

The foods that are addictive

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Foods are not all potentially addictive. It is now generally agreed that the foods most liable to be addictive are processed, energy-dense and high in added sugar, fat and/or salt, and typically ultra-processed, with additional characteristics liable to make them addictive. Studies on food addiction should focus upon ultra-processed foods.

Gearhardt & DiFeliceantonio's paper [1] defines 'food addiction'; identifies foods liable to be addictive; and proposes what should be done. It shows that the US criteria [2] defining tobacco as addictive, including compulsive use, brain and mood changes and craving, also apply to some types of food.

Everybody needs to eat; but there is no substantial evidence that whole foods or freshly prepared dishes, meals or even feasts mainly made with whole foods and culinary ingredients, however delicious they may be, are addictive. It is now commonly said that the foods most liable to be addictive are 'highly processed foods' (HPFs) [1], a vague term which therefore cannot be methodically investigated. More specific terms are drinks high in added sugar (SSBs) [3] and foods that are high in fat, sugar and/or salt (HFSS) [4].

Another term, used parenthetically in the paper [1] and explicitly favoured in two recent papers on food addiction [5, 6], is 'ultra-processed food', a term precisely defined and specified [7, 8], which has been and is being investigated in many countries [9, 10].

Ultra-processed foods are characteristically energy-dense, high in added sugar or added fat or often in both sugar and fat [7, 8], a combination practically unknown in nature that potentiates reward independently of liking [11]. They also have other characteristics that may be or are likely to be reasons why they are potentially addictive.

They are novel formulations made mainly or entirely with substances extracted from foods, often chemically transformed, and from additives [7, 8]. Humans are not evolved to metabolize such concoctions and are unlikely to have become adapted to them. The structures of whole food vital for metabolism and digestion and sense of satiety are destroyed by ultra-processing [12].

Common ingredients of ultra-processed foods are cheap sources of protein, such as soy and other plant isolates; modified starches and

sugars such as maltodextrin, high fructose corn syrup and invert sugar; and oils altered by partial hydrogenation or interesterification [7, 8]. Such mixtures would, by themselves, be unpalatable or disgusting, so cosmetic additives are also used. These include flavours, dyes and other colours; colour and flavour enhancers and many other types of additive. All these are not formally checked for addictive potential, or for impact on brain function [13]. Some additives are used by manufacturers to induce craving, and have often been publicized as such [14]. Added flavours in particular might induce overeating and weight gain by promoting hedonic eating and overriding homeostatic control of food intake [15].

Ultra-processed foods usually have fibre, protein and water removed, and texturizers soften the food. This allows them to be consumed more rapidly and increases the speed with which highly rewarding ingredients, such as refined carbohydrates, are absorbed into the system [6].

Most ultra-processed foods are made by corporations with huge budgets for marketing and advertising. They can be consumed anytime, anywhere. Since the 1980s, production and consumption of ultra-processed foods have risen very rapidly [16]. This global industrial food system now supplies more than half the total dietary energy consumed in some high-income countries, such as the United States, Canada and the United Kingdom [17]. Levels in lower-income countries are currently lower, but are rising rapidly [16].

Alone, reformulation policies to reduce the quantity of fat, sugar and salt in food supplies will not be enough to deal with the addictive impact of ultra-processed foods. Products lower in added sugar, fat and/or salt, likely to be marketed as 'healthy' perhaps at premium prices, would remain ultra-processed; and if the policies were voluntary, unreformulated products would remain on the market [18].

What is needed are effective statutory policies and actions designed to make fresh and minimally processed foods more available, attractive and affordable, that promote fresh meals and that reduce production and consumption of ultra-processed foods. These will reduce the incidence of many diseases and disorders, including food addiction.

A recent review of the science concludes: 'Ultra-processed foods... are created in ways that parallel the development of addictive

drugs, including the inclusion of an unnaturally high dose of rewarding ingredients that are rapidly absorbed into the system and enhanced through additives', and states 'When addictive substances become cheap, easily accessible, heavily marketed, and socially acceptable to use, the prevalence of addictive responses will increase' [6]. We agree.

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DECLARATION OF INTERESTS

The authors have no conflicting or competing interests.

AUTHOR CONTRIBUTIONS

Carlos A Monteiro: Conceptualization; writing-original draft; writing-review and editing. **Geoffrey Cannon:** Conceptualization; writing-original draft; writing-review and editing.

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