Advisory Committee on Nutrition (SACN) on Feeding in the First year of Life (2018) and in their latest (draft) guidance on feeding children aged one to five years (2022).

NOVA defines UPFs as “**formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes, many requiring sophisticated equipment and technology**” (Monteiro et al, 2019). The two key features guiding NOVA classification are therefore processes and ingredients. It does not distinguish products on the basis of nutrition composition, unlike traditional nutrient profile models focusing on fat, salt and sugar (DoH, 2011), one of the reasons the classification attracts criticism (see **box 3**).

BOX 3

CRITICISM OF THE NOVA CLASSIFICATION

This classification is contentious for several reasons. Key issues include (Fraanje and Garrett, 2019):

- Concern that the evidence base associating UPF consumption with negative health outcomes is at present largely observational (and association does not equal causation), along with a currently limited understanding of the mechanisms at play.
- Confusion around how products that do not have an ‘unhealthy’ nutrition composition can be considered harmful to health because they are ultra-processed. Related to this, confusion as to the logic of classifying products with comparable nutrition composition in different NOVA categories because one is home-made and one manufactured industrially.

We address these issues in **section 4**. In addition, it is relevant to note that while some object that the classification takes an ideological prejudice against the food industry (Fraanje and Garrett, 2019), others suggest that the food industry itself is driving criticism of NOVA through championing ‘nutritionism’ and a focus on single foods and single nutrients – mainly fat, salt and sugar – as a means to divert attention away from ingredients, additives and processing techniques (Scrinis, 2020).



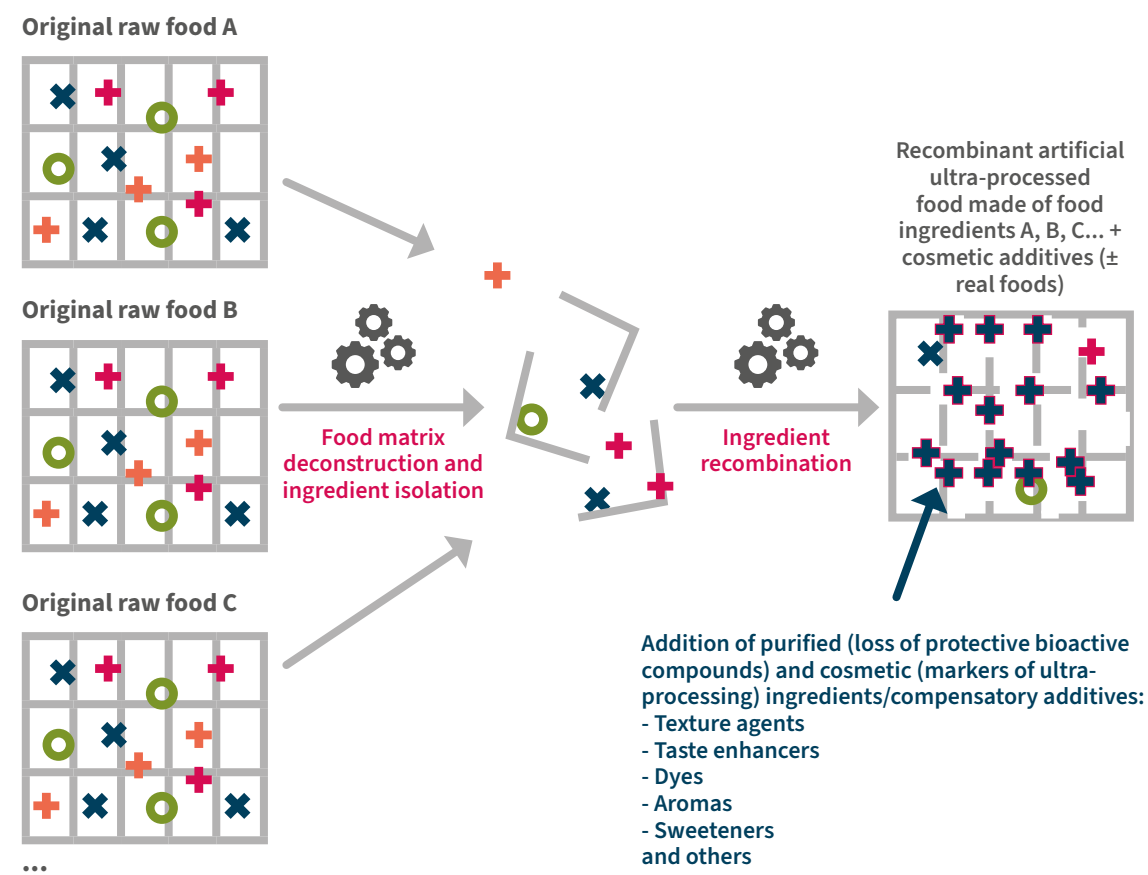
TYPICAL PROCESSES AND INGREDIENTS

Manufacturing processes for UPF involve several steps, different industries and complex technologies (Monteiro et al, 2019). The first step is fractioning of whole foods into isolated ingredients or food substances, followed by chemical modifications of selected substances, for example through hydrolysis (breakdown of raw food into smaller molecules in the presence of water and often an enzyme preparation) or hydrogenation (chemical change to alter the properties of fats), then re-assembly of unmodified and modified food substances with little to no whole foods, using industrial techniques such as extrusion (the use of mechanical energy to mix and cook ingredients so that a product that can be dense or puffed), moulding

(ingredients are fed into a mould in viscous form, and solidifies into a particular shape) and pre-frying (cooking of food in hot fats or oils). Additives are then typically applied to make the product appealing and palatable or hyper-palatable (see **figure 3**). Finally, the product is packaged, typically in synthetic materials.

As well as additives, UPF may contain process contaminants generated when an ingredient in a food is processed (e.g. acrylamide or toxic fat derivatives) and harmful substances can migrate in to the food from its packaging (e.g. bisphenols). These are discussed further in **section 4**.

FIGURE 3
HOW UPFS ARE CREATED FROM ISOLATED INGREDIENTS OR FOOD SUBSTANCES (Fardet and Rock, 2020)

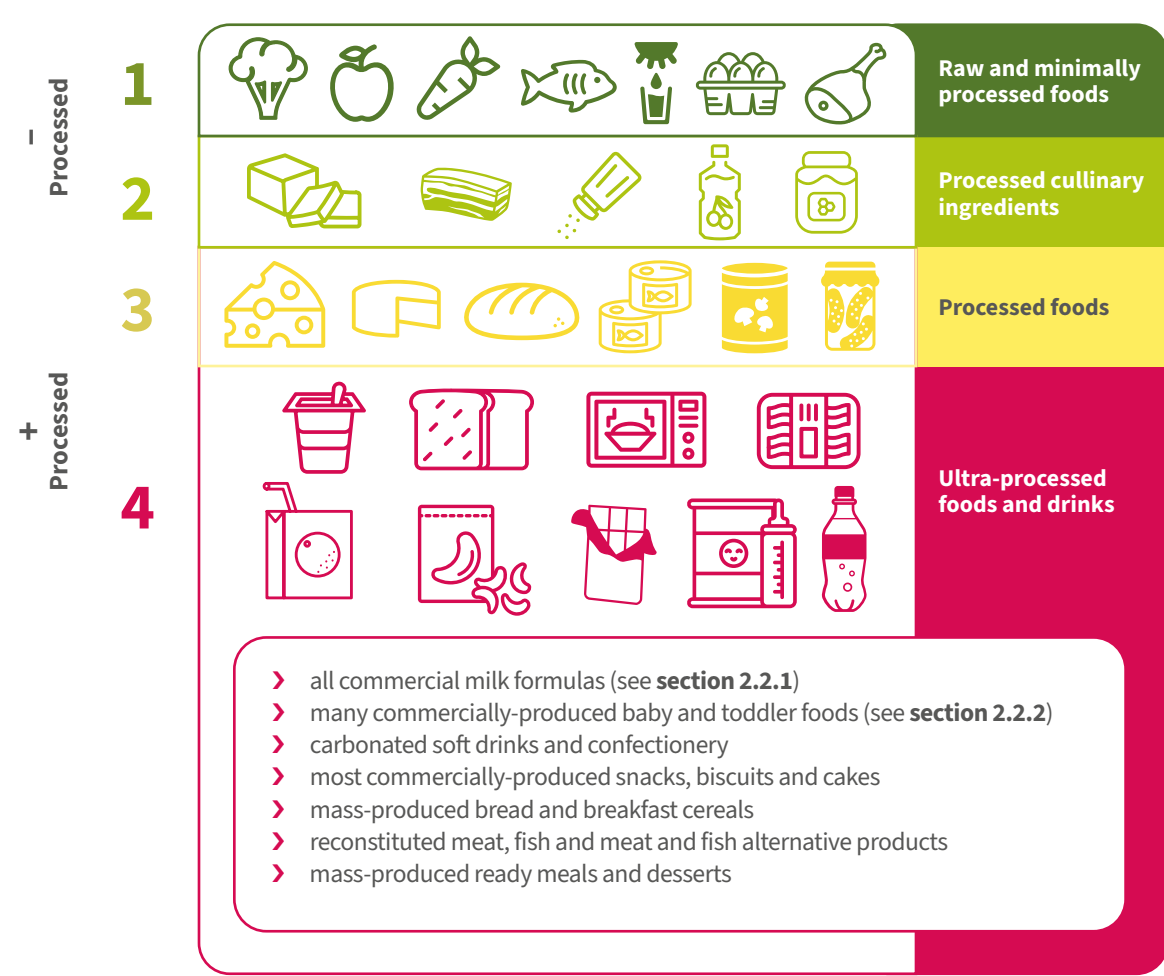


SOURCE: Schematic representation of UPFs through fractionation of original raw foods and ingredient recombination with 'cosmetic' additives. Figure was originally created by the Siga Society©.

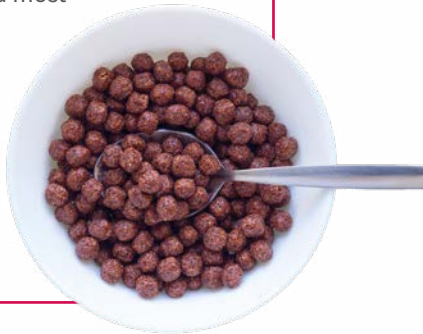
- INGREDIENTS IN UPFS INCLUDE:**
- > **SUGARS** (fructose, high-fructose corn syrup, 'fruit juice concentrates', invert sugar, maltodextrin, dextrose, lactose, glucose, isomaltulose, maltose, golden syrup, barley malt, fruit and vegetable powders)
 - > **MODIFIED OILS** (hydrogenated or interesterified oils)
 - > **MODIFIED SOURCES OF PROTEIN** (hydrolysed proteins, soya protein isolate, gluten, casein, whey protein, and 'mechanically separated meat', organic dried egg whites)
 - > **MODIFIED STARCHES** (rice starch, potato starch, corn fibre)
 - > **COSMETIC ADDITIVES** to make the final product more appealing and palatable, such as colours, flavours (including those labelled 'natural'), flavour enhancers (e.g. monosodium glutamate), emulsifiers, thickeners, sweeteners, foaming, anti-foaming, bulking (e.g. isomalt, mannitol), carbonating, gelling and glazing agents.

Together, the processes and ingredients used to make UPF typically create convenient (many ready-to-eat), hyper-palatable and highly profitable products; the latter through the use of cheap ingredients with long shelf-lives, and aggressive marketing (Scrinis and Monteiro, 2022).

FIGURE 4
THE NOVA CLASSIFICATION (Fardet, 2018)



- 1. Unprocessed or minimally processed foods:** Unprocessed, edible parts of plants and animals, or natural foods altered by minimal processing (e.g. pasteurisation, freezing, filtering, roasting) to preserve natural foods for storage, or make them safe, edible or more palatable (e.g. fresh fruit, vegetables, grains, legumes, meat, milk). A variety of foods in this group should form the basis of a healthy diet.
- 2. Processed culinary ingredients:** Substances extracted from group 1 (e.g. fats, oils, sugars and starches) or from nature (e.g. salt) used to cook and season group 1 foods, and not intended for consumption on their own. Processing may include pressing, grinding, crushing, pulverising and refining.
- 3. Processed foods:** Products made by adding group 2 to group 1 (e.g. canned vegetables in brine, tinned fish in oil, fruit in syrup, some cheeses, smoked salmon, bacon). Processing may include salting, smoking, fermenting and pickling. Processed food products usually retain the basic identity and most constituents of the original food. But when excessive oil, sugar or salt are added, they become nutritionally unbalanced. They are generally produced to be consumed as part of meals or dishes, or as snacks. Most foods in this group are highly palatable.
- 4. Ultra-processed foods:** Formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes, many requiring sophisticated equipment and technology (Monteiro et al, 2019). See [section 2.1](#).



2.2 What foods marketed for infants and young children are UPF?

2.2.1 COMMERCIAL MILK FORMULAS

All commercial milk formulas can be classified as UPF because of their extensive ingredient list encompassing food components and additives, and the large number of sophisticated and highly technical processes needed

to produce them (First Steps Nutrition Trust, nd, b). Published studies support this approach to their classification (Grammatikaki et al, 2021; Da Rocha et al, 2021). But whilst infant formula is essential for some infants (see **box 4**), other commercial milk formulas are discretionary.



BOX 4

INFANT FORMULA: AN EXCEPTIONAL UPF

Infant formula is essential for healthy babies up to one year old who are not breastfed or partially breastfed. For this reason, the nutrition composition of infant formula is regulated to ensure that these products are safe and suitable to support adequate growth.

Whilst this makes them the only widespread and necessary food that can be described as both ultra-processed and nutritious, no commercial milk formula can impart the immune benefits of breastmilk. Breastfeeding protects babies' health in the short and long term, reducing

risks of infectious diseases, diabetes, heart disease, asthma and obesity, and also the health of their mothers, whose risk of ovarian cancer, breast cancer and heart disease is reduced by breastfeeding (Victora et al, 2016; Rollins et al, 2016; Horta et al, 2015).

PROCESSES

Powdered formulas are made by industrial-level dry blending (mixing of dehydrated food substances and additives to uniformity) and/or a wet-mixing or spray-drying process (blending of food substances and additives with water in large batches, followed by homogenisation, pasteurisation, and spray-drying to produce the powdered product) (First Steps Nutrition Trust, nd, a). 'Ready-to-feed' liquid formulas are made by wet mixing of food substances and additives, with emulsifying, homogenising and heat treatment.

INGREDIENTS

The basic components are proteins, fats, carbohydrates, vitamins, minerals and trace elements. Producers develop

their own branded formulations, with a combination of these nutrients from a range of isolated ingredient sources and food substances. Ingredients can differ as long as the nutrition composition complies with legal requirements where these exist, i.e. for infant formula and follow-on formula, but not for commercial milk formulas marketed for use from one year of age (see **section 1**).

Commercial milk formulas also contain permissible but non-mandatory, non-essential ingredients that lack sufficient evidence for benefit that would require their addition by law (EFSA, 2014). These include: oligosaccharides (including 'Human Milk Oligosaccharides'

(HMOs) – synthetic analogues of a small number of the 200+ in breastmilk); arachidonic acid (ARA) (a long chain polyunsaturated fatty acid which can be synthesised from linoleic acid, a mandatory ingredient); taurine (an essential amino acid that can be synthesised by the body); and nucleotides (structural components of RNA and DNA found in breastmilk).

Lastly, some additives are permissible by law, being necessary to ensure that formulations do not separate, that acidity is regulated or ingredients resist oxidation, or if liquid formula, that they remain emulsified. Typical ingredients and additives in commercial infant milks are outlined on our website, www.infantmilkinfo.org (First Steps Nutrition Trust, nd, b).

which restrict permissible ingredients and additives (see **annex 1**). This means it is likely that products that do meet the definition of an ultra-processed food by virtue of "resulting from a series of industrial processes, many requiring sophisticated equipment and technology" may be misclassified because these industrial processes are not listed on product labels.

The study most relevant to babies and young children in the UK is by Grammatikaki et al, who reviewed the labels of 3,427 foods and drinks marketed for infants and young children (excluding commercial milk formulas), launched or re-launched across 27 European countries between March 2017 and March 2021 (Grammatikaki et al, 2021). The sample included 494 products for sale in the UK.

Products whose ingredients list included only unprocessed foods such as fruits and vegetables were classified as minimally processed. Products listing

culinary ingredients such as salt, sugar and fats were classified as processed, and those that contained additives intended to enhance flavour, colour or texture – such as flavourings, colourants and emulsifiers – were classified as ultra-processed. When possible to infer from the product name, the use of industrial techniques such as extrusion, hydrogenation and carbohydrate modifications was also used to inform the classification.

Overall, the study classified over a quarter (29.2%) of the surveyed foods and drinks as UPF, and the proportion for the UK products was similar at 28.8% (E. Grammatikaki, personal communication 26/11/2021), see **figure 5**. Both for the whole sample and for products on the UK market, UPF products were found to dominate the baby biscuits/rusks and baby cereal categories, while close to half of baby snacks were found to be UPFs.

Among the UK products, about a fifth of baby juices/drinks and baby fruit products, desserts and yoghurts were classified as UPF. As above, these proportions of products classified as UPF should be seen as minimum estimates because of the heavy reliance on ingredient data in a context of EU legislation limiting permissible ingredients including additives.

2.2.2 COMMERCIAL BABY AND TODDLER FOODS

Several studies have attempted to apply the NOVA classification to foods marketed for infants and young children (Grammatikaki et al 2021; Araújo et al 2021; Da Rocha et al 2021), one of which included products sold in the UK (Grammatikaki et al, 2021). Because of a lack of transparency over the specific processes used to make certain products, in all cases classification focuses primarily on information available on product labels, which is limited to ingredients (as typically mandated by domestic laws). This practical approach follows the recommendation of Monteiro et al (2019), which focuses on identifying typical ingredient markers of food ultra-processing rather than evidence of processing:

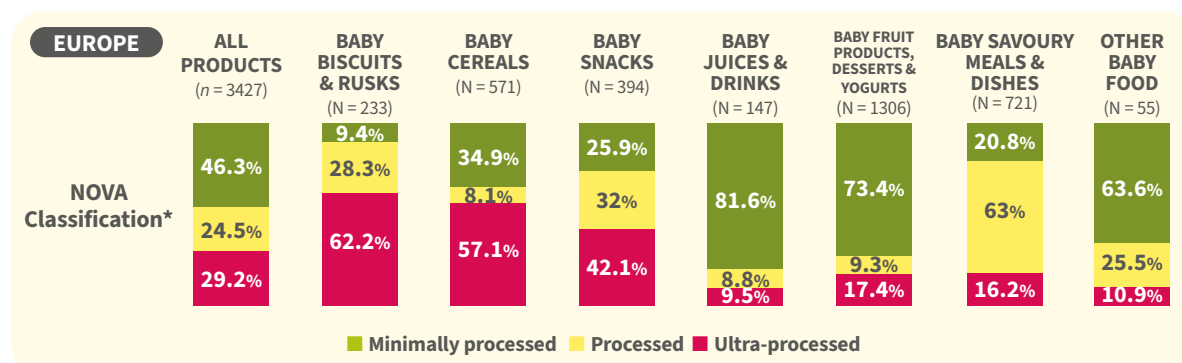
"The practical way to identify if a product is ultra-processed is to check to see if its list of ingredients contains at least one item characteristic of the ultra-processed food group, which is to say, either food substances never or rarely used in kitchens, or classes of additives whose function is to make the final product palatable or more appealing ('cosmetic additives')".

It is important to recognise that this approach raises specific challenges when applied to commercial baby and toddler foods given UK/EU regulations



FIGURE 5

NOVA CLASSIFICATION OF FOODS AND DRINKS MARKETING FOR INFANTS AND YOUNG CHILDREN IN EUROPE AND UK* ACCORDING TO GRAMMATIKAKI ET AL 2021** (including examples of UPFs on the UK market in 2023)



Baby porridge and cereals

Includes powdered or ready-to-eat semolina, porridges, creamed rice and breakfast cereals (e.g. corn flakes) marketed at babies.

Baby biscuits and rusks
All biscuits, rusks and crackers marketed for babies and toddlers.

Baby juices and drinks

All beverages (including mixes and concentrates) aimed at babies, including fruit juices and fruit and cereal drinks, and drinks that claim to be a meal. Excludes milk drinks and formulas.

Baby fruit products, desserts and yoghurts
Includes single-fruit and multi-fruit purées, fruit

and cereal combinations, milky desserts, yoghurts and fruit pieces aimed at babies and toddlers. Fruit-flavoured snacks are under Baby snacks.

Baby snacks
All items marketed as snacks for babies but excluding those in other categories, e.g. desserts, biscuits, fruit pieces etc.

Baby savoury meals and dishes

Includes vegetable purées, soups, meat and fish dishes, vegetarian dishes and all complete meals.

Other baby food
All other ingredients and foods marketed for babies and toddlers, such as cheese, pastas, stocks, sauces and dressings.

* Given the very small number of products for some of the sub-categories, this data should be used with caution. **This data captures newly launched and re-launched products during the period examined and is not fully representative of the overall food offer during that period.

Two similar but much smaller studies examining the extent to which foods marketed to infants and young children are ultra-processed were conducted in Porto, Portugal (Araújo et al, 2021) and in Natal, Brazil (Da Rocha et al, 2021). Similar to the Europe-wide study and the UK data within, a high proportion of UPFs were found in the categories including biscuits, snacks, cereals and drinks, but also yoghurts in Porto²¹ and fruit and vegetable purées in Natal²². This was despite the Portuguese study not taking into account any evidence of industrial processing in the course of classification e.g. not classifying puffs and other extruded products as UPF regardless of their ingredients.

PROCESSES

As above, there is a lack of transparency with respect to the specific industrial processes used to make certain commercial baby foods, their combination, sequence, extent and purpose, which hinders classification of specific products. However, it is safe to assume that, generally, the processes may be the same as those used to make UPF marketed at the general population; i.e. fractioning, followed by chemical modifications, the addition of additives (where these are permitted), followed by 'reassembly' e.g. through extrusion, moulding and pre-frying, then packaging.

In some cases, the use of specific processes such as extrusion and moulding are clear from the shape and form of the end product, e.g. puffed or wafer snacks. The ingredients list may list the raw ingredients, but the product may have undergone extrusion to create a puffed consistency, or fruit may have been puréed then dried and reshaped to create a fruit snack (as shown in

figure 6). For other products, however, which may also list raw ingredients, the extent and type of processing may be clear. For example, fruit and vegetable purées may undergo maceration and heat treatment, making them ultra-processed, but without any ingredient markers or signs from the shape and form of the end product to make an objective classification possible.

For prior analysis of the ultra-processed dried fruit snacks, and fruit and vegetable purées being marketed for infants and young children in the UK including comment on common additives and likely processes used and their effects, see (Sparks and Crawley, 2018) and (Westland and Crawley, 2018).

INGREDIENTS

Among the 3,427 foods and drinks marketed for infants and young children in Europe and analysed by Grammatikaki et al, those classified as UPF typically had higher energy, fat, saturated fat, sugar and sodium content and a lower fibre content than comparable less processed products (Grammatikaki et al, 2021). Though the authors focused mainly on analysis of nutrition composition rather than ingredients, they did look at sugar-contributing ingredients: 60% of the UPFs contained one, mostly free sugars and/ or fruit and vegetable powder, compared to only 28% of minimally processed or processed products. Rocha et al (2021) and Araújo et al (2021) did not report on ingredient differences by NOVA category.



FIGURE 6

COMMERCIAL BABY SNACKS MADE USING INDUSTRIAL PROCESSES



²¹ By category the proportion UPF were: 100% of 'biscuits/wafers/crisps' (n=7); 92% of 'cereal/porridge' (n=146/158); 100% of 'juice/smoothie/tea/other drink' (n=12); 79% of 'yoghurt or yoghurt related products' (n=23/29), 19% of fruit and vegetable purées (n=19/98), none of 18 'meat or fish based meals, or the single soup.

²² By category the proportion UPF were: 79% overall, 100% of 'cereals' (n=25); 58% of fruit and vegetable purées (n=7/12), none of the 'meat or fish meals' (n=15) or the single soup.

2.2.3 COMMERCIAL FOODS AND DRINKS MARKETED AT PRE-SCHOOL CHILDREN

We could only find two surveys on foods and drinks marketed at pre-school children in the UK through use of cartoons and other child-friendly images and devices. As reported in **section 1**, one showed that these products are likely to be in discretionary food categories including biscuits, cakes, chocolate, confectionery and desserts (Pombo-Rodrigues et al, 2020) and classifiable as 'unhealthy' according to the Ofcom Nutrient Profile Model (DoH, 2011), principally because of their sugar content (Pombo-Rodrigues et al, 2020). All these product types are also ultra-processed according to the NOVA classification (**figure 4** in **section 2.1**).

The other study exposed how products being marketed as healthy choices for pre-school children could also be classifiable as 'unhealthy' using the Ofcom Nutrient Profile Model (NPM) (Garcia et al, 2019). Neither study explores the industrial processes used to manufacture these products. However, Garcia et al (2019) examined the sugar containing ingredients in 332 products marketed as healthy - including

cereals and cereal bars, dairy alternatives, fruit snacks, ready meals and smoothies. Nearly a third (29.5%) contained fruit juice concentrate, which is an ingredient marker of ultra-processed foods.

We could not find any survey data on other ingredient markers of ultra-processing in this product category. However, because the ingredients in products marketed for pre-school children are not specifically regulated, they are legally allowed to contain additives which baby and toddler foods are not, including sweeteners and colours. We have reported on these additives and what is known about food sources in children's diets in two prior reports (Wall and Crawley, 2020; Sibson and Crawley, 2019).



Box 5 illustrates the abundance of UPF being marketed for pre-school aged children but falling outside of regulations governing the composition and marketing of foods for young children.



BOX 5

EXAMPLES OF UPF MARKETED FOR PRE-SCHOOL CHILDREN IN THE UK

Applying the approach of Monteiro et al 2019, we found many examples on UK supermarket shelves of UPFs targeted at pre-school children through the use of cartoon or animal characters, as shown.

<p>Breakfast cereals</p>	<p>Mealtime staples</p>	<p>Fromage frairs</p>
<p>Crisps and puffed snacks</p>	<p>Savoury chilled snacks</p>	<p>Drinks</p>
<p>Confectionery and chocolate</p>	<p>Desserts and cakes</p>	<p>Ice creams and lollies</p>

3 UPF consumption by infants and young children



In section 2, we showed the extent to which foods marketed for infants and young children may be classifiable as ultra-processed, as well as unsuitable on the basis of their ingredients, taste, texture and marketing. In this section we outline the scale of UPF consumption in the UK, showing that, from their first months of life, most infants and young children consume UPF: from commercial milk formulas to commercial baby and toddler foods and ultra-processed 'family foods' and snacks, including those aimed at pre-school age children. Many of these are discretionary and therefore avoidable.

As all formulas are ultra-processed, data on infant feeding makes it possible to quantify UPF intake in the first weeks and months of life. Then, for

two-to five-year-olds in the UK, published analysis of UPF consumption exists (albeit based on old data).

However, for the age group in-between, we face a glaring gap: there are no national estimates of UPF consumption during the second half of infancy and into the second year of life. Quantification for this age group is even more challenging due to the available national dietary data being very dated (i.e. the DNSIYC for which data was collected in 2011 (Lennox et al, 2013) in relation to the constantly evolving range of marketed products. In addition, this data does not account for the level of processing, as the NOVA classification is relatively new.

For these reasons, we make tentative inferences about UPF consumption for the period from

one to two years of age using up-to-date commercial baby food market survey data from Mintel (Mintel, 2022)²³, applying what we know about the extent to which product types may be UPF from the study by Grammatikaki et al (2021), as presented in section 2.

Worryingly, our analysis suggests that infants and young children in the UK are being fed significant amounts of UPF in the form of commercial milk formulas and baby and toddler foods, and transition early to UPF family foods. Many popular UPFs are discretionary, and many UPFs marketed for infants and young children imitate UPF family foods. By age two to five, UPF account for nearly two thirds of their calorie intake. Considering that much of the available data is fairly old, the current picture may be more worrying still.

3.1 From birth to less than two years

COMMERCIAL MILK FORMULAS

Because of high use of commercial milk formulas, the majority of infants in the UK start their lives on a near exclusive ultra-processed diet. By 10-11 months of age, formulas still contributed a third of average daily total energy intake in the UK in 2011 (Lennox et al, 2013). As per public health recommendations, breastfeeding is optimal for infant and maternal health but where it is not possible, infant formula is a safe and nutritious alternative for use in the first 12 months, and in this regard is an exceptional UPF.

From one year of age, whilst breastfeeding remains beneficial, public health recommendations state that formulas are unnecessary. Despite this, both the Mintel market survey (Mintel, 2022) and dietary survey data (Lennox et al, 2013) indicate sustained use into the second year (and beyond, see below), most likely of growing-up and toddler milks. This represents entirely avoidable consumption of an ultra-processed food. In the latest Mintel survey, 49% of surveyed parents whose youngest child was one year of age purchased commercial milk formula for them and 55% were given formula at least once a day²⁴ (Mintel, 2022).

²³ The Mintel data come from 800 internet using parents (aged 16 years +) of children aged up to age four. Data for infants 6-12 months were not reported as the sample size was too small.

²⁴ Given that the DNSIYC reported that commercial milk formula contributed 10% of average daily total energy intake for UK children aged 12-18 months in 2011 (Lennox et al, 2013), it would seem likely that there has been an increase in the use of these heavily marketed, ultra-processed products over the last decade.

COMMERCIAL BABY AND TODDLER FOODS AND DRINKS

In the latest Mintel survey, among surveyed parents whose youngest child was up to six months old, between a third and a quarter purchased commercial baby meals, finger foods and/or baby drinks, and more than a third of babies were given such products at least once a day (Mintel, 2022) – see **figure 7**. Applying the results of the study by Grammatikaki et al (2021), up to about a half of baby meals, close to three quarters of finger foods and one in five baby drinks may be UPF (Grammatikaki et al, 2021)²⁵. Only 14% of parents with a youngest child up to six months old reported not purchasing any commercial baby foods or drinks (Mintel, 2022).

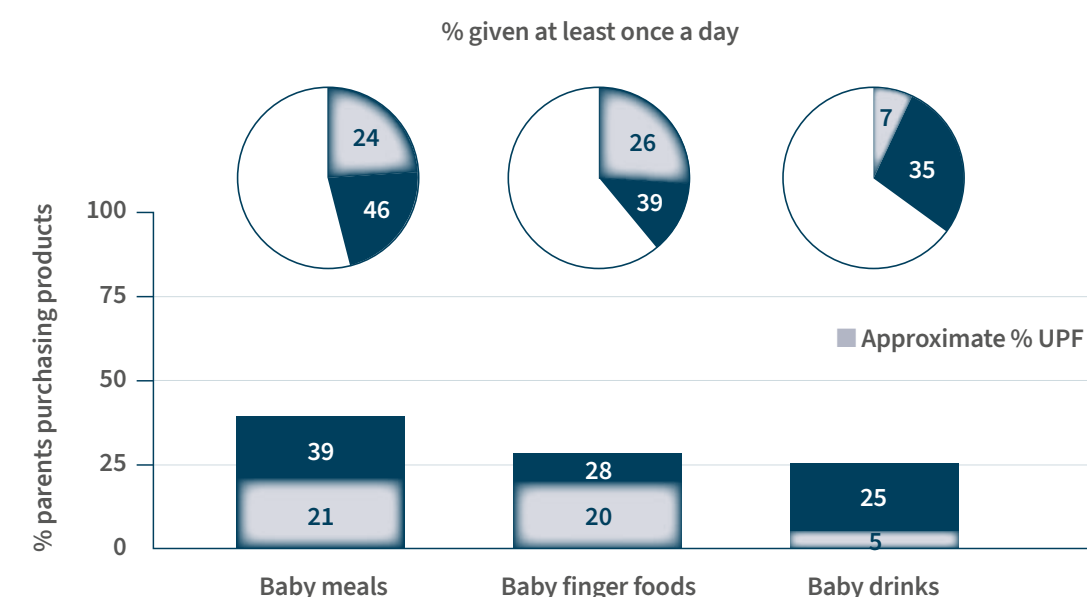
Whilst public health recommendations are to introduce solids at around six months and not before, it is not possible to tell from this data at what age these products were given to the infant. However, we assume this represents some feeding too early, given what we know about common practices (see **section 1**). In addition, baby drinks and snack foods are entirely discretionary before the age of one.

This data therefore suggests the avoidable consumption of discretionary commercial baby foods and drinks among infants from birth to six months, a variable and sometimes large proportion of which are UPFs.

“Commercial baby foods and drinks aimed at children up to 36 months may provide infants’ first non-milk taste experiences and form a substantial proportion of their diet” (PHE, 2019)

Only **14%** of UK parents with youngest child up to **SIX MONTHS** did not buy **ANY** commercial baby foods or drinks

FIGURE 7
PROPORTION OF PARENTS OF 0-6 MONTH OLD BABIES PURCHASING COMMERCIAL BABY FOODS AND GIVING AT LEAST ONCE A DAY, BY PRODUCT TYPE (Mintel, 2022) AND APPROXIMATE PROPORTION UPF



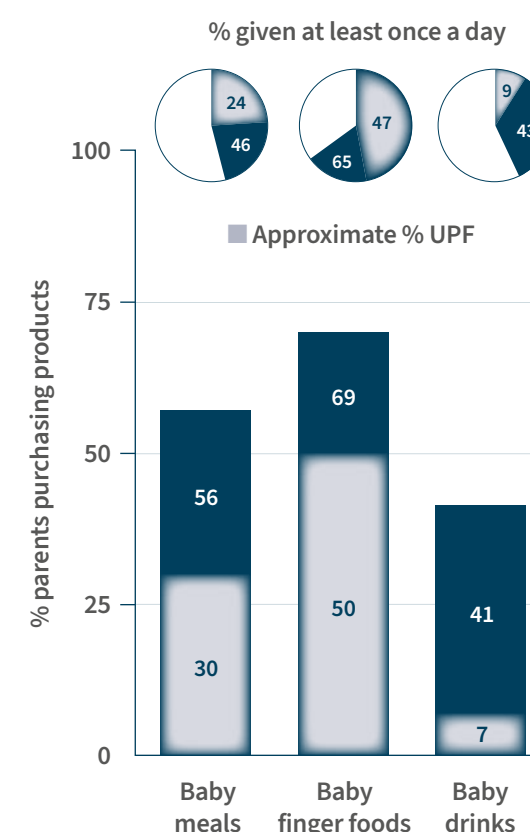
²⁵ The minimum estimated proportions of products classifiable as UPF in UK data from the survey by Grammatikaki et al (2021) were as follows: main meals (comprising savoury meals and dishes, 10% ultra-processed; baby cereals, 53% ultra-processed; fruit products and desserts 17% ultra-processed), finger foods (comprising baby biscuits and rusks, 73% ultra-processed; snacks, 48% ultra-processed) and drinks (21% ultra-processed).

Comparable Mintel data for six- to 12-month-olds is not available. The most recent data on dietary intakes spanning this age range comes from the 2011 DNSIYC, which revealed that close to three quarters (72%) of seven- to nine-month-olds and two thirds (67%) of 10-11-month-olds had eaten a commercial baby or toddler meal for their main meal of the day, and for 23% and 18% respectively, this was always or almost always the case (Lennox et al, 2013). As above, up to about a half of baby meals may be UPF (Grammatikaki, et al 2021)²⁵.

Consistent with the commercial baby food market share by product type (as outlined in **section 2**), Mintel data for

parents whose youngest child was one year of age shows that commercial finger foods are most popular product type and very widely used: about two thirds purchase and give them at least once a day (Mintel, 2022)²⁶. Comparable data for commercial baby meals and commercial baby drinks are shown in the figure (see **figure 8**). Only 6% of parents whose youngest child was one year old reported not purchasing any commercial baby foods or drinks (Mintel, 2022). As above, given that a variable and sometimes large proportion of commercial baby foods and drinks may be UPF (Grammatikaki et al, 2021)²⁵, these market survey data paint a picture of likely widespread exposure among young children, including from discretionary drinks.

FIGURE 8
PROPORTION OF PARENTS OF ONE YEAR OLD CHILDREN PURCHASING COMMERCIAL BABY FOODS AND GIVING AT LEAST ONCE A DAY, BY PRODUCT TYPE (Mintel, 2022) AND APPROXIMATE PROPORTION UPF



²⁶ Given that the DNSIYC reported that 42% of 12-18 month olds consumed commercial infant snacks in 2011 (Lennox et al, 2013), it is likely that the frequency of consumption of these heavily marketed products has increased over the last decade.

72% of seven- to nine-month olds in the UK have eaten a commercial baby or toddler meal as their main meal of the day...

23% ALMOST ALWAYS

ONLY **6%** of UK parents with youngest child aged one year old did not buy **ANY** commercial baby foods or drinks



COMMERCIAL FOODS AND DRINKS MARKETED AT PRE-SCHOOL CHILDREN

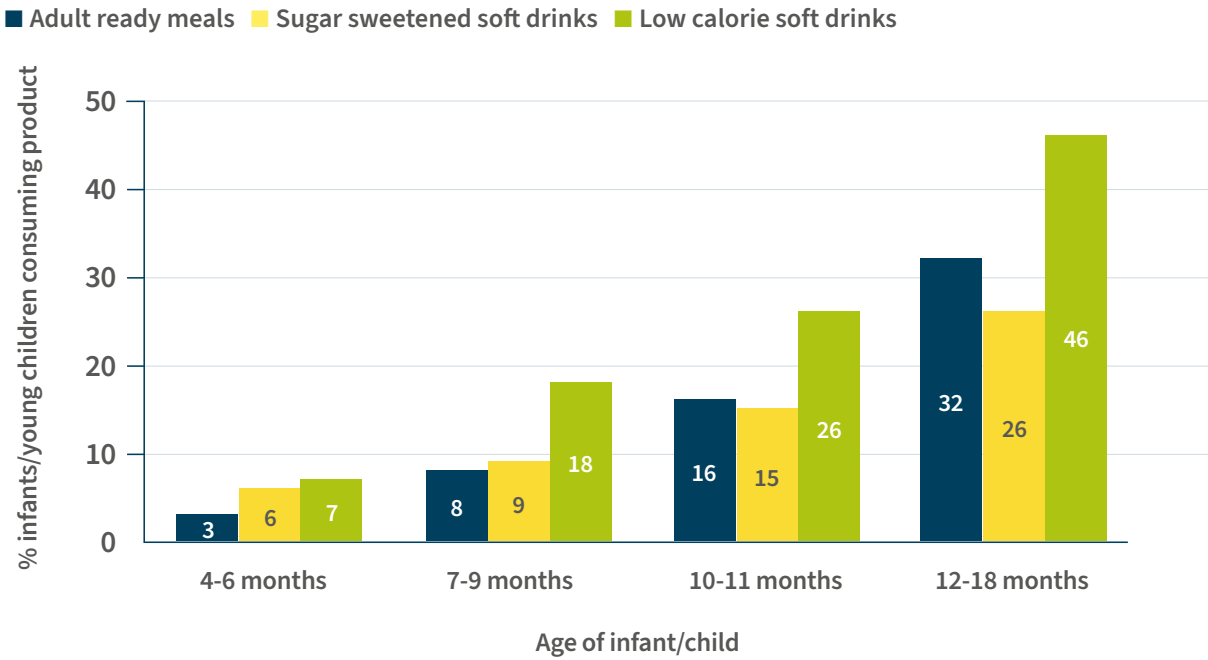
Data from the Gemini twin cohort study of 2,336 children born in the UK in 2007 have been recently analysed to assess their UPF intake at 21 months of age, i.e. in 2009 (personal communication R. Conway, 01/02/2023). UPF accounted for 47% of mean energy intake and the most frequently consumed UPFs were fruit drink concentrates, bread, breakfast cereals, biscuits, fromage frais and yoghurts. The author acknowledged that certain UPF are widely used now but were not at the time of data collection – such as growing-up milks – meaning the percentage could now be even higher.

This study data is 14 years old, but more recent studies by Action on Sugar and Action on Salt (2019) and Garcia et al (2019) (outlined in sections 1.4 and 2.2.3) show that such food types remain common. These also highlight how biscuits, cereals, dairy products, juices and smoothies are

marketed specifically at pre-school children, with cereals, juices and dairy products being presented as healthy choices despite being high in fat, salt or sugar. A quarter are ultra-processed by virtue of containing at least one ingredient marker, such as fruit juice concentrate.

Data (albeit dated) from the DNSIYC also indicates a trend for infants and young children to be given certain ultra-processed, discretionary adult or family foods as they get older (see figure 9). As highlighted in section 1, it is pertinent to note the trend for giving soft drinks to infants and young children, contrary to public health recommendations. Undoubtedly because of campaigns, tools and policies promoting low and reduced sugar foods and drinks, low-calorie, artificially sweetened soft drinks are more commonly consumed than sugar-sweetened soft drinks and in greater volumes. Both are UPF, but only the latter are considered unhealthy due to their nutrient profile. See more on this in section 6.6.

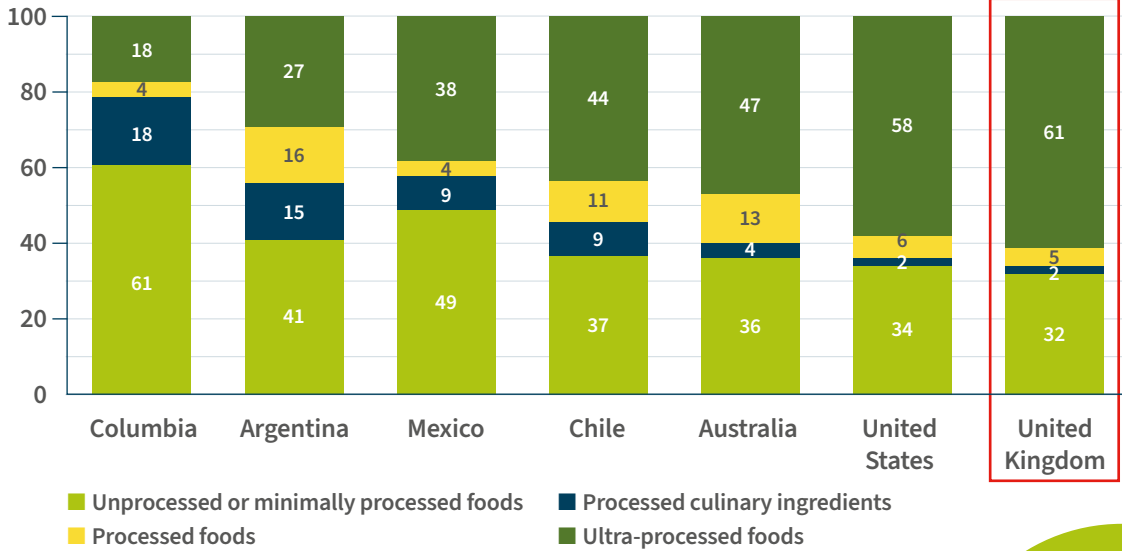
FIGURE 9
PROPORTION OF INFANTS AND YOUNG CHILDREN CONSUMING THREE COMMON UPF IN THE UK IN 2011
(Lennox et al, 2013)



3.2 From age two to five

The consumption of UPF among the UK's pre-school aged children has been quantified using NDNS data from 2008-2014 (Neri et al, 2022). Concerningly, this showed that UPF account for nearly two thirds (61%) of the total mean energy intake of UK children between two and five at that time – higher than any of the other six countries studied, including the United States and Australia (see figure 10). In contrast, only 32% of energy came from unprocessed and minimally processed foods.

FIGURE 10
THE CONTRIBUTION OF UPF AND THE OTHER NOVA FOOD GROUPS TO TOTAL MEAN ENERGY INTAKE IN TWO- TO FIVE-YEAR-OLDS IN THE UK AND SIX OTHER COUNTRIES (Neri et al, 2022)



In this analysis, the most commonly consumed UPFs included soft drinks, sweet or savoury packaged snacks, confectionery, packaged breads and buns, reconstituted meat products and pre-prepared frozen or shelf-stable dishes (Neri et al, 2022). This is consistent with analysis of 2016-2019 NDNS data for one to five-year-olds in the UK, indicating that ‘biscuits, buns, cakes, pastries, pies and puddings’, ‘sugars, preserves and confectionery’, and ‘crisps and savoury snacks’ contribute an increasing proportion of their average daily total dietary energy intake (SACN, 2022). This NDNS data indicate a decline in energy contribution of commercial milk formulas and ‘commercial toddler foods and drinks’ over the same age range (SACN, 2022). This is at odds with current market survey data suggesting greater levels of consumption, and may reflect that small amounts are consumed and/or that some commercial baby foods have a low energy density (Crawley and Westland, 2017). More research would be needed to reconcile these data sources.

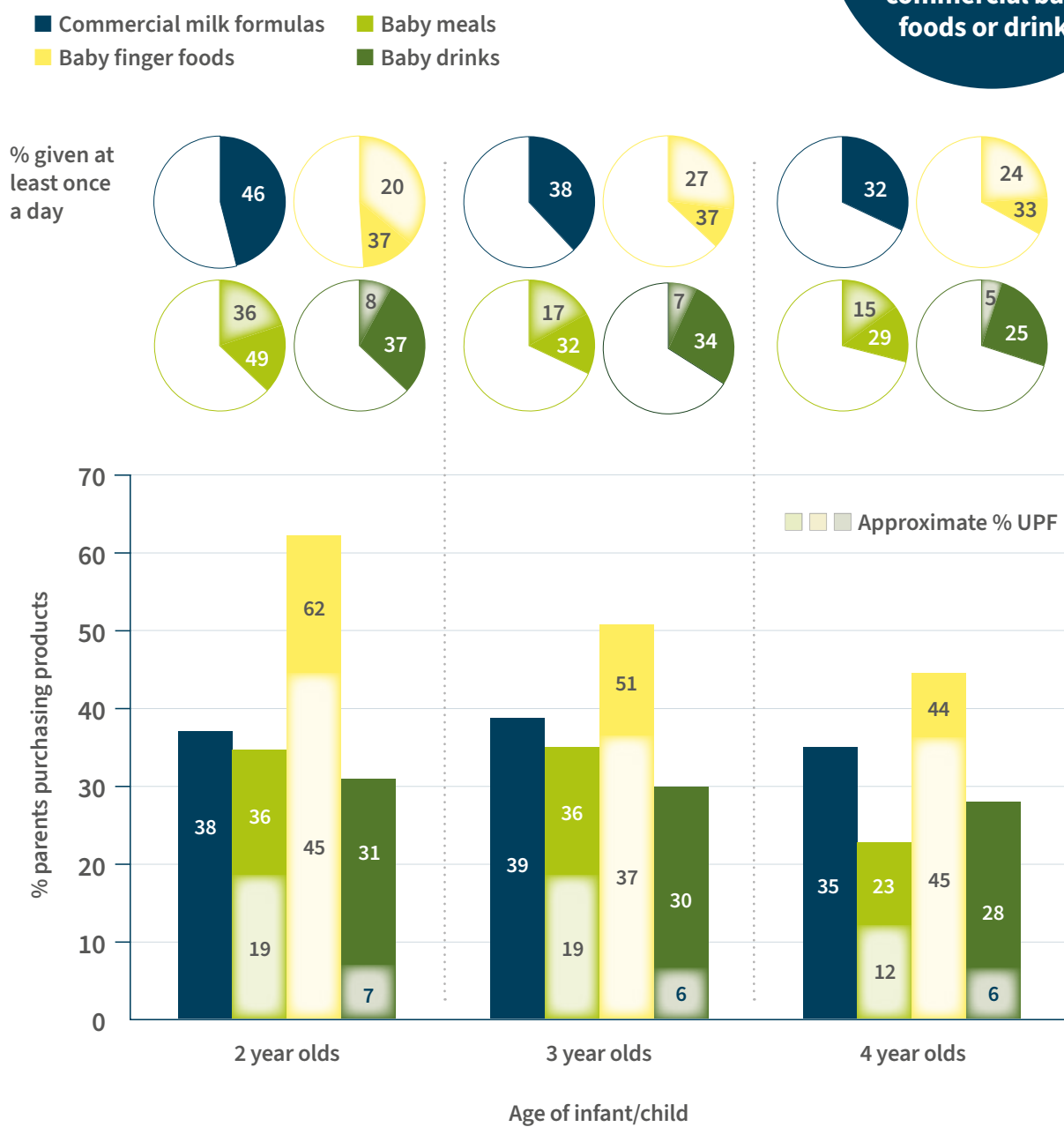
2022 Mintel data indicate that it is common for commercial

milk formulas and commercial baby and toddler foods and drinks (a share of which can be classified as UPF²⁵) to be used into the preschool years (see figure 11). Only 16%, 21% and 31% of parents whose youngest child was two, three or four years old respectively, reported not purchasing any commercial baby foods or drinks (Mintel, 2022).

Data on the growth of the ‘baby milk’ and baby food market (including by extending product ranges to three years old and beyond) are supportive in suggesting increased consumption of commercial baby and toddler products over the last 10 to 15 years (The Grocer, 2022) (see section 6.1, box 11). It could be therefore that current UPF consumption is higher than this available estimate (Neri et al, 2022), and products marketed for infants and young children may make a bigger contribution to the diet. However, more research is needed to confirm this.

UPF account for **61%** of total mean energy intake of UK children aged two to five

FIGURE 11
PROPORTION OF PARENTS OF 2, 3 AND 4 YEAR OLD CHILDREN PURCHASING COMMERCIAL BABY FOODS AND APPROXIMATE PROPORTION UPF



Only **16%** of UK parents with youngest child aged two did not buy ANY commercial baby foods or drinks

4 The health risks of UPF-rich diets in infants and young children

Population-level national estimates also based on the 2008-2014 National Diet and Nutrition Survey, and including children 1.5 years and older, indicate that 56.8% of calories originate from UPFs (Rauber et al, 2018). The similarity of the extent to which UPFs are estimated to dominate the diets of two- to five-year-olds and the whole population aged 1.5 years and older indicates an early

transition to ultra-processed family foods. It seems likely that a gradual transition from UPF commercial baby and toddler foods to UPF family foods is driven in part by the fact that the former imitate the latter, and cultivate habits and preferences from infancy – this issue is discussed further in **section 6**.

It is well understood that the first 1,000 days – from conception to aged two – sets the trajectory for lifelong health. What a mother eats and drinks while she is pregnant and breastfeeding, and what a child eats and drinks from birth, impact on the child's immunity, development and health, and can shape lifelong taste preferences and dietary habits. In this context it is concerning that, as shown in **section 3**, UPFs dominate early years diets.

In this section, we summarise the large and rapidly accruing body of evidence which now consistently links high UPF consumption to a range of negative health outcomes, from pregnancy through to infancy, early childhood and to adulthood. The evidence is strongest for an association between UPF-rich diets and obesity or adiposity measures in children. This is concerning, as infants and young children who gain weight too fast are also more

likely to carry excess weight into their adolescent and adult life (Sibson and Crawley, 2021).

While elucidating the mechanisms linking UPF-rich diets to obesity and other diseases may benefit from further research, we explain below how high levels of UPF consumption in the early years can undermine the formation of optimal taste development and healthy feeding behaviours, normalise snacking, promote a liking for sweet tastes and soft textures, and displace the minimally processed and unprocessed foods needed for optimal growth, health and development, starting with breastmilk.

It is important to note that the evidence linking UPF consumption with disease outcomes does not distinguish between specific UPFs, but is concerned with the health implications of a diet rich in UPF overall.

4.1 The links between UPF intake and negative health outcomes throughout life

An abundance of evidence now indicates that high UPF consumption is associated with a range of negative health outcomes, particularly obesity and intermediate markers of obesity. The evidence base is largely observational (a point of contention regarding UPF outlined in **section 2**), but includes a very large number of population-based epidemiological studies which have adjusted for confounding factors such as body mass index, nutrient intake and dietary patterns, and which show mainly consistent results. In addition, some of these studies indicate a dose-response relationship between UPF intake and health outcomes, adding weight to the evidence. Lastly, although these observational studies only allow for the study of associations, a tightly controlled randomised trial provides evidence of a causal association between UPF consumption and excess calorie intake and subsequent weight gain and explores likely mechanisms.

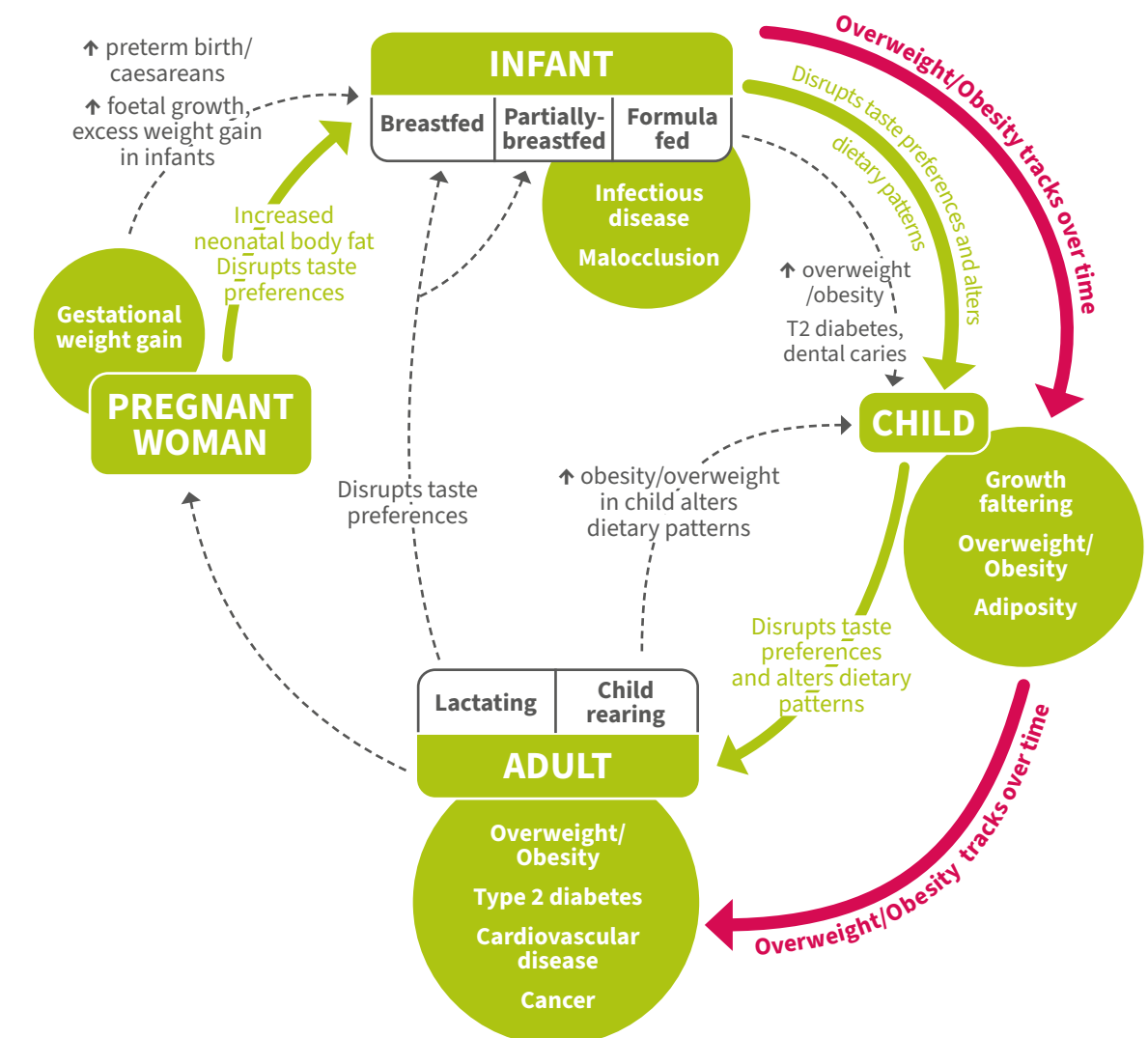
Whilst the majority of research to date has studied adult diets and health outcomes, a growing body of studies examining UPF consumption and health outcomes in childhood confirms the findings seen in adults, indicating that the mechanisms involved are likely generalisable to infants and young children. The following section, summarised in **figure 12**, gives an overview of the current evidence by life stage.



FIGURE 12

THE LINKS BETWEEN HIGH UPF INTAKE AND NEGATIVE HEALTH OUTCOMES ACROSS THE LIFE COURSE

Evidence strongly indicates that high UPF consumption is associated with negative health outcomes during pregnancy, infancy, childhood and adulthood, with the consumption of UPF-rich diets early in life potentially setting the trajectory for long-term health. Furthermore, UPF consumption in infancy and early childhood may contribute to a life-long preference for UPF, with health implications later in life.



“Consumption of UPFs leads to... excessive maternal gestational weight gain and increased neonatal body fatness”

(ROHATGI ET AL, 2021)



PREGNANCY

UPF consumption by women during pregnancy has been associated with an increase in neonatal body fat in one study in the US (Rohatgi et al, 2017). A one percentage point increase in the percentage of energy intake from UPF in women's diets was associated with an increase in the thigh skinfold, subscapular skinfold and total body adiposity of their newborn babies. Further evidence (see **annex 2**) implicates UPF consumption during pregnancy with increased gestational weight gain in pregnant women with and without diabetes (Gomes et al, 2021; Rohatgi et al, 2017; Silva et al, 2021). Excess gestational weight gain should be avoided because of its association with increased fetal growth, preterm delivery, cesarean delivery, infant mortality and long-term metabolic health outcomes for the infant (Champion and Harper, 2020).

INFANCY (MILK FEEDING)

Studies comparing never- and partially-breastfed children to breastfed children provide evidence from which we can infer the health effects of milk feeding based on commercial milk formulas. In addition to changing taste preferences away from foods that support a healthy diet (Fietas et al, 2018) (see **box 7**), not breastfeeding is associated with significantly increased risks for childhood infections and malocclusion, as well as increased risks of obesity and type 2 diabetes, with implications for oral and long-term health

(Victora et al, 2016). According to numerous studies (Victora et al, 2016; Hawkins et al, 2009; Institute of Education, 2017) and as summarised in our earlier report (Sibson and Crawley, 2021), breastfeeding protects infants from being overweight or obese later in life.

CHILDHOOD

Seven robust epidemiological studies (see **annex 3**) provide evidence for an association between UPF consumption in childhood, and obesity and measures of adiposity between age three and 13 (Chang et al, 2021; Costa et al, 2019; Costa et al, 2021; Costa et al, 2022; Leffa et al, 2020; Rauber et al, 2015; Vedovato et al, 2021). One study also found a link between UPF intake and growth faltering (Costa et al, 2022). Together with what we know about the extent to which UPF are being consumed by infants and young children in the UK (see **section 3**), this evidence suggests that UPF-rich diets are a key driver of the high prevalence of obesity in the UK, whilst simultaneously leaving children at risk of growth faltering, likely caused by micronutrient deficiencies.

Among these studies, a prospective cohort study in Brazil showed that higher intake of UPF in children between age seven and 13 was associated with additional yearly weight gain into adulthood (Chang et al, 2021). Four further

studies, conducted in Brazil and Portugal, showed that UPF consumption between two and six years of age was also associated with overweight and adiposity later in childhood (Costa et al, 2019; Costa et al, 2021; Costa et al, 2022; Vedovato et al, 2021).

The evidence linking UPF intake with growth faltering comes from a prospective cohort study in Brazil measuring length/height-for-age in children between two and four years old (Costa et al, 2022). This is consistent with a meta-analysis of nationally representative surveys on UPF consumption and the dietary/nutrient composition of respondents' diets, which showed UPF intake to be correlated with a decrease in protein, zinc, magnesium, vitamins A, C, D, E, B12 and niacin – all of which are needed for optimal growth and development (Martini et al, 2021).

As well as evidence of the link to obesity and growth faltering, two longitudinal studies in Brazil have shown increased UPF consumption at preschool age to be associated with increased cholesterol and/or triglycerides (two intermediate markers of cardiovascular disease) at school age (Leffa et al, 2020; Rauber et al, 2015). And a systematic review and meta-analysis of 42 studies revealed an association between UPF intake from infancy to adolescence (three months to 19 years) and dental caries, with the strongest quality of evidence from cohort studies among children under six years, likely mediated by sugar content (Cascaes et al, 2022).

ADULTHOOD

The foundations of taste preferences are laid in the early years (McCann et al, 2022), so it is logical to expect that children who eat UPF-rich diets will likely grow up to consume similar diets, with associated adverse health outcomes. Many robust epidemiological studies (see **annex 4**) provide evidence for an association between the UPF consumption and obesity, type 2 diabetes and cardiovascular disease in adults.

Three meta-analyses of data from 20 different epidemiological studies, including from the UK, show an association between UPF consumption and overweight/obesity (Pagliai et al, 2021; Moradi et al, 2023; Askari et al, 2020), while associations with cardiovascular disease were reported in two meta-analyses, (Suksatan et al, 2021 and Pagliai et al, 2021, with the latter including UK data), and in three subsequent prospective cohort studies (Bonaccio et al, 2022; Yuan et al, 2023; Chen et al, 2022, with the latter based on UK biobank cohort data). One of these shows a positive linear dose-response relationship between cardiovascular events and UPF intake (Yuan et al, 2023). A further meta-analysis including data from the UK showed a linear dose-response relationship between UPF intake and type 2 diabetes (Delpino et al, 2022).

Further evidence reveals a plausible association between UPF intake and colorectal cancer (Wang et al, 2022a), breast cancer and total cancer (Fiolet et al, 2018), and all-cause mortality, as evidenced by meta-analyses (Pagliai et al, 2021; Suksatan et al, 2021), and an observational prospective study of the UK biobank cohort over more than ten years (Chen et al, 2022).

UPF intake among mothers during the child-rearing period has also been shown to put children at increased risk of overweight or obesity by the time they reach between seven and 18 years of age (Wang et al, 2022b). Results are likely to be mediated in part through the way in which the maternal diet shapes their child's diet, as the study showed a positive correlation between maternal and child consumption of UPF. The authors hypothesise that genetics may also be a factor, and recommend larger studies with dietary assessment specifically targeting the pregnancy period to understand this further.

As the impact of UPF intake on adiposity has been observed in pregnancy, childhood and adulthood, this suggests common mechanisms of action, which are outlined in **section 4.2**.

BOX 6

THE NEED FOR FURTHER RESEARCH

Though the evidence is still preliminary, a number of studies have suggested correlations between UPF intake and a variety of other health outcomes, including depression and anxiety (Lane et al, 2022), gastro-intestinal diseases (Lo et al, 2022; Narula et al, 2021; Schnabel et al, 2018), impaired renal function (Zhang et al, 2022), hyperuricemia, non-alcoholic fatty liver disease, dementia, Alzheimer's disease and vascular dementia (Li et al, 2022), frailty (Sandoval-Insausti et al, 2020); COVID-19 infection (Zhou et al, 2023) and gout (Zhang et al, 2023). Further research is needed to confirm and better understand these study findings.



4.2 How UPF intake negatively impacts infant and young child health

An improved understanding of the mechanisms by which UPF consumption may negatively impact health, including promoting overweight and obesity, could lend plausibility to the evidence base (which is largely based on observational studies). Clarity on the different mechanisms may also help determine what remedial actions might be most appropriate to safeguard health. But whilst more research could be insightful to understand the mechanisms, it is important to acknowledge that they will never be fully understood because they are multiple, complex, and overlapping: a huge range of combinations are possible. In our view, enough is already known.

Because UPF, including those marketed for infants and young children, are more likely to be high in fat, sugar and salt than foods in the other NOVA categories, UPF-rich diets are also more likely to be nutritionally imbalanced than those based on unprocessed and minimally processed foods (Martini et al, 2021; Neri et al, 2022).

“[Evidence] suggests that the adverse consequences of UPFs are independent of dietary quality or pattern.” (DICKEN AND BATTERHAM, 2022)

Though this mechanism is important, several studies show it does not fully account for the association between UPF consumption and poorer health (Dicken and Batterham, 2022; Bonaccio et al, 2022; Hall et al, 2019). This is key in addressing the point of contention regarding UPF outlined in **section 2, box 3** – namely how products that do not have an ‘unhealthy’ nutrient profile – assessed only on fat, salt and sugar content – can be considered harmful to health because they are ultra-processed; and related to this, the logic of classifying products with comparable fat, salt and sugar content in different NOVA categories simply because one is home-made and one manufactured industrially.

The studies discussed below show that other mechanisms are at play, including the following (see **figure 14**):

- UPF consumption increases energy intake
- UPF consumption in infancy disrupts the development of healthy diet preferences and habits
- UPFs can negatively impact on the optimal development of the gut microbiota
- UPFs may contain harmful additives and contaminants

In **section 4.2.1** we discuss in more detail each of these five potential mechanisms by which UPF-rich diets are associated with obesity and other health harms.

4.2.1 UPF CONSUMPTION CONTRIBUTES TO DIETARY NUTRIENT IMBALANCES

Nationally representative studies conducted in 13 countries globally, including the UK, have revealed a strong inverse correlation between the dietary share of UPF and the nutritional quality of diet (Scrinis and Monteiro, 2022). So, while there are multiple drivers of poor diet quality among infants and young children, the extent to which UPF dominate the diet is now recognised as a significant factor in nutrient deficiencies at population level, including in the UK, both in terms of nutrients to promote and limit.

Ultra-processed commercial baby and toddler foods are typically higher in fat, salt and sugar than unprocessed or minimally processed foods, acting as vectors to the disproportionate amounts of these nutrients into the diet. The seminal study by Grammatikaki et al (see **section 2**) reported that in most categories, those

classified as UPF had higher energy, fat, saturated fat and sodium content, and lower fibre content compared to comparable minimally processed or processed products (Grammatikaki et al, 2021). The study also found that more than 60% of the products classified as UPF were defined as such as they contained at least one sugar-contributing ingredient, and the majority contained free sugars.

It is unsurprising, therefore, that UPF consumption has been found to be linked to nutritionally imbalanced diets in children. The study by Neri et al (2022) which examined the diets of children aged two to five in eight countries including in the UK (see **section 3**), showed positive associations between UPF intake, dietary energy density and free sugars (Neri et al, 2022). This is consistent with analysis of the 2008-2014 NDNS data which showed UPF intake to be associated with reduced dietary fibre among two- to five-year-olds, and protein, fibre and potassium across all ages (Rauber et al, 2018).

Furthermore, a meta-analysis of nationally representative surveys, including data on the diets of UK children from 18 months, shows that UPF are likely to contribute to an increase in free sugars, total fats, and saturated fats, as well as a decrease in fibre, protein, potassium, zinc, magnesium, vitamins A, C, D, E, B12 and niacin (Martini et al, 2021).

4.2.2 UPF CONSUMPTION INCREASES ENERGY INTAKE

Important evidence of a causal association between UPF consumption and excess calorie intake and subsequent weight gain comes from a randomised controlled trial among US adults (Hall et al, 2019). The study found that energy intake was greater among those consuming a diet rich in UPF than a diet high in minimally processed foods, despite both diets being matched for energy, macronutrients, sodium, sugar and fibre (though not texture, or the energy density of the meals). This was explained by participants in the UPF-rich group eating more, and so consuming more fat and carbohydrates, resulting in increases in weight and body fat.

As above, this study clearly shows that something other than ‘problem nutrients’ in UPF-rich diets causes excess energy intake and weight gain, and implicates factors related to extensive processing. This is pertinent to commercial baby and toddler food and drinks, which are often marketed as ‘healthy’ and frequently make claims related to their ingredients, and yet may be classifiable as UPF (see **sections 2** and **6**).

A secondary analysis of Hall et al's trial data showed that the differences in the diets' texture and the energy density of the meals caused a higher energy intake rate in the UPF diet compared to the less processed diet (Teo et al, 2022). UPF consumption may also contribute to excess calorie intake by affecting the hormonal response that determines satiety. In Hall et al's trial, participants eating the minimally processed diet had lower secretions of the hunger hormone ghrelin and higher levels of the satiety hormone PYY (peptide PYY) compared to those eating the ultra-processed diet (Hall et al, 2019). This is relevant because processing methods which are used in the production of baby purées and meals, such as puréeing or juicing fruits and vegetables, alter their texture, and are known to reduce their satiety, probably due to inappropriate insulin release (Haber et al, 1977).

Another reason UPF consumption may contribute to excess calorie intake is by altering the energy required for digestion, absorption, transport and storage of the ingested food, known as postprandial energy expenditure (De Amicis et al, 2022). Relevant to infants and young children are the extensively milled flours and processed peanuts found in baby cereals and snacks, where processing has been shown to speed up the delivery of usable calories (Kelly et al, 2022).

Finally, excess calorie intake may be a result of overconsumption encouraged by the availability and convenience, hyper-palatability and intensive marketing of



UPF (Elizabeth et al, 2020). For example, baby finger foods are the most popular commercial baby food type by sales in the UK, and are used almost universally, despite being discretionary (Mintel, 2022). They are often sweet and have a uniform texture, requiring less chewing than minimally or unprocessed alternatives. These features make them hyper-palatable. This and other drivers of UPF consumption in infancy and childhood are discussed further in **section 6**.

4.2.3 UPF DISRUPT THE DEVELOPMENT OF HEALTHY TASTE PREFERENCES AND DIETARY HABITS

As well as UPFs being marketed as appropriate first foods for infants, their ubiquitous availability, convenience, intensive marketing and hyper-palatability all encourage unhealthy eating patterns that do not align with public health recommendations for feeding infants and young children (see **sections 1** and **6**). These UPFs disrupt taste preferences, displace minimally and unprocessed foods needed for optimal growth, health and development, and encourage unnecessary snacking.

These suboptimal dietary practices contribute to nutritionally imbalanced diets and help to perpetuate a food culture dominated by UPF, with longer-term effects. Evidence of this comes from a prospective cohort study in Portugal which showed high UPF consumption at four years of age to be positively associated with ‘the urge to eat’ when children saw or smelt palatable food at seven years of age (Vedovato et al, 2021).

UPF consumption in early childhood is a specific cause for concern as biological and learned preferences for these foods – which may be energy dense – reinforce ➤

> one another (Fox and Timmer, 2020). This may result in children preferring these foods, in turn leading to dietary patterns dominated by UPF into adulthood.

DISRUPTING DEVELOPING TASTE PREFERENCES

Infants are born with innate positive responses to sweet and umami (savoury) flavours, and negative responses to bitter and sour flavours (Birch and Fisher, 1998). Although these preferences are physiological and determined largely by genetics, both their mother's diet during pregnancy and food experiences in infancy and early childhood shape and modify infant taste preferences (Ventura and Worobey, 2013).

The development of the gustatory (taste) and olfactory (smell) systems in utero is evidenced by foetal responses to flavours in the amniotic fluid (Freitas et al, 2018). Foetal responses to amniotic fluid flavour profiles (Vertura and Worobey, 2013) and infant exposure to maternal dietary flavours through breastmilk (Freitas et al, 2018), suggest that UPF consumption by women during pregnancy and whilst breastfeeding could be an important predictor of taste preferences of their babies in early childhood. In addition, breastfed infants are exposed, through breastmilk, to a wider range of flavours from their mothers' diet compared to formula-fed infants, and may accept a wider variety of foods as a result (Freitas et al, 2018) (see **box 7**).

BOX 7

HOW FORMULA SHAPES TASTE PREFERENCES

From birth, formula-fed babies experience different tastes to breast(milk)-fed babies. Although different types and brands of formula may taste different, babies fed one formula product will experience a constant and unchanging taste profile until their first solid foods (Ventura and Worobey, 2013). This contrasts with breastfed babies, who experience a wide diversity of flavours, facilitating the acceptance of a greater variety of foods than formula-fed babies (Freitas et al, 2018).

Young children consuming growing-up and toddler milks, which are typically sweet due high levels of free sugars, may also develop a preference for sweet tastes. This means that toddlers given these discretionary formulas instead of less sweet cows' milk (the recommended main milk drink from one year) will experience a different and less preferable taste transition if they are being weaned off formula (First Steps Nutrition Trust, 2021).



Public health advice on complementary feeding in infancy and in early childhood focuses on achieving dietary variety by introducing a range of foods with different tastes, colours and textures to promote acceptance (see **section 1**). The innate flavour preferences of infants are modified by exposure to different flavours in early life, which means that what infants are given to eat during the second half of infancy is critical in influencing lifetime food preference.

UPF-rich diets during this period deny infants the necessary exposure to the tastes, colours and textures of unprocessed and minimally processed foods needed to assist the process of learning to like and accept such foods, and to develop the physical ability to eat them. To illustrate this point, **figure 13** compares photos of selected ultra-processed commercial baby and toddler foods, out of their packaging, with photos of the unprocessed and minimally processed foods on which they purport to be based.

FIGURE 13

SELECTED ULTRA-PROCESSED COMMERCIAL BABY AND TODDLER FOODS COMPARED TO THE UNPROCESSED AND MINIMALLY PROCESSED FOODS ON WHICH THEY PURPORT TO BE BASED



DISPLACING UNPROCESSED AND MINIMALLY PROCESSED ALTERNATIVES

As discussed in **section 1**, commercial milk formula is an important and unique example of food displacement in the diets of UK infants and young children. While infant formula is an exceptional UPF (see **section 2, box 4**), follow-on formula and growing-up and toddler milks (displacing breastmilk and/or minimally processed cows' milk) are discretionary products. Cows' milk is lower in sugar than growing-up and toddler milks (First Steps Nutrition Trust, 2021) and may protect against the development of insulin resistance associated with type 2 diabetes and heart disease (De Araújo et al, 2021).

Another example of UPFs displacing unprocessed and minimally processed alternatives is the use of commercial baby foods based on fruit and vegetable-based purées (see **box 8**). While the proportion of these products which can be classified as ultra-processed on the basis of ingredient markers is probably low, it is likely that many more meet the definition on the basis of the series of industrial processes used during their manufacture (see **section 2**). These include maceration and heat treatment, which are likely to affect the quantity and bioavailability of nutrients and phytonutrients, including total fibre, glucosinolates and heat-sensitive nutrients such as vitamin C (Westland and Crawley, 2018).

Moving on to food displacement in young children, a meta-analysis using UK data from children aged 18 months and up shows that higher intakes of UPF are linked to reduced intakes of fruit, vegetables and legumes – all rich sources of micronutrients that support good health and nutrition (Martini et al, 2021).

Lastly, in one small prospective observational study in the US, higher intakes of UPF were associated with reduced consumption of fruit and vegetables in pregnant and post-partum women (Nansel et al, 2022), with potential implications for foetal growth and development and infant diets.

ENCOURAGING SNACKING

As outlined in **sections 1 and 2**, a wide range of commercial baby 'finger foods' are available on the UK market (Mintel, 2022), a significant proportion of which are ultra-processed (Grammatikaki et al, 2021). These clearly imitate ultra-processed snack foods often high in fat, salt and sugar, such as crisps and sweets (see **section 6**).

In **section 3**, we outlined how commercial baby foods, including finger foods, are widely used across all socio-economic groups and in **section 6** we outline key drivers,

which include aggressive marketing. The commonplace use of ultra-processed, commercial baby snacks normalises and establishes unnecessary and unhealthy snacking from an early age and is contrary to public health advice that snacks are unnecessary in infancy, and from one year should be based on healthy family foods (see **section 1**).

BOX 8

FRUIT AND VEGETABLES... OR UPF?

At first glance, national survey data on infant and young child feeding appears to show encouragingly high levels of consumption of fruit and vegetables among four- to 18-month-olds in the UK, with children consuming on average between 48 and 96g of fruit, and between 52 and 84g of vegetables a day (taking into account that an adult portion is 80g) (Lennox et al, 2013).

However, these figures hide the high proportion of foods classified as fruit and vegetables that are actually commercial baby and toddler foods listing fruits and vegetables as ingredients, such as baby juices and drinks, and baby fruit products, desserts and yoghurts. It is likely that at least a fifth of these products (if not more) are UPF (Grammatikaki et al, 2021).



4.2.4 UPF MAY AFFECT OPTIMAL DEVELOPMENT OF THE GUT MICROBIOTA

UPF-rich diets may contribute to long-term disease by changing the composition of the gut microbiota and encouraging low-grade inflammation, favouring the onset of noncommunicable diseases including cancer, type 2 diabetes, and cardiovascular disease (Tristan Asensi et al, 2023).

A small number of observational studies suggest that UPF intake may be associated with markers of inflammation in adults, including pregnant women (Tristan Asensi et al, 2023). The hypothesised mechanism is the displacement of minimally and unprocessed foods, such as whole plant foods, that are the foundations of dietary patterns known to protect against inflammation (Zinöcker and Lindseth, 2018).

In addition, the additives associated with UPF-rich diets are proposed to impact negatively on the composition of the gut microbiota. This suggestion comes from animal studies which indicate that additives may disrupt the balance of micro-organisms in the gastrointestinal tract, which plays a key role in immunity, digestion, absorption and inflammation, and may therefore impact on chronic inflammatory diseases (Zinöcker and Lindseth, 2018) and metabolic syndrome (Chassaing et al, 2017).

The impact of UPF-rich diets on the gut microbiota is of particular importance in infancy, as this is a crucial period in the development of the immune system (Tanaka and Nakayama, 2017).

4.2.5 UPF MAY CONTAIN HARMFUL ADDITIVES AND CONTAMINANTS

As outlined in **section 2**, UPF – including products aimed at infants and young children – may contain permitted cosmetic additives (such as colourings, sweeteners and flavourings), 'functional' additives (such as emulsifiers, antioxidants and thickeners), as well as contaminant by-products of processing. In addition, harmful substances that can migrate from food packaging to food (e.g. bisphenols) will be more commonly consumed by those with UPF-rich diets.

There has been little scrutiny of the impact of additives on health outcomes at a population level, and none on infants and young children. However, a large cohort study among adults in France monitored additive consumption in detail and recently reported associations between emulsifiers and (artificial) sweeteners and cancer risk (Debras et al, 2022; Sellem et al, 2022). **Box 9** provides a brief overview of some of the safety concerns around additives and contaminants in early years' diets. Next, we focus on the specific concerns related to a small number of additives and contaminants commonly found in UPFs consumed by infants and young children.

BOX 9

SAFETY CONCERNS AROUND ADDITIVES AND CONTAMINANTS IN THE DIETS OF INFANTS AND YOUNG CHILDREN

Existing relevant regulations pertaining to infant and follow-on formulas and baby foods allow the use of some additives, but with restrictions (see **annex 1**). However, and as shown in **section 3**, many infants and young children are consuming additive-containing UPFs which do not fall under these regulations, particularly biscuits, confectionery, cakes and ice cream – some marketed for pre-school children.

The concern is that safety assessments for some additives permitted in foods have not been extensive enough, as most are based on toxicity from animal testing and do not look at the impact of longer-term intakes, or the 'cocktail effect' of

consuming multiple additives. Infants and young children have additive and contaminant intakes proportionately greater than the rest of the population due to their comparatively lower body weight, and young children may have a higher dietary exposure to chemicals than adults due to a combination of rapid growth rates and more limited food intake patterns (Martyn et al, 2013).

In addition, metabolic differences between children and adults mean more oxygen and nutrients are needed per kilo bodyweight for a child compared to adult organs (Ginsberg et al, 2004) and the distribution and absorption of chemicals throughout the body can differ. For example, water-soluble substances are distributed

over a relatively greater volume within a child's body compared to an adult's, and can move more easily into tissues and organs from the bloodstream (VWA, 2008).

Assessment of additive safety for exclusively formula-fed infants under 16 weeks has been ongoing at the European Food Safety Authority (EFSA) over the past five years, but assessments remain focused on toxicity testing rather than on reviewing potential impacts on the microbiome. This is exemplified by the recent review of the emulsifier mono- and diglycerides of fatty acids (E471), currently permitted in all commercial milk formulas, even those marketed for the most vulnerable infants (EFSA, 2021).

SURFACTANT EMULSIFIERS

Surfactant emulsifiers are a group of additives used widely in UPF, including liquid commercial milk formulas, to ensure that mixtures containing oil and water remain as an emulsion. Several studies have suggested that they may have a causative role in a rising number of diseases linked to impaired intestinal barrier functions and changed intestinal microbiota, such as allergic diseases, coeliac disease, type 1 diabetes, Crohn's disease and colorectal cancer (Csáki and Sebestyén, 2019).

NON-SUGAR SWEETENERS

Non-sugar sweeteners (NSS) (also called artificial sweeteners) are also widely used in UPF. By law they cannot be added to foods and drinks marketed for infants and young children in the UK (see **annex 1**), however in a previous report we have shown they are present in many foods consumed by infants and young children, notably low-sugar and no-sugar soft drinks (as shown in **section 1**), baked beans, tinned pasta shapes in tomato sauce, tomato ketchup and jellies (Sibson and Crawley, 2019).

A recent systematic review and meta-analysis on the possible long-term health impact of consuming NSS highlighted the potential for short-term reductions in adiposity, but longer-term negative effects including increased risk of type 2 diabetes, hypertension, cardiovascular events, cardiovascular mortality, bladder cancer and increased risk of all-cause mortality in adults (Rios-Leyvraz and Montez, 2022). In addition, prospective cohort studies indicate the consumption of NSS during pregnancy may increase birthweight and adiposity in offspring later in life. This research informed recently published WHO guidelines, advising not to include NSS in the diet (WHO, 2023).



The UK Government's proposed Acceptable Daily Intakes (ADI) for NSS have been calculated without data on infants' intake and with limited data on young children's intakes. Documented negative effects of sweetener consumption in the early years include increased calorie intake and weight gain among pre-pubertal children, and a potential impact on the microbiota (Sibson and Crawley, 2019).

PROCESS CONTAMINANTS

Chemical process contaminants may be formed unintentionally during the industrial processes used to create UPF. Cooking starchy foods – including commercial

baby snacks like puffs and wafers – at high temperature produces acrylamide, which is associated with a higher risk of cardiovascular disease and cancer (Chen et al, 2020). UK legislation requires food business operators to put in place simple, practical steps to manage acrylamide within their food safety management systems, and routine analysis of foods, including commercial baby food products, is undertaken in the UK (FSA, 2022). Yet despite this, there is a concern about the potential cumulative high levels of acrylamides in the diets of infants (Esposito et al, 2021).

Furan, a potentially carcinogenic compound, is created when sugars are processed at high temperatures, such as in the production of baby meals and desserts with long shelf-lives (Crawley and Westland, 2017). As furan cannot escape during high-temperature processing used to manufacture sealed jars and pouches, it is likely to be present in these products. Recognising its potential carcinogenicity, the Food Standards Agency (FSA) monitors levels of furans in commercial baby foods. However, there is currently no guidance on acceptable upper levels in food, or analysis of the cumulative furan content of UPF-rich diets among infants and young children.

The thermal processing of palm oils and fats (and to a lesser extent other vegetable oils) produces glycidyl fatty acid esters, which are potentially genotoxic and carcinogenic, and 3-monochloropropanediol, which can cause kidney damage (EFSA, 2016). These oils and fats are used in the production of ultra-processed commercial baby foods and commercial milk formulas. Modelling by EFSA has revealed younger age groups, including infants and toddlers, to be at greatest risk of exposure to 3-monochloropropanediol due to the contribution of glycidyl esters from infant formula (EFSA, 2016).

EFSA has established maximum levels for vegetable oils and fats used in the production of baby food and processed cereal-based food for infants and young children, and commercial milk formula (European Commission, 2018). However, the cumulative intake among infants and children with diets dominated by UPF containing these oils and fats is of concern.

CONTAMINANTS FROM PACKAGING

Commercial baby foods packaged in plastic bottles or pots, or glass jars with plastic-lined lids, may contain endocrine-disrupting chemicals linked to metabolic diseases and obesity, including bisphenols (Martínez Steele et al, 2020). Although bisphenol-A is now banned in many countries, it may be replaced with bisphenol S, which also has endocrine-disrupting properties (Juil and Bere, 2022). These chemicals can leach into foods,

especially when the food remains in contact with the packaging for long periods of time or is heated in its container. All UPFs are packaged, many in plastic, and so it is unsurprising that children with UPF-rich diets show higher levels of bisphenol and phthalate metabolites in their urine (Martínez Steele et al, 2020). This has implications for metabolic disease and obesity risk.

IN CONCLUSION

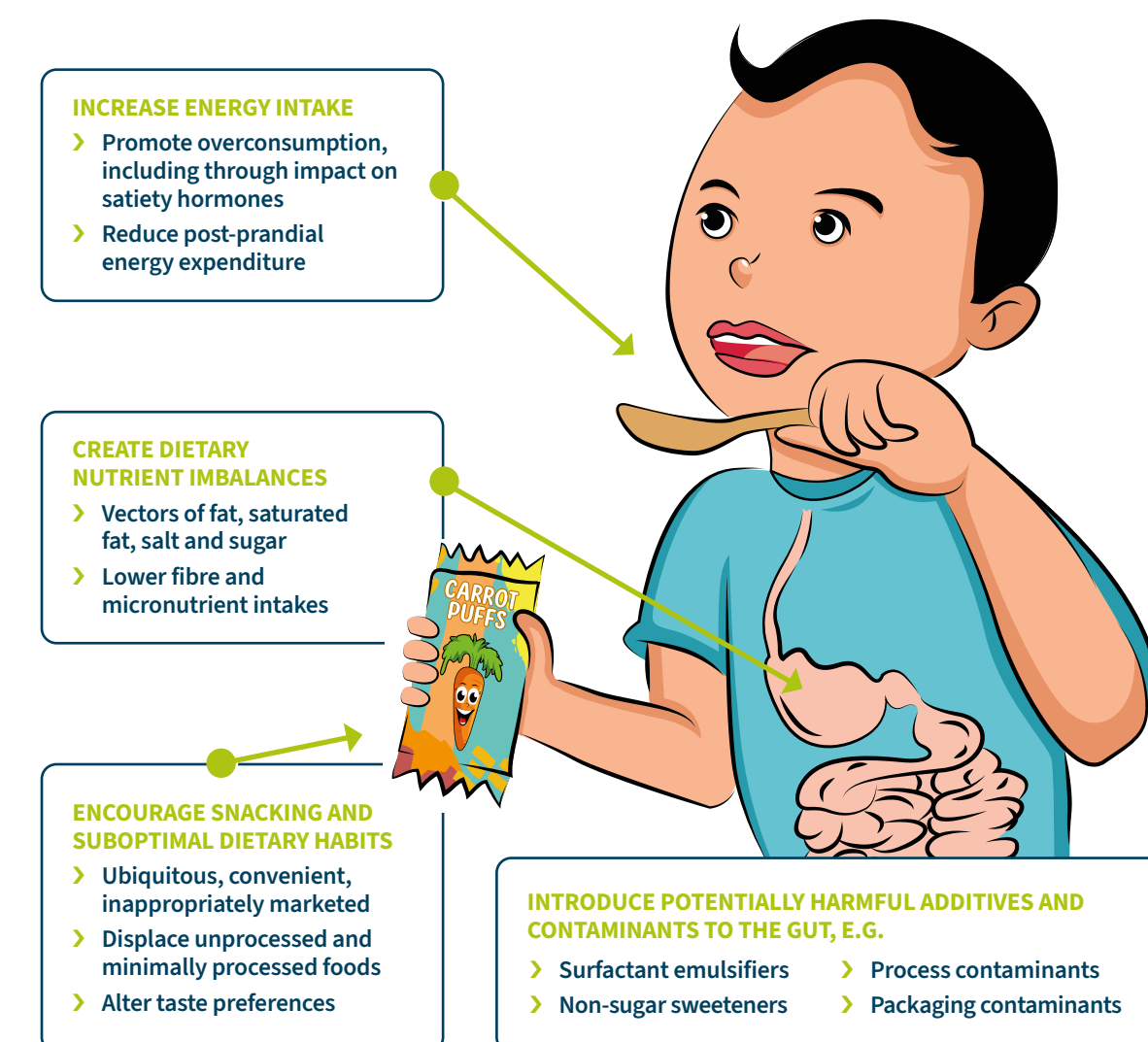
Evidence points towards numerous probable mechanisms by which UPF-rich diets in the early years may negatively impact on short- and longer-term health, and how they

can be implicated in driving high rates of overweight and obesity. **Figure 14** summarises how UPFs impact on physiology (including hormonal response, the gut microbiota and energy expenditure), altering nutrient and energy intake in the short-term and setting the trajectory for dietary patterns dominated by such foods in the longer term.

This transition away from minimally and unprocessed foods towards diets dominated by ultra-processed products that are extensively packaged and transported long distance also has an environmental cost, as discussed in the next section.

FIGURE 14

SUMMARY OF NEGATIVE EFFECTS OF UPF-RICH DIETS IN INFANCY AND EARLY CHILDHOOD



5 Environmental impact of UPF and why it is concerning for infants and young children



Along with health implications, the negative impacts of diets rich in UPF on infants and young children include damage to the environment which they are born into and will grow up in. International food corporations, in a bid to drive up demand for UPF in pursuit of profit, have altered the nature of the global food system. They support and encourage global supply chains to mass-produce cheap ingredients; use more energy, processing steps and packaging; and transport products over greater distances than for less processed foods. The production, processing, transport and consumption of discretionary UPF result in excessive use of energy, land and water and generates unnecessary waste – all with detrimental impacts on the environment (Seferidi et al, 2020) (see figure 15).

BOX 10

GREENHOUSE GAS EMISSIONS

As the global food supply chain contributes more than a quarter of the greenhouse gas emissions produced by human activities, research has been conducted to identify the foods or food groups most responsible for these emissions. Current evidence suggests that excessive consumption of calories from animal sources contributes most to the

production of excess global greenhouse gas emissions through food (Fardet and Rock 2020). However, due to the energy-intensive agricultural and processing methods required to produce them, and their long-distance distribution, UPF may also be significantly contributing to excessive greenhouse gas emissions.

UPF are likely to have a greater environmental impact than other types of food. Established methods to quantify the environmental impacts of food production, such as the lifecycle assessment method (Jones et al, 2016), do not consider the numerous industrial processes associated with the large variety of components included in UPF, such as food additives and their packaging (Seferidi et al, 2020). This means that their environmental impact is likely to be underestimated.

It is logical to assume that the extensive processing required in the production, use and disposal of these foods and their packaging are likely to have a more harmful environmental impact than minimally processed or unprocessed foods. This is evidenced by a study investigating the environmental pressures of diets based on UPF consumption, using data from the French Individual and National Food Consumption survey (Kesse-Guyot et al, 2023).

AGRICULTURAL PRODUCTION

International agricultural and food corporations, driven by profits, have shaped global agriculture, favouring a limited number of food crops that may be industrially processed to support the production of cheap ingredients. This is known as commodity cropping (Fardet and Rock, 2020). The Food and Agriculture Organization of the United Nations (FAO) estimates that “of the 10,000 plant species that can be used as food for humans, only approximately 150 have been commercially cultivated, and only four (rice, wheat, maize and potatoes) supply 50% of the world’s energy needs, with the latter being used for the massive production of starches, modified starches and sugar syrups used in UPFs”.

Agricultural production is a leading source of greenhouse-gas emissions (Swinburn et al, 2019) and commodity >

> cropping has led to increasingly intensive agricultural methods, which require larger quantities of water, energy, insecticides and fertilisers compared to lower-input and organic farming methods (Fardet and Rock, 2020) (see **box 10**).

In addition, UPF account for a large proportion of diet-related fertiliser use, in particular environmentally damaging phosphorus-based fertilisers, which are linked to biodiversity loss and land degradation. This makes it increasingly difficult for farmers to grow the crops needed as the basis of sustainable and healthy diets (Leite et al, 2022). In Brazil, the land area used to farm soy for livestock feed and UPF production rose by 70% between 2008-2019. During this same period, land for staple crop production reduced, with a loss of 43% in area for rice and 30% for beans.

Intensive livestock rearing, including for processed and ultra-processed meat products, results in the production of excess methane – a key contributor to global greenhouse gas emissions (Anastasiou et al, 2022). Intensive rearing comes with additional concerns around animal welfare, loss of biodiversity and increased use of antibiotics and vaccines (Fardet and Rock, 2020).

FOOD PROCESSING

Food processing has a greater environmental impact than transport, retail or refrigeration (Anastasiou et al, 2022). A large proportion of the energy used to produce processed and ultra-processed foods is associated with thermal processes: dehydration and sterilisation alone



BOX 11

THE CARBON FOOTPRINT OF COMMERCIAL MILK FORMULAS

Commercial milk formulas contribute significantly to greenhouse gas emissions. One estimation suggested that if all UK babies were breastfed exclusively for six months (as per public health recommendations), it would save between 95 and 153 kilograms of carbon dioxide per baby – the equivalent of taking up to 77,500 cars off the road each year (Joffe et al, 2019).

account for 29% of the EU food sector's total energy use (Fardet and Rock, 2020), and also require significant water resources. The industrial processing techniques used to make UPF are resource intensive (Van der Goot et al, 2016) and require significant energy inputs. For example, making powdered milk (an ingredient in many UPFs) requires over nine times more water, four times more raw milk and energy, and three times more fuel than preparing milk for consumption as a liquid (Foster et al, 2007) (see **box 11**).

FOOD PACKAGING AND DISPOSAL

To maintain shelf life, most food products are packaged to a lesser or greater degree. UPFs are almost always packaged and the production of this packaging requires a significant amount of energy (Alabi et al, 2019). It has been estimated that more than 200kg of UPF are consumed in the UK per person per year and the overwhelming majority are packaged in plastic (PAHO, 2015).

Disposal of this volume of packaging poses significant challenges for waste management and nearly 80% of all plastic packaging ends up in landfill or the environment (Fardet and Rock, 2020), with beach surveys revealing that UPFs contribute towards this figure (Anastasiou et al, 2022). The inappropriate disposal of plastics can impact on human health through soil, water and air contamination (Alabi et al, 2019). It has notable implications for marine life who can become entangled in, ingest or absorb plastic waste (Fardet and Rock, 2020).

As outlined in **section 2**, nearly 35% of commercial baby foods marketed in the UK are packaged in portion-sized pouches (PHE, 2019), posing a particular environmental concern. Many pouches are made from plastic layers with an aluminum core, making them non-recyclable (Crawley and Westland, 2017).

AVOIDABLE ENVIRONMENTAL DAMAGE

A study that looked at the temporal patterns in greenhouse gas emissions, water footprint and ecological footprint of food purchases by NOVA category in Brazilian metropolitan regions may provide the most convincing evidence of the negative environmental effects of UPF. While there was no significant change in the contribution of any other NOVA food groups, there was a significant increase in greenhouse gas emissions, water footprint and ecological footprint for UPF in the 30 years between 1987/88 and 2017/18 (measured as impact per 1000Kcal of food purchased) (Da Silva et al, 2021).

The vast majority of UPFs are not necessary components of healthy diets, including for most infants and young children. Enabling breastfeeding and the consumption of diets based largely on unprocessed and minimally foods from the first years of life would be more sustainable and beneficial for health and for the environment.

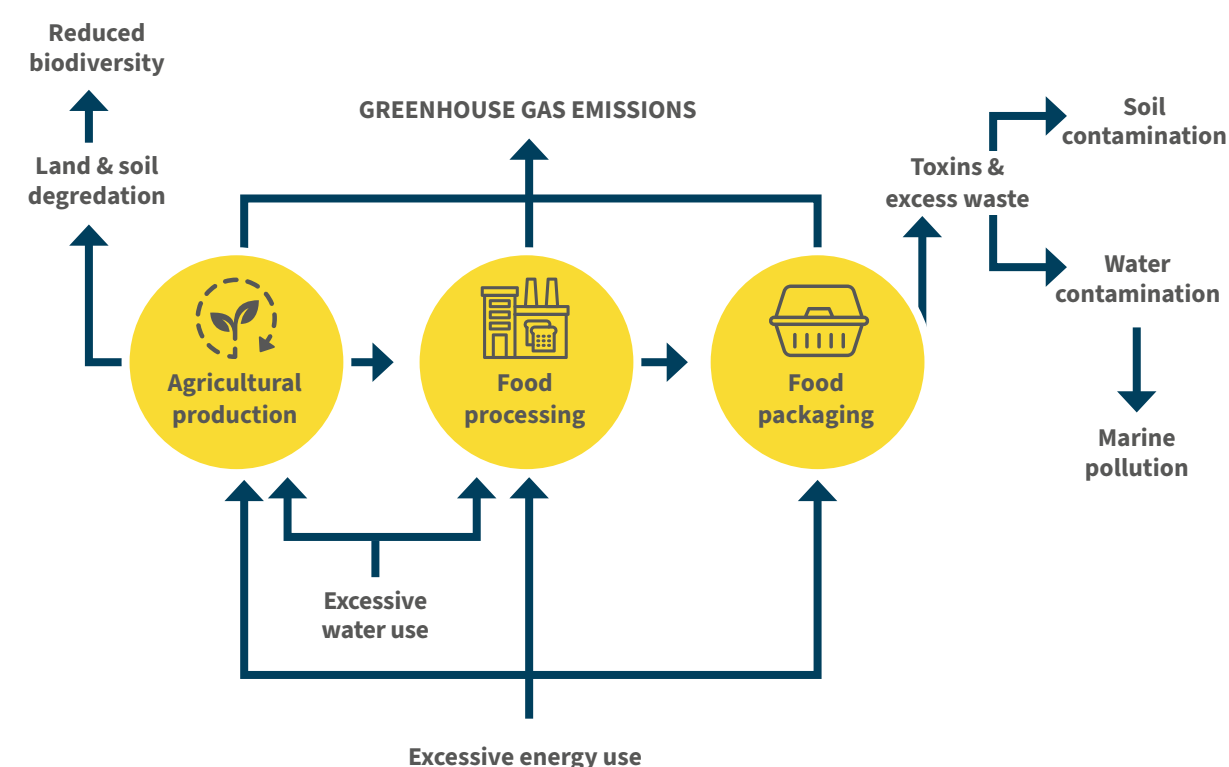
“Only four [commercially cultivated crops] - rice, wheat, maize and potatoes - supply 50% of the world's energy needs, [and these are] used for the massive production of starches, modified starches and sugar syrups used in UPFs.”

(FARDET AND ROCK, 2020)



FIGURE 15

THE ENVIRONMENTAL IMPACTS OF UPF Adapted from Anastasiou et al, 2022





6 Drivers of high UPF consumption by the UK's infants and young children

The reasons why we see high UPF intake among many infants and young children in the UK are complex and reflect wider population-level shifts towards diets dominated by widely available, highly palatable, highly processed food and drink (Popkin, 2011).

Drivers may differ somewhat between the types of UPF we know are consumed in the early years – such as commercial milk formulas, ultra-processed commercial baby and toddler foods and other products aimed at pre-school children – and ultra-processed family foods including soft drinks, juices, bread, cereals, biscuits, fromage frais and other dairy and non-dairy alternatives.

However, several common factors are at play, which are discussed in detail in this section: ubiquity, palatability, perceived low cost, convenience, inappropriate marketing and ambiguous public health recommendations. A number of these are even more pertinent given the current cost of living crisis faced by UK families.

6.1 Ubiquity

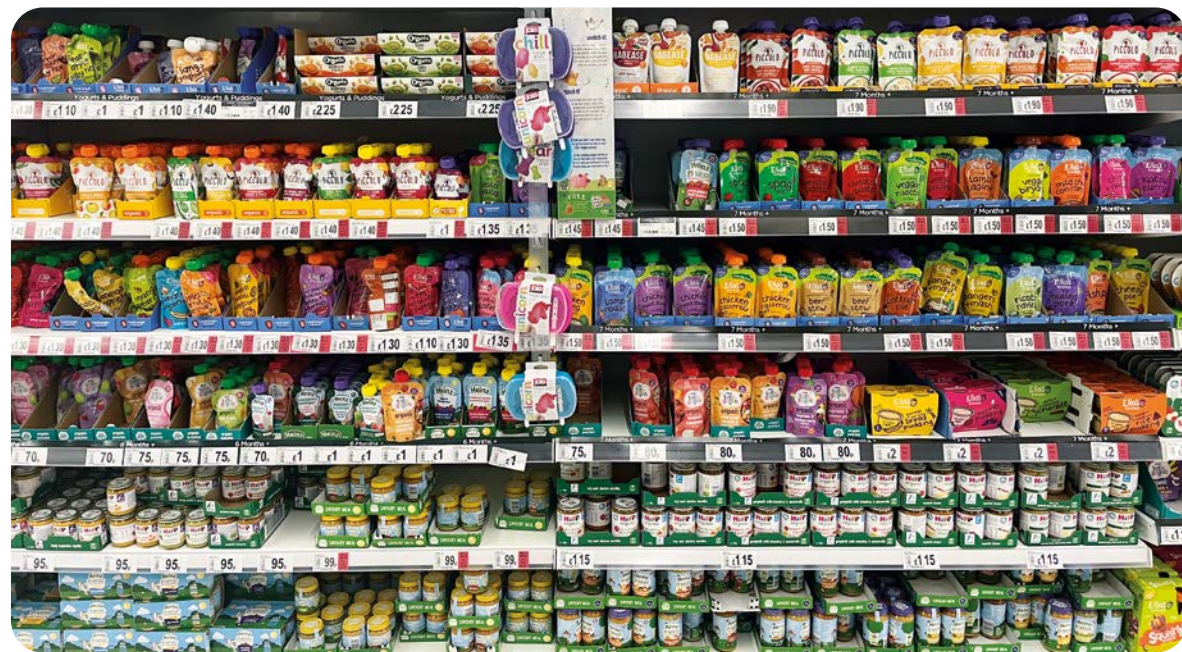
A foundation of the high levels of UPF consumption among infants and young children is their universal availability and accessibility (Elizabeth et al, 2020). Parents/carers seeking healthy and appropriate foods for their babies, toddlers and preschool-aged children are presented with a vast array of commercial products (many of them ultra-processed) created (or appearing to be created) specifically for them (see **box 12**), and marketed accordingly (see **section 6.5**).

In the context of examining the implications of the current cost of living crisis on diets, the Food Foundation states:

“Strategies such as reducing fuel usage, selecting palatable foods and reliance on food aid all direct households towards more processed and pre-prepared foods, which are typically made more palatable during the production process through addition of sugars, sweeteners, salt and a range of chemical substances used to enhance both flavour and shelf-life.”

(Food Foundation and City University, 2023)





BOX 12

THE UK'S BURGEONING BABY FOOD MARKET

The UK's 'baby food' market includes all commercial milk formulas, meals and desserts, finger foods and drinks marketed for infants and toddlers. This market is vast – it was valued at £656 million in 2021 (Mintel, 2022). The 'baby finger food' category grew by £16 million in 2021 – a growth of 17% from the previous year (Mintel, 2022).

The market evolves quickly to sustain profits. Since 2012 a decline in birth rates has led to falls in overall volume sales, resulting in competition between businesses to

The
baby 'finger
food' market grew
17%
between 2020
and 2021

maintain sales and hold onto market share. This has been achieved through new product development in order to appeal to 'untapped' markets, such as snacks for pre-school aged children labelled '3 years +' and plant-based foods and drinks for young children in vegan families, but also by marketing more costly brands and formats, particularly in the baby milk and baby finger food categories (Mintel, 2022). Many of these products do not yet appear in the available national based dietary surveys for infants and young children as they predate their availability.



6.2 High palatability

UPF are typically hyper-palatable (Scrinis and Monteiro, 2022), a feature which extends to ultra-processed products consumed by infants and young children in the UK (Isaacs et al, 2022).

The flavour profiles of commercial and ultra-processed baby foods are dissimilar to unprocessed and minimally processed alternatives and their ingredients and ingredient combinations are designed to ensure a high

degree of palatability (Crawley and Westland, 2017). Related to this, ultra-processed commercial baby foods have been found to be more likely to have higher energy, fat, saturated fat and sodium content than comparable products classified as minimally processed or processed (Grammatikaki et al, 2021).

Garcia et al suggest that baby food manufacturers are under commercial pressure to produce instantly palatable

foods, driving the fact that sweet foods make up a large proportion of their offer (Garcia et al, 2016). As outlined in **section 2**, the commercial baby and toddler food market is dominated by sweet-tasting products appealing to innate sweet preferences.

Sweet-tasting products have also been found to be more common than savoury among products aimed at pre-school children, and marketed as healthy (Garcia et al, 2019). Analyses of the nutrition composition and ingredients in growing-up and toddler milks, commercial baby foods, as well as products marketed for pre-school children shows high levels of free sugars (First Steps Nutrition Trust, 2021; PHE, 2019; Garcia et al, 2019), and more so in products defined as ultra-processed than those in other NOVA categories (Grammatikaki et al, 2021).

Market research has shown that an important consideration for families when buying commercial baby foods is that they know their child likes the flavour (Mintel, 2016). For some, the fact that their child likes a particular commercial baby food and is likely to finish the packet makes it appear more cost effective than home-made meals, which may be more likely to be wasted (Isaacs et al, 2022) – a point that may be particularly pertinent given the current cost of living crisis.

This is despite the fact that food rejection is physiologically normal during the early years, meaning new foods may need to be offered repeatedly to facilitate acceptance (SACN, 2018). In addition, it is possible to make home-made foods at a lower cost using higher proportions of more expensive, nutrient-rich ingredients (Crawley and Westland, 2017; Action on Sugar, 2022) given appropriate resources (see **section 6.3**).

The packaging of commercial baby foods also has an impact on the extent to which they are liked and consumed by children, and therefore appeal to parents (see **section 6.4**).

Lastly, it is striking the extent to which ultra-processed baby and toddler foods imitate highly palatable ultra-processed (and typically HFSS) family foods, as the images in figure 16 show. We propose that the similarities between, for example **puffed baby 'finger foods'** and **crisps**, **dried fruit-based 'finger foods'** and **sweets**, and **baby biscuits** and **standard biscuits** is a key reason for the early transition to ultra-processed family foods, along with the fact that they are cheaper.

FIGURE 16

ULTRA-PROCESSED COMMERCIAL BABY FOODS AND THE ULTRA-PROCESSED HFSS FOODS THEY IMITATE



6.3 Low cost or perceived cost effectiveness

Whilst UPF are typically cheaper than less processed foods, this is not the case with commercial baby and toddler foods (a proportion of which are UPF) compared to home-made alternatives. In our opinion, this means that it cannot be said that the high cost of unprocessed and minimally processed foods is a widespread barrier to their use over commercial infant and toddler foods, especially given that these products are used across all socio-economic categories (PHE, 2019).

It is, however, also important to acknowledge the wider resources required to eat well which may pose barriers in some households to greater use of home-made foods for infants and young children. These include: time (to plan,

shop, prepare and cook); transport to get to the shops; energy/fuel; and the other facilities needed to prepare, cook and store foods and meals, such as utensils, devices, fridges/freezers.

While ultra-processed baby and toddler foods are more expensive than unprocessed and minimally processed foods, ultra-processed family foods are likely to be the cheapest option available. In the current context of rising food insecurity – where households with children under four have the highest prevalence of food insecurity (Food Foundation, 2023) and record high food inflation (above general inflation) – this is a clear cause for concern regarding the appropriateness of diets of infants and young children in families on low incomes.

Infants and young children (under four) and pregnant women in households on the lowest incomes (as well

as pregnant teenagers) are eligible for a specific nutritional safety net benefit called Healthy Start (in England, Wales and Northern Ireland (NHS, 2023b), or Best Start Foods in Scotland (for the under threes) (MyGov.Scot, 2022). The schemes provide vitamin tablets/drops, and a monetary allowance for buying fruits and vegetables, cows' milk, pulses and other minimally processed foods, as well as infant formula if desired.

In theory the schemes should improve the affordability of minimally processed foods for those least able to access them. But whilst the Best Start Foods scheme has been subject to improvements in recent years, the Healthy Start scheme needs reform, most notably with respect to its accessibility and therefore coverage, but also the value of the allowance in relation to high and rising food prices (Food Foundation, 2023).

6.4 Convenience

Practical considerations often take precedence in food choice (Hayter et al, 2015). Time and access to adequate kitchen facilities have been cited as barriers to feeding children nutritious, minimally processed foods, as assessed by a systematic review of dietary patterns across age groups and countries, including mothers in the UK (Mills et al, 2017). Some parents/carers may also feel they lack the knowledge and/or skills to prepare at-home foods suitable for their babies and young children (Isaacs et al, 2022). In this context, commercially prepared products – many of which may be ultra-processed – may seem a convenient choice.

Time pressure is likely an increasing reality facing many low-income working families, particularly given the current cost of living crisis (Food Foundation and City University, 2023). In contrast to nutritious whole or minimally processed foods and meals, ready-to-eat UPFs may be more convenient as they require less cooking time, or no cooking at all (such as baby pouches and 'finger foods'), and also incur no costs related to cooking. Using commercial baby and toddler foods may also help save the time needed to plan, budget, shop and prepare, compared with creating a home cooked meal (Food Foundation and City University, 2023).

Research among parents of two-year-olds in Norway has shown that those with higher time constraints were three times more likely to use ultra-processed dinner products, 1.6 times more likely to consume snacks and soft drinks, and twice as likely to eat fast food away from home (Djupegot et al, 2017).

“The consumption of UPF at household level has been shown to decrease confidence in cooking skills, promoting further reliance on ready-to-eat meals, which are often ultra-processed”

(KHANDPUR ET AL, 2020)

However, the consumption of UPF at household level has been shown to decrease confidence in cooking skills, promoting further reliance on ready-to-eat meals, which are often ultra-processed (Khandpur et al, 2020). In contrast, it has been shown that better home food preparation skills (and their more frequent use) was associated with lower UPF consumption (Lam and Adams, 2017).

The packaging of UPFs creates convenience in other ways. The long shelf lives and ambient nature of many UPFs may make them more convenient and cost effective for some families, e.g. those without fridges or freezers. And the way certain commercial products are packaged makes them convenient: pouches are commonly consumed straight from the pouch (see **box 13**) and 'finger foods' are typically packaged in individual 'portions'.

A recent survey among 1,000 UK parents of six- to 36-month-olds reported that the top reason for buying commercial baby foods was convenience (Action on Sugar, 2022) and pouches are perceived as particularly useful (Isaacs et al, 2022).

BOX 13

BABY FOOD POUCHES: CONVENIENT OR HARMFUL?

Over one-third (35%) of commercial baby foods – a proportion of which are UPF – are packaged in pouches (PHE, 2019), facilitating marketing through the use of bright colours and cartoons that appeal to children. Many have nozzles, meaning babies can suck foods from the pouch without the need for spoons and bowls, which no doubt drives their perceived convenience and therefore popularity (Isaacs et al, 2022).

However, their use in this way may encourage overconsumption as portion sizes are often too big, children cannot see what they are eating, and packaging does not allow those feeding them to know how much they are eating (Westland and Crawley, 2018). It is also a risk to dental health given the sustained contact of a product high in free sugars with the teeth. And as they do not require chewing, over reliance on pouched baby foods may hinder the development of eating skills.



Whilst perceptions of lacking time, knowledge and skills are no doubt entirely valid for some parents/carers, we propose that they have been greatly amplified by inappropriate marketing by the baby food industry in the context of patchy access to professional support for many parents/carers. Central to this is the shortage of health visitors in England at a time when the need for support is growing due to the cost of living crisis and aftershocks of the pandemic (iHV, 2022). Those in post may have very large caseloads, making it hard to deliver on their mandated visits.

In addition, with many Sure Start centres having closed since 2010, England's new 'Family Hubs' – designed to support families and improve health and education outcomes for all – are only being rolled out in half of all local authorities with short-term funding (DfE and DHSC, 2022). What is more, health eating is not currently one of their priority areas.

6.5 Inappropriate marketing

UPFs are typically marketed aggressively (Scrinis and Monteiro, 2022). For infants and young children, this is best exemplified by the marketing of commercial milk formulas, although there is also ample evidence for commercial baby and toddler foods, and some for products aimed at pre-school children. Below is a snapshot of how UPFs aimed at infants and young children are marketed inappropriately.

“Marketing means product promotion, distribution, selling, advertising, product public relations, and information services” (WHO, 1981)

6.5.1 COMMERCIAL MILK FORMULAS

Infant formula is subject to regulations intended to prevent inappropriate marketing (see **annex 1**). This domestic legislation encompasses some (but not all) provisions of the International Code of Marketing of Breastmilk Substitutes and subsequent World Health Assembly resolutions ('the Code') (WHO, 2022). The Code is a global policy framework which the WHO advises should, at national level, be enacted in full and enforced so that parents/carers are protected from inappropriate and misleading marketing of products for infant and young child feeding.

Among provisions within the UK law are those meant to prevent 'cross promotion' of infant formula through the marketing of follow-on formula and growing-up and toddler milks. This involves making their common brand the feature of the advertisement or promotion (WHO, 2019). However, and despite legal restrictions, this practice is commonplace, as captured by the 2020 report *Marketing of infant milks in the UK: What do parents see and believe?* (Brown et al, 2020).

The legally permitted marketing of these unnecessary formulas (follow-on, growing-up and toddler milks), also aims to convince parents/carers that these ultra-processed, and at times high sugar milk drinks are nutritionally superior to cows' milk, the less processed >



> and cheaper alternative advised by the NHS (First Steps Nutrition Trust, 2021). Cross promotion is just one example among many which highlights poor enforcement of current legislation governing the marketing of commercial milk formulas²⁷.

Along with mainstream marketing techniques (print and broadcast advertisements and media campaigns), formula manufacturers also employ more sophisticated online marketing techniques and public relations activities aimed

at pregnant women and new parents, for example so-called 'baby clubs' (see **box 14**). Online marketing enables digital surveillance by companies, with the consumer insights it yields being used to build trust with parents/carers, who may regard certain brands as sources of reliable information on what and how to feed their infants and young children (WHO, 2022; Mintel, 2022; Isaacs et al, 2022). Much of this marketing is legally allowed in the UK, but violates the International Code of Marketing of Breastmilk Substitutes and could be legislated against.

BOX 14

MARKETING BEGINS IN PREGNANCY

Formula and baby food companies target prospective mothers from early pregnancy onwards to build awareness of their products, develop trust in the brand and influence feeding choices. They may do this through offering advice on eating well in pregnancy, and target mothers-to-be through their online searches related to pregnancy, childbirth and infancy.

Marketing activities include providing classes, social events and other interactive campaigns: "Experiential campaigns allow brands to build an image of caring about people's health and wellbeing from the first stages of motherhood. Marketing aimed at mothers-to-be also helps brands to become front of mind for parents before they choose food/drink for their child" (Mintel, 2019).

Most companies also have a 'baby club' to engage with pregnant women and mothers by email and post. Companies give out free branded toys and diaries to parents joining their club, encourage families to use their telephone and instant messaging helplines and direct them to their websites for further support and information on infant feeding (Hastings et al, 2020). In doing so, they seek to actively build relationships with women, reassuring them that their brand can be trusted as a source of nutritional advice whilst promoting their products.

Digital marketing is particularly powerful as personal data can be collected through interactions with consumers, allowing content to be targeted to different groups of women. So for some, content may focus on a child's wellbeing and happiness, for others it seeks to reassure with technical claims about health or development that distort science and are difficult to distinguish from independent healthcare information. It has also been shown to be effective, as women who have signed up to baby clubs or telephoned advice lines are then more likely to buy a specific brand's products (Hastings et al, 2020).

More information on how commercial baby food companies target families through digital marketing can be found in our report *Why Government should end online infant formula marketing to protect children from overweight* (Hickman et al, 2020).



6.5.2 COMMERCIAL BABY AND TODDLER FOODS

Parents/carers trust that the products food companies make and market for babies and young children are appropriate and align with public health recommendations (PHE, 2019). They may also assume that the ingredients, composition and marketing of these products are appropriately regulated, when in reality specific legislation may be weak or non-existent (see **section 1** and **annex 1**). For example, the permissible marketing and labelling of commercial baby foods for use from age four months is interpreted by some parents/carers to mean that this is the appropriate time to introduce solids, despite public health recommendations to do so from around six months (DHSC, 2022).

“The permissible marketing and labelling of commercial baby foods for use from age four months is interpreted by some parents/carers to mean that this is the appropriate time to introduce solids, despite public health recommendations to do so from around six months”

Many companies who manufacture and market commercial milk formulas also produce similarly branded baby foods, which they market using print and broadcast advertisements and media campaigns, as well as through their baby clubs and digital marketing.

A very common marketing strategy is the legal but inappropriate use of nutrition and health-related claims on the packaging of commercial foods aimed at infants and young children – including ultra-processed products. These are successfully used to create a perception that the products are healthy, safe, 'natural', and/or developmentally appropriate (Isaacs et al, 2022; Garcia et al, 2019; Sparks and Crawley, 2018) (see **box 15**).

As for the marketing of commercial milk formulas, baby food marketing techniques have become more sophisticated over time. For example, Isaacs et al use the term 'brand eco-system' to mean marketing and advertising that is broader than a specific product, and highlight the popularity of one baby food brand that positions itself as a reliable source of information on infant and young child feeding (despite the clear conflict of interest) and provides parents with a free 'weaning chart', guide and vouchers for money off their products (Isaacs et al, 2022).

Another example is the co-opting of public health initiatives or campaigns as a means to promote their brand and products. For example, a call for sensory food education in the early years, recommended by the Independent Review for the National Food Strategy published in 2021, was then pursued as a campaign by the commercial baby food company Ella's Kitchen in 2022.

25% of parents with children aged up to four seek feeding advice FROM A BABY/TODDLER FOOD BRAND WEBSITE...

compared to **34%** using the NHS OR START 4 LIFE WEBSITES²⁸

6.5.3 FOODS FOR PRE-SCHOOL CHILDREN

With respect to the marketing of foods to pre-school children, the use of cartoons is unrestricted in the UK and an extensively used marketing strategy which can negatively influence diet-related behaviours in children, especially with regard to the consumption of energy-dense and nutrient-poor foods (Kraak and Story, 2014), which will include UPFs.

Even before a child has learnt how to read, they can readily recognise brands (McAlister and Cornwell, 2010), and studies have shown that a child's knowledge of food brands can be a significant predictor of adiposity (Cornwell et al, 2014). This is in part because cartoons are used to promote HFSS foods, which are also more likely to be UPF than to fall in to another NOVA category.

For example, the Action on Salt and Action on Sugar survey of 2019 reported on in **section 1.4** found that 50% of UK food products featuring Peppa Pig and 54% featuring Paw Patrol were classed as 'unhealthy' on the basis of their fat, saturated fats, sugar and/or salt content as per the Ofcom NPM (Action on Sugar, 2019). Furthermore, in a multi-country meta-analysis (including UK data) of food products designed for children, those aged two to seven years had considerably higher taste preferences for high fat, salt, and sugar items when characters were used on the packaging of those foods (Packer et al, 2022).

²⁷ e.g. on marketing of specialised infant milks / infant milks as foods for special medical purposes: Westland and Sibson, 2022; on contravention of labelling regulations: Conway et al, 2023; on contravention of regulations governing claims: Cheung et al, 2023

²⁸ According to a recent survey of UK 800 internet users who have children aged birth to four years (Mintel, 2022).

6.6 Ambiguous public health recommendations and initiatives focusing on ‘problem nutrients’

In the context of all of the above factors promoting UPF consumption, the absence of explicit public health recommendations relating to UPF in the diets of infants and young children is of serious concern. As our summary of the recommendations in **section 1** shows, families are not advised to base their children’s diets on unprocessed and minimally processed foods, even if this is what the images and recipes on NHS and Better Health Start 4 Life websites suggest.

Additionally, efforts to reduce high rates of obesity in the UK have focused on achieving a population-level reduction of high fat and/or high sugar foods, with these identified using the Ofcom NPM (DHSC, 2022). Unfortunately, this is inadvertently promoting consumption of UPF.

An example of this is the way in which the NHS Food Scanner App (launched in January 2022) works. The app encourages shoppers to scan the barcodes on commercial products to identify the amount of sugar, saturated fat and salt (Soil Association, 2023). If a product contains

higher than the recommended amount, an alternative ‘smart swap’ is suggested. However, such smart swaps can include artificially sweetened soft drinks (shown in **section 1** to be more commonly consumed by young children, and in larger volumes, than sugar-sweetened soft drinks), biscuits, cakes, crisps and chocolate puddings.

A second example, also focusing on drinks, is the Soft Drinks Industry Levy, requiring businesses to pay tax on the production and import of soft drinks that contain added sugar. The levy has been lauded as a success for its impact on sugar consumption and potentially on obesity (among 11-year-old-girls). However, soft drinks sales have actually risen since the levy was introduced, and 89% of sales now come from soft drinks containing non-sugar sweeteners (NSS) (Food Foundation, 2023). This is a concern given that soft drinks are unnecessary and public health recommendations include the avoidance of artificial sweeteners in the early years (see **section 1.1**), added to which there is evidence that they may cause harm (see **section 4.2.5**).

“The UK’s reductive focus on nutrients provides an ideal platform for manufacturers of UPFs to market their products using nutrition and health claims based on nutrients and ingredients.”

(SCRINIS AND MONTEIRO, 2022)



BOX 15

MARKETING CLAIMS AND STATEMENTS ON ULTRA-PROCESSED BABY AND TODDLER FOODS



HEALTH CLAIMS

The latest Mintel market survey indicates that perceived healthiness is the primary factor driving parents’ purchasing decisions for commercial baby and toddler foods: 55% of the 533 parents with children aged up to age four who reported using commercial baby and toddler foods said they would purchase a product ‘contributing to my child’s five a day’, and 48% one with ‘added vitamins/minerals’ (Mintel, 2022).

Products marketed as healthy and/or tasty are particularly likely to appeal to families who feel they lack the knowledge or skills to prepare suitable foods (Isaacs et al, 2022), and they perceive them as suitable in part because they are readily consumed.

“Provides 2 of your little one’s 5-a-day”

Little Dish Cottage pie

“Perfectly balanced for growing babies”

Ella’s Kitchen Organic Peach & Banana Melty Sticks

“Our Veggie Plus recipes are created with a natural source of iron from amaranth, to provide your little ones with 18% of their daily iron requirement in one quick & easy meal”

HiPP Organic Baby Food Jar Veg & Mozzarella Potato Bake

“Enriched with calcium, iron and vitamins. Nutritionally tailored for your baby’s needs”

HiPP Organic Summer Berry Multigrain Porridge Baby Cereal



CLAIMS RELATED TO SAFETY

On-pack messaging gives commercial baby food companies the opportunity to promote their products as ‘safe’ by alleviating parental concerns around choking and allergens (Isaacs et al, 2022).

Anxiety around choking and gagging is cited as a reason why some parents choose to feed their baby puréed commercial baby foods (many of which will be ultra-processed) and commercial ‘finger foods’ that dissolve easily when eaten (which, given this texture, will undoubtedly be ultra-processed) (Isaacs et al, 2022). Many of the latter products contain on-pack messages such as ‘melty texture’ and ‘hollow centre’ to imply that they are safer than alternative unprocessed and minimally processed foods. This is inappropriate, given that feeding reflexes are learned through exposure to foods with different textures (SACN, 2018).

Parents concerned about allergens may perceive that feeding their children commercially prepared foods, sometimes marketed with ‘free from’ claims, makes them easier to avoid (Isaacs et al, 2022).

“I’m super melty to disappear in little mouths”

Ella’s Kitchen Vanilla and Banana Melty Hoops

“Gluten & dairy free. Soft and chewy”

Piccolo Mighty Banana & Cocoa Oaty Baby Cereal Bars

“This recipe contains no allergens”

Organix Baby Corn Snacks with Tomato

BOX 15 (continued)



CLAIMS THAT THE PRODUCT IS 'NATURAL'

Many commercial baby and toddler foods are labelled to reassure parents of their 'purity', despite being ultra-processed. Among the 494 commercial baby and toddler food and drink products launched re-launched for sale in the UK in the study by Grammatikaki et al (see **section 2.2.2**), more than half of the baby biscuits/rusks, baby cereal products and baby snacks marketed as 'natural' were in fact UPF (Grammatikaki et al, 2021) (see **figure 17**). An even higher percentage of UPF products in these categories were marketed with claims of 'no artificial ingredients'.

"No added sugar or salt – I contain naturally occurring sugars"

Ella's Kitchen Pear & Apple Organic Baby Rice Pouch

"No artificial additives or preservatives"

HiPP Organic Little Mealmakers Chicken Puree

"Natural fruity flavour. No artificial colours, flavours or preservatives"

Heinz Splash Apple & Blackcurrant Juice

"100% natural finger food"

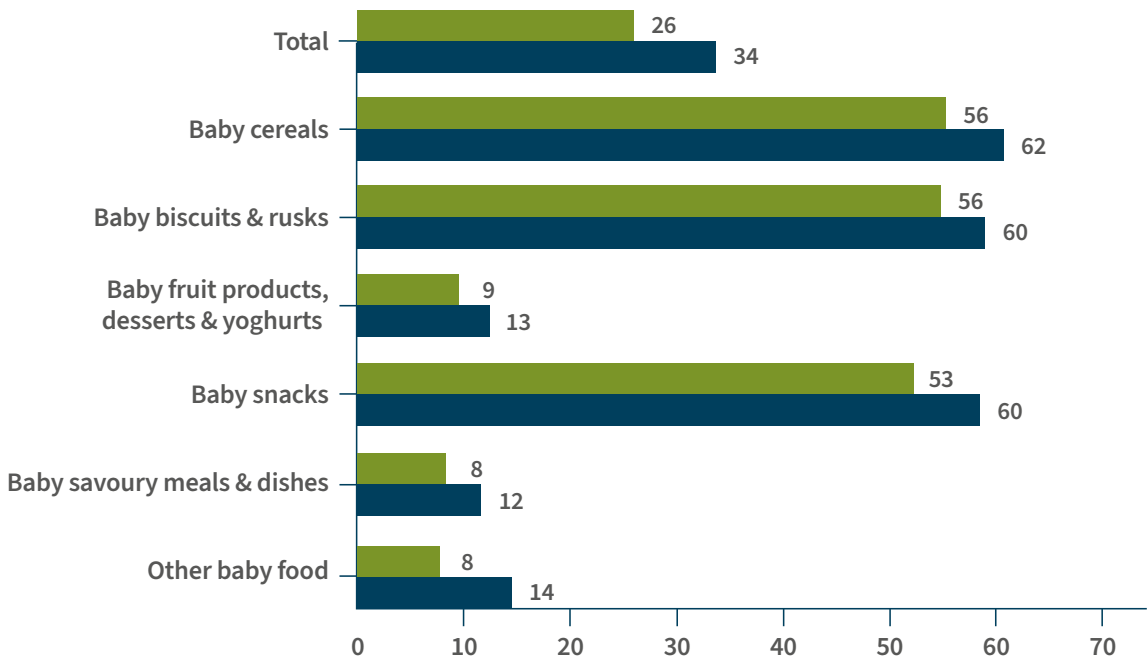
Piccolo Organic Apple, Banana, Yoghurt Melts

FIGURE 17

PERCENTAGE OF ULTRA-PROCESSED COMMERCIAL BABY FOOD AND DRINKS MARKETING IN THE UK WITH A 'NATURAL' OR 'NO ARTIFICIAL INGREDIENT' POSITIONING STATEMENT

Based on personal communication with E. Grammatikaki on 23/04/2023²⁹

■ UPF within those with a 'Natural' statement
■ UPF within those with a 'No artificial ingredients' statement



²⁹ Products that had at least one statement about being free of 'artificial additives', 'artificial colourings', 'artificial flavourings' or 'artificial preservatives' are included in the 'no artificial ingredient' category. No percentages are presented for baby juices & drinks (for both statements) and for other baby food for the 'No artificial ingredient' statement due to the very low number (1, 2 or 3) of total products displaying such statements in the sampled products.



CLAIMS RELATED TO DEVELOPMENT

Baby 'finger foods' (of which a high proportion can be classified as UPF) are designed for infants to eat by themselves. Several of these are marketed with claims related to motor development, shown to be particularly appealing to parents (Isaacs et al, 2022). For example, in a survey of 73 sweet snacks (biscuits, rusks and oat bars) for infants and young children on the market in summer 2021, close to a quarter (23%) were found to make a development or feeding claim (Action on Sugar, 2021).

"A blend of soft and durum wheat flours, it's the ideal texture for their first teeth."

Heinz Let's Cook Animal Shape Pasta

"I'm a fun & tasty finger food made for playing and learning, with less mess. I'm just the right size & shape for little ones developing finger & thumb 'pincer grip'"

Ella's Kitchen Melty Hoops

"It's perfect for growing tastebuds and getting little mouths really chewing!"

Organix Banana, Peach & Apple Muesli



CLAIMS RELATED TO CONVENIENCE

A wide variety of claims also cultivate and appeal to families' perceived need for convenience when choosing foods for their babies and young children, as the packaging statements illustrate.

"Encourages self-feeding"

Kiddylicious Wafers Blueberry Baby Snack

"Just add milk"

Cow & Gate Multigrain Banana Porridge Baby Cereal

"Perfect for on the go"

Ella's Kitchen Sweetcorn and Carrot Melty Sticks

7 What the UK can learn from other countries



The preceding sections outline how and why the diets of the UK's infants and young children are dominated by UPF, including products marketed specifically for them. We have also summarised the research investigating the health effects of UPF-rich diets – which strongly implicates these foods in driving persistently high levels of childhood obesity – and have touched on their environmental impacts.

Despite this growing body of evidence and unlike a number of other countries, the UK currently lacks a clear position on UPF. This section provides an overview of what other countries are doing to address high levels of UPF consumption, including among infants and young children. We discuss what the UK Government could learn from these nations, and recommend a novel tool for addressing the appropriateness of commercial baby and toddler foods on the UK market which has the potential to prevent the inappropriate marketing of UPFs to the under-threes.

7.1 The UK's ambiguous position on UPF

As summarised in **section 1**, the UK's current public health recommendations for feeding infants and young children focus on food groups and are largely nutrient-oriented (SACN, 2018; SACN 2022; NHS, nd, a; NHS, nd b; NHS, 2019). Public-facing resources are illustrated with images of minimally processed and processed foods, and suggested recipes and meal ideas for infants and young children do not show any commercial foods, implicitly suggesting that UPFs should be avoided (because not all commercial foods are UPF but all UPF are commercial).

However, they make limited explicit mention as to whether or not the extent to which food is processed should be factored into parent/carer feeding decisions, and SACN does not recognise the concept of UPF as defined in the NOVA classification (see **box 16**). This makes the recommendations as they stand ambiguous.

BOX 16

SACN makes the following assessment of UPF in the draft report *Feeding young children aged 1-5 years*, issued for consultation in 2022.

“Foods high in saturated fat, salt or sugar is a description that has been used in the UK since 2007 as part of the Nutrient Profiling Model, a tool (developed by the UK Foods Standards Agency) to help television broadcasters restrict advertisements of unhealthy foods to children. However, such foods have also been referred to as ‘processed foods’ or ‘ultra-processed foods’; for which there are no universally agreed definitions (DoH, 2011)”. (SACN, 2022)

In our opinion, this is incorrect and misleading, as it appears to be based on outdated information that predates the development and subsequent wide international acceptance of the NOVA classification (with its agreed definition of UPF). It also suggests that nutrient composition is the defining feature of UPF.

7.2 The UK focus on High Fat Salt Sugar (HFSS) foods

As outlined in **section 6**, it is relevant to note that, to date, efforts to reduce high rates of obesity in the UK have included tackling population-level intakes of high fat and/or high sugar foods, with these identified using the Ofcom Nutrient Profile Model (SACN, 2022).

Whilst there is no doubt that reducing the proportion of energy intake from HFSS foods in the early years should be a public health priority, relying on this approach alone presents at least two important shortcomings.

Firstly, as described in **section 6**, a focus on HFSS drives solutions based on reformulation of commercial foods, which – without appropriate safeguards – may inadvertently promote consumption of UPF (Percival, 2021).

Secondly, as outlined in our 2021 report *'Enabling children to be a healthy weight'* (Sibson and Crawley, 2021), and reiterated in the subsequent 2022 flagship report of the Obesity Health Alliance (OHA, 2022), there has been inadequate appreciation for the fact that prevention of excess weight gain in the first 1,000 days is essential for sustainable reductions in obesity levels. This requires close attention to the diets of infants and

young children. And yet, because the NPM is based on dietary requirements and thresholds for the general population (which differ from those for infants and young children, due to their smaller stomach sizes, lower energy requirements, and proportionately higher nutrient requirements), and was developed to inform broadcast advertising restrictions, the concept of HFSS is not the most appropriate way to assess commercial baby and toddler foods and drinks.

This is an important omission in the Government approach to tackling obesity, given the extent to which these products are consumed (see **section 3**). Fortunately, in December 2022, WHO Europe launched a new Nutrient and Promotion Profile Model (NPPM) designed specifically to assess the appropriateness of commercial baby and toddler foods (WHO Europe, 2022) (see **box 17**). Given the nutrient focus of the model, it is not designed to identify UPF. However, it serves as a credible starting point because all UPF are commercial, and UPF (including ultra-processed commercial baby and toddler foods) generally have a less desirable nutrient content compared to those in other NOVA categories (see **section 4**) and/or are typically marketed inappropriately (see **sections 2** and **6**).



BOX 17³⁰

WHO EUROPE NUTRIENT AND PROMOTION PROFILE MODEL

This model is the first to assess commercial foods and drinks marketed for infants and young children up to the age of three years by examining nutrient composition and product promotion. It is rooted in World Health Assembly Resolution 69.9 on ending the inappropriate promotion of foods for infants and young children, which was approved in 2016 (WHO, 2017), updating the International Code of Marketing of Breastmilk Substitutes (WHO, 1981).

The model is accompanied by an online tool allowing users (e.g. manufacturers, policy makers, enforcement officers) to assess the appropriateness of individual products. The model and tool are designed to improve the nutrition composition of commercial baby and toddler foods and to help combat the inappropriate marketing of commercial milk formulas, foods and drinks for infants and young children up to three years old.

On the right, are the tool's results for an **apple rice cake**, an ultra-processed baby 'finger food' labelled as suitable for infants from seven months of age.

While the nutrition profile of the product appears appropriate, the tool assesses the food as unsuitable on the basis of the presence of inappropriate health and nutrition claims, a misleading name and an unclear ingredient list.



³⁰ <https://babyfoodnppm.org/about>

7.3 International approaches to UPF

Unlike in the UK, several countries around the world have recently updated their national dietary guidance to make explicit mention of UPF or processed foods (See **figure 18**)³¹. Current government guidance from Brazil, Mexico, Israel and France include specific recommendations to reduce UPF consumption among children – the UK Government could learn from these.

FIGURE 18
MULTI-COUNTRY COMPARISON OF NATIONAL DIETARY GUIDANCE ON UPF OR PROCESSED FOODS

Country	National food-based dietary guidelines (FBDG) references to UPF or processed foods	FBDG references to UPF or processed foods in the diets of children
Argentina (Ministerio De Salud Argentina, 2016)	Responsible and moderate consumption of UPF within the framework of a varied, wide, inclusive and healthy diet	
Belgium (Flemish) (Flemish Institute for Healthy Living, nd)	Choose as few ultra-processed products as possible. UPF have no real added value in a healthy and environmentally responsible diet	
Brazil (Ministry of Health of Brazil, 2015; Ministry of Health of Brazil, 2019)	Avoid UPF. Always prefer natural or minimally processed foods and freshly made dishes and meals	Do not offer UPF to children
Canada (Government of Canada, 2019)	Limit highly processed foods and drinks because they are not part of a healthy eating pattern. If you eat highly processed foods, try to: <ul style="list-style-type: none">• Eat them less often• Eat them in small amounts• Replace them with healthier options	
Ecuador (Ministerio de Salud Pública del Ecuador y FAO, 2021)	Avoid the consumption of UPF	
France (Santé publique France, nd, a) (Santé publique France, 2022)	Limit sugary drinks, fatty, sweet, salty and ultra-processed foods	Avoid giving ultra-processed products to under-threes. Avoid giving commercial baby foods and ready meals to under-threes
Israel (Israeli Ministry of Health, 2019) (Ministry of Health, Israel, nd)	Reduce the consumption of UPF as much as possible	Avoid processed, industrialised and packaged foods as much as possible. There is no need to buy food made especially for children and babies
Mexico (SSA, INSP, GISAMAC, UNICEF, 2023).	Avoid ultra-processed foods	Ultra-processed foods promote preference for very sweet or salty flavours, and increase the risk of both obesity and malnutrition.
Peru (Serrano et al, 2020)	Avoid the consumption of UPF	
Uruguay (Basso et al, 2016)	Base your diet on natural foods and avoid the regular consumption of ultra-processed products with excessive contents of fat, sugar and salt	



Some countries have also produced practical guidance to support implementation of the recommendations, promoting habits such as preparing and sharing meals at home (Flemish Institute for Healthy Living, nd; Academia Nacional De Medicina, Mexico, 2015; Serrano et al, 2020; Santé publique France (nd, b), avoiding snacking (Ministry of Health of Brazil, 2015), eating with family or friends (Ministry of Health of Brazil, 2019), and recognising the role of food industry advertising (Basso et al, 2016).

In Brazil, numerous bills have been introduced to regulate the practices of UPF manufacturers (Mariath and Martins, 2021). Law No. 3766/2023, passed in January 2023, in Niterói, Brazil, is the first of its kind, prohibiting the sale, marketing and distribution of products that contribute to childhood obesity in schools, including UPFs (Global Health Advocacy Incubator, 2023). The law includes a legally defined list of qualifying ingredients, additives, production processes, and specific examples of prohibited products, and applies to 70,000 children in public and private schools.

As yet, other nations’ laws do not regulate UPF despite national guidance acknowledging their harmful impact on nutrition and health (Flemish Institute for Healthy Living, nd; Government of Canada, 2019; Ministerio de Salud Pública del Ecuador y FAO, 2021; Serrano et al, 2020), dietary habits (Israeli Ministry of Health, 2019), culture (Israeli Ministry of Health, 2019), social life (Israeli Ministry

of Health, 2019) and the environment (Flemish Institute for Healthy Living; nd, Israeli Ministry of Health, 2019).

The first country to enact fiscal measures on UPF is Colombia, which will begin taxing all such products (excluding infant formula and traditional Colombian foods) in November 2023. The new Colombian measures define UPF as edible products formulated from food-derived substances along with additives, and that contain added sugars, sodium, and saturated fats exceeding specific thresholds for those nutrients (Global Food Research Program, nd).

Here, we present three case studies from which the UK Government could learn, illustrating how their dietary guidance addresses UPF or processed foods. We start with Brazil, where a significant portion of the evidence on UPF originates. Brazil has formulated comprehensive guidelines to discourage the consumption of UPF by infants and young children, and, as above, is the only nation to have developed and implemented legislation to regulate industry practices. Secondly, we discuss Israel, which has also established detailed guidelines to discourage UPF consumption among infants and young children, and has endeavoured to adapt its health policies to reduce their consumption among both adults and children. Lastly, we showcase France, which also extends its advice on UPFs to the under-threes, focusing on encouraging home cooking as a means of reducing UPF consumption.

³¹ On March 31st 2023, the Nordic Council of Ministers published draft Nordic Nutrition Recommendations for public consultation (Nordic Council of Ministers, 2023). Despite an evidence review which recommended the need to limit UPF consumption, the review proposes not making a national dietary guideline on UPF. Taking an early years perspective, and drawing on the evidence presented in this report, the stated reasons for not addressing UPF consumption should not preclude promoting diets based on unprocessed and minimally processed foods. However, for this to happen the NOVA classification does need to be acknowledged.



CASE STUDY 1 BRAZIL

Development of the Brazilian Dietary Guidelines to discourage UPF consumption in infants and young children



The Brazilian Dietary Guidelines, introduced in 2014, were developed over a three-year period by the Brazilian Ministry of Health with the technical assistance of the Centre for Epidemiological Studies on Health and Nutrition at the University of São Paulo, and the Pan American Health Organization (Monteiro et al, 2015). The guidelines aim to

address and overcome recognised weaknesses in traditional food-based dietary guidance, including the treatment of foods as carriers of isolated nutrients and the lack of consideration for food processing, meals and the contexts of eating, cultural dimensions of diets and the link between diet and the social and environmental sustainability of food systems.

Recommended food choices are based on the NOVA classification. Thought is also given to modes of eating (time, place, company, attention) that influence how foods are digested and absorbed; and the barriers to reducing UPF such as access to natural or minimally processed foods, loss of culinary skills, lack of time and the inappropriate marketing of UPFs (Monteiro et al, 2015).

The public-facing message is to avoid UPF because they are nutritionally unbalanced, they tend to be consumed in excess and displace natural or minimally processed foods and “their means of production, distribution, marketing and consumption damage culture, social life, local economies and the environment.”

The guidelines are designed to be realistic and feasible, and are based on the diets of roughly one fifth of the Brazilian population (40 million people) who already derive 85% or more of their total daily energy intake from natural or minimally processed foods.

Practical suggestions on avoiding UPF include eating in appropriate settings, enjoying meals in company, sharing cooking skills, planning time for food preparation, avoiding outlets selling UPF and being wary of food marketing.

In contrast to nutrient-based guidance, the guidelines do not specify amounts of food, dietary energy or nutrient intake by meal, but recognise individual energy and nutrient needs, and the numerous combinations and amounts of foods that can make up healthy diets. Guidance for infants and young children mirrors that for the rest of the population, with specific reference to “cooking the same food for children and family” (Ministry of Health of Brazil, 2015).

The guidelines recommend to:

- **Make natural or minimally processed foods the basis of your diet**
- **Limit processed foods to small amounts as ingredients in culinary preparations or as part of meals based on natural or minimally processed foods**
- **Avoid ultra-processed products**

Specific recommendations for children under two years include:

- **Do not offer UPF to children**
- **Provide infants with foods that are natural and minimally processed**

The overall golden rule is: “Always choose natural or minimally processed foods and freshly made meals instead of UPF. Opt for water, milk and fruits instead of soft drinks, dairy drinks and biscuits. Do not replace freshly prepared dishes with products that do not require culinary preparation. Stick to homemade desserts, avoiding industrialised ones.”

“...[the] means of production, distribution, marketing and consumption [of UPFs] damage culture, social life, local economies and the environment.”



CASE STUDY 2 ISRAEL

Adaptation of health policies to reduce UPF consumption among adults and children

Nearly one-fifth of seven-year-old children in Israel are overweight or obese, with the figure increasing to 58% of the adult population (Gillon-Keren et al, 2020). Data on dietary intakes reveals that 15% of the foods consumed can be defined as ultra-processed, and that before the age of one, children are exposed to significant amounts of sweetened drinks, desserts and salty snacks (Israeli Ministry of Health, 2019).

The Israeli Ministry of Health, whose role is to formulate health policy, has promoted a comprehensive dietary programme to address the obesity problem and alter the local obesogenic environment. Its updated nutritional guidelines, published in 2019 (Israeli Ministry of Health, 2019) state that “it is important to reduce the consumption of UPFs as much as possible since they come with a substantial health cost.”

In addition to outlining the health implications associated with consuming UPFs, the guidance states the following reasons to reduce their consumption:

- **UPFs contain large amounts of additives such as salt/sugar or their non-natural substitutes which damage the taste and nutritional balance of the original food**
- **UPFs are characterised by excessive consumption, at the expense of healthier foods**
- **UPF consumption is harmful to culture, social life and the environment**
- **UPFs encourage subconscious eating due to being ready to eat, without the need for a plate, table and other accessories**
- **The manufacture, distribution, marketing and consumption of UPFs are injurious to health, culture, social life and the environment**

Guidance for infants and young children, which can be found on the Israeli Ministry of Health website (Ministry of Health, Israel, nd), recommends avoiding industrially produced and packaged foods as much as possible, and instead serving natural, traditional and homemade food to babies and children.



“It is important to reduce the consumption of UPFs as much as possible since they come with a substantial health cost.”

In support of recommendations to limit the consumption of UPFs specifically during the complementary feeding period, the Israeli Ministry of Health states: “the texture of UPF frequently does not entail chewing and encourages becoming accustomed to such eating. Thus, for example, toddlers who become used to UPF sometimes refuse to eat fruit and vegetables since they are not accustomed to the chewing process.” (Israeli Ministry of Health, 2019).

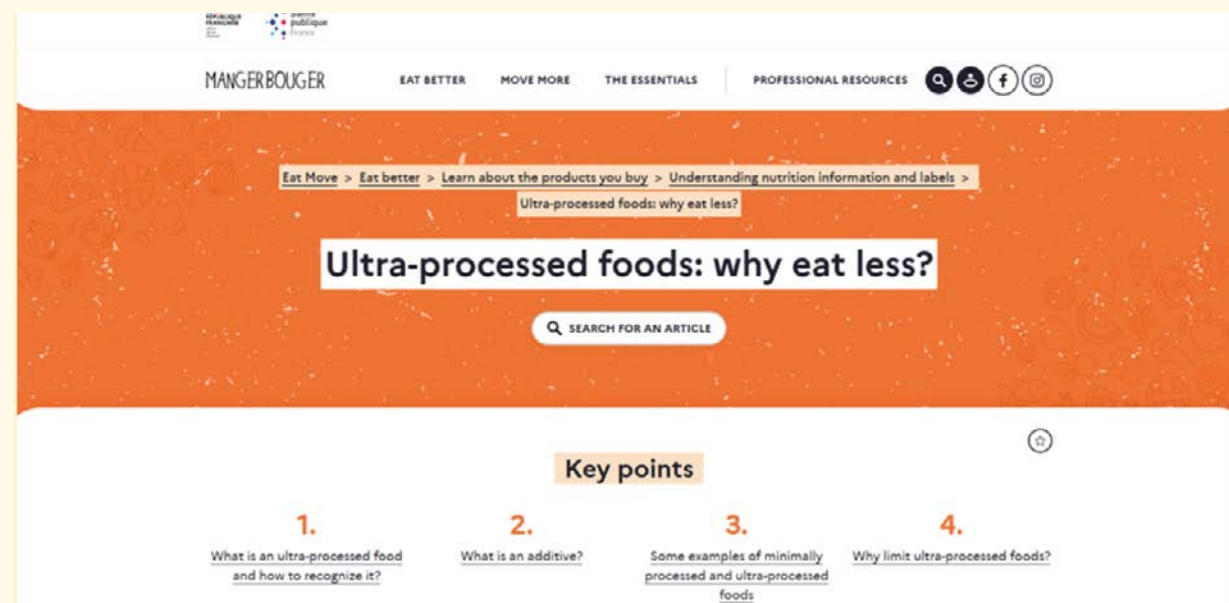
The Israeli Ministry of Health also recognises the role of marketing and advertising in influencing eating habits (Ministry of Health, Israel, 2023). To promote health and nutrition in Israel, a Regulatory Committee was formed in 2016, which recommended the development of a voluntary front-of-pack green label to provide reliable information and assist in the choice of healthier food (Gillon-Keren et al, 2020).

Recognising concerns around the role of additives, along with the health risks associated with processing, the Committee decided to profile foods based not only on their nutrient composition, but also their level of processing (Gillon-Keren et al, 2020). Although the NOVA classification has not been fully adopted, only foods free from additives are awarded a green check mark. Legumes, for instance, might be eligible for a green check mark, but processed goods using extracts of bean protein will not. In practice, this means that the majority of UPFs cannot be awarded a green check mark.



CASE STUDY 3 FRANCE

Public health recommendations towards reducing UPF consumption, including in under-threes



Acknowledging evidence from the ‘Nutri-Net Santé’ study (Étude Nutrinet Santé, 2016), which suggested an association between UPF consumption and the risk of chronic diseases, the French Government’s 2019-2023 National Health and Nutrition Programme, includes an objective to intervene to arrest the rise in UPF consumption, and set a target to reduce consumption by 20% between 2018 and 2021 (Ministère des Solidarités et de la Santé, 2018).

This is despite far lower levels of consumption in France than the UK: in 2017, UPFs made up over half of total purchased dietary energy in the UK, compared to only 14.2% in France (Monteiro et al, 2017). Public-facing explanations of what UPF are, why and how to limit them is provided on the ‘manger bouger’ [eat move] website, pictured above (Santé publique France (nd, b)).

This commitment to reduce UPF consumption can also be seen in Government guidance for feeding infants and young children, which discourages the use of

“Avoid ultra-processed products... whose impact on human health is not yet precisely known”.

commercial foods for under-threes³². In 2020, the High Council of Public Health (a body which advises on the development of health policies) updated the National Health and Nutrition Programme dietary benchmarks for children aged up to 36 months, and three to 17 years (HCSP, 2020).

This then informed the publication, by Public Health France in 2021, of revised dietary recommendations for feeding children up to three years, along with practical guidance for health and early childhood professionals and parents (Santé Publique France, 2021). This initiative is a part of Santé Publique France’s wider efforts to “contribute to enabling environments for healthy eating for all ages”, and more specifically to promote environments conducive to the health of the child from pregnancy to two years – the first 1000 days.

Recommendations from the High Council on Public Health include:

- “complementary foods for infants can be home-made or commercial products, but home-made foods are preferred: they can offer the opportunity for a greater variety of textures and flavours while aligning with family and cultural preferences, and they also make it possible to control the

ingredients used” (page 8, HCSP).

- “[For under-threes] favour home-made preparations of fruits and vegetables over commercial products” (page 14, HCSP)
- “[For under-threes] favour home-made preparations, which make it possible to control the quantities of fat, sugars or added salt, and

These recommendations are reflected in guidance for parents/carers of under-threes called *Step by Step, your child eats like a grown up*’ (Santé Publique France, 2022). Below is an extract.

To vary tastes and textures, home-made has everything good

More tastes, more textures, more ‘yum’!

Home cooking allows you to use products from your culinary culture to offer a wide variety of tastes and textures, and to know what you put in what you prepare. When shopping, choose more seasonal foods (often cheaper) and if possible local products. For fruits and vegetables, for whole and semi-whole starchy foods (wholemeal or cereal bread, rice, pasta and whole semolina...) and pulses (lentils, beans, chickpeas...), choose organic if possible. Wash and peel fresh fruits and vegetables thoroughly. Frozen foods are convenient, but choose plain, uncooked products: vegetable purées, peeled and chunked vegetables and fruits, plain fish fillets, etc.

Avoid ultra-processed products that are often fatty, sweet or salty (chips, nuggets, pizzas, sodas) and contain additives (colourings, preservatives, etc.) whose impact on human health is not yet precisely known.

Commercial baby foods and ready meals for children under three years old

These are practical when you do not have time to cook, when you’re outside the home, while travelling... But they offer less variety than home-made foods in terms of tastes and textures.

thus promote the establishment of healthy eating habits from an early age” (page 21, HCSP)

- “[For three-17 year olds] pay attention to processed poultry products as they may be ultra-processed; it is recommended to consult the list of ingredients and additives and choose the option with the least” (page 26, HCSP).



³² Choosing home-made products as a method of reducing UPF consumption is made explicit on this page of the Manger Bouger website: Reduce sugary drinks, sugary and ultra-processed products (mangerbouger.fr) (Santé publique France, nd, a).

8 Conclusions and recommendations

UPF dominate the diets of the UK's babies and toddlers from the first months of life, likely with long-lasting negative effects. Among these UPFs are many products specifically marketed for infants and young children, and which parents/carers trust are appropriate and even health promoting.

However, as we have shown, a wide-ranging and compelling body of evidence implicates UPF-rich diets in driving overweight and obesity and other negative health effects, as well as negative environmental impacts.

The fact that many UPFs are vectors of fat, salt and sugar is only one of the reasons linking their consumption to obesity. Several other likely mechanisms by which health harms may occur are cause for concern. These include undermining the formation of optimal taste development and healthy feeding behaviours in the early years, normalising the consumption of snack foods, promoting a liking for sweet tastes and soft textures, and displacing the minimally processed and unprocessed foods needed for optimal growth, health and development, starting with breastmilk.

Whilst more evidence on the mechanisms linking UPF-rich diets to obesity and other health harms

could be insightful, in our opinion we know enough to take action to reduce UPF consumption.

The dominance of UPF in the diets of the UK's infants and young children is ultimately a food system issue, and should be tackled by the UK Government as part of a cohesive food policy that addresses the whole food system, encompassing poverty, inequalities, and access to healthy and sustainable diets. However, specific actions focused on the early years are also warranted.

To inform action, we make the following seven recommendations to the UK Government. These take into account some of the likely drivers of high UPF consumption levels, draw on what other national Governments are doing, make use of available opportunities and existing initiatives, and build on our earlier recommendations for enabling children to be a healthy weight.

In our view, the following seven actions would improve the food environment in which parents/carers are making decisions about when, what and how to feed their babies and young children, so that they are able to reduce their UPF intakes.

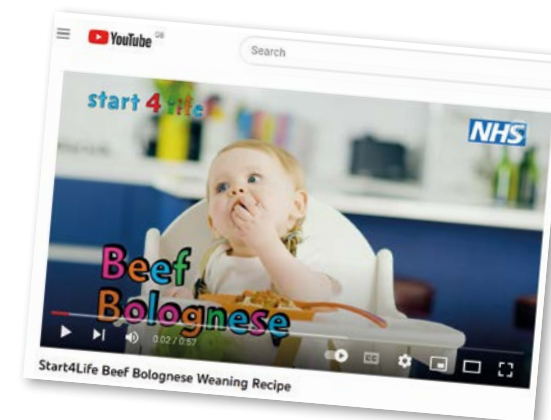


Recommendations

1 Update public health recommendations on infant and young child feeding to explicitly address food processing using the NOVA categories

The UK Government should acknowledge the NOVA classification and make explicit that diets in infancy and early childhood, in particular, should be based on minimally processed foods and drinks, as well as being appropriate to meet energy and nutrient needs and avoid excess consumption of free sugars and salt.

Practically, this could be supported by explicitly discouraging the use of commercial baby and toddler foods³³ (especially discretionary products such as baby baby snacks marketed as 'finger foods', and growing-up and toddler milks), and packaged foods and drinks marketed with cartoons and promotions aimed at pre-school aged children. This would align with the images and videos already in use on the NHS and Better Health Start 4 Life websites. >



³³ With the exception of infant formula, given that the reduced use of infant formula requires Government action to enable and support breastfeeding – see recommendation 5

> The DHSC should ensure its public health campaigns, initiatives and guidelines relevant to early years diets can support updated recommendations designed to minimise consumption of UPF. This would include:

- > Re-designing the NHS Food Scanner App to take into account the extent of processing as well as the fat, sugar and salt content of the scanned products
- > Updating the (voluntary) food and drink standards for early years settings and associated menus
- > Making soft drinks containing non-sugar (artificial) sweeteners taxable under the Soft Drinks Industry Levy³⁴

The DHSC should accompany amendments to the public health recommendations with relevant communications campaigns to raise awareness and understanding of the recommendations among parents/carers and all those involved in catering for and/or feeding infants and young children, including those working in early years settings.

2 Regulate the composition, labelling and marketing of commercial baby and toddler foods and drinks

The composition, labelling and marketing of foods and drinks for infants and young children, many of which are ultra-processed, should be better regulated. This will help protect the youngest consumers and empower parents/carers to make informed decisions in line with public health recommendations, updated as above.

We recommend that UK regulation is based on the WHO Europe Nutrient and Promotion Profile Model, and that products marketed with cartoon characters as well as those labelled with an age are considered in scope.

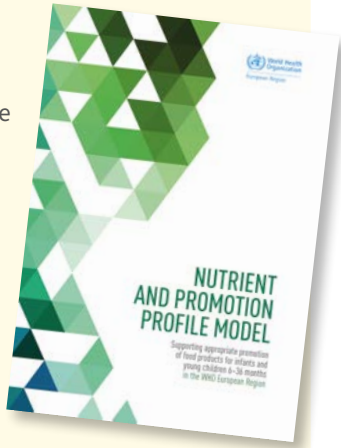
New regulations should take a precautionary approach to additives, limiting their presence in foods and drinks marketed for infants and young children.

Adequate resources should be provided to local authorities to ensure appropriate monitoring and enforcement.

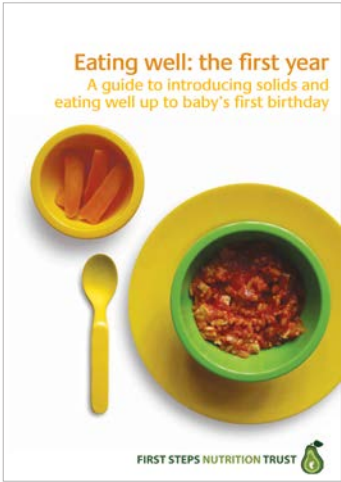
In the short term, OHID should, as a matter of urgency, publish its long awaited (voluntary) guidelines for industry on baby food composition, and consult on marketing and labelling guidance for commercial baby foods (including growing-up and toddler milks). We recommend issued guidance is made up to date by including the recommendations of WHO Europe in their recently published NPPM, and that robust monitoring should be put in place to ensure compliance.

“[We do] not suggest that healthy diets are composed only of unprocessed and minimally processed foods and processed ingredients. The issue is one of proportion.”

(MONTEIRO ET AL, 2010)



3 Provide independent information and practical guidance and support to parents/carers on complementary feeding



All families should have access to user-friendly, realistic, evidence-based information – independent from the baby food industry – about what an appropriate, nutrient-dense and diverse complementary diet based on minimally processed foods looks like. Parents/carers should also be informed of the disadvantages of commercial baby and toddler drinks, foods and snacks, many of which are UPF.

Families should also be able to access practical guidance and support locally on how to provide an appropriate diet to their babies and young children. This may include addressing any self-perceived gaps in skills and knowledge (e.g. through cook and taste classes).

In this regard, the Government's investment in Family Hubs in areas of deprivation in England are a welcome means of ensuring locally accessible support for parents/carers. However, this funding needs to be extended to all local authorities and with long-term sustainability built in to give areas the confidence to develop services for the longer term.

In addition, as health visitors play a unique and essential role in supporting parents/carers to apply public health recommendations on feeding infants and young children, we urge the UK Government to ring fence sufficient funding for the health visiting service, and ensure that all parents/carers receive the five mandated reviews, delivered by health visitors with sufficient training. Families should also have easy access to additional targeted support when needed.

Our guide *Eating well: the first year* is an example of practical guidance on offering an appropriate, nutrient-dense and diverse complementary diet based on minimally processed foods.

We also provide practical guidance on eating well for children aged one to four years, available on our website www.firststepsnutrition.org.



³⁴ From November 2023, Colombia will tax all UPF, including drinks such as carbonated and non-carbonated beverages, malt-based beverages, teas, coffee-type beverages, fruit drinks and nectars, fruit concentrates, energy drinks, sports drinks, flavoured waters and powder mixes (Global Food Research Program, nd).

4 Ensure parents/carers on low incomes can afford to feed their infants and young children nutritious diets based on minimally processed foods and drinks

The Healthy Start scheme should be reformed to help break down the economic barriers to parents/carers implementing the updated public health recommendations as above. The scheme is a nutritional safety net for young pregnant women and young families on low incomes in England, Wales and Northern Ireland. Scotland's equivalent scheme, Best Start Foods, has already undergone significant improvement and sets an example for the other nations.

We endorse the asks of the Healthy Start Working Group, of which we are members. Necessary changes include:

- Expanding eligibility of the scheme to include more low-income families, and to support children in those families until five years of age
- Increasing the cash allowance in line with the inflation rates of the minimally processed foods to be purchased with this benefit (i.e. milk, fruits, vegetables and pulses), as well as infant formula, which is currently essential for many infants
- Improving accessibility and therefore coverage, including through switching to opt-out enrolment
- Supporting the scheme to meet its nutrition objectives, including the provision of information, guidance and support to beneficiaries on breastfeeding and eating diets based on minimally processed foods.

5 Enable and support women who want to breastfeed

To ensure all women who want to can meet their breastfeeding goals, the Government should follow through on its existing commitments to improve support for breastfeeding (e.g. through Family Hubs and the inclusion of UNICEF Baby Friendly Initiative accreditation for maternity services in the long term plan).

In addition, we recommend further investment to work towards universal access to breastfeeding support (e.g. extending the Baby Friendly Initiative to other services and university courses), and commensurate intervention to better protect against inappropriate marketing of commercial milk formulas, bottles, teats, foods and drinks for children under the age of three years.

This could be achieved through upgrading the UK law in line with the International Code of Marketing of Breastmilk Substitutes and all subsequent World Health Assembly resolutions, and ensuring the law is enforced. It should be noted that the WHO Europe NPPM incorporates the Code and would support its implementation in practice.

Additional measures to protect breastfeeding should include ensuring appropriate protection for breastfeeding in public (in line with Scottish law) and legislating support for breastfeeding mothers returning to work (making Advisory, Conciliation and Arbitration Service guidance statutory).



6 Undertake research on UPF consumption in the early years

The UK Government should commit to regularly collecting comprehensive data on maternal, infant and young child feeding in the UK in order to inform policy and practice. This research needs to quantify the types and amounts of UPF consumed across different life stages and age groups, assess drivers of consumption, and health effects.

Focused research on additives should be commissioned – in particular, maximum allowable levels of all cosmetic additives, processing and packaging contaminants linked to health risks should be established specifically for commercial baby and toddler foods.



7 Acknowledge and publicise the environmental benefits of diets based on minimally processed foods

The public promotion of early years diets based on minimally processed foods could also deploy messages about their environmental benefits. With climate change and environmental degradation increasingly acknowledged as threats to the health and wellbeing of future generations, the environmental advantages of a population-wide dietary change towards less processed foods should be emphasised and positively promoted.

Annexes

ANNEX 1

Regulations governing commercial milk formula and baby and toddler foods and drinks

The composition, marketing and labelling of certain foods aimed at infants and young children are subject to limited regulations, discussed here. As well as this limited legislation being inadequate in scope, the monitoring and enforcement of compliance has been judged as inadequate³⁴.

It is also inherently difficult to ensure legislation remains relevant, given the fast-paced evolution of a market sector which is constantly offering new products marketed in ever more novel ways. Since the 2018 evidence review by PHE (PHE, 2019) the market has changed and grown, and many of the concerns highlighted are not addressed in current legislation³⁵.

In addition, the fate of these current laws under the Retained EU Law (Revocation and Reform) Bill remains unclear, although they have recently been taken off the list of legislation that will be ‘sun-setted’ by December 2023 (Retained EU Law (Revocation and Reform) Bill, 2023).

Commercial milk formulas

The composition and marketing of some commercial milk formulas in the UK is governed by EU Directive (FSG) (609/2013) on Foods for Specific Groups (Council Directive 2013/609/EU). This directive contains delegated acts: EU delegated regulation 2016/127 relates to infant and follow-on formula (Council Regulation (EC) 127/2016).

The regulation is implemented in England and the devolved nations by Statutory Instruments – for links, see our infantmilkinfo.org website. A summary of information on the required nutritional compositional of infant formula is also available on this website.

Key provisions of the regulations pertaining to the marketing and labelling of infant formula:

- Nutrition and health claims are not permitted for infant formula
- Labelling, presentation and marketing must make a clear distinction between infant and follow-on formula, particularly in respect of the text, images and colours used, to avoid confusion between them

- Advertising is restricted to publications specialising in baby care and scientific publications
- All advertising must provide only information that is scientific and factual in nature.

The required nutritional composition of follow-on formula differs only slightly from that for infant formula: it may contain more iron, and there are some differences in certain mandatory and permissible ingredients (protein, choline, inositol, carbohydrate). In addition, the restrictions on advertising of infant formula do not apply to follow-on formula. The key points of the follow-on formula regulations are summarised on our infantmilkinfo.org website.

Currently, no specific regulations govern the composition, marketing or labelling of commercial milk formulas marketed as growing-up or toddler milks. And despite these being marketed for use from one to three years, they are also specifically excluded from the baby food regulations (see below).

Commercial baby and toddler foods and drinks

The Processed Cereal-based Foods and Baby Foods for Infants and Young Children (England) Regulations (2003) set forth regulations in England, and comparable laws exist in Scotland, Wales and Northern Ireland.

These regulations implement Commission Directive 2006/125/EC on processed cereal-based foods and baby foods for infants and young children (Commission Directive 2006/125/EC). The regulations consider the use of specific ingredients and ‘nutritional substances’ (i.e. vitamins, minerals, amino acids and ‘others’ such as inositol and choline), specify the maximum amounts of some nutrients, and specify the pesticide levels permitted.

They also place restrictions on the use of food additives such as colours, sweeteners and flavour enhancers, and on the presence of some additives for other purposes (via Council Regulation (EC) 1333/2008)). The regulations do not specify what the composition of baby foods should be, but simply set a minimum or maximum amount for certain ingredients and nutrients. They also outline labelling requirements.

In order for processed cereal-based food and baby foods to be specifically marketed as suitable for children aged between four months and three years, the following compositional criteria apply:

- Maximum amounts of sodium, fat and total carbohydrate
- Minimum protein content (if meat, poultry, fish, offal or other traditional source of protein are the only ingredients mentioned in the name of the product)
- Minimum vitamin C content in fruit or vegetable juices and minimum vitamin A content in vegetable juices
- Maximum limits for vitamins, minerals and trace elements, if added
- Maximum limits for pesticide residues.

More information on compositional regulations is found in the appropriate sections of our 2017 report *Baby foods in the UK: A review of commercially produced jars and pouches of baby foods marketed in the UK*. A summary of key points can be found in the appendix of the report (Crawley and Westland, 2017).

In addition, the following information must be included on labels for processed cereal-based food and baby foods:

- A statement as to the appropriate age, which should not be under four months (see above)³⁶
- The available energy value, and the protein, carbohydrate and fat content
- The average quantity of each mineral substance and of each vitamin (where a maximum or a minimum compositional requirement is specified)
- Appropriate instructions for preparation, if necessary.

ANNEX 2

Studies showing an association between the UPF consumption by women in pregnancy, and their gestational weight gain and their infant’s body fat

Author & country	Outcome	Effect	Study design
Gomes et al, 2021 Brazil	Gestational weight gain	An increase of 1 percentage point in energy consumption from UPF in the third gestational trimester led to an average increase of 4.17 (95% CI 0.55; 7.79) g in weekly GWG in this period.	Prospective cohort
Rohatgi et al, 2017 US	Gestational weight gain Neonatal body fat	A 1%- point increase in PEI-UPF (percent of energy intake from ultra-processed foods) was associated with a 1.33kg increase in gestational weight gain ($P = 0.016$), a 0.22mm increase in thigh skinfold ($P = 0.045$), 0.14mm in subscapular skinfold ($P = 0.026$), and 0.62 percentage points of total body adiposity ($P = 0.037$) in the neonate.	Longitudinal
Silva et al, 2021 Brazil	Glycemic control Total gestational weight gain (in pregnant women with diabetes)	The increase of every 1 kcal in the calorie intake from UPF in the third trimester increased glycated hemoglobin by 0.007% ($\beta = 0.007$, $P = 0.025$), raised 1-h postprandial glucose by 0.14mg / dL ($\beta = 0.143$, $P = 0.011$), and added 0.11kg to total gestational weight gain ($\beta = 0.11$, $P = 0.006$).	Prospective cohort

³⁴ As evidenced by studies reporting violations of the laws, for example Cheung et al, 2023.

³⁵ The recently published WHO Europe Nutrient Promotion and Profile Model shows what parameters could be used to inform laws that better align with UK public health recommendations on feeding infants and young children (WHO Europe, 2022). See more on this in section 7.2, box 17.

³⁶ The stipulation of a lower age range of four months contradicts UK public health guidance to introduce foods at around 6 months of age (SACN, 2018), because it is informed by EU legislation which permits advertising of products for use from four months.

ANNEX 3

Studies showing an association between UPF consumption in children and measure of their weight and adiposity

Author & country	Outcome	Effect	Study design
Chang et al, 2021 UK	Weight Waist circumference BMI Fat-mass index	Highest quintile of UPF intake (67.8% weight contribution to daily food intake), compared to lowest intake (23.2%), between ages 7-13 and into adulthood associated with: Additional gain of 0.2kg / year Additional gain of 0.17cm / year Increased trajectory by 0.06 / year Increased gain of 0.03 kg/m ² / year	Prospective cohort
Costa et al, 2019 Brazil	Waist circumference	10% increase in energy contribution from UPF at 4 years associated with increase in delta waist circumference of 0.7cm at 8 years.	Longitudinal
Costa et al, 2021 Brazil	Fat-mass index	Gain of 0.14kg / m ² between 6 and 11 years for those consuming 100g / day more UPF than reference group.	Longitudinal
Costa et al, 2022 Brazil	BMI Length/height- for-age	Frequency of consumption of UPFs associated with higher BMI-for-age Z-score (β 0.02, 95% CI (0.01, 0.03), <i>P</i> value for linear trend 0.001) lower length/height-for-age Z-score from 2 to 4 years old (β -0.06, 95 % CI (-0.11, -0.01)	Prospective cohort
Leffa et al, 2020 Brazil	Total cholesterol Triglycerides	Positive dose-response; absolute increment of 10% total energy UPF associated with increased total cholesterol (β 0.07 mmol/l, 95% CI 0.00, 0.14) and triglycerides (β 0.04 mmol/l, 95% CI 0.01, 0.07) between 3 and 6 years of age.	Longitudinal
Rauber et al, 2015 Brazil	Total cholesterol LDL cholesterol	Ultra-processed product consumption (% contribution to daily energy) at preschool age was a predictor of a higher increase in total cholesterol (β = 0.430; <i>P</i> = 0.046) and LDL cholesterol (β = 0.369; <i>P</i> = 0.047) from preschool (3-4 years) to school age (7-8 years).	Longitudinal
Vedovato et al, 2021 Portugal	BMI	UPF consumption (as % contribution to total energy intake) at 4 years of age, predictor of higher BMI at 10 years of age (β = 0.028; 95% CI 0.006, 0.051).	Prospective cohort

ANNEX 4

Studies showing an association between UPF consumption by adults and overweight / obesity, cardiovascular disease, type 2 diabetes and cancer

Author & country	Outcome	Effect	Study design
Askari et al, 2020 Multiple, including UK	Overweight / obesity	A significant association was identified between UPF intake and overweight (pooled effect size: 1.02 (95% CI: 1.01,1.03), <i>P</i> <0.001) and obesity (pooled effect size: 1.26 (95% CI: 1.13, 1.41), <i>P</i> <0.001)	Meta-analysis
Bonaccio et al 2022 Italy	Cardiovascular mortality All-cause mortality	The hazard ratios were 1.19 (1.05 to 1.36); absolute risk difference 9.7% (5.0% to 14.3%) and 1.27 (1.02 to 1.58); 5.0% (1.2% to 8.8%), respectively, for all-cause and cardiovascular mortality when the two extreme categories of UPF intake were compared.	
Chen et al, 2022 UK	Cardiovascular disease Coronary heart disease Cerebrovascular disease All-cause mortality	Higher intake of UPF was associated with a higher risk of CVD (hazard ratio (HR) = 1.17, 95% CI: 1.09-1.26), coronary heart disease (HR = 1.16, 95% CI: 1.07–1.25), cerebrovascular disease (HR = 1.30, 95% CI: 1.13–1.50) and all-cause mortality (HR = 1.22, 95% CI: 1.09–1.36).	Prospective cohort
Delpino et al, 2022 Multiple, including UK	Type 2 diabetes mellitus	Compared with non-consumption, moderate intake of UPF increased the risk of diabetes by 12% (relative risk (RR): 1.12; 95% CI: 1.06–1.17, <i>I</i> ² = 24%), whereas high intake increased risk by 31% (RR: 1.31; (95% CI: 1.21–1.42, <i>I</i> ² = 60%).	Prospective cohort
Fiolet et al, 2018 France	Breast cancer Overall cancer	The hazard ratio for a 10% increment in the proportion of UPF in the diet was 1.12 for overall cancer risk (95% CI: 1.06 to 1.18) and hazard ratio 1.11 (1.02 to 1.22) for breast cancer risk.	Meta-analysis
Moradi et al, 2023 Multiple, including UK	Overweight / obesity	UPF consumption was associated with an increased risk of obesity (OR = 1.55; (95% CI: 1.36, 1.77); <i>I</i> ² = 55%), overweight (OR = 1.36; (95% CI: 1.14, 1.63); <i>I</i> ² = 73%), and abdominal obesity (OR = (1.41; 95% CI: 1.18, 1.68); <i>I</i> ² = 62%). Furthermore, every 10% increase of UPF consumption in daily calorie intake was associated with a 7%, a 6%, and a 5% higher risk of overweight, obesity, and abdominal obesity, respectively.	Prospective cohort



ANNEX 4 (continued)

Author & country	Outcome	Effect	Study design
Pagliai et al, 2021 Multiple, including UK	Overweight / obesity Waist circumference HDL-cholesterol Metabolic syndrome Cardiovascular disease Cerebrovascular disease All-cause mortality	Cross-sectional studies: highest UPF consumption was associated with a significant increase in the risk of overweight / obesity (+39%), high waist circumference (+39%), low HDL-cholesterol levels (+102%) and the metabolic syndrome (+79%) Prospective cohort studies: highest UPF consumption was found to be associated with increased risk of all-cause mortality in five studies (risk ratio (RR) 1·25, 95% CI 1·14, 1·37; <i>P</i> < 0·00001), increased risk of CVD in three studies (RR 1·29, 95% CI 1·12, 1·48; <i>P</i> = 0·0003), cerebrovascular disease in two studies (RR 1·34, 95% CI 1·07, 1·68; <i>P</i> = 0·01) and depression in two studies (RR 1·20, 95% CI 1·03, 1·40; <i>P</i> = 0·02).	Meta-analysis
Susktan et al, 2021 Multiple	Cardiovascular diseases-cause mortality Heart-cause mortality All-cause mortality	UPF consumption was related to an enhanced risk of all-cause mortality (HR = 1.21; 95% CI: 1.13, 1.30; I2 = 21.9%; <i>P</i> < 0.001), cardiovascular diseases (CVDs)-cause mortality (HR = 1.50; 95% CI: 1.37, 1.63; I2 = 0.0%; <i>P</i> < 0.001), and heart-cause mortality (HR = 1.66; 95% CI: 1.50, 1.85; I2 = 0.0%; <i>P</i> = 0.022). Each 10% increase in UPF consumption in daily calorie intake was associated with a 15% higher risk of all-cause mortality (OR = 1.15; 95% CI: 1.09, 1.21; I2 = 0.0%; <i>P</i> < 0.001).	Meta-analysis
Wang et al, 2022b Multiple	Hypertension	Higher UPFs consumption significantly increased the risk of hypertension (odds ratio: 1.23; 95% CI: 1.11, 1.37; <i>P</i> = 0.034).	Meta-analysis
Yuan et al, 2023 Multiple	Cardiovascular event	Pooled effect size for the highest versus lowest category in UPF consumption showed positive associations with risk of cardiovascular event. For each additional daily serving of UPF, the risk of cardiovascular event increased by 4% (RR=1.04, 95% CI, 1.02-1.06).	Meta-analysis

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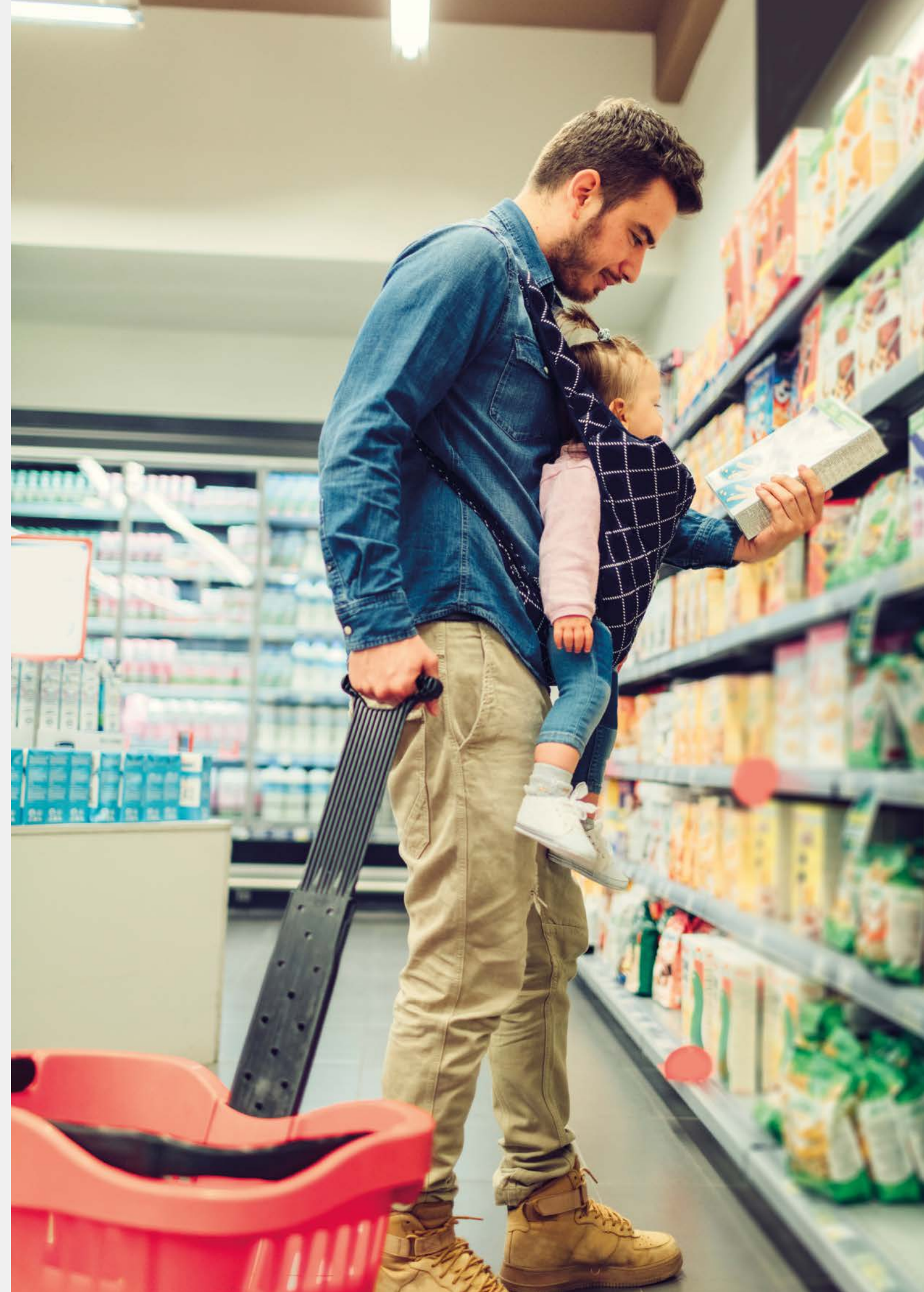
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