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Commentary

The big issue is ultra-processing

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Introduction

The most important factor now, when considering food, nutrition and public health, is not nutrients, and is not foods, so much as what is done to foodstuffs and the nutrients originally contained in them, before they are purchased and consumed. That is to say, the big issue is food processing – or, to be more precise, the nature, extent and purpose of processing, and what happens to food and to us as a result of processing. Specifically, the public health issue is 'ultra-processing', as defined here. This is my basic proposal. It is illustrated and symbolised by the mass-produced double cheese-and-bacon burger above. Such products are made at distance as separate items that are trucked in, assembled, and made ready-to-heat and –to-eat at a fast food site.

The proposal that food processing has an impact on public health may seem obvious. But it is largely overlooked by conventional nutrition science. As now applied in policies, programmes and interventions, nutrition science has failed to have much significant impact on what is currently the uncontrolled pandemic of obesity. As a result, it is now seen by policy-makers and the public as not particularly relevant to their needs. To be blunt, our science has become somewhat discredited. One reason, as I maintain here, is that it continues to depend on concepts and food classifications devised almost a century ago, which are now obsolescent.

This commentary concerns the impact of food processing on human health. Its scope is relatively modest. It only very briefly touches on cultural and other social impacts of ultra-processed branded products, their use by transnational and other giant industries to displace traditional food systems and small businesses, and other economic impacts (1). It does not touch on the effects of the globalised food system in its present form on national and international stability, the living and physical environment, and the biosphere (2,3). Proper discussion of these fundamental and crucial issues is for a later paper.

Box 1

Food processing

Food processing, in any broad sense of this term, is not a public health issue. To suppose so would be rather foolish. This would be like supposing that food technology – or any other form of technology – is intrinsically problematic. Much discussion of food, nutrition and health that mentions processing as such as a factor is almost meaningless. To begin with, almost all food and drink always has been processed, in some real sense. A characteristic of many foodstuffs as found in nature, is that they are unpalatable or inedible unless subjected to some process, such as preparation or cooking. Also, all perishable foods, unless consumed promptly, need to be preserved in some way. This is a point often and rightly made by the food and drink manufacturing industry.

Here are the issues

The issue therefore is not processing as such. It is the nature, extent, and purpose, of processing, and in particular, the proportion of meals, dishes, foods, drinks, and snacks within diets that are 'ultra-processed' – a term I will precisely define below in this text. Also, it would be absurd to suppose that ultra-processed products, which characteristically are ready-to-eat or ready-to-heat 'fast' or 'convenience' meals, dishes, foods, drinks, and snacks, are some sort of poison. Indeed, one characteristic of ultra-processed products, as manufactured by transnational and other large firms, is that they are microbiologically safe. This is part of the pitch made by transnational firms. Cola drink manufacturers for example point out that in countries where water supplies are liable to be contaminated, their products are a way to avoid diarrhoeal diseases. Such manufacturers are now also big players in the bottled water business.

The issue is also one of proportion. This commentary does not say, nor does it imply, that the only healthy diets are those consisting solely or predominantly of unprocessed or minimally processed foods. Nor is anybody going to suffer as a result of genuinely occasional consumption of for example chips (French fries), crisps (chips), confectionery (candy), pastries, biscuits (cookies), sugared soft drinks, uncontaminated burgers, or packaged pizzas, to name some ultra- processed products, although it is true that any of these can be so habit-forming as to amount to a form of 'soft addiction'.

The public health problem caused by ultra-processing becomes evident and then an acute crisis, as the proportion of ultra-processed products within food systems, food supplies and diets rises, as it rapidly has throughout the world especially since the 1980s. A theme of this commentary is that ultra-processed products now are becoming, or already are, so dominant within industrialised food systems, that the one and only really useful way to classify foods from a health point of view (and other points of view also) is in terms of the nature, extent, and purpose of their processing.

As stated in the boxed text here, there is no issue with food processing as such. Even the foods and drinks we think of as fresh have in a sense been processed by plant and animal breeding. Tap water has been filtered and purified. Food and drink manufacturers rightly point out that the human species has evolved and developed by means of discovering and developing processes such as those that use fire and water, and such as drying, fermentation and salting, to make raw foods eatable, palatable and enjoyable, and to preserve them at times of scarcity and in winter. In doing so, manufacturers give us the impression that their ultra-processed products really are nothing more than an extension of artisanal foods produced in family farms or prepared and cooked at home. Any such impression is misleading.

Examples of ultra-processing

To understand the impact of various types of processing now on industrial food systems, it is necessary to be more precise. Take the double cheese-bacon burger shown in the picture above. It delivers almost 1,000 calories, or close to half the daily energy turned over by a basically sedentary adult. This 'fast food', whose constituent parts are mass manufactured off-site and trucked onto the burger outlet to be assembled and heated on-site, is an example of what is termed in this commentary, an 'ultra- processed product'. Its substrates, and the product as a whole, are the result of a series of sophisticated technical processes. Also – another characteristic of ultra-processed products – it features a 'wholesome' or 'natural' touch, in this case the sesame seeds scattered on top of the bun.

Burgers were first formulated for the mass market over a generation ago, and in a sense are rather old-fashioned ultra-processed products. Extrusion technology is now increasingly used to fabricate products. For example, 'economy' chicken and other nuggets often have as an ingredient, a slurry 'mechanically recovered' from remnants of the animals that otherwise would be discarded, by use of high-pressure grinders and centrifuges. The animal-source material becomes an ingredient much like the refined starches, oils and other substrate of the product, reconstituted to look, smell and taste like a juicy battered slice of chicken.

As well as products using animal-source material, increasingly typical now, are a vast number of other novel branded products that are attractively packaged, powerfully promoted, and formulated to smell, taste and feel good. Examined out of such stimulating contexts, they often do not look like food, being completely removed from anything found in or directly derived from nature. They are confected from various refined and processed materials whose total cost is a small fraction of the price of the product. Any 'wholesome' touch is often supplied by added micronutrients, whose presence is emphatically advertised. Some food technologists have celebrated products like these as 'space age food'. Critics who prefer relatively unprocessed food call them 'edible food-like substances' (4)

Box 2

Industry

This commentary is not an attack on industry as a whole. Nor is it an attack on the food industry, or more specifically, the food and drink production, manufacturing, distribution, catering and associated industries and their trade organisations, as a whole. It might be read as such, perhaps in particular by those with an interest in evading the issues it raises by labelling it, its author, and his colleagues, as 'anti-industry'. But it is not.

It should go without saying that the development and survival of the human species, and of civilisation in any sense of the word, has always depended on reliable and sustained production of food. Gatherer-hunters prepare food. Peasant farmers cultivate and breed food. The creation and sustenance of towns and cities depend on food systems. Trade in food as well as other things, has built empires and cultures. More recently in history, the emergence of most of of the populations of most industrialised nations from misery, famine, starvation, and deficiency diseases, has been achieved by partnerships of legislators, public health leaders and other campaigners, with food producers, manufacturers, distributors, and sellers. Modern methods of production, manufacture, distribution and sale, create secure food supplies for all populations and communities with adequate and secure disposable incomes, all over the world. To demonise the food industry as a whole would be ignorant, foolish, and in effect irresponsible.

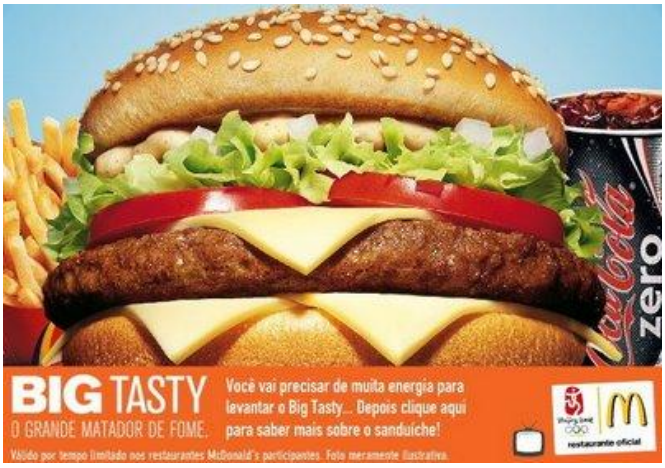
The makers of ultra-processed products

That said, this commentary is indeed implicitly sharply critical of the current policies and practices of food and drink manufacturers, caterers and associated industries, whose profits currently depend on the sale of what are termed here, ultra-processed products. The conventional evidence that some of these products – in particular sugared soft drinks – as now consumed in typical quantities, are seriously harmful to public health, is conclusive. I doubt that anybody independent of the indicted industries would now say otherwise.

What makes matters worse, is that transnational food and drink manufacturers continue to spend what overall amounts to many $US billions a year, making claims for their products, some of which they surely must know are misleading or even untrue. No uncontaminated food or drink product is as toxic as tobacco products are, but some of the techniques being used by some manufacturers to protect their bottom lines, their share price and their investors, and the salaries and pensions of their executives, are reminiscent of the methods used by the cigarette industry until these were blocked by legislation, including the imposition of gigantic fines. Support or sympathy for the prevailing policies and practices certainly of some transnational and other big food and drink manufacturers, would also be irresponsible, or at least foolish and ignorant.

The picture below is of part of the package of a branded sugary breakfast cereal made by the leading transnational food manufacturer. It has been a popular product on supermarket shelves in my own country of Brazil, formulated and marketed to attract children above the age of 18 months. Such products, most of which are made by three transnational manufacturers, are sold all over the world. Singling out any specific ultra-processed products, may give the false impression that they are unusual novelties. It would also be mistaken to single out any specific manufacturer, no matter how large. Supermarket lead lines are the result of lightly regulated 'market forces'. Production and consumption of ultra-processed foods and drinks has sharply risen, especially since the 1980s. As defined below, they now add up to a large proportion of the diets consumed in most lower-income countries, and supply most of the calories consumed in various high-income countries, including the USA and the UK (5). Readers with access to supermarkets are encouraged to go and see for themselves.

The thesis



This commentary distinguishes between three types of food and drink processing, and in turn three groups of foods and drinks, depending on the nature, extent and purpose of their processing. The first group are unprocessed (as defined here) or minimally processed foods. The second group are processed culinary or food industry ingredients. The third group are ultra-processed products – two examples of which are ready-to-eat eat breakfast cereals and burgers. Other papers of which I am author or co-author have also outlined this classification (5-6).

The fairly recent Brazilian advertisement for the 'big tasty' burger shown above says that it is 'The big hunger-killer'. The copy says '*Você vai precisar de muita energia para levantar o Big Tasty*', meaning that the burger is so enormous that the customer will need a lot of energy just to pick it up. As can be seen, the advertisement also carries a logo celebrating the manufacturer as sponsor of the Beijing Olympic Games. In the advertisement, which is for the leading global fast-food and burger catering chain, the Big Tasty is accompanied by a packet of thin-cut French fries, and for the figure-conscious, a small cardboard bucket filled with chemically sweetened cola. These are also ultra-processed products.

The impact of ultra-processed products

This commentary claims that the rapid rise in consumption of ultra-processed food and drink products, especially since the 1980s, is the main dietary cause of the concurrent rapid rise in obesity and related diseases throughout the world.

There are a number of plausible reasons for this claim. For a start, ultra-processed products, as a group, are much more energy-dense than unprocessed and minimally processed foods and processed culinary ingredients taken together. This has been demonstrated at least in two countries. In UK, at typical fast-food outlets the average energy density of the entire menus is 65 per cent higher than the average UK diet (7). In

Brazil, the average energy density of ultra-processed products purchased by urban households for consumption at home is 66 per cent higher than all the other foods that are purchased (5).

Box 3

Evidence

This commentary is proposing a theory, in the dictionary sense of 'a system of ideas or statements explaining something'. What is claimed and proposed here is new, and therefore is not and cannot yet be consensual. Likewise, the conclusions of this commentary do not directly derive from studies whose results are now generally identified as 'strong' or 'hard' evidence. Such studies, and in particular randomised controlled trials (RCTs) whose conclusions are made more powerful by meta-analyses and systematic reviews, have not been undertaken. Until now they could not be. This is because RCTs in the field of nutrition and health depend on a system of classification of food – itself dependent on the concept that foods should be grouped roughly according to their relative content of chemical macro- and micro-constituents – which still almost completely ignores or at best marginalises the significance of food processing.

The theory of this commentary is eminently testable. It is consistent with the narratives of independent expert reports such as those produced by relevant United Nations agencies and authoritative national bodies. It is, I believe, a more plausible and powerful account of the impact of modern food systems on human health, than is contained in such reports.

Why processing is overlooked

There are a number of reasons why the significance of food processing is generally overlooked or marginalised. One is that food technology is not included as a significant part of the nutrition science curriculum. Another is that nutrition scientists continue to depend on a conceptual framework of their discipline elaborated from the discoveries of biochemists between the early 19th and early 20th century, which has diminishing relevance.

Another is that any approach to nutrition and human health that gives special attention to food processing, is a 'hot potato'. Even more now in these days of 'public-private partnerships', much of the discourse of food and nutrition policy involves collaboration between international and national civil servants, their scientific advisors, and university and research centre departments and senior scientists, with representatives of the transnational and other big food and drink manufacturers whose profits depend on ultra-processed products. It may be fair to say that most nutrition scientists now do not see this as a problem. But it is.

Perhaps the greatest impediment to seeing the significance of food processing in all its aspects, is the identification of nutrition as solely or mainly a biological discipline, a

branch of biochemistry heavily influenced by the clinical 'medical model'. Many of the points made in this commentary, including those made in this section, are outside the scope of conventional nutrition science, and therefore identified as not relevant. But they are.

The scope of nutrition science

The significance and impact in particular of ultra-processing on human health, can be seen only with a 'big picture' vision, which identifies nutrition – or at least public health nutrition – as also a social, economic and environmental discipline (8). For older nutrition scientists whose training is solely or principally biological and medical, this is a challenge.

Much depends on what is counted as evidence, in the dictionary sense of 'facts in support of a conclusion, statement or belief'. Thus, findings from the so-called 'soft' social sciences need to be admitted as evidence, and as a necessary contribution to any soundly based conclusions and recommendations on nutrition and human health. Also, wise conclusions are not mechanical. They require common sense and considered judgement. Further, there are occasions in public life that are so urgent, important and critical, that action must be taken before all the evidence that makes scientists and civil servants comfortable is in. The impact of the action can then be examined and monitored, and if necessary the action revised. The pandemic of obesity, in particular among children and young people, is such a case.

Ultra-processed products are characteristically formulated from 'refined' and 'purified' ingredients freed from the fibrous watery matrix of their original raw materials. They are formulated to be sensually appealing, hyper-palatable, and habit-forming, by the use of sophisticated mixtures of cosmetic and other additives, and state-of-the-craft packaging and marketing. Further, ultra-processed products are 'convenient' – meaning, ready-to-eat (or drink) or ready-to-heat.

The leading branded ultra-processed foods and drinks are manufactured by transnational companies most able to purchase substrates for their products at rock-bottom or even subsidised process. They penetrate new markets in lower-income countries, with massive marketing and advertising budgets, and may undercut local industries, drive them out of business, or take them over.

In the last decades, ultra-processed products have usually become relatively or even absolutely cheaper to manufacture, and sometimes – not always – relatively cheaper to buy. They are often manufactured in increasingly supersized packages and portions at discounted prices with no loss to the manufacturer. The packaging may cost more than the contents.

Ultra-processed snacks and soft drinks are available in 'convenience' stores and other outlets often open late or even 24/7, and vended in machines placed in streets, gas

stations, hospitals, schools and many other locations. Ultra-processed fast foods and soft drinks are the main business of transnational and big national catering chains, whose outlets are also often open until late at night, and whose products are designed to be consumed also in the street, while working or driving, or watching television. Over-consumption is also pushed by lightly regulated or often practically unregulated advertising that identifies fast and convenience food, soft drinks and other ultra-processed products as a necessary and integral part of the good life, and even, when the products are 'fortified' with micronutrients, as essential to the growth, health and well-being of children.

A feature of the promotion of ultra-processed products in Brazil, and no doubt other lower-income countries, is incitement to over-consumption much more blatant than any now commonly found in the US, the UK and other high-income countries where obesity is understood by all to be a crisis. Another feature is the direct marketing of branded products to impoverished communities (9). A variant is the 'floating supermarket' that recently has been visiting riverside towns and villages in Amazonia, shown in the picture below. A company media release explains that this 'offers access to Nutrition, Health and Wellness to the remote communities'. One of the products on sale is the 'Bono' sweet biscuit. In Brazil it is advertised with the slogan (as translated here): 'The biscuit full of filling. It's hard to resist Bono. Take one taste and you'll surrender!'

These are some of the contexts of ultra-processed products. It would be strange if, in the volume now manufactured and consumed, they were not a leading cause of the current pandemic of obesity.

A personal note

Like many senior nutrition scientists, my formal qualifications are as a medical doctor with a higher degree in nutrition. My professional career also included training in the USA, and a period based at the World Health Organization in Geneva. Unlike most senior nutrition scientists, I am a national of a lower-income country – Brazil. For most of my professional life I have worked at the University of São Paulo. I divide my research work between topics specifically relevant to my country, and those with higher international relevance, notably focusing on the so-called linked demographic, nutritional and epidemiological transitions in lower-income countries, in collaboration with my long-standing US colleague Barry Popkin (10-12).

In the last 30 years, as a research scientist and a public servant as a consultant to the Brazilian government, I have had special access to the excellent periodical national surveys on health and nutrition and on household expenditures that are a feature of Brazilian descriptive epidemiology. A large part of my work has been analysis of these surveys, in order to track trends in population nutritional status and food and drink consumption in Brazil, and to draw conclusions and make recommendations, including to the authorities in the federal Ministry of Health in Brasília (13,14).

The shift in disease patterns

When I was a young health professional working in Brazil, obesity, and the chronic diseases linked with obesity, was mainly only of academic interest. Far and away the most important public health issues until the 1970s in most of Brazil, and until later in impoverished regions, were infectious diseases, and 'classic' malnutrition – impoverished populations suffering from inadequate and deficient diets, as they still do within many countries in Asia and Africa.

The increase in overweight and obesity in Brazil since the first national nutrition survey, in 1975, to the most recent one, conducted in 2009, has been phenomenal. The combined prevalence of overweight and obesity more than doubled among adults (from 23.6 to 49.1 per cent) and increased four times among adolescents (from 4.2 to 16.8 per cent) and 5 to 9 year-old children (from 6.0 to 25.5 per cent).

The shift in dietary patterns

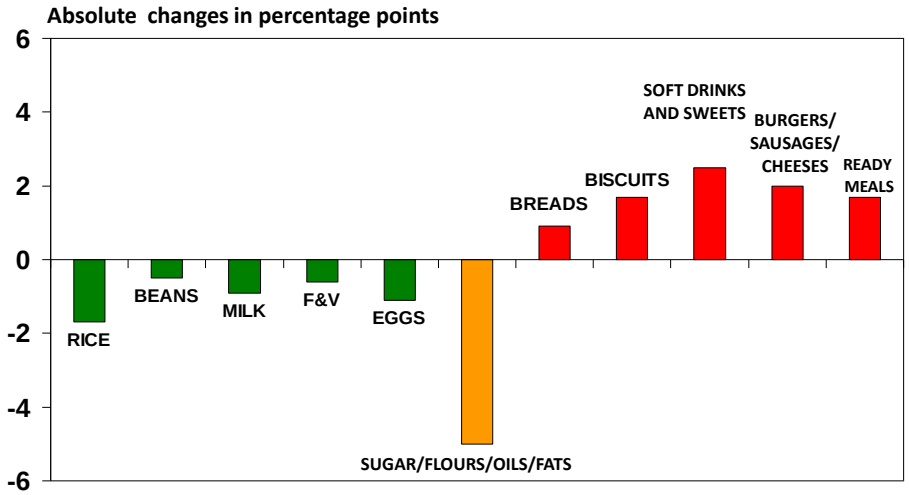
Over these years, what my studies of household food patterns in Brazil have showed, as seen in Figure 1, is decreases in staple or basic foods and also in basic culinary ingredients purchased as such. In only 16 years, from 1987 to 2003, the consumption of rice and beans declined by 10 per cent (from 22.4 to 20.2 per cent of total calories), milk and eggs by 27 per cent (from 7.4 to 5.4 per cent), and fruit and vegetables by 20 per cent (from 3.6 to 3.0 per cent). In the same period, oils declined by 18 per cent (from

12.3 to 11.1 per cent), table sugar by 20 per cent (from 12.8 to 10.3 per cent), and wheat and manioc flour by 26 per cent (from 4.9 to 3.6 per cent). As also seen in Figure 1, in the same 16-year period, 'cereal products' such as breads and biscuits increased by 21 per cent (from 12.6 to 15.2 per cent of total calories), 'meat products' such as burgers and sausages and 'dairy products' such as cheeses and sugared milk drinks increased by more than 100 per cent (from 1.9 to 3.9 per cent), and soft drinks and sweets increased also by more than 100 per cent (from 2.4 to 4.9 per cent).

Figure 1

Foods whose contribution to total dietary energy changed significantly from 1987 to 2003. Brazil

Figures derived from national household expenditure surveys



Source: Reference 5.

In terms of the conventional food groupings used for dietary recommendations (see the 'food pyramid' later in this commentary) the shifts shown in the figure are hardly consistent with the increase in obesity. True, consumption of rice and beans and of fruit and vegetables dropped, and of soft drinks and confectionery rose, which are the wrong directions according to conventional recommendations. But the foods whose consumption share most conspicuously declined, were those conventionally classed within the 'fats, oils, sugar' food group. These are usually recommended to 'use sparingly' (and positioned at the tip of food pyramids). Also, substantial increases were seen in foods conventionally classed within the 'meat' group or the 'dairy' group, usually officially recommended in moderation (in the middle of pyramids), and also in the 'bread and cereals' group, now usually strongly recommended – 'eat more of these' (at the base of pyramids). So if anything, judged conventionally, the main shifts in dietary patterns in Brazil were in 'healthy' directions.

As time went on I came to realise what breads and biscuits, soft drinks and sweets, burgers, sausages and cheeses, and also ready meals, have in common, together with very many other products consumption of which is also rising all over the world. They are ultra-processed. And so it is time to explain what this term means.

What processing is

International expert committee reports are now beginning to acknowledge that increased production and consumption of industrially processed foods and drinks is an important cause of the current pandemics of obesity and related chronic diseases (15-16). *The 6th Report on the World Nutrition Situation* is published by the United Nations Standing Committee on Nutrition at the time this commentary was being completed. On a global scale it notes 'a shift away from traditional diets towards a more globalized intake pattern that involves increased quantities of processed foods, animal products, sugars, fats, and (sometimes) alcohol' (17). This stress on food processing is new.

However, no United Nations or other authoritative report known to me, includes a precise definition of what is meant by industrially processed foods (in this commentary, drinks are included within the term 'foods'). Also, distinctions are only sketchily made between different types of industrial food processing, and indeed different types of home preparation and cooking. Further, biological mechanisms by which the consumption of industrially processed foods could influence human health are usually mentioned only briefly if at all. (Nor are they here: this is a topic for another paper). In addition, to the best of my knowledge, evidence presented on the association between industrially processed foods and disease is restricted to that from studies examining the role of just a few products such as sugared drinks (in the case of obesity) and processed meats (in the case of certain types of cancer) (15-16).

Discussion of processing as a factor in human health may be inhibited by arguments put forward by the food manufacturing industry and its associated organisations. For example, a recent document carefully states that 'Many processed foods are just as nutritious or in some cases more nutritious than fresh or home-cooked foods, depending on the manner which they are processed' and correctly, that 'Nowadays, it is difficult to eat a diet based on fresh, unprocessed foods', while going on to say rather more tendentiously 'The major portion of our family's food needs comes from processed food products that add variety to our diet and convenience to our busy lives. Processed foods enable consumers to shop less frequently and to stock a wide range of foods on which to base varied and nutritious meals' (18).
So what to think? Clarity requires clear definitions of industrial food processing, and clear distinctions between different types of processing. It also requires a classification

of foods according to the nature, extent, and purpose of processing. Following, is what I with my colleagues propose.

What unprocessed food is

Food is any substance intended to be, or reasonably expected to be, ingested by humans that provides nutrients needed to maintain life.

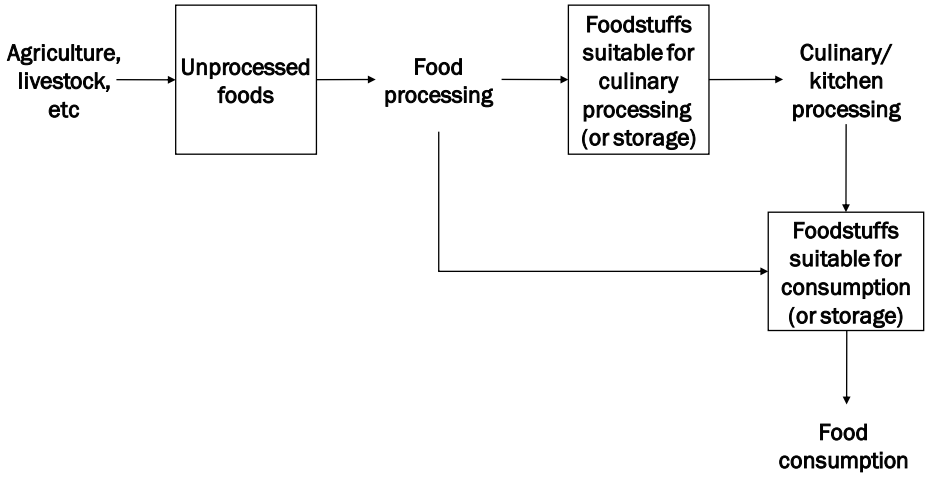
Unprocessed foods, also known as fresh foods, are defined here as parts of plants (such as seeds, leaves, roots, fruits) or animals (such as muscles, offals, milk, blood) and also fungi or algae, shortly after they have been harvested, butchered or extracted, or after they have been gathered from nature. Most unprocessed foods have two important limitations. First, they are highly perishable and cannot be stored for a long time. Second, they require kitchen (culinary) preparation and cooking to be digestible, safe, and palatable. These limitations are the main reasons for the development of numerous techniques of industrial food processing.

What industrial food processing is

Industrial food processing is defined here as a series of industry-performed operations by which unprocessed foods are converted into foodstuffs suitable for storage and/or consumption, with less or no kitchen (culinary) preparation and cooking. Figure 2 shows the position of industrial food processing in food systems.

Figure 2

Industrial processing within food systems



The three types of processing

A classification of three types of food processing, and a corresponding three groups of processed foods, the result of discussions that began in 2008, is now proposed. Also described elsewhere (6), these are now summarised.

A classification with more or many more divisions could be made, and much of the discussion I have shared with colleagues has been on this point. Eventually, we agreed that the simplest possible system, focusing on the general purposes and nature of processing, was best. The classification does not imply that what are defined here as 'ultra-processed' products are best never consumed. It is safe to say that nobody has ever become sick as a result of consuming one burger, unless it was infected with pathogenic microbes. The issue is one of proportion.

Type 1 processing

The processes classified here as type 1 do not substantially change the nutritional properties of the original unprocessed foods, and may improve them, intrinsically or in effect. Such processes include and are not confined to cleaning, removal of inedible fractions, grating, squeezing, draining, flaking, drying, parboiling, bottling (without additions other than water), chilling, freezing, fermentation (when the result is not alcoholic), pasteurisation, vacuum and gas packing, and simple wrapping.

The purpose of type 1 food processing is to extend the duration of unprocessed foods, to enable extended storage, and often to reduce the time and effort involved in their culinary preparation. The results of type 1 food processing are minimally processed foods, classified below as group 1 foods, together with fresh, perishable, unprocessed foods. Meat and milk, cereals (grains), pulses (legumes), nuts, and fruits, vegetables, roots and tubers sold as such, are usually minimally processed in various ways.

Type 1 food processing is usually undertaken by the primary producer, packing house, distributor or retailer, as well as by manufacturers, for eventual sale to consumers.

Type 2 processing

The second group of processes extract and 'purify' specific substances from unprocessed foods. There are many. They include pressing, crushing, milling, refining, 'purifying', hydrogenation, hydrolysation, extrusion, and use of enzymes and additives. Combinations of such processes are commonly used to make manufactured products.

One purpose of type 2 food processing is to convert unprocessed foods into culinary ingredients. These are used in preparation and cooking of unprocessed or minimally processed foods in the home, or in catering outlets such as restaurants, cafes and street

markets where meals are made on site. The other purpose of type 2 food processing is to convert unprocessed foods into food industry ingredients used in the industrial development of ultra-processed foods (see below)..

The results of type 2 food processing are therefore culinary or food industry ingredients. Examples are oils, fats, sugar and sweeteners, flours and pastas (when made of flour and water), and starches. Salt is a group 2 ingredient. Most end products of type 2 food processing are depleted or devoid of nutrients and essentially provide energy. They are not palatable by themselves apart from sugar (which however is not commonly eaten neat), and are not consumed by themselves. Oils are used in the cooking of cereals (grains), vegetables and pulses (legumes), and meat, and are added to salads. Flours are made into pastry used as a covering for meat or vegetable dishes or as a basis for cakes. Pastas are the base for dishes that include vegetables, meat and other group 1 foods, and also oil. Table sugar is used to prepare fruit- or milk-based desserts. And so on.

This group also includes industrial ingredients usually not sold directly to consumers, such as processed remnants of meat, high fructose corn syrup, lactose, milk and soy proteins, gums, preservatives, and cosmetic and other additives. In modern food systems, the processing of such ingredients is mostly undertaken by specialist firms, for sale to food manufacturers.

Type 3 food processing

The third type of processing combines the already processed group 2 ingredients, such as oils, fats, sugars, salt, flours, starches, remnants of meat, with some (often only a small or even minuscule amount) of unprocessed or minimally processed group 1 foods. Sometimes no group 1 foods are included, although they may be imitated. Specific processes include baking, battering, frying, deep frying, curing, smoking, pickling, canning, use of preservatives and cosmetic additives, addition of synthetic vitamins and minerals, and sophisticated types of packaging.

The purpose of type 3 food processing is the creation of durable, accessible, convenient, attractive, ready-to-eat or ready-to-heat products. Such ultra-processed products are formulated to reduce microbial deterioration ('long shelf life'), to be transportable for long distances, to be extremely palatable ('high organoleptic quality') and often to be habit-forming. Typically they are designed to be consumed anywhere – in fast-food establishments, at home in place of domestically prepared and cooked food, and while watching television, at a desk or elsewhere at work, in the street, and while driving. This is why they are termed 'fast' or 'convenience' foods.

Ultra-processed products are themselves of two types. One includes soft drinks, and ready-to-eat savoury or sweet snacks, or products liable to be consumed as such. The other includes pre-prepared ready-to-heat products designed to replace dishes and meals in the home or on site in catering establishments. Their processing is undertaken by

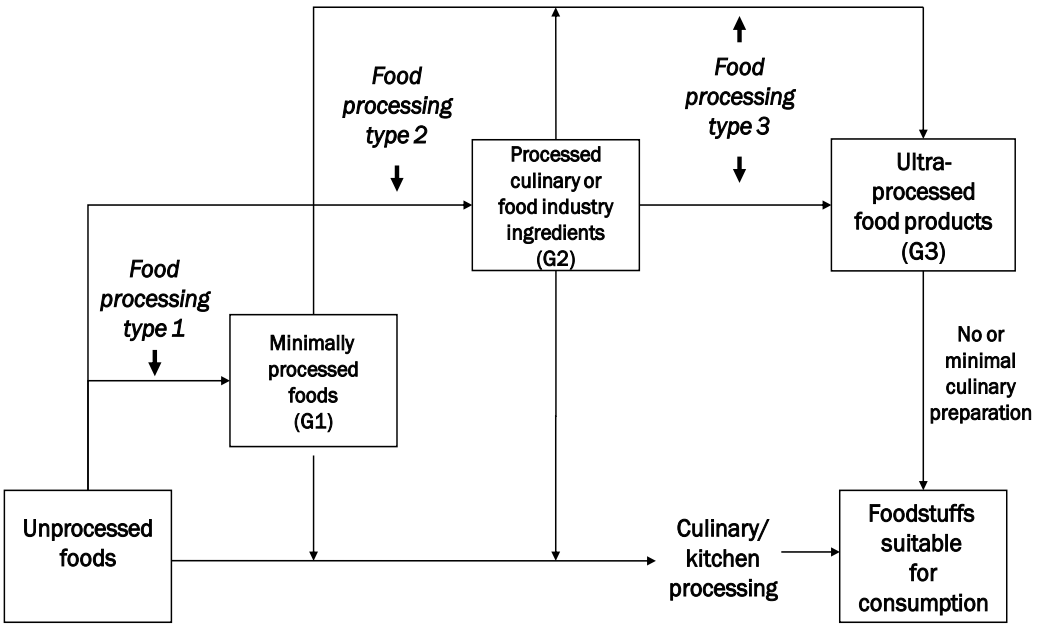
food manufacturers, or by caterers such as those that supply burger and pizza outlets, or food retailers such as bakeries.

From the public health point of view, ultra-processed foods are problematic in two ways. First, their principal ingredients (oils, solid fats, sugars, salt, flours, starches) make them excessive in total fat, saturated or *trans*-fats, sugar and sodium, and short of micronutrients and other bioactive compounds, and of dietary fibre. Taken together this increases the risk of various serious diseases. Second, their high energy density, hyper-palatability, their marketing in large and super-sizes, and aggressive and sophisticated adverting, all undermine the normal processes of appetite control, cause over-consumption, and therefore cause obesity, and diseases associated with obesity.

Ultra-processed products are usually not consumed together with unprocessed and minimally processed foods. They are designed to be ready-to-eat or ready-to-heat, and are often consumed alone or in combination with other ultra-processed products, such as savoury snacks with soft drinks, and bread with burgers. Any accompanying fresh food, such as lettuce within a burger, is usually little more than trimming or decoration, added to give an illusion of wholesomeness.. For this reason it is right to isolate ultra-processed products in dietary analyses and guidelines. Figure 3 shows the position of the three types of food processes within food systems.

Figure 3

The three types of food processes within food systems



The three food groups

Now for the three food groups that derive from the three types of process. Table 1 repeats some of the information summarised above, included here for convenience.

Table 1

Food classification based on the extent and purpose of industrial and other processing

Food group	Extent, purpose of processing	Examples[1]
Group 1 foods Unprocessed or minimally processed foods	No processing (as defined here), or mostly physical processes used to make single whole foods more durable, accessible, convenient, palatable, or safe. Specific processes include cleaning, removal of inedible fractions, grating, squeezing, draining, flaking, drying, parboiling, bottling (without additions other than water), chilling, freezing, fermentation (when the result is not alcoholic), pasteurisation, vacuum and gas packing, and simple wrapping.	Fresh, chilled, frozen, vacuum-packed fruits, vegetables, fungi, roots and tubers; cereals (grains) in general; fresh, frozen and dried beans and other pulses (legumes); dried fruits and 100% unsweetened fruit juices; unsalted nuts and seeds; fresh, dried, chilled, frozen meats , poultry and fish; fresh and pasteurised milk, fermented milk such as plain yoghurt; eggs; teas , coffee, herb infusions, tap water, bottled spring water
Group 2 ingredients Processed culinary or food industry ingredients	Extraction and purification of components of single whole foods aiming the production of ingredients used in the preparation and cooking of dishes and meals made up from Group 1 foods in homes or on the spot in catering outlets, or else in the formulation by manufacturers of Group 3 foods.. Specific processes include pressing, crushing, milling, refining, 'purifying', hydrogenation, hydrolysation, extrusion, and use of enzymes and additives.	Vegetable oils, margarine, butter, milk, cream, lard; sugar, sweeteners in general; salt; starches, flours, 'raw' pastas and noodles. Food industry ingredients usually not sold to consumers as such, including high fructose corn syrup, lactose, milk and soy proteins, gums and similar products.

Group 3 products Ultra-processed food products	Combination of already processed group 2 ingredients usually with some unprocessed or minimally processed group 1 foods in order to create durable, accessible, convenient, and palatable drinks or ready-to-eat or to-heat products liable to be consumed as snacks or desserts or to replace home- or restaurant-prepared dishes and meals.. Specific processes include baking, battering, frying, deep frying, curing, smoking, pickling, canning, use of preservatives and cosmetic additives, the addition of synthetic vitamins and minerals, and sophisticated types of packaging.	Breads, biscuits (cookies), cakes and pastries; ice cream; jams (preserves); fruits canned in syrup; chocolates, confectionery (candies), cereal bars, breakfast cereals with added sugar; chips (French fries), crisps (chips), sauces; savoury and sweet snack products; cheeses; sugared fruit and milk drinks and sugared and 'no-cal' cola and other soft drinks; frozen pasta and pizza dishes; pre-prepared meat, poultry, fish, vegetable and other 'recipe' dishes; processed meat including chicken nuggets, hot dogs, sausages, burgers, fish sticks; canned or dehydrated soups, stews and pot noodle;, salted, pickled, smoked or cured meat and fish; vegetables bottled or canned in brine, fish canned in oil; infant formulas, follow-on milks, baby food.

Taken from reference 6.

[1] These listings do not include alcoholic drinks. The examples given are not meant to be complete. Many others can be added, especially to Group 3, using the general principles specified in the text and as indicated in the second column.

The so far irresistible rise of ultra-processed products

All over the world, unprocessed and minimally processed foods, and processed culinary or food industry ingredients, have been, are being, and continue to be, displaced by ultra-processed products.

Initial analysis of surveys conducted in high income countries indicates this process may be more or less complete. In the USA, the five most commonly consumed foods are 'regular' sugared soft drinks, cakes and pastries, burgers, pizza, and potato chips. These are all ultra-processed (19). In the UK, eight ultra-processed products, breads, cakes, pastries, confectionery, biscuits, processed meats, cheeses, and soft drinks, together supply 45.3 per cent of total household purchased calories (20).

In Brazil my colleagues and I have made more precise calculations based on household expenditure surveys and the classifications used in this commentary. Here, the percentage rose from 19.2 in 1987 to 28.0 in 2003 (5). Preliminary analysis of the 2009 survey indicates that this trend is continuing.

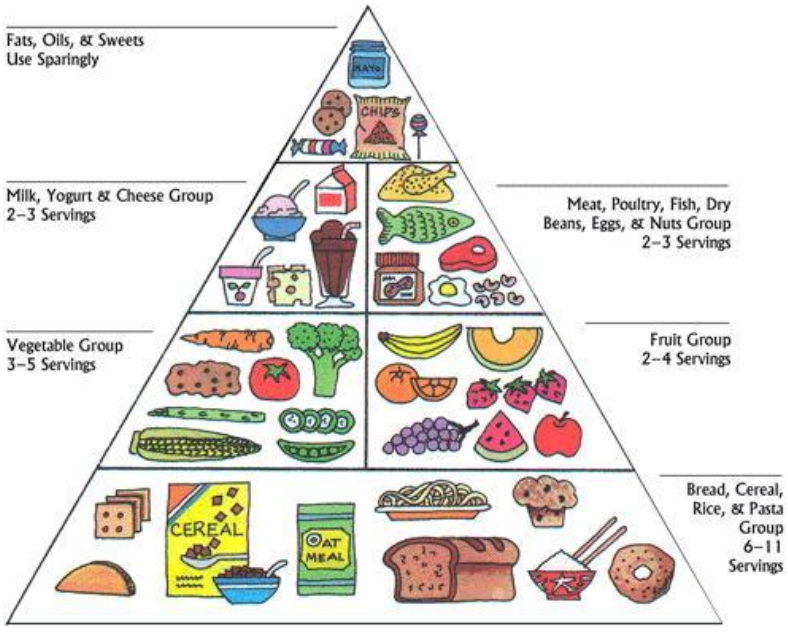
Calculations for the UK and Brazil are based on household expenditure surveys. So they do not include food and drink products purchased for consumption outside the home, which by their nature will more often be ready-to-consume ultra-processed products.

The bulk of the current business of transnational and other big food and drink manufacturing companies, and the principal source of their turnovers and profits, are ultra-processed products. In this respect, while being competitive with one another within product ranges, they all have the same overall policy. To adapt a jingle once used by the leading cola drink company, they want to teach the world to snack. This is the problem. There is no immediate answer, but problems can be resolved only after they have been identified.

Classification

No classification of foods and drinks can be clear-cut. Take the 'Food Pyramid' issued in many countries by government departments as a guide to good nutrition. One is shown here, as Figure 4. It derives from what is now a century-old classification of foods usually into 4 to 7 groups, broadly based on their relative content of chemical constituents – in particular, of proteins, carbohydrates, fats, vitamins and minerals.

Figure 4
A 'food pyramid'



The most obvious problem of this and any other food pyramid (or other device, such as a 'rainbow' or 'plate') based on such classifications, is that they include only a few of the food and drink products that people actually purchase and consume. In this pyramid, soft drinks are not shown, and nor are burgers, pizzas, or other ready-to-eat or -heat foods, dishes or meals. The base of the pyramid, illustrating the recommendation to consume more starchy foods ('complex carbohydrates') includes cakes, buns and biscuits together with wholegrain bread, oatmeal and boiled rice. Overall, this pyramid makes no explicit reference to food processing. At best, it is not particularly useful.

Box 4

Meat and bread

Most quizzical or critical comments on this thesis, as contained in papers already published, or in conference presentations, have addressed classifications that seem unexpected or counter-intuitive. Two examples are meat and bread. Should these and other foods or products give rise to sub-classifications? There is a case to do so, and we thought about introducing type 3A for ready-to-consume snacks and drinks, and type 3B for ready-to-heat meals and dishes. We chose not to do this.

For different reasons, many people might want to make a sharp distinction between meat from wild and free-ranging animals, and meat from industrially produced animals. We discussed this. Industrially produced meat certainly could be counted as ultra-processed. Strongly on balance, we felt that such meat is not 'manufactured' in the sense that sausages and burgers are, and that the arguments for making it a type 3 product are largely ethical and environmental – not part of our brief. Also, and importantly, we are not saying that any item that is unhealthy should for this reason be classed as type 3, or that all unprocessed or minimally processed foods are healthy..

The classification that so far has led to most comment, is bread. At the September 2010 Porto congress on public health nutrition Lluis Serra-Majem, a leading champion of the Mediterranean Diet, stated that bread has always been a part of the healthy Mediterranean Diet. Indeed so it has, but this commentary is not saying that it is only products devised by modern industrial methods that are counted as ultra-processed. People have been ultra- processing meat and fish by salting, pickling, and smoking for thousands of years. Nor are I and my colleagues saying that ultra-processed products should all be avoided. As stated, the issue is partly one of degree and proportion.

Rather as with meat, it is tempting to make a distinction between wholegrain and other 'rough' or artisanal breads that are delicious consumed by themselves or as a part of meals, as traditionally done in the Mediterranean region, on the one hand, and on the other hand breads that are made from degraded flour, pumped full of air, and that are disgusting unless used to be covered with or to contain usually fatty or sugary foods. But all bread by our and we suggest any rational definition is ultra-processed. Distinctions for nutritional and other reasons between different types of bread can be made in the text accompanying general classifications.

The classification proposed in this commentary is also not clear-cut, in the sense of being unarguable, and again it could not be. Overall, as already mentioned, with my colleagues I decided to keep the classification simple. We were tempted to make further distinctions and thus create more groups. Usually the argument to do so was based on a feeling that distinctions should be made between more or less healthy and unhealthy versions, or less or more processed versions, of the same sort of food. Our decision was not to do this, largely because we agreed that the crucial distinctions are to do with the extent and purpose of processing, rather than its intensity. Made into a manual, the classifications can be accompanied by text that explains and emphasises differences in nutrient nature and quality, and type and intensity of processing.

Three theses

Within the general thesis set out here, three proposals are made, in the form of specific these that derive from the main thesis, and from the investigations and observations set out here. They come from a public health point of view. Some recommendations are also included.

Thesis 1

Diets mainly made up from combinations of processed ingredients and unprocessed and minimally processed foods, are superior to diets including substantial amounts of ultra-processed products.

Unprocessed and minimally processed foods, processed ingredients, and ultra-processed products, all have advantages and disadvantages. To repeat, it is not stated or implied here that the best diets consist predominantly of unprocessed and minimally processed foods, nor that ultra-processed food and drink products are best eliminated from diets.

One key aspect of the food classification used here, is that processed ingredients are not palatable and with one exception (sugar) not edible by themselves. Their purpose, in all methods of food preparation and cooking developed until recently, has been to be used together with unprocessed and minimally processed foods, in the making of the meals (including feasts), dishes, foods, drinks and snacks that altogether make up international, national and local cuisines. The main dietary element in most ingredients is energy (calories), and typically the processes used to produce them leave them with relatively few nutrients. This is of course significant, and they can be over-used.

Processed ingredients are not the problem

Greasy and sugary cuisines, and feast foods eaten regularly rather than occasionally, are liable to make their consumers fat. This said, in judging the quality of diets it is not meaningful to isolate the nutrient profiles of ingredients, because they are consumed

together with unprocessed and minimally processed foods, suitably prepared. The unit to assess is not the ingredients, but the combination. Furthermore, the dishes that result are commonly consumed as part of meals including fresh foods, such as salads and fruits.

This is an important finding. It explicitly or implicitly contradicts most dietary recommendations, which for half a century, and still now, pick out ingredients in isolation. Thus, the 'food pyramid' above states, of fats and oils, 'use sparingly', and other guidelines use the same phrase for sugars. This implies that the issue is fats and oils as ingredients used by a family member in home cooking, and usually it is not. It also implies that those responsible are the home cooks, and this is rarely the case. The finger is pointing in the wrong direction.

In sharp contrast, ultra-processed foods and drinks are designed to be consumed by themselves. They may seem to be industrial versions of home cooking – combinations of unprocessed and minimally processed foods with processed ingredients. Industry publicity is often designed to give the impression that mass manufacturing is really just kitchen preparation on a bigger scale. But this is not so. Characteristically the amount of unprocessed and minimally processed food included within ultra-processed products is minimal. In this case it is appropriate to assess ultra-processed products as a unit. Further, the high energy density and other properties of various ultra-processed products, including hyper-palatability and super-size servings, and provision of a lot of calories in liquid form in the case of sugared soft drinks, sabotage human (and animal) appetite regulation mechanisms and energy balance. Artificially sweetened drinks stimulate cravings for sweetness, making people more likely to eat sweet foods. Passive overconsumption and obesity is also driven by the packaging and advertising of ultra-processed products.

The advice given with 'food pyramids' is misleading. Since governments usually approve official advice after consultations with food manufacturers, and/or expert advisors who are executives of or consultants to food manufacturers, this is perhaps not surprising. It would be more somewhat more helpful if the 'pyramid' guidance was: 'Avoid manufactured products containing substantial amounts of sugar and/or fat, especially saturated fat, and avoid *trans* fats'. But this is complicated advice, and food labels are bewildering. The really helpful advice is simple. 'If you consume ultra-processed products, do so only occasionally'. The text can then specify what this means, making distinctions between different types of ultra-processed products. No, it does not mean 'Always avoid…', nor 'Never consume….'.

It follows that as a rule, all adequate and varied traditional diets are superior to any diets containing a substantial amount of industrialised ultra-processed diets. A detailed set of recommendations can quantify such judgements.

Thesis 2

Almost all types of ultra-processed product, including those advertised as 'light', 'premium', supplemented, 'fortified', or healthy in other ways, are intrinsically unhealthy.

Once again, just to make very sure there is no misunderstanding, this does not mean that occasional consumption of ultra-processed products of itself is likely to be a significant cause of obesity or chronic diseases – always allowing for the caution that so many such products are very skilfully formulated, packaged and marketed to be habit-forming. By analogy, when dietary guidelines say that fruit and vegetables are healthy, this does not mean that an apple a decade will keep the doctor away, and when they say that alcohol is unhealthy, this does not mean that a drink a week, or indeed usually a couple of beers or a shared bottle of wine a weekend, is likely to do anybody normal healthy person any harm.

The basic point here, is that ultra-processed products have all the disadvantages of processed culinary ingredients, without their crucial advantage of being combined with unprocessed and minimally processed foods. With exceptions, ultra-processed products typically are confected from processed ingredients with little and even sometimes practically no content of unprocessed or minimally processed food. Manufacturers often take a lot of trouble to give the opposite impression, in 'friendly' names of products, references to herbs and 'nature-identical' ingredients, 'homely' or 'country' images used on packaging, 'warm' copywriting on the packaging and in publicity material, link-ups with smiling famous chefs, and so on, and in the product's presentation, which often includes the fresh item sprinkled on top, or conspicuous in some other way. Don't be misled.

Transnational and other big food and drink manufacturers are now of course sensitive to the fact that a great deal of disquiet is being expressed by citizens, health professionals, and indeed governments, about the obesity pandemic. The current president of the USA has given the impression that left to himself he would impose a 'soda tax' on sweetened cola and other soft drinks. Industry is united in promotion of spectator sport and personal physical activity, the idea being that people who skip rope or do circuits three times a week, or who play outdoors with their children at weekends, can consume all the processed products they feel like, and get or stay lean. It seems unlikely that anybody really wholly believes this.

Ultra-processed products are not good or better for you

Over the years, and increasingly in recent years, manufacturers have responded in different ways. One way has been to divide their products into 'fun', 'better for you', and 'good for you', and such-like categories. 'Fun' products are, as might be expected, ultra-processed items about which nothing or almost nothing nutritionally good can be said – what are commonly termed 'junk foods'. Techniques for advertising these are

somewhat like those once used to advertise cigarettes as essential accessories of the good life – glamour, smiling, sharing, and in the case of soft drinks, convivial young people partying.

The 'better for you' category includes products that are normally very fatty, sugary or salty, that have been reformulated to be somewhat less so, or to contain somewhat more dietary fibre. Such products may be promoted as 'lite', but are usually still 'heavy' – just rather less so. Rules are agreed with regulatory authorities that allow the manufacturers to boast about these changes in big lettering on the product labels. Cynics say that these moves are similar to those in the 'low-tar' stage of cigarette manufacture. A strong concern expressed particularly in the USA, is that in the last 20 years or so, manufacturers have removed some fat from their products, and thus have been able to advertise them as in effect 'better for you' (or even 'good for you') while preserving their 'organoleptic quality' (or 'yumminess' or 'more-ishness') by adding more sugar.

In one case, strong pressure has led to industry seeing the writing on the wall. *Trans*-fatty acids are now being eliminated from many products. These therefore become 'less bad for you', but this is not a phrase used by manufacturers. Sometimes products boast about containing no noxious substance, like *trans*-fats, or cholesterol, that previously never contained such things.

The 'good for you' category includes three types of ultra-processed products. One is product variants marketed as 'premium' – high quality or luxury. These may also be marketed as being good for the producer. Chocolate containing high proportions of cocoa, often stated to be fairly traded, is an example. These are of course expensive. The second type is reformulated to contain more unprocessed or minimally processed foods. Staying with chocolate, brands containing whole nuts are an example, though chocolate usually relies on marketing emphasising naughtiness but niceness, with coy references to chocoholism .

'Good for you' ultra-processed products are now big business. Some have been around for a long time. These notably include milk-based drinks and bases for drinks for children, including young children, and breakfast cereals. The claim is based on their being 'fortified' with synthetic vitamins or minerals. This is now a very sophisticated business, as anybody can see by looking at the nutrition information labels of ready-to-eat breakfast cereals, including some sugary lead lines promoted vigorously as good for children. The number, combination and dose of the added micronutrients is usually negotiated between the manufacturer and regulatory authorities, with reference to the findings of recognised international or national expert advisory committees. This enables strong claims to be made.

More recently, soft drinks and waters are being marketed and promoted as 'fortified' and therefore healthy. One previously niche brand of water with added vitamins was recently purchased by the leading cola drink manufacturer for $US 4.1 billion. (Yes,

billion). This product is promoted as an essential part of the gear of any sparky young executive. Such products obviously are not unhealthy, for those who can buy them, and are a better choice than sugared soft drinks. They are unhealthy only inasmuch as they reinforce the notion that anything eatable or drinkable that is 'fortified' is therefore healthy.

With the reservations and exceptions mentioned here, all types of ultra-processed products are unhealthy, whatever they say, and however legitimised their claims are. As said, they undermine appetite regulation and so drive overconsumption and thus obesity. 'Better for you' and usually 'good for you' versions remain high energy-dense, hyper-palatable, fast foods. The marketing of 'premium' ultra-processed foods and drinks, which is misleading, is becoming even more aggressive than the marketing of their 'regular' counterparts.

Thesis 3

Significant improvement and maintenance of public health always requires the use of law. The swamping of food systems by ultra-processed products can be controlled and prevented only by statutory regulation.

The pandemic of overweight and obesity, including among children and young people, also greatly increases the risk of 'adult-onset' diabetes in early life. We are in the midst of a vast global public health emergency. It is parallel with, and in some ways linked with, the more familiar outrageous emergency of undernutrition, food insecurity, and deficiency and related infections.

At the root of both crises is the ideology that has prevailed in the most powerful countries especially since the 1980s, and imposed by them on most vulnerable countries. This is the doctrine of 'the sovereignty of the market'. In practice this continues to mean releasing big businesses from what their chief and other executives regard as regulatory burdens, so that that they can engage in any currently legal policies and practices that will maximise their market share and their profits, worldwide.

This might not always be troublesome. In the case of food it certainly is. A relatively small number of transnational food and drink manufacturing industries, with associated businesses, now dominate international and global food systems. Their competitiveness within their own sectors disguises the fact that they all have the same overall interest. They are all predominately or mainly in the business of making and selling ultra-processed branded and very heavily marketed products.

What this means, is that legislation is essential, to check and reverse the worldwide increase in production and consumption of ultra-processed food products. This point should not be controversial. In many areas of public activity, enjoyment of and pleasure in life has been enhanced by regulations that govern access to parks and wilderness areas, that zone land for different uses, that make neighbourhoods and streets safer, and

that protect children and young people. Laws governing guns, drugs, dogs, and cars, are now rarely disputed. Laws governing access to alcohol and that control smoking have become rapidly accepted. The same needs to apply to ultra-processed food and drink products, in the public interest, and perhaps most of all vulnerable populations, including the poor, sick, and old, and mothers and children.

A public health issue

At any population level, 'business as usual' will not control or reduce overweight and obesity. This is a public health issue. All public health challenges and opportunities require public support, public money, and public resources, from the public authorities. This means that formally the lead must come from government, and in the case of a global crisis at all levels, from global to international to national to state and province, to municipalities and communities.

On 1 May 2009 the delegates assembled at the World Federation of Public Health Association, at its global meeting held every three years, agreed *The Istanbul Declaration* (21) Its purpose is in part to remind the profession of the duties and responsibilities of public health professionals worldwide. Its preamble begins:

'Now is the time to make a new commitment to the health of populations. The need for improvement and maintenance of public health must now be recognised, advocated and achieved by all policy-makers and decision-takers. Protection of public health is a first responsibility of governments at all levels, especially including heads of state and prime ministers. This implies renewed political will. It also implies a new understanding of public health as the first public good, needing adequate and therefore increased human, financial, and other material resources'

The final statement of the preamble includes: 'We are now living in a new world, of unique challenge and also unique opportunity for those committed to public health and for everybody. The challenges we now face are as great as those that faced public health pioneers of the 19th and early 20th centuries. Committed and sustained leadership is needed, including from young people. Now is the time for all those who affect the lives of others, working in government, industry, and in civil society, and as health care workers, academics, community and faith-based leaders, and citizens, to affirm the fundamental and elemental importance of public goods, including public health, and to assert and practice the basic human values of solidarity, sustainability, morality, justice, equity, fairness and tolerance'.

With my colleagues, I agree that this and other similar statements made recently should become the principles that govern and guide rational policies and effective actions. They should mark the revival of public health in the great tradition, which particularly since the 1980s has become increasingly privatised.

Box 5

Two appeals

Here are two appeals. The first is addressed to researchers who, like me, have access to well-conducted national and other substantial surveys of food consumption patterns over substantial periods of time The second appeal is addressed to citizens.

To researchers

Information from relevant well-conducted surveys needs to be pooled and newly analysed, in terms of the conceptual framework proposed here. In the preliminary stages of this initiative, some aspects of the system of classification set out here may be revisited and revised. This work needs to be done in parallel with analysis of trends in obesity and chronic diseases, allowing for agreed time-lags between consumption and the emergence of clinically observable diseases.

My prediction is that the results will prove to be a more powerful basis for rational policies and effective actions designed to control and prevent obesity and chronic diseases, than any results which, as they are now, are based on obsolescent classifications of food.

To citizens

Properly seen, nutrition as practised is a branch of public health. The health of populations is crucial to the social, economic and other aspects of the welfare of nations. The current pandemic of obesity is a great warning sign that something has gone very wrong with the systems of governance now being operated in the world.

The issue is comparable with and related to other global crises that are now affecting us all, including those of finance, fuel, climate and natural resources. This is not a time in history for 'business as usual'. Nor can information and education campaigns, or charitable Initiatives sponsored by governments, industry and foundations make a really significant difference.

What is needed is structural change. This can begin with groups of engaged professionals and informed citizens coming together, and forming or reforming energetic civil society organisations. Then legislators will listen. I will support such an initiative. Who will make the move?

The need for rational law

How can the change come? As with tobacco and alcohol, and indeed other big public health issues, all the evidence shows that the lead has to come from governments. But governments will not make the move for public health until politicians and civil servants realise that it will be politically more convenient to legislate in favour of public health,

than to leave transnational and other big food and drink manufacturers free to do whatever they like within existing laws to maximise their market penetration and profits. This will depend on sustained intense pressure from intelligent and resourceful civil society organisations, supported by health professionals and their organisations acting in the public interest.

Regulatory systems can be flexible, and allow for varying basic circumstances. In some high-income countries, the market may already be saturated with ultra-processed food products. In low- and middle-income countries, these products are still in the process of displacing traditional food systems. This suggests different regulatory strategies.

A rationally and carefully regulated market, with its implication of a 'level playing field', is in the interests of industry. Any unregulated 'free-for-all' makes the more responsible companies the victims of their most ruthless competitors. Also, the transnational and other big food and drink manufacturers could do quite a lot themselves. Product reformulation can have some benefits, even if this only slows down increases in the prevalence of epidemic disease. Other initiatives genuinely in the interests of public health can also be taken. With increasingly impatient colleagues inside and outside the public health professions throughout the world, I look forward to these.

Conclusion

In this commentary, as stated above, I advance a thesis and make proposals not directly derived from what is now regarded as the 'hard evidence' of methodically sophisticated and statistically powerful randomised controlled trials, meta-analysed and systematically reviewed. However, the relevant evidence and types of evidence known to me are consistent with the analysis, proposals and recommendations made here. It should be remembered that pandemic overweight and obesity, including among children, as illustrated in the picture here, is an emergency.

Much of what is stated in this commentary is circumstantial and inferential, and so not normally counted as 'hard' evidence – or even, for those who only admit results from trials, as information that can be counted as evidence. This must be so, because the published results of trials still virtually all derive from and depend on a conceptual framework of the science of nutrition that was originally conceived in the early years of the last century. This framework, using classifications of food largely derived from their relative contribution of chemical constituents, is not particularly appropriate, helpful, useful or even relevant in this century and the circumstances in which we live now.

Until the 1980s obesity among children and young people was uncommon in any country, although the population of the USA and a few other countries was becoming notoriously fatter. Now, populations of obese children and young people amount to the overwhelming public health crisis in high-income countries.

But as is now well-known, obesity is not a crisis only in high-income countries, and higher-income populations in other countries. Increasingly it is overwhelming lower-income countries and, within them, impoverished populations. The picture that ends this commentary, of a mother in her 30s and her teenage daughter, in a provincial city in my country of Brazil, illustrates the point. In Brazil a generation ago, obese young people were rare. Not now.

In my judgement, the impact of ultra-processed products on food systems and supplies and thus diets, is so blatant and obvious, that the heavy burden of proof is on those who wish to claim that ultra-processing is harmless or incidental to public health. Evidence to back such a claim would be credible only if it came from studies undertaken by researchers who are directly and indirectly free from any inappropriate influence, notably that of transnational food and drink manufacturers whose profits currently depend on the sale of ultra-processed products. I believe that such credible evidence will not be forthcoming.

The main direct dietary reason for the rapid increase in overweight and obesity throughout the world especially since the 1980s, which is now an uncontrolled pandemic, has been, is, and continues to be, the correspondingly rapid increase in production and consumption of ultra-processed food and drink products. That is the thesis of this commentary.

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CAM states: This commentary was drafted and revised in a continuous process by me and the colleagues mentioned below. Geoffrey Cannon drafted the boxed text for revision and approval by me. The commentary has benefited from discussions I have had in the last two years or so with my Brazilian colleagues Inês Castro, Renata Bertazzi-Levy, and Rafael Claro, who are co-authors with me of other papers referenced here, as are Geoffrey Cannon and Fabio Gomes. The main ideas underlying the different nature of different types of industrial food processing, and the mechanisms linking ultra-processed foods and human health, have been developed with their help. I have no conflicts of interest, unless these include a firm belief that too much power concentrated in too few hands, as with the control over food systems and supplies now exerted by transnational food and drink companies, is bad for human society.