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CHEAP AS CHIPS

Is a healthy diet affordable?

Christopher Snowdon
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About the author

Christopher Snowdon is the Director of Lifestyle Economics at the IEA. He is the author of *Selfishness, Greed and Capitalism*, *The Art of Suppression, The Spirit Level Delusion* and *Velvet Glove; Iron Fist*. He has authored a number of IEA publications including *Drinking, Fast and Slow, Sock Puppets, The Proof of the Pudding, The Crack Cocaine of Gambling* and *The Fat Lie*.

Summary

It is widely believed that healthy eating is relatively expensive whereas ‘junk food’ is relatively cheap. This has led to an assumption that poor diets and obesity are directly caused by economic deprivation.

Some studies have compared the price-per-calorie of various types of food. The inherent bias of this method has the effect of making many high-calorie food products appear cheap. For example, a low calorie yoghurt appears to be more expensive than an otherwise identical high-calorie yoghurt despite both products retailing at the same price.

This report compares the price of food under two separate methodologies: direct comparisons of healthy and less healthy substitutes, and comparisons of healthy and less healthy products by edible weight. Prices were taken from two leading British supermarkets in November 2016.

There is little difference between the price of regular food products and their healthier substitutes in most categories, such as baked beans, soft drinks, milk and bread. A few healthier options are more expensive (eg. brown rice, lean mince) while others are cheaper (eg. low-sugar breakfast cereals, yoghurt). White meat is significantly cheaper than red meat, but processed meat tends to be cheaper than fillets of meat. Most healthy substitutes cost the same, or are within 10 per cent (+/-), of the less healthy option.

Measured by edible weight, healthier food in supermarkets tends to be cheaper than less healthy food. A wide range of fruit, vegetables and starchy carbohydrates are available at ≤ £2.00 per kilogram. By contrast, the majority of less healthy products, such as ready-meals, chocolate, crisps and bacon, cost ≥ £3.00, with very few available for less than £1 per kilogram.

With the exception of fish, all of the food groups recommended in the UK government's Eatwell Guide can be bought for less than £2.00 per kilogram and a wide range of vegetables are available for less than £1.00 per kilogram. The recommendation of eating five portions of fruit and vegetables a day can be met for as little as 30p.

The ingredients for a nutritious meal can be bought for significantly less than the cost of 'junk food', ready-meals and - by a wide margin - takeaway food. It is not the direct cost of less healthy food choices that drives their consumption. On the contrary, it seems that UK consumers are prepared to pay more for taste and convenience. Neither price nor nutritional quality are necessarily considered paramount by food shoppers.

Since healthy food is generally cheaper than less healthy food, it is unlikely that taxes and/or subsidies would have a significant impact on dietary choices. Taxing food that is disproportionately consumed by people on low incomes in order to subsidise food that is disproportionately consumed by people on high incomes would be heavily regressive unless people on low incomes responded by changing their dietary habits dramatically, which is unlikely.

The belief

There is a common belief that healthy eating is unaffordable and that 'junk food' is cheap. In 2014, it was reported that 'Healthy foods cost three times as much as unhealthy foods' (*Telegraph)* and that an 'Affordable healthy diet [is] "too expensive for many"' (*BBC*). Helen Stokes-Lampard, the chair of the Royal College of GPs, claims that fruit and vegetables are so expensive that many people cannot afford to follow the government's advice of eating five portions a day:

> 'For people that have got a low income five-a-day is really, really hard. It's expensive to have five-a-day. I get my five-a-day, no problem, but for many people they can't afford that five-a-day.' *(Campbell 2016)*

Arguing from this premise, it is a not a big leap to claim that obesity and poor nutrition are driven by economic factors and that people on low incomes, in particular, have little choice but to eat 'cheap' ready-meals, takeaways and 'junk food'.

It is well documented that people on low incomes tend to eat fewer vegetables, fruits, whole grains, seafood and dairy (excluding whole milk) (Beydoun et al. 2015) and tend to consume more processed meat and sugar (Nelson et al. 2007). It is also well documented that people on low incomes are more likely to be obese than wealthier people. Measured by the Index of Multiple Deprivation, the poorest fifth of English adults have an obesity rate of 29 per cent, compared to 22 per cent in the wealthiest fifth (HSCIC 2016).

Studies have found that people who spend more money on food tend to have better diets (Cade et al. 1999; Rehm et al. 2011; Drewnowski and Specter 2004) but this does not prove that healthy diets are unaffordable.

Affluent consumers may spend more money on food because they shop at more expensive stores and buy premium brands. Cade et al. (1999) found that the wealthiest women were more likely to go to the expense of growing their own food, buy organic produce, and shop in health food shops. They were also more likely to be vegetarian and live in one or two person households. All of these factors increased the cost of their grocery shopping but none of them are inherent costs of healthy eating. In large part, they reflect the discretionary expenditure of those who can afford to spend more money on food.

It is therefore not enough to observe how much money different people spend on groceries. Rehm et al. (2011) reported that higher food expenditure was associated with better quality diets but that some groups, including older adults, women and Hispanics, were able to consume 'lower-cost yet higher-quality diets'. There are expensive fish and vegetables, such as fresh tuna and kale, but there are also cheap fish and vegetables, such as sardines and carrots. The aim of this study is to use data from the UK to establish whether a healthy diet is less affordable than an unhealthy diet in Britain.

What is a healthy diet?

The UK government, via Public Health England and the NHS, has detailed recommendations about the constituents of a healthy diet. The average man and woman of working age is advised to consume 2,500 and 2,000 calories a day respectively, and to limit consumption of added sugars to no more than 33 grams and 27 grams respectively (Public Health England 2016). The government's Eatwell Guide recommends a diet based around starchy carbohydrates, such as rice, bread, pasta and potatoes, with at least five portions of fruit and vegetables a day. It recommends unsaturated oils and low fat spreads in preference to saturated fat and butter. Low fat dairy and wholegrain foods are favoured and consumption of processed meat is discouraged. It recommends no more than 70 grams of red meat per day and at least two portions of fish per week. The Eatwell Guide does not discriminate between frozen, fresh, organic, canned, dried or juiced food.

Although it would be wrong to describe any food product as inherently unhealthy, the take-home message from the Eatwell Guide is that added sugar, saturated fat and processed meat should be consumed sparingly whereas starchy carbohydrates, fruit, vegetables, fish, wholegrain food and low fat diary products should form the basis of the diet.

(In recent years it has become fashionable to view carbohydrates as fattening and saturated fat as healthy. Although this view has passionate adherents, it is the opposite of the UK government's guidance. Since it is beyond the reach of this paper to contest nutritional science, we have assumed that the Eatwell Guide reflects a scientific consensus that is broadly correct.)

The food groups favoured in the Eatwell Guide are not selected to counter obesity *per* se. Obesity occurs when individuals consume more calories

than they burn over a sustained period of time. If taken in excess, the foods recommended in the Eatwell Guide could cause obesity. By the same token, ‘unhealthy’ food would not cause obesity if it delivered less than the recommended number of calories per day. A distinction should be made between a diet that is ‘unhealthy’ because of its limited nutritional value and a diet that is ‘unhealthy’ because it is likely to lead to excessive calorie consumption. Although these are distinct and separate issues, there is a great deal of cross-over between them. Energy-dense foods which are high in sugar and saturated fat generally contain few vitamins and minerals whereas nutritious fish, fruit and vegetables contain relatively few calories.

Direct substitutes

One way of measuring the price of food is to make direct comparisons between healthy and less healthy versions of the same product, such as full-fat and low-fat yoghurts. Academic studies have produced mixed results when using this method.

In a study conducted in New Zealand, Ni Mhurchu and Ogra (2007) found 'only a marginal price difference' between the cost of a healthy basket of goods and an unhealthy basket ($96.63 versus $90.21). The difference was mainly due to the higher cost of lean meat ($5.19). The healthy variants of canned fish, breakfast cereal and bread were all cheaper, and the authors concluded that 'substantial improvements in nutrition are possible without incurring an increase in price for many staple food categories'. Wang et al. (2010) also used data from New Zealand, but found a stronger tendency for healthier items to be more expensive, with sugar substitutes and lean meat being particularly expensive.

Several US studies have looked at the issue. Ricciuto et al. (2008) reported that margarines with lower levels of trans-fats cost more than those with higher levels. Jetter and Cassady (2006) found that most items in a healthy food basket were more expensive than those in a less healthy food basket, with the exception of milk and potatoes. Liese et al. (2007) looked at a small selection of food options in rural grocery shops and reported that 'the healthful version of a food was typically more expensive than the less healthful version'. Krukowski et al. (2010) found that lean meat was more expensive than fatty meat whereas several healthier options, including 'low-fat milk, reduced fat dinners, lower-fat baked goods, and low sugar cereals' were cheaper. Rao et al. (2013) collated the evidence from some of these studies and found that lean meat was substantially more expensive than fatty meat, but their data revealed little or no difference between the price of healthy and less healthy dairy, grains, fats and soft drinks.

Katz et al. (2011) monitored grocery prices in US supermarkets and concluded that the price of 'more nutritious foods did not differ significantly from that of less nutritious foods overall'. Healthier types of bread were more expensive but healthier versions of breakfast cereal, cereal bars and biscuits were cheaper. For other products, such as juice, crackers and peanut butter, there was no significant difference. These findings were largely replicated by Gosadi et al. (2016) who found little or no difference in the price of healthy and less healthy versions of food products in Saudi Arabia, with a tendency for the healthier variants to be cheaper.

The findings from research of this kind are sensitive to which items are included and how 'healthy food' is defined. For example, Wang et al. (2010) used chicken with skin as the 'unhealthy' version of meat and chicken without skin as the healthy version. In effect, they compared the price of a whole chicken (or chicken drumsticks) to the price of chicken fillets. Whole chickens tend to be quite cheap whereas fillets require more preparation by the manufacturer and use only the best part of the bird. Consumers are not obliged to eat the skin and could easily remove it before or after cooking. In any case, it is debatable whether consumption of the skin transforms chicken from a healthy to an unhealthy food. Most health authorities recommend a diet of lean, white meat plus plant-based protein, and see the real distinction as being between red meat and white meat, or between processed meat and raw meat.

Nevertheless, comparisons between some direct substitutes can be made, particularly when processed foods have low-fat, low-sugar or low-calorie alternatives. To assess the relative cost of healthy and unhealthy versions, we looked at 43 products in two of Britain's leading supermarkets. The two supermarkets have a combined market share of 45 per cent. Prices were recorded in November 2016 and the cheapest brands were selected in every case. Cost was measured by the price per 100 grams (or 100 millilitres for drinks). In addition to comparing 22 sets of direct substitutes, we also compared white meat (chicken) to red meat (pork and beef). The less healthy option is shown in bold in Tables 1 to 4. Further notes on methodology are in Box 1.

Box 1

As in similar studies (eg. Katz et al. 2011), healthier substitutes are those which contain less saturated fat, less sugar and/or more fibre. Brown rice is higher in fibre and lower in fat than white rice. Wholemeal bread is higher in fibre and slightly lower in sugar and salt than white bread. Vegetable oil is lower in saturated fat than sunflower oil. Light baked beans are lower in sugar and salt than the standard variety.

All the healthier soft drinks contain no sugar and the substitute healthier breakfast cereals are lower in sugar.

Streaky bacon is higher in salt, total fat and saturated fat than back bacon and chicken is lower in saturated fat than either pork or beef.

Table 1: Staples and sauces

Food product	Supermarket 1	+/-	Supermarket 2	+/-
White bread	**5.6p/100g**		**11p/100g**	
Wholemeal bread	5.6p/100g	SAME	11p/100g	SAME
Chocolate breakfast cereal	**24p/100g**		**27p/100g**	
Ordinary cornflakes	7.6p/100g	-68%	19p/100g	-30%
Bran flakes	11.5p/100g	-52%	12p/100g	-56%
Muesli	11.8p/100g	-51%	12p/100g	-56%
Frosted cornflakes	**24p/100g**		**23p/100g**	
Cornflakes	7.6p/100g	-68%	19p/100g	-17%
White rice	**£0.45/kg**		**£0.45/kg**	
Brown rice	£1.74/kg	+287%	£1.20/kg	
Bolognese sauce	**20p/100g**		**36p/100g**	
Low fat bolognese sauce	20p/100g	SAME	36p/100g	SAME
Baked beans	59.8p/100g		59p/100g	
Light baked beans	61p/100g	+2%	59p/100g	SAME
Sunflower oil	9.8p/100ml		10p/100ml	
Vegetable oil	9.8p/100ml	SAME	10p/100ml	SAME
Mayonnaise	16p/100g		16p/100g	
Light mayonnaise	14.7p/100g	-8%	16p/100g	SAME

Among these staple foods with direct, healthier substitutes, there was little or no difference in price except for healthier cereals which were significantly cheaper than high-sugar cereals, and brown rice which was much more expensive than white rice (both supermarkets sell an exceptionally cheap brand of white rice in large bags).

Our finding that healthy breakfast cereal is cheaper than high-sugar alternatives is in line with Ni Mhurchu and Ogra (2007) and Katz et al. (2011). Our findings for bread, however, contrast with those of Liese et al. (2007), Krukowski et al. (2010) and Wang et al. (2010), all of whom found that wholemeal bread was more expensive.

Table 2: Meat

Food product	Supermarket 1	+/-	Supermarket 2	+/-
Pork steaks	**39.3p/100g**		**42.2p/100g**	
Chicken fillets	38.2p/100g	-2%	38.2p/100g	-9%
Beef steak	**80p/100g**		**100p/100g**	
Chicken fillets	38.2p/100g	-52%	38.2p/100g	-62%
Streaky bacon	**37.8p/100g**		**37.9p/100g**	
Back bacon	39.8p/100g	+5%	45p/100g	+18%
Mince (20% fat)	**32.5p/100g**		**33.8p/100g**	
Lean mince (5% fat)	61.3p/100g	+87%	80p/100g	+137%

In common with other studies, we find that lean mince is significantly more expensive than ordinary mince. We also find that streaky bacon, which is particularly high in salt and saturated fat, tends to be somewhat cheaper than back bacon. Neither variety of bacon can be described as ‘healthy’, however, since they are both high in salt and fat.

A more meaningful distinction is between white meat and red meat. Comparing the cheapest chicken fillets to the cheapest pork or beef fillets shows red meat to be more expensive. Both types of bacon are about the same price as chicken fillets. Sausages are even cheaper at 9.8p/100g in one supermarket and 10.9p/100g in the other (see Tables 5 and 6 below). Other processed meat products are more expensive. For example,

the cheapest sliced ham (which is high in salt), was priced at 41.7p/100g in Supermarket 1 and 48p/100g in Supermarket 2.

Table 3: Dairy

Food product	Supermarket 1	+/-	Supermarket 2	+/-
Full fat yoghurt	**13.3p/100g**		**21p/100g**	
Low fat yoghurt	9p/100g	-32%	7p/100g	-67%
Whole milk	**43.6p/litre**		**44p/litre**	
Semi-skimmed milk	43.6p/litre	SAME	44p/litre	SAME
Skimmed milk	43.6p/litre	SAME	44p/litre	SAME
Cheese	**£4.80/kg**		**£5.56/kg**	
Low fat cheese	£4.80/kg	SAME	£5.56/kg	SAME
Salted butter	**£3.20/kg**		**£3.40/kg**	
Unsalted butter	£3.40/kg	+6%	£3.40/kg	SAME
Margarine	**£1.70/kg**		**£1.78/kg**	
Light margarine	£1.76/kg	+4%	£2.00/kg	+12%

Several studies have found that healthier versions of dairy products are cheaper than the less healthy versions (Ni Mhurchu and Ogra 2007, Wang et al. 2010). Our analysis found little difference in price except for yoghurts which were significantly cheaper in their reduced fat form. Low fat margarines were slightly more expensive.

Table 4: Soft drinks

Food product	Supermarket 1	+/-	Supermarket 2	+/-
Cola	**2.3p/100ml**		**3p/100ml**	
Diet cola	2.3p/100ml	SAME	1p/100ml	-66%
Lemonade	**2p/100ml**		**2p/100ml**	
Sugar-free lemonade	2p/100ml	SAME	1p/100ml	-50%
Water	1p/100ml	-50%	1p/100ml	-50%
Orange squash	**Not available**		**15p/100ml**	
Orange squash (no added sugar)	5p/100ml	-	15p/100ml	SAME

Krukowski et al. (2010) and Wang et al. (2010) found that high-sugar and low-sugar soft drinks had a similar price. Looking only at the cheapest brands, we found that sugar-free fizzy drinks were the same price as full-sugar fizzy in one supermarket and significantly cheaper in the other. Bottled water was consistently cheaper (and tap water is, of course, cheaper still). When we looked at premium brands with the largest market shares, such as Coca-Cola and Pepsi, there was no difference in price between the full-sugar and sugar-free brands (both were in the range of 5p to 10p per 100ml).

Supermarket 1 did not stock a sugary orange squash drink and the cheapest orange squash in both supermarkets was a double strength variety which contains no sugar. The table above shows the results for standard strength (sugary) squash against standard strength, zero-sugar squash.

Direct comparisons: conclusion

Overall, there was little or no difference in the price of healthy and unhealthy brands of most direct substitutes. The main exceptions were the healthier versions of mince and rice, which tended to be more expensive, and the healthier versions of breakfast cereal, yoghurt and soft drinks, which tended to be cheaper. White meat tended to be cheaper than red meat, and the price of processed meat varied significantly depending on the product.

Alternative measurements

Direct comparisons between healthy and less healthy versions of the same product show that meaningful improvements to the diet can be achieved at no extra cost, but there are limitations to using this methodology when looking at the cost of a healthy diet. Some of the differences are quite trivial and some of the products are essentially healthy (eg. rice) or essentially unhealthy (eg. bacon) either way.

One problem with direct comparisons is that most healthy foods do not have a less healthy version with which to compare (and vice versa). This is particularly true of raw, unpackaged products such as fruit, vegetables and eggs which are usually ignored in cost-of-food studies or, if included, are judged on trivial differences which have no real impact on health, such as whether they are canned or frozen. Jetter and Cassady (2006: 39), for example, draw a distinction between 'light tuna' and 'albacore tuna' (with the former being 'unhealthy'), and between vegetable oil and canola oil. The nutritional differences between these products are small.

For people making food choices in the real world, the less healthy substitute for tuna is fried fish or processed meat, and the less healthy substitute for vegetable oil is lard. It is doubtful whether the difference between canned pears in fruit juice and canned pears in light syrup (ibid.) is important when the realistic alternatives to pears are high-sugar desserts (eg. chocolate fudge cake) or high-calorie snacks (eg. crisps). The real question of whether a healthy diet as defined in the Eatwell Guide is expensive is not fully answered by comparing marginally healthier varieties of a limited range of products.

There are other ways of measuring the cost of food, although none is perfect. A common method is to look at the cost per 1,000 calories. Under this system, a number of US studies have concluded that healthy food is

more expensive (Drewnowski and Specter 2004; Drewnowski and Darmon 2005) although one randomised trial found that a weight-loss diet is no more expensive than an unhealthy diet (Raynor et al. 2002).

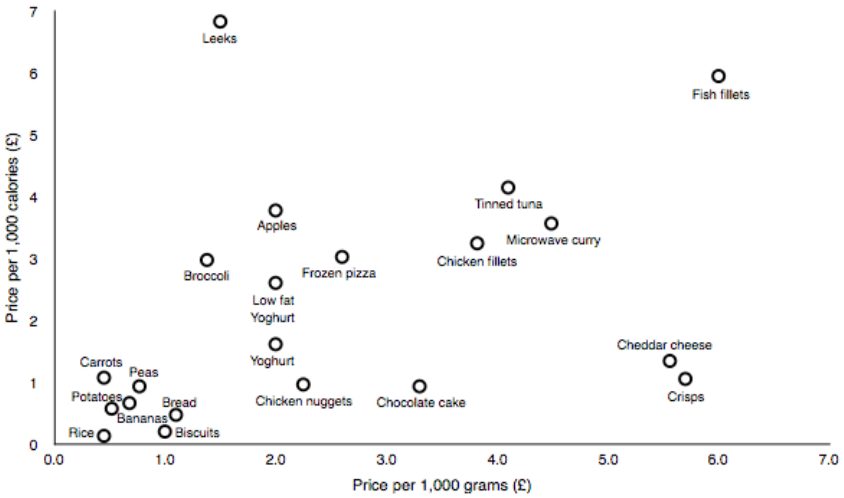
The cost-per-calorie method has also been used in two British studies which concluded that healthy food is relatively expensive. Moubarac et al. (2013) found vegetables to be three times more expensive than ready-meals and eight times more expensive than cereals. Grains, beans and margarine were the only healthy foods that were cheap under this measure. Jones et al. (2014) also used a definition of 'unhealthy food' that included calorie density and concluded that healthier items such as fruit and vegetables were three times more expensive than food and drinks that are high in sugar and/or fat. The Food Foundation, a think tank, cited Jones et al.'s figures in a 2016 report as evidence that 'healthy foods and diet patterns are more expensive' (Food Foundation 2016: 30). The title of their report ('Force-Fed') implied that this left low income consumers with little choice but to eat unhealthily.

But as a measure of the cost of a *diet* the cost-per-calorie method has a critical flaw. If 'unhealthy' implies 'fattening' then it is almost guaranteed to make unhealthy food appear cheap since most 'unhealthy' food is high in calories. It is almost a tautology to say that high-calorie food is cheap if price is measured by the calorie. As Carlson and Frazão (2012: 3) note, if 'less healthy foods are defined as energy-dense (a higher number of calories per edible gram), the metric suffers from mathematical coupling or negative autocorrelation'.

The cost-per-calorie measure was developed in the nineteenth century when scarcity, not abundance, was the pressing issue and consumers needed to get the most calories for their money. In developing countries today, a decline in the cost-per-calorie remains a good marker of economic progress, but in the rich world people rarely struggle to consume enough calories to maintain their weight. On the contrary, the challenge for many people is to avoid calories. 'In the setting of a global obesity pandemic,' write Rao et al. (2013: 12), 'assessing price differences per calorie may make little sense when a healthier diet also leads to reductions in total calorie consumption'. For millions of people today, a healthier diet begins with eating fewer calories.

To answer the central question of whether the cheapest healthy diet is less affordable than the cheapest unhealthy diet, a more appropriate method is to look at the cost-per-kilogram. As Figure 1 shows, food can appear to be both cheap and expensive depending on how cost is defined.

Figure 1: The price of food by gram and by calorie



In the bottom left corner of the graph are a number of cheap, energy-dense and mostly healthy staples that are inexpensive under both measures. A healthy, if dull, vegetarian diet of 2,500 calories made up of fruit, vegetables, starchy carbohydrates (potatoes, rice) and fibre (wholemeal bread) can be supplied by foods in this corner of the graph for less than £2 a day.

On the bottom right of the graph, cheese and crisps are cheap if measured on a per-calorie basis but expensive if measured by weight. By contrast, broccoli and leeks appear to be quite expensive under the cost-per-calorie measure despite being quite cheap by weight. Finally, there are products such as fish and meat which are relatively expensive under both measures.

The positions of low-fat and full-fat yoghurts in Figure 1 illustrate the problem with the cost-per-calorie measure. The two yoghurts are identical brands sold at the same price in the same sizes, and yet the low-fat yoghurt appears to be more expensive on the vertical axis. This is purely because it contains fewer calories. The cost-price autocorrelation turns the virtue

of being low in calories into the vice of being expensive. Zero-calorie cola would appear infinitely more expensive than a regular cola under this measure, despite both drinks retailing at the same price per bottle.

Cost by weight

The cost-per-kilogram measure is not flawless, especially when a product is bulked up with liquid or bones, but it gives a more realistic guide to food as it is eaten in real life, ie. to satisfy hunger rather than to fulfil a calorie quota. When the government defines portion sizes, it usually does so by weight (eg. 80 grams of grapes is one fruit portion).

We looked at the cost-per-kilogram of 20 food products that are typically regarded as being unhealthy and compared them with 23 food products that are generally regarded as healthy. As in the previous section, the cheapest brands were selected for each product. For branded goods, this was usually, though not always, the supermarket's own brand.

All the healthy foods in the list are encouraged under the Eatwell Guide whereas most of the unhealthy foods are high in salt, sugar and/or fat and therefore cannot be advertised during children's programmes in the UK. The unhealthy food category includes confectionery, frozen dishes and snacks, as well as five of the cheapest, ultra-processed ready-meals: shepherd's pie, Chinese, Indian, lasagne and hotpot. The unhealthy products are shown in bold in Tables 5 and 6.

Box 2

As we are only interested in the *edible* weight of food, the price of the following products has been increased to account for trim loss (eg. discarding skin or core):

Onions: 10 per cent. Sweet potatoes, parsnips, apples and pears: 20 per cent. Brussels sprouts: 25 per cent. Bananas and broccoli: 40 per cent.

Custard creams were selected as they were the cheapest biscuit available by weight.

The cheapest ready-meals were selected in every instances. In supermarket 1, the ready-meal curry contained 588 calories. In supermarket 2 it contained 1,263 calories.

Table 5: Comparison of unhealthy (bold) and more healthy (plain) foods by £ per edible kilogram (Supermarket 1)

Food product	Price per kilogram
Mature cheddar	**£4.80**
Shepherd's pie ready-meal	**£4.60**
Fish fillets (frozen)	£4.44
Crisps	**£4.00**
Bacon	**£3.80**
Chocolate fudge cake	**£3.33**
Chicken fillets (frozen)	£3.33
Chocolate bar	**£3.00**
Sardines	£2.83
Burger (frozen)	**£2.77**
Steak pie	**£2.50**
Chocolate breakfast cereal	**£2.40**
Salted peanuts	**£2.40**
Sweet and sour ready-meal	**£2.38**
Microwave curry	**£2.38**
Minced beef hotpot	**£2.38**
Pizza (frozen)	**£2.36**
Microwave lasagne	**£2.33**
Pork pie	**£2.27**
Chicken nuggets	**£2.25**
Whole chicken (fresh)	£1.97
Fresh tomatoes	£1.60
Lentils	£1.50
Biscuits (custard creams)	**£1.25**
Brussels sprouts	£1.25
Sweetcorn (frozen)	£1.20
Fresh parsnips	£1.20
Pears	£1.20
Apples	£1.20
Muesli	£1.18
Tinned peas	£1.14
Broccoli	£1.11
Sausages	**£0.98**
Bananas	£0.95

Food product	Price per kilogram
Sweet potatoes	£0.88
Mixed veg (frozen)	£0.77
Onions	£0.74
Tinned tomatoes	£0.63
Brown bread	£0.62
Chips (oven)	£0.50
Potatoes	£0.47
Carrots	£0.45
Pasta (spaghetti)	£0.40

Table 6: Comparison of unhealthy (bold) and more healthy (plain) foods by £ per edible kilogram (Supermarket 2)

Food product	Price per kilogram
Crisps	**£5.70**
Mature cheddar	**£4.90**
Microwave curry	**£4.49**
Chicken fillets (frozen)	£3.82
Bacon	**£3.80**
Fish fillets (frozen)	£3.66
Chocolate fudge cake	**£3.30**
Steak pie	**£3.30**
Sardines	£3.30
Chocolate bar	**£3.00**
Burger (frozen)	**£2.78**
Chocolate breakfast cereal	**£2.70**
Pizza (frozen)	**£2.60**
Microwave lasagne	**£2.50**
Shepherd's pie ready-meal	**£2.50**
Minced beef hotpot	**£2.50**
Salted peanuts	**£2.40**
Sweet and sour ready-meal	**£2.38**
Pork pie	**£2.30**
Chicken nuggets	**£2.25**
Whole chicken (fresh)	£1.99

Food product	Price per kilogram
Pears	£1.96
Lentils	£1.80
Apples	£1.60
Fresh tomatoes	£1.38
Broccoli	£1.36
Fresh parsnips	£1.29
Brussels sprouts	£1.25
Muesli	£1.20
Tinned peas	£1.14
Sausages	**£1.09**
Brown bread	£1.10
Sweetcorn (frozen)	£1.10
Biscuits (custard creams)	**£1.00**
Sweet potatoes	£0.95
Bananas	£0.95
Tinned tomatoes	£0.78
Mixed veg (frozen)	£0.77
Onions	£0.65
Potatoes	£0.52
Chips (oven)	£0.50
Carrots	£0.45
Pasta (spaghetti)	£0.40

In both supermarkets, all but three of the 20 unhealthy products cost £2.25 per kilogram or more whereas only three of the 23 healthy foods were found in this price range (fish fillets, sardines and chicken). Of the cheapest products (£1.00 per kilogram or less), nine out of eleven were healthy in Supermarket 1 and seven out of ten were healthy in Supermarket 2.

All the fruit and vegetables examined in both supermarkets cost £2.00 per kilogram or less. Oven chips, sausages and biscuits were the only processed foods that could compete with the healthier items on price (and it is questionable whether oven chips are truly ‘unhealthy’ - the cheapest brands examined were not high in salt, fat or sugar).

Measured by weight, stereotypically unhealthy food products such as microwave ready-meals, frozen pizzas, crisps, chocolate and sugary breakfast cereals are much more expensive than fruit, vegetables,

wholemeal bread and muesli. Of the 20 healthy options that are encouraged in the Eatwell Guide, only fish and unprocessed meat are in the same price range as the cheapest brands of processed food.

In both supermarkets, chicken was cheaper than the cheapest red meat (pork), both as frozen fillets and as fresh cuts, but meat and fish were nearly always more expensive than vegetables. Frozen chicken fillets were the cheapest 'healthy' meat products available, being slightly more expensive than bacon in one supermarket and cheaper in another. Tinned sardines were among the cheapest fish options, but other relatively fish products were available, including frozen fish fillets (£3.66/kg) and fish fingers (£2.40/kg).

These findings are in line with those reported in American studies such as Stewart et al. (2011) and Carlson et al. (2014) which found a tendency for foods high in added sugar and saturated fat to be more expensive. Carlson and Frazão (2012: 30) concluded that ‘when measured on the basis of edible weight or average portion size, vegetables and fruit are less expensive than most dairy, protein, and moderation foods’ (‘moderation foods’ being those which should not be eaten too often).

The cost of' five-a-day'

People do not eat food by the kilogram, but we can use standard portion sizes to estimate the cost of a healthy meal. The NHS defines an adult portion of fruit and vegetables as 80 grams. For vegetables, this is roughly equivalent to the amount a person 'can fit in the palm of their hand'. For fruit it is the equivalent of a whole apple, banana, pear or orange (NHS 2016). Table 7 below shows the price per portion of a selection of 20 fruit and vegetables in Supermarket 1. See Box 3 for methodology.

Table 7: Price per portion of fruit and vegetables (Supermarket 1)

Food	Price per portion
Carrots	3.6p
Tinned tomatoes	5.8p
Onions	5.9p
Frozen peas	6.1p
Mixed veg	6.2p
Tinned pineapple	6.5p
Cabbage	7.2p
Sweet potatoes	7.7p
Parsnips	8p
Pears	8.3p
Apples	8.3p
Tinned peas	9.1p
Frozen sweetcorn	9.6p
Brussels sprouts	10.0p
Tinned peaches	11.2p
Fresh tomatoes	12p

Food	Price per portion
Broccoli	12.4p
Bananas	14p
Oranges	20.8p
Grapes	28p

Box 3

To find the edible weight of each product, the prices of the following have been increased to account for trim loss (eg. discarding skin or core):

Onions: 10 per cent. Cabbage, sweet potatoes and parsnips: 20 per cent. Brussels sprouts: 25 per cent. Bananas and broccoli: 40 per cent. All other vegetables shown as price per 80g. All fruits shown as price per individual fruit, except grapes which are shown per 80g.

As these figures show, British consumers can eat their 'five a day' for well under £1. For example, a combination of carrots, peas, tinned tomatoes, pineapple slices and an apple can be bought for 30p. A more expensive combination of broccoli, sprouts, fresh tomatoes, grapes and an orange costs 83p.

The 'five a day' only provides around 200 calories and the Eatwell Guide recommends that the bulk of energy intake comes from starchy carbohydrates such as rice, potatoes and pasta. As we have seen, these are among the cheapest foods on the market regardless of whether we measure cost by weight or by calorie. In Supermarket 1, one kilogram bags of rice were on sale for 45p, and 7.5 kilogram bags of potatoes were available for £3.50. The cheapest starchy carbohydrates are shown in Table 8 below. As with fruit and vegetables, a portion is defined as 80 grams and, again, the costs are very low in terms of both servings and energy provision.

Table 8: Price per portion of starchy carbohydrates

Food	Price per portion	Price per 1,000 calories
White bread	4.5p	23.4p
Brown bread	4.5p	24.2p
Spaghetti	3.2p	27p
Rice	3.6p	38.1p
Pasta shapes	4.8p	40.8p
Potatoes	3.7p	60.6p

It should be clear from these figures, as well as the costs of products shown in the previous tables, that a simple vegetarian diet that ticks all the boxes in the Eatwell Guide can be purchased for as little as £1 per day. The addition of two daily portions of fish or meat raises the cost somewhat, but 100 gram portions of chicken fillets (138 calories), fish fillets (102 calories) sardines in tomato sauce (155 calories) can all be bought for less than 50p. Alternatively, two portions of lentils costs 30p. Meat or lentils (<50p) combined with two portions of vegetables (<12p) and a portion of carbohydrates (<5p) produces a healthy main meal for less than 77p.

We assume the cost of cooking (electricity, gas, utensils etc.) is similar for the preparation of both healthy and unhealthy meals. Adding in the cost of salt, pepper, margarine, cooking oils and condiments makes only a marginal difference to the overall price. A 70g bowl of muesli for breakfast (8.5p), plus a weekly jar of jam for toast (4p per day) adds a further 16p to the daily cost, but the raw ingredients for a simple, nutritious diet of three square meals a day can certainly be bought for less than £2 and would fulfil an adult's calorie requirements.

It is difficult to find a cheaper diet of 'junk food'. The cheapest option is an 80 gram portion of oven chips (4p) although, as mentioned, oven chips are not high in fat, salt or sugar. 100g portions of sausages, chicken nuggets, burger meat and bacon cost 10p, 23p, 28p and 38p respectively. These are low prices, but no lower than the healthier options shown above, and most other unhealthy options are significantly more expensive. Starting the day with a 50g bowl of budget chocolate breakfast cereal, for example, costs 17p compared with 8.5p for a 70g bowl of muesli, and low fat milk is the same price as whole milk. The cheapest ready-meals and pizzas are £1.00 each. Two of them would cost more than

an entire day's healthy diet. Sugary drinks further add to the cost whereas tap water costs virtually nothing.

Fast food and takeaways are still more expensive. The cost of a single meal at McDonalds, KFC or Burger King is far greater than an entire day's healthy diet bought from a supermarket. The cheapest adult meal at McDonalds costs £4.59. At Kentucky Fried Chicken it is £3.99 and at Burger King it is £3.49. The reputation of these outlets for being cheap is based on their prices compared to other sit-down restaurants. By the standard of supermarkets, they are very expensive. McDermott et al. (2010) looked at the costs of feeding a single parent and child in the USA and concluded that a diet of fast food was around twice as expensive as a shop-bought healthy diet using the least expensive options. Even on a cost-per-calorie basis, the fast food diet was approximately a third more expensive, despite it containing 50 per cent more calories.

Discussion

The crude association between poverty, obesity and poor health has led some to assume that it is the affordability of unhealthy food that causes obesity. Drewnowski and Darmon (2005: 2,705), for example, argue that obesity can be 'primarily accounted for by purely economic variables'. However, in Britain at least, the market price of healthy food is not conspicuously high. On the contrary, a simple diet that meets government recommendations is generally more affordable than a diet of processed, high-calorie food. This finding is consistent with two recent studies. Lee et al. (2016) found that a healthy diet was cheaper than the diet currently being consumed by Australians of all social classes. In the UK, Scarborough et al. (2016) found that an optimal diet which meets the stipulations of the Eatwell Guide is no more expensive that the current, less healthy British diet.

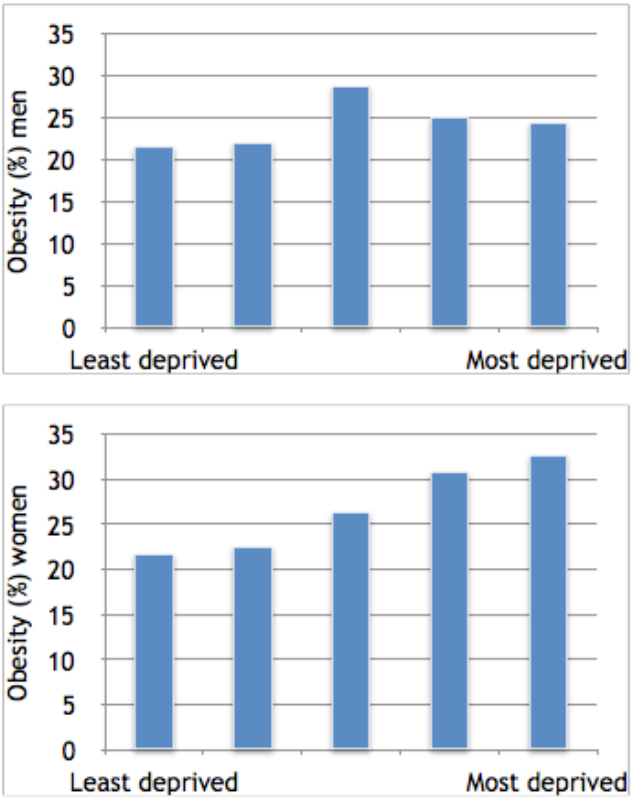
Recently published research from the USA helps explain why people perceive healthy food to be expensive. In a series of behavioural experiments, Haws et al. (2017) found that consumers tend to assume that more expensive food products must be healthier, even when the products are nutritionally indistinguishable from cheaper substitutes. The mere existence of a price premium seems to be enough to imply health benefits. One reason for this, argues the chef Anthony Warner (2016), is that fad diets and wellness gurus 'focus almost solely on exclusive, exotic ingredients' such as quinoa and chia seeds at the expense of 'cheap, easily consumed sources of valuable nutrition like carrots, potatoes, bread and cheese'. Organic and gluten-free food, for example, is assumed to be healthier as a result of the exaggerated claims made on their behalf and because they are more expensive.

Associating price with quality can be a useful heuristic but associating price with *nutritional* quality can be misleading when shopping for food. If

people wrongly perceive healthy food to be more expensive, it is easy to see how they might assume that healthy diets are unaffordable for people on low incomes and yet the hypothesis that poverty causes obesity as a result of healthy food being too expensive has several obvious flaws. It does not explain why obesity has increased rapidly at a point in history when real incomes have risen and the price of all types of food has fallen, nor does it explain why obesity rates are higher in rich countries than in poor countries. It does not explain why people fail to buy more fruit and vegetables when they become richer (Stewart et al. 2003) and it cannot account for the high rate of obesity among people on middle and high incomes. If people's food purchasing decisions were based on achieving daily calorie targets at the lowest cost, as the cost-per-calorie method implies, it does not explain why people incur greater costs by exceeding their calorie intake.

Much has been made of the socio-economic gradient of obesity but obesity rates exceed 20 per cent among all income groups and, in England at least, the relationship between deprivation and obesity is only linear among women, with no such clear gradient among men for whom obesity rates are highest in the middle of the distribution (see Figures 2 and 3 below) (HSCIC 2016: table 9.5).

Figures 2 and 3: Obesity prevalence among adults (England)



The reasons why low income women have higher rates of obesity are beyond the scope of this paper, but the price of food does not provide a satisfactory answer. If price was the primary consideration, British consumers - and low income groups especially - would consume more fruit, vegetables and starchy carbohydrates. With the possible exception of fish and fresh meat, the foods recommended in the Eatwell Guide are not expensive when compared to the 'junk food' alternatives.

'It blows your mind how cheap a £1 cheeseburger is', writes Zoe Williams in *The Guardian* (Williams 2011). But compared to what? The same £1 could purchase a kilogram of sweet potatoes, two kilograms of carrots, two-and-a-half kilograms of pasta, ten apples or seven bananas. A single McDonalds cheeseburger contains 301 calories but does not constitute

a meal. A more filling and nutritious meal would be cheaper under any metric, including the cost-per-calorie measure, even after cooking costs.

The appeal of 'unhealthy' food does not lie in its price but in its taste and convenience. As Drewnowski and Specter (2004: 8) acknowledge, energy-dense foods are 'more palatable' and 'provide more sensory enjoyment and more pleasure'. Noting that most low income consumers could buy enough fruit and vegetables to meet US dietary guidelines if they wanted to, Carlson and Frazão suggest that their failure to do so 'may indicate that they are making their budget allocations based on considerations other than meeting dietary recommendations, such as taste and convenience' (Carlson and Frazão 2012: 28). For a large number of consumers, the price and healthfulness of food is secondary to taste and convenience. If it were not, there would be no demand for less healthy options such as white bread, sugary soft drinks, high-fat cheese and high-calorie yoghurt which are sold at the same price as their healthier substitutes.

Obesity is related to economic factors but not in the way that 'public health' campaigners often claim. The crucial factor is absolute affluence, not relative poverty. Prosperity gives people the option of spending less time cooking, or not cooking at all. It allows us to burn fewer calories by giving us labour-saving devices, motorised transport and sedentary jobs. The labour-saving options are not cheap when compared to the alternative of cooking a healthy meal or taking a walk, but they are cheap in absolute terms. As a proportion of income, they have never been cheaper. Expenditure on food and non-alcoholic drinks amounts to just 11 per cent of the average household budget. Even among the poorest fifth of the population, it is only 16 per cent (DEFRA 2012: 55).

The appeal of microwave ready-meals and takeaway food is that they require less effort and fewer cooking skills. Monsivias et al. (2014) report that time spent prepping food in the USA has fallen since the 1960s and that those who spend the least time preparing, cooking and washing up spend the most money eating out - and consume the least fruit and veg. There are opportunity costs incurred by cooking and by learning cooking skills. As Cade et al. (1999: 505) note, there are also 'intangible costs, such as the stress of convincing family members to forgo chips and sweets in favour of vegetables'. These non-financial costs should not be overlooked, but acknowledging that fast food saves people time is very different to claiming that people eat fast food because they cannot afford to do otherwise. Neither opportunity cost nor monetary cost can explain why

people prefer a chocolate bar to an apple, or a bag of crisps to a banana. Nor do they explain a preference for frosted cornflakes over (much cheaper) bran flakes. Flavour and convenience are the only credible explanations.

Personal preferences vary and some people value health more than others. As tasty food tends to be less healthy and more energy-dense, there is a trade-off between health and other factors, such as pleasure, convenience, time and the acquisition of cooking skills. The extent to which an individual is prepared to sacrifice time or flavour for health depends on their circumstances and preferences. In a study of American attitudes to food, Glanz et al. (1998) divided consumers into seven groups ranging from 'physical fantastics' to 'noninterested nihilists'. Every group valued taste over nutrition and only the two most health-conscious groups valued nutrition over price. The authors noted that 'concerns about reductions in the taste quality of the diet are the most often mentioned obstacles to adopting reduced-fat and healthful diets' (ibid.: 1125).

In recent years, various campaign groups have proposed taxes and/or subsidies to promote healthy eating. Aside from the difficulty of classifying any given food product as unhealthy *per se*, it is not easy to see how food could be subsidised without creating vast administrative costs (Snowdon 2016). Even if these problems could be overcome, it is doubtful whether changes to pricing would have a significant impact given that healthy food is already cheap in both absolute and relative terms. Taxing food that is disproportionately consumed by people on low incomes in order to subsidise food that is disproportionately consumed by people on high incomes would be highly regressive unless people on low incomes responded by changing their dietary habits dramatically (Muller et al. 2016). Given the importance of taste and convenience to consumers of all classes, it seems unrealistic to expect such a dramatic shift in eating habits to result from any fiscal measures that could feasibly be introduced in a democracy.

Limitations

The vast range of food products available means that research of this kind can never be comprehensive. It will always be possible to find cheap 'unhealthy' products and expensive 'healthy' products, and some previous studies have been open to the charge of cherry-picking. We hope to have avoided that charge by taking as broad a view as possible, using two different methodologies and examining the cost of dozens of popular food products in two popular supermarkets.

This study has focused on the cheapest brands, which are often the supermarket's own brands. These are not always the brands with the largest market share, however, and in some instances may not be big sellers. In the breakfast cereal category, for example, supermarket own-brands have a combined market share of 23 per cent, which is less than the market leader Kellogg's. In the baked bean category, Heinz has more than two-thirds of the market.

As premium brands are significantly more expensive, they are not relevant to the question of whether a healthy diet is affordable, but if healthier versions of premium products were more expensive it could help explain obesity in wealthier households if the cost-obesity hypothesis were correct. We find no evidence for this, however. Heinz's low sugar baked beans are the same price as its regular baked beans and Kellogg's high sugar cereals, such as Frosties and Coco Pops, are at least as expensive as its Corn Flakes. As with Coca-Cola and Diet Coke, healthier versions of similar premium brands generally retail at the same price. Further research could look exclusively at the price of premium brands but we doubt the findings would differ greatly from those laid out in this report.

Branding is less important for fruit and vegetables, and is absent altogether when they are sold loose. If we were to compare the price of premium

brands of processed foods to the price of fruit and vegetables, a healthy diet would appear even more affordable, relatively speaking, than the figures above suggest. This might not be the relevant comparison for people on tight budgets, but it reflects the choices that many people on middle and high incomes make in practice.

The prices in this study are all from supermarkets. Prices in corner shops and convenience stores are generally higher and it has been argued that people on low incomes are restricted to more expensive local shops (Segal 2010). These claims may have some validity in the United States, but it is doubtful whether 'food deserts' exist in Britain (Cummins and McIntyre 1999). Three-quarters of English households have access to a car and even in the poorest fifth of households, 52 per cent have access to a car (Department for Transport 2016: 42). Of those who do not, 79 per cent say that accessing a supermarket is 'very easy' or 'fairly easy' (compared to 95 per cent of car owners) (DCLG 2009: 162).

All told, no more than six per cent of the population struggles to access supermarkets because they do not have access to a car. The number of supermarkets has risen enormously in recent decades, with many situated in residential areas and accessible by bus or on foot. Most supermarkets also sell online and deliver to the door. For some consumers, it may be more convenient to buy some perishable items such as milk and bread in a local shop, but supermarket shopping is a viable option for the vast majority of Britons.

Conclusion

Food in the UK has never been more affordable and healthy food is generally cheaper than unhealthy food. A day's diet that meets the requirements of the Eatwell Guide can be purchased for less than the price of two cheap supermarket ready-meals and for much less than a single meal at a fast food chain. Switching to healthier versions of many staple products can be achieved at no extra cost, and a wide range of fruit, vegetables and carbohydrates can be bought in supermarkets for less than £1 per kilogram. Five portions of fruit and vegetables can be purchased for as little as 30p.

Some studies that have come to the opposite conclusion have used a cost-per-calorie measure of food pricing which makes high-energy food appear expensive regardless of the cost of a meal. Others have compared a small selection of food products which are classified as 'healthy' or 'unhealthy' on the basis of relatively minor differences. By looking at the cost by edible weight and studying the price of typical food portions, this report has been able to make better comparisons between the cost of healthy and unhealthy diets in Britain today.

We conclude that the real question is not why unhealthy food is so cheap but why people consume unhealthy food despite it being more expensive. The answer, we suggest, is that taste and convenience often play a larger role in people's food choices than price or nutritional quality.

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The Institute of Economic Affairs
2 Lord North Street
London SW1P 3LB
Tel 020 7799 8900
email iea@iea.org.uk