**The energy and nutritional content of snacks sold at supermarkets and coffee-shops in the UK**

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Conflicts of interest

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Transparency declaration

The lead authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported. The lead authors affirm that no important aspects of the study have been omitted and that any discrepancies from the study as planned (Open Science Framework, reference 8z7t5, <https://osf.io/8z7t5/>) have been explained.

**Abstract**

Background

Snacking being associated with higher daily energy intake, dietary guidelines recommend snacks of no more than 200 kcal for adults and 100 kcal for children. This study examines the energy content, nutritional quality, and price of single-serving snack food products sold by major chains in the UK.

Methods

Energy content, nutritional content and price of single-serving snack products were recorded in 2019 via the websites of 14 major chains (7 supermarkets; 7 coffee shops).

Results

The mean energy content of all eligible snack products (n=2283) was 186 kcal (95% CI: 182 to 190). The mean energy content of the snack products sold at coffee shops (n=379; 282 kcal; 95% CI: 269 to 295) was significantly higher than the energy content of the snack products sold at supermarkets (n=1904; 167 kcal; 95% CI: 164 to 170). 79% of supermarket snacks exceeded energy recommendations for children and 32% for adults. In coffee shops, 91% exceeded recommendations for children and 73% for adults. 42% of snacks were high in saturated fat, 39% were high in sugar and 7% were high in salt. Cheaper snack products were more likely to be of lower nutritional quality.

Conclusions

The high proportion of snack products that do not meet public health recommendations for energy content may contribute to the association between snacking and increased energy intake. Public health measures to increase the availability and reduce the price of snack products that meet public health energy content recommendations may reduce population level obesity.

**Introduction**

Increases in daily energy intake triggered by major changes to the food environment have been identified as a key contributor to overweight and obesity worldwide.(1–4) Over recent decades, changes to the food environment have also been accompanied by changes in eating patterns. Snacking, defined as eating occasions between main meals, has become more common and its contribution to total energy intake has increased.(5,6) In the US, between 1977 and 2003, the percentage of people who consumed snacks increased from 71% to 97% and the number of snacks per day increased from 1.4 to 2.2 on average.(5) In the UK, energy intake from snacking has been estimated to contribute between 16% to 36% of total energy intake.(7) Evidence for an association between snacking and body weight have been found to be equivocal,(8) but several studies have found that daily energy intake tends to be higher in people who report snacking episodes than in people who do not.(9–12) Yet, it remains unclear whether snacking may contribute to positive energy balance due to increased frequency of eating or due to the typical energy and nutritional content of snacks. Self-reported dietary data indicates higher energy density and lower nutrient density of foods consumed as snacks compared to foods consumed as part of meals (13–15). Furthermore, in one UK study consumption of snacks lower in nutritional quality was associated with higher BMI and waist circumference in women (7). There has been no research on the energy content and nutritional quality of snack products being sold in the UK. Given that a large and increasing amount of food is bought and consumed outside of the home and snacking may occur ‘on the go’,(16) characterising the nutritional quality of ready-to-eat snack products available to consumers is of importance.

In an attempt to reduce obesity in the UK, Public Health England (PHE) have provided guidelines that adults should consume snack products that are no more than 200 kcal (100 kcal for children).(17,18) The recommendation adds that the consumers should prioritise snack products with more greens and ambers as opposed to reds on the UK traffic light label system which indicates low (green), medium (amber) or high (red) content of four harmful nutrients (fat, saturated fat, sugars and salt).(19) However, it is unclear how easy it is to adhere to this public health recommendation in the UK, in terms of the availability and accessibility (e.g., price) of lower energy snack products. These considerations are important because both the availability and price of products are major drivers of food choice.(20,21)

We aimed to examine the energy content, nutritional quality and price of single-serving snack food products sold by major chain retailers in the UK. We were able to sample snack products from major supermarket and coffee shop chains. This allowed us to compare nutritional quality of snacks across these two business types where consumers buy single-serving snacks for themselves. Public health action on improving the nutritional quality of food has to date focused largely on voluntary food industry action, either through reformulation plans (e.g., providing sugar and salt reduction targets),(22,23) or by encouraging the incorporation of the UK traffic light label into the front of pack nutrition label.(19) Because this action has primarily been directed at supermarkets,(24) we reasoned that there may be differences between the nutritional quality of snack products in supermarkets and coffee shops.

**Methods**

Businesses and snack products identification

We sampled major chains that sell single-serving snack products in physical outlets and provide online nutritional information for these products (i.e. supermarkets and coffee shops). We defined supermarket chains as businesses that sell foods and household goods on a self-service basis, and coffee shop chains as businesses that do not tend to provide table service and predominantly sell drinks and snacks as opposed to full meals. We also examined whether snack products were sold by major fast food chains, but only one chain had a snacking menu section and we therefore excluded fast food chains from analyses (see online supplementary materials, **Table S1**). We aimed to identify the ten largest supermarket and coffee shop chains in the UK based on market share reports and previous research. (25–27) We included nine supermarket chains from the market share reports (there was no clear largest 10th). Two chains were excluded because there was a lack of nutritional information on their websites. For the coffee shops, among the ten largest chains, three did not provide sufficient nutritional information on their websites. The final sample consisted of seven supermarket chains and seven coffee shop chains.

Based on previous studies,(28,29) we defined a snack product as being a single-serving portion of food (i.e. no multipacks, share bags or products with serving sizes for more than one person), consumable “on the go” without cooking or preparation and that only require a small amount of time to consume. Our definition excluded ready-made meals (e.g., sandwiches, savoury pastries, pre-prepared main course) but included products that would require the use of disposable cutlery were eligible. We limited our scope to single-serving products because they are most likely to be consumed in their entirety by a single person, so the energy content of the product reflects likely energy intake. Beverages were not included as we did not consider them to be a type of snack food. In order to minimize ambiguity between snack products and small meals at coffee shops,(30) savoury items outside of the snack section were not considered as snack products (e.g., toasties). Examples of eligible products were single-serving packets of crisps, fruit pots and cereal bars. To characterise the different types of snack products identified, each product was classified based on 20 snack food categories adapted from a similar US study to reflect the UK market (e.g., yoghurts, baked goods).(31) For definitions and examples of snack type categories see online supplementary materials, **Table S2**.

Online data extraction

The UK websites of all chains were accessed in 2019 by two independent researchers who extracted the names of all eligible snack products and classified them into the different snack food categories. Researchers located subsections of the websites that sold snack products (e.g. ‘Single Chocolate Bars and Bags’) and searched all products to identify eligible products. When the number of servings in a snack product was not explicitly mentioned on a website, we determined whether the product was likely to be single-serving by comparing product weight to other single-serving snack products from the same snack food category (e.g. 20-50g for crisps). Discrepancies in eligibility and categorisation were resolved by a third researcher. Inter-coder eligibility consistency was examined by comparing the number of snack products identified online that were deemed eligible by both researchers independently, compared with the number of snack products identified by one of the researchers but not the other. To examine inter-coder consistency for snack product categorisation we used the percentage of eligible snack products that both researchers coded as being in the same category. For each eligible snack product, price, weight, total energy in kcal, and nutritional values per 100g (energy, fat, saturated fat, carbohydrates, sugars, fibre, protein, salt) were extracted from the chains websites by one researcher and verified by a second researcher. See online supplementary materials for more details on the online data extraction.

In-store visits

We also conducted in-store visits (Liverpool, Merseyside) to examine whether the energy content of snack products online was broadly similar to snack products sold in stores and to collect missing price information for eligible snack products identified online (see online supplementary materials, **Table S3)**. Two researchers visited eligible chains and recorded all eligible single serving snack products in the ‘snack’ section of the store. For more information about in store visits see the online supplementary materials.

Statistical analyses

We characterised the proportion of snack products that were ‘green’, ‘amber’ and ‘red’ for fat, saturated fat, sugars and salt according to Food Standards Agency Traffic Light Labelling guidance.(19) We also characterised the proportion of snacks that were 100 kcal or lower and 200 kcal or lower.(17,18) Products with missing nutrition information were excluded from descriptive analyses relating to the missing data but included in descriptive analyses unrelated to missing data.

Mixed models were run to examine differences in the energy content, price, and number of harmful nutrients in excess in snack products (number of red traffic lights, from 0 to 4) based on business type (coffee shop vs. supermarket). The number of red traffic lights was chosen as an indicator of poor nutritional quality as it reflects adherence to traffic light labelling recommendations. All mixed models included the chain as random effect to account for potential correlations between energy content, price and nutritional values of the snack products sold by the same chain. As there was variability in the numbers of snack products sold by each chain, weighted mixed models were run so that all the chains had the same weight in the analyses. For each snack product *i* sold by chain *j*, the weight was calculated as wi,j = 1 / (number of snacksj / number of snacks in total).

We also examined the price of snack products based on energy content. Based on PHE recommendations, we compared the price of snack products that were 200 kcal or less and more than 200 kcal at supermarkets and coffee shops. We used mixed models with price (per snack, £) as the dependant variable, energy content category (≤ 200 kcal vs. > 200 kcal, business type (coffee shop vs. supermarket) and the interaction between energy content category and business type as fixed effects. We also examined the relationship between price and the number of red traffic lights at supermarkets and coffee shops. We used mixed models with price (per snack and per 100 kcal, £) as the dependant variables, number of red traffic lights, business type (coffee shop vs. supermarket) and the interaction between number of red traffic lights and business type as fixed effects.

**Results**

Of the snack products identified online by the first coder (2238 products), 91% were also identified by the second coder, and of the snack products identified online by the second coder (2207 products), 92% were identified by the first coder, indicating reasonable consistency between the two coders. After discrepancies between the two coders were resolved, the final number of eligible snack products was 2283.

Of the eligible snack products, 86% were classified in the same snack food category by the first and the second coder. The initial 20 categories were recoded into 16 categories by combining categories with less than 30 items with another similar category (e.g., chocolate bags with other chocolate snacks). The type of snack products sold by the different business types are shown in **Table 1**. The most common type of snack products sold at supermarkets were yoghurts (26%) followed by chocolate bars (11%). At coffee shops, baked goods (e.g. pastries) were the most common snack products (51%).

**Table 1.** Number and percentage of snack products by category and business type (online sampling)

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Overall**n (%) of snacks | **Supermarkets**n (%) of snacks | **Coffee shops**n (%) of snacks |
| Yoghurts | 515 (22) | 495 (26) | 20 (5) |
| Baked goods | 289 (13) | 97 (5) | 192 (51) |
| Nuts and seeds bars | 219 (9) | 196 (10) | 23 (6) |
| Chocolate bars  | 215 (9) | 204 (11) | 11 (3) |
| Crisps | 158 (7) | 136 (7) | 22 (6) |
| Fruit | 138 (6) | 114 (6) | 24 (6) |
| Other bars | 131 (6) | 130 (7) | 1 (1) |
| Meat- and cheese-based snacks1 | 108 (5) | 93 (5) | 15 (4) |
| Sweets | 105 (5) | 100 (5) | 5 (1) |
| Bags and other chocolate snacks2 | 95 (4) | 84 (4) | 11 (3) |
| Fruit-based snacks/bars | 86 (4) | 80 (4) | 6 (2) |
| Cereal or granola bars | 58 (3) | 53 (3) | 5 (1) |
| Popcorn, rice, corn, and oatcakes3 | 51 (2) | 42 (2) | 9 (2) |
| Biscuits and crackers | 51 (2) | 27 (1) | 24 (6) |
| Vegetable- and bean-based snacks4 | 22 (1) | 16 (1) | 6 (2) |
| Other | 42 (2) | 37 (2) | 5 (1) |
| **TOTAL** | 2283 | 19045 | 3796 |

1 Cheese-based snacks and Meat-based snacks initial categories combined. 2 Chocolate bags and Other chocolate snacks initial categories combined. 3 Rice, corn and oatcakes and Popcorn initial categories combined. 4 Bean-based snacks and Vegetable-based snacks initial categories combined. 5 From ASDA (394), Coop (89), Iceland (18), Morrison’s (206), Sainsbury’s (474), Tesco (408) and Waitrose (315). 6 From Costa (48), EAT (53), Greggs (59), Caffé Nero (62), Prêt-à-manger (64), Coffee Republic (43) and Starbucks (50).

A single-serving snack product sold in the UK contained a mean energy content of 186 kcal (95% CI: 182 to 190) and cost of £1.02 (95% CI: 0.99 to 1.04). Across all snack products with energy information, 415 (19%) had an energy content of ≤ 100 kcal and 1309 (61%) had an energy content ≤ 200 kcal (**Table 2)**. The energy content of snack products online did not differ substantially from that of snack products sold in physical stores (see online supplementary materials, **Table S4)**. Energy content and other nutritional values of snack products by food categories is available in the online supplementary materials, **Table S5**.

**Table 2.** Description of snack products identified online by business type (mean ± SD unless otherwise specified)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Supermarkets****(n=1904)** | **Coffee shops****(n=379)** | **Overall****(n=2283)** |
| Total energy, kcal | 167 ± 74 | 282 ± 126 | 186 ± 95 |
| Price, £/snack | 0.95 ± 0.51 | 1.72 ± 0.65 | 1.02 ± 0.56 |
| Price, £/100 kcal | 0.71 ± 0.59 | 0.79 ± 0.78 | 0.72 ± 0.61 |
| **Nutritional values /100g** |  |  |  |
| Energy, kcal | 323 ± 181 | 367 ± 144 | 330 ± 177 |
| Fat, g | 15.1 ± 13.2 | 18.5 ± 11.4 | 15.7 ± 13.0 |
| Saturated fat, g | 6.1 ± 6.9 | 7.3 ± 6.2 | 6.3 ± 6.8 |
| Carbohydrates, g | 36.8 ± 25.0 | 43.4 ± 18.5 | 37.9 ± 24.2 |
| Sugars, g | 22.0 ± 20.8 | 22.5 ± 15.6 | 22.1 ± 20.0 |
| Fibre, g | 4.0 ± 4.7 | / | 4.0 ± 4.7 |
| Protein, g | 9.5 ± 9.5 | 6.2 ± 4.1 | 9.0 ± 8.9 |
| Salt, g | 0.6 ± 1.3 | 0.5 ± 0.4 | 0.6 ± 1.2 |
| **Traffic Light Labelling** |  |  |  |
| Fat green, n (%) amber, n (%) red, n (%) | 449 (25)663 (37)687 (38) | 34 (10)127 (36)185 (54) | 483 (22)790 (37)882 (41) |
| Saturated fat green, n (%) amber, n (%) red, n (%) | 521 (29)566 (32)701 (39) | 56 (16)107 (30)191 (54) | 577 (27)673 (31)892 (42) |
| Sugars green, n (%) amber, n (%) red, n (%) | 416 (24)706 (39)670 (37) | 61 (17)121 (34)174 (49) | 477 (22)827 (39)843 (39) |
| Salt green, n (%) amber, n (%) red, n (%) | 1007 (56)637 (36)149 (8) | 127 (37)211 (60)12 (3) | 1134 (53)848 (40)161 (7) |
| Number of red traffic lights 0 1 2 3 4 | 759 (40)457 (24)314 (16)374 (20)0 (0) | 101 (26)79 (21)105 (28)94 (25)0 (0) | 860 (38)536 (24)419 (18)468 (21)0 (0) |
| **PHEa recommendations** |  |  |  |
| Snacks ≤ 100 kcalb, n (%) | 384 (21) | 31 (9) | 415 (19) |
| Snacks ≤ 200 kcalc, n (%) | 1212 (68) | 97 (27) | 1309 (61) |
| Snacks > 200 kcal, n (%) | 581 (32) | 261 (73) | 842 (39) |

Missing values for total energy: 132, for price/snack: 278, for price/100 kcal: 323, for energy/100 g: 164, for fat/100 g: 126, for saturated fat/100 g: 138, for carbohydrates/100 g: 127, for sugars/100 g: 131, for fibre/100 g: 905, for protein/100 g: 127, for salt /100 g: 140. Fibre information was not available online for any coffee shops snack product.

a Public Health England. b Recommendation for children. c Recommendation for adults.

Linear mixed models investigating the effect of business type showed that on average snack products sold at coffee shops had 123 kcal more (95% CI: 95 to 151), cost £0.72 more (95% CI: 0.41 to 1.02) and contained 0.44 (95% CI: 0.12 to 0.76) more harmful nutrient in excess (i.e., number of red traffic lights) than snack products from supermarkets. No difference was found in price per 100 kcal between coffee shops and supermarkets (£0.05, 95% CI: -0.09 to 0.19). Results were similar in weighed mixed models (see online supplementary materials, **Table S6**).

We also examined the price of snack products based on energy content and on the number of red traffic lights per product. For a complete description of the models, see online supplementary materials, **Table S7** and **Table S8**. At supermarkets, the price of snack products that were 200 kcal or less (£0.89, 95% CI: 0.82 to 0.97) was significantly lower than the price of snack products that were more than 200 kcal (£1.17, 95% CI: 1.09 to 1.25). At coffee shops there was no significant difference between the price of snack products that were 200 kcal or less (£1.65, 95% CI: 1.28 to 2.01) vs. more than 200 kcal (£1.71, 95% CI: 1.38 to 2.05). Lower price was associated with a higher number of red traffic lights per product at both supermarkets (β=-0.03, 95% CI: -0.05 to -0.01) and coffee shops (β=-0.13, 95% CI: -0.20 to -0.05). Lower price per 100 kcal was also associated with a higher number of red traffic lights per product (supermarket: β=-0.15, 95% CI: -0.17 to -0.13; coffee shops: β=-0.27, 95% CI: -0.38 to -0.17).

**Discussion**

Across the sampled single-serving snack products sold at major supermarket and coffee shop chains in the UK, 61% met Public Health England energy recommendation for adults (≤ 200 kcal), whereas only 19% met recommendation for children (≤ 100 kcal). However, very few snack products sold in coffee shops met public health energy recommendations for adults (27%) or children (9%). Overall, it was common for snack products to be high in saturated fat (42%) and sugar (39%), although relatively few products had high amounts of salt (7%). Supermarket chains offered on average healthier snack products (i.e., less caloric and with fewer harmful nutrients in excess) than coffee shops chains. At supermarket chains, snack products meeting recommendation for energy content were less expensive than snack products exceeding this recommendation. This was not the case at coffee shops, as products exceeding energy content recommendation were similar in price to those meeting recommendations. Moreover, snack products with less favourable nutritional profiles (more red lights on the traffic light label system) tended to be cheaper and this relationship was particularly pronounced among snack products sold in coffee shop chains.

The present study is the first characterisation of the nutritional quality of single-serving snack food products available in UK supermarket and coffee shop chains. Although it has been shown that the most energy dense and nutrient-poor food groups are often the least expensive sources of energy,(32,33) the association between the nutritional quality of snack products and their prices had not previously been investigated. The findings in the present study contrast a US study, in which only 15% of a limited range of sampled snack food products were classified as ‘high’ in harmful nutrients (including sodium, sugars and fat).(31) Notably, the study was funded and conducted by the US food industry. The present study adds to a growing body of research which shows that food sold outside in the home (e.g. restaurants, cafes, coffee shops) in the UK is often high in energy and a large proportion of foods being sold exceed public health guidelines.(34–36)

The lower energy content and better nutritional quality of the snack products sold at supermarkets compared to coffee shops may be explained in part by differences between the types of snack products sold by these two types of business. For example, 51% of coffee shop snacks were baked goods and this number was only 5% in supermarkets. However, even among the same categories of snack type, coffee shop products were often higher in energy (see online supplementary materials, **Table S5**) and therefore it may be of interest to understand how product ingredients and/or portion size explain differences observed in the present study. Finally, the present study may be useful in tracking changes in the nutritional quality and price of snack products sold in the UK and examining whether future public health actions result in changes to the nutritional quality of snack products.

Limitations

Our analyses were limited to supermarket and coffee shop chains that provided nutritional information online and it may be the case that chains not providing information sell snack products of lower nutritional quality. In the UK, supermarkets vary in size (e.g. large megastores vs. smaller convenience stores) and it is plausible that the types of snack food stocked by each store differ. Our sampling methodology does not account for this. However, we did make in-store visits and found that the energy content of snack products sold in-store was comparable to the snack products sampled online. Our results relied on self-reported nutrition information by chains. A study of food label accuracy of 24 popular snack food products in the U.S found that energy content was 4.3% higher than reported,(37) so our study may have underestimated the energy content of snack food products available in the UK. We limited our scope to single-serving products and assumed that they are eaten in their entirety. However, it may be the case that products with more energy are more likely to not be eaten in full. Likewise, eating motives may sometimes differ between coffee shops (e.g. snacking for indulgence) and supermarkets (e.g. snacking for functionality) and this may affect how likely it is products are eaten in their entirety. Some snack products are also sold in ‘share bags’ or contain multiple servings, but it is unclear how often these products are consumed in their entirety by one person (as opposed to being shared) and we therefore did not sample these types of product. Snack products are bought at locations other than coffee shops and supermarket chains, for instance in some chain businesses whose core business is not described as food and drink (e.g. pharmacies, newsagents). Therefore, further research characterising the nutritional quality of snack products in other sectors of the retail market would be informative.

**Conclusion**

The high proportion of snack products that did not meet PHE recommendations is likely to be contributing to excess energy consumption in the UK. As snacking constitutes a meaningful part of the British diet,(7) it is now of importance that the calorie content of snack foods is reduced. Coffee shops in particular may be an area of intervention. In supermarkets the majority of the snack products were 200 kcal or less (68%), whereas it was a minority at coffee shop chains (27%). Furthermore, snack products with a lower energy content were less expensive than snack products with a higher energy content at supermarkets but no such difference was found for coffee shops. These results suggest that public health action encouraging reformulation and nutrition labelling of supermarket chains food products might have had a positive impact,(38,39) Given that both the availability and price of lower vs. higher energy foods drive food choice,(40,41) policies that aim to decrease the availability of higher energy snack products and make lower energy products more favourable in terms of cost, should be prioritised.

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