Information-based cues at point of choice to change selection and consumption of food, alcohol and tobacco products: a systematic review

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Abstract

Background: Reducing harmful consumption of food, alcohol, and tobacco products would prevent many cancers, diabetes and cardiovascular disease. Placing information-based cues in the environments in which we select and consume these products has the potential to contribute to changing these behaviours.

Methods: In this review, information-based cues are defined as those which comprise any combination of words, symbols, numbers or pictures that convey information about a product or its use. We specifically exclude cues which are located on the products themselves. We conducted a systematic review of randomised, cluster-randomised, and non-randomised controlled trials to assess the impact of such cues on selection and consumption. Thirteen studies met the inclusion criteria, of which 12 targeted food (most commonly fruit and vegetables), one targeted alcohol sales, and none targeted tobacco products.

Results: Ten studies reported statistically significant effects on some or all of the targeted products, although studies were insufficiently homogenous to justify meta-analysis. Existing evidence suggests information-based cues can influence selection and consumption of food and alcohol products, although significant uncertainty remains.

Conclusions: The current evidence base is limited both in quality and quantity, with relatively few, heterogeneous studies at unclear or high risk of bias. Additional, more rigorously conducted studies are warranted to better estimate the potential for these interventions to change selection and consumption of food, alcohol and tobacco products.

Trial registration: PROSPERO, 2016;CRD42016051884.

Keywords: Food, Alcohol, Information-based cues, Point of choice, Selection, Consumption

Background

Non-communicable diseases, including cardiovascular disease, many cancers, diabetes, and chronic respiratory disease are the leading cause of death worldwide [1]. Importantly, major risk factors for these diseases are modifiable health behaviours, including smoking, high alcohol intake, excessive consumption of food and physical inactivity [2]. These behaviours are multifaceted and driven by numerous factors, including cues in the environments that surround us, often without our awareness [3–5]. Altering cues in small-scale environments, or proximal physical micro-environments [6, 7], where people select products, such as grocery stores, restaurants and bars offer an opportunity to influence selection [8] across diverse consumer populations [9]. These include simple information-based cues, which when present within the same environment as that in which the behaviour is performed, and therefore proximal to that behaviour, both spatially and temporally, could influence selection of a target product without the need for extensive or conscious engagement with the information provided.

These information-based cues are different to traditional on-pack nutritional labels, which the EU Food...
Information Regulations made mandatory for most pre-packaged foods (Regulation (EU) 1169/2011) [10]. These regulations are to ensure people have appropriate information to make informed selections about the food they buy and eat. The UK Department of Health has also pledged to increase people’s awareness and understanding of alcohol units, committing alcohol producers to label their products with unit and health information [11]. While these regulations are supported by evidence that labelling can be an effective means of helping consumers choose healthier products [12, 13], labels are not consistently read and used by consumers [14, 15]. A recent review estimated that among students and young adults, only about 37% used labels [16]. It has also been proposed that nutritional information on labels, which may contain detailed information on the quantities of a range of nutrients, often in multiple formats on the same product, is too complex to be readily understood and used by some populations [17].

Given these considerations, the implementation of simple information-based environmental cues which are placed within the micro-environment, but not directly on the product, represent a complementary means of influencing people’s behaviour. Such information-based cues, sometimes also referred to as point of choice (POC) or point of purchase (POP) interventions may have the potential to influence selection of products across large proportions of the population, including those who do not readily engage with more detailed, on-product labelling [18]. Previous data of on-product labelling exist [12, 13], however, to our knowledge, there has been no attempt to systematically review their potential impact of information-based cues placed within the physical environment. The aim of the current review is to estimate the effect of information-based cues on selection and consumption of food, alcohol and tobacco products.

Methods

Following the PRISMA guidelines [19] and the Cochrane Handbook for Systematic Reviews [20] we developed a protocol which was registered on the PROSPERO international Prospective Register of Systematic Reviews database in advance of the review being conducted [21].

Criteria for inclusion in the review

Types of studies

To be included in the review studies were required to be randomised controlled trials, or cluster-randomised trials. Non-randomised controlled trials were only included when investigators had attempted to standardise the groups and minimise allocation bias [22].

Types of interventions

Interventions considered eligible for this review were those which involved the comparison of the effect of an information-based cue at point of choice on food, alcohol or tobacco selection or consumption to that of a non-information-based cue condition. Interventions included those conducted in any out-of-home environment, where an individual had a range of food, alcohol or tobacco products to select from; including grocery stores, supermarkets, restaurants, bars, school canteens, and workplace cafeterias. Eligible studies were required to report unregulated selection or consumption (with or without purchasing) of food, alcohol or tobacco item(s). Unregulated refers to the behaviour of individuals not being regulated by explicit instructions or actions of the researcher.

Definition of information-based-cue

Information-based cues were defined as those comprising any combination of words, symbols, numbers or pictures that convey information about the product or its use (including the impact of its use) [7]. The media by which the information-based cues were communicated could include: point of purchase advertising boards, display stands, banners, posters, flyers, and labelling on store equipment (e.g. shelving, shopping trolley, baskets, cafeteria trays). Standardised in-store announcements (e.g. those conveyed over a speaker system) and standardised information on screens within the out-of-home environment were also included.

Exclusion criteria

Interventions were excluded if the information-based cue was placed directly on the product of interest (i.e. the consumable substance and its immediate or integral packaging), for example studies which investigated the effect of traditional food labels (back of pack and front of pack labels), or interventions which provided warning messages on tobacco products (noting that systematic reviews are available on nutritional labelling [12, 13, 23], and tobacco warning labels [24]). Information-based cues which provided specific nutrient or energy claims, (e.g. “low-fat”), those which provided the nutritional content of a product, and those which listed specific nutritional values (e.g. amount of fat, carbohydrate, sugar, salt or energy content, alcohol volumes) were excluded. Information-based cues provided through the Internet or television, interventions targeted or tailored to specific individuals, or those that were designed to be delivered in an interactive fashion (for example interventions delivered in real-time by humans) were excluded. Studies involving non-human participants, and those for which the information-based cue concerned food allergens (e.g. gluten free information) were excluded. No other exclusion criteria were set.
Search strategy
To ensure a complete yet precise search was conducted, we developed a strategy to include medical subject headings and free text terms based on the eligibility criteria. The search was initially developed for MEDLINE ((OvidSP In-Process 1946 to 25th November 2016) (Additional file 1 Table S1), and tested for sensitivity to retrieve a set of reference papers. The search strategy was then adapted for EMBASE (OvidSP 1974 to 26th November 2016), PsycINFO (OvidSP inception to 26th November 2016), Cochrane Central Register of Controlled Trials (CENTRAL 1992 to 26th November 2016) and Web of Science (inception to 25th November 2016), using each individual database thesauri and notes. There was no restriction on publication date, format or language. Reference lists of all eligible articles were searched, and we additionally conducted forward citation tracking using Google Scholar.

Study selection
All abstracts were imported into a reference manager software package to facilitate selection, duplicates were removed and abstracts screened against the eligibility criteria by the lead author. Potentially relevant full texts were obtained and screened independently by two authors. Disagreements were resolved via discussion and a third author acted as arbiter where necessary.

Risk of bias
All articles were assessed using the Cochrane Collaboration risk of bias tool [20]. The tool comprises six specific domains of potential bias: selection bias, performance bias, detection bias, attrition bias, reporting bias and any other sources of bias. The tool was applied to each included study individually by two authors and justification for each judgement of bias (low, unclear or high risk) for each domain was recorded. Any disagreements were resolved by discussion by the two authors, with a third author acting as arbiter where required. Following these guidelines [20] an overall summary ‘Risk of bias’ judgement (low, unclear or high risk) for each study was derived based on the included domains. This means an article was only considered to have low risk of bias if all domains were judged as low risk. If any one domain was judged as high risk, the overall summary was judged as high risk of bias.

Study synthesis
Due to the heterogeneous nature of the included articles in terms of intervention, study design and participant characteristics, the results were synthesised narratively. The included articles reported outcome data in various ways; therefore, we have not attempted to standardise outcomes, but present data as stated by authors in each included article.

Results
The search strategy generated a total of 12,224 potentially eligible articles, after removing duplicates. Abstract and title screening identified 145 full-text articles that had the potential to be included. Twelve articles (which included 13 studies) met all inclusion criteria, and were included in the review. Details, including reasons for exclusion are shown in the PRISMA flow diagram (Fig. 1).

Included studies
Seven studies were conducted in the United States of America [25–31], three in the Netherlands [32–34], two in Switzerland [35] and one in France [36]. Three of the studies targeted selection by children [26, 31, 35], one targeted purchases by university students [28], three studies were conducted in the workplace [32, 33, 35] and one in bars [34]. The remaining studies were conducted in locations used by both adults and children [25, 27, 29, 30], although the most likely consumers would be adults.

Product of interest
Twelve of the 13 studies targeted food intake, eight studies included a measure of fruit and vegetable selection or consumption, of which six solely targeted fruit and vegetables [25, 26, 29–31, 36]. Four of the studies aimed to increase the selection of healthier food and beverage items or reduce selection of unhealthy options [27, 28, 32, 33]. Two studies targeted selection of both healthy and unhealthy snacks [35]. One study targeted alcohol sales [34], and we did not identify any studies targeting tobacco products.

Characteristics of the information-based cue
Medium of cue
Of the 13 included studies, 11 examined the effect of a visual information-based cue. The primary medium across the different studies included signs [25, 32, 36], vinyl banners [26], TV segments [26], menu boards [27], posters [35], placards [28, 33], and arrows placed on the floor [30]. A number of the studies included secondary information-based cues, for example, additional posters [27, 28, 32], paper menus [27], and table tents [28, 32]. The remaining two studies investigated the use of audio information-based cues, one of which examined the effect of a morning audio announcement in schools [31] and the other investigated music being played in bars [34].

Content of the cue
Of the 11 studies that examined the effect of a visual information-based cues, five studies included bright colours with images of the product of interest [25–30], for example images of fruit and vegetables, as the content of their cue. Two studies included posters which depicted different images, including Giacometti sculptures, a nature
scene, an activity scene or a fun fair [35]. Three studies incorporated a logo [27, 32, 33] and one study had simple writing on a white easel [36]. Of the two audio information cues, one included messages featuring a magical superhero, “bean man” [31] and the other played contemporary popular music which included lyrics with reference to alcohol [34].

**Location of the intervention**
Six of the studies were conducted in cafeterias, three of which were school based cafeterias [26, 31, 36], two were worksite cafeterias [32, 33], and one university dining halls [28]. Three studies were based in supermarkets [25, 29, 30], one in take-away restaurants [27], one in bars [34], one was in university buildings [35] and one in workplace buildings [35].

**Outcome measures**
The outcome measures varied across studies. Data were not presented in full for many of the included studies. Five studies measured sales data [25, 27, 32–34]. Other reported outcomes included proportion of produce spending to total food spending per person per day [29, 30], percentage snack choice [35], frequency of choice [31, 36], total number and percentage of children selecting vegetables [26], and reported intake of fat, fibre and vegetables [32, 33].

**Risk of bias**
For the overall summary of bias, three studies were judged to have unclear risk of bias [25, 32, 33] and ten had a high risk of bias [26–31, 34–36]. Notably, all studies had either unclear or high risk of bias in relation to the method of random sequence generation. Only two studies had low risk
of bias for the domain of selective reporting [28, 32]. Figure 2 provides judgements for each domain across each included study and Fig. 3 summarises risk of bias judgements across included studies. Full details of review authors’ judgements are presented in Additional file 2 Table S2.

Intervention effect
Ten studies reported a statistically significant intervention effect on some or all products. Three observed no evidence for an intervention effect within their primary analysis. Although results were mixed, the direction of findings was generally in favour of the intervention increasing selection of healthier products or decreasing selection of unhealthy products. Full details are presented in Table 1.

Fruit and vegetables
Two interventions conducted in supermarkets found significant intervention effects on selection of fruit and vegetables. Stores which placed placards on grocery carts observed an increase in average spending on produce per day by 16%, as compared to an increase of 4% in control stores [29]. The placement of green arrows around store perimeters increased average spending on produce per day by 8% compared to baseline (data for the control stores was not provided) [30]. In contrast, a further study conducted in supermarkets found no difference in sales when large signs were placed above produce items [25]. The remaining studies were conducted in cafeterias. One study placed brightly coloured banners around salad bars and played TV segments which included branded vegetable characters, daily servings of vegetables increased from 60 to 185 (p = 0.028) over time [26]. A study in France found the presence of labels stating “new recipe” or “special mix for superhero’s” resulted in significantly more children selecting novel vegetables as compared to when no cue was present (no label versus new recipe p = 0.012 and no label versus special mix for super hero’s label, p = 0.002) [36]. A worksite cafeteria study with a logo based information-based cue found statistically significant effects on the selection of fruit; however, this was estimated to be a change of just one piece of fruit per 50 customers [33]. A study conducted in University dining halls found no evidence of an intervention effect on reported fruit or vegetable intake of students [28]. One study investigated the use of recorded, morning audio-announcements promoting bean dishes in primary schools. No evidence was found that this influenced the selection of bean based dishes [31]. Although a sub-analysis of matched school pairs suggested that in the school where the announcement was played the most often, children were 2.5 times more likely to select the bean dishes than children in the comparison schools.

Healthier menu items
Studies which aimed to increase selection and consumption of healthier products or decrease unhealthy products provide mixed results. Two studies were conducted in the Netherlands. One found no increase in sales of low-fat soups, sandwiches, salads or snacks [33]. The other found an increase in sales of low-fat desserts (an increase from 28.6% to 44.4%) but observed no change in sales of low-fat milk, butter, cheese or meat products [32]. Similarly, a study conducted in university dining halls found a significantly lower level of reported junk food and high-fat meat intake by students in intervention halls as compared to comparison sites; however, no effects were observed for low-fat dairy products [28]. Serving of junk food and high-fat meat products decreased by 0.1 and 0.9 servings in the intervention halls, as compared to the control halls where both products increased in sales, an increase in 1.8 serving of junk
food and 0.9 servings of high-fat meat per week, \((p = 0.01\) and \(0.001\) respectively) [28]. A study conducted in take-away restaurants found no significant effects of an information-based cue on sales for the total number of healthier items sold [27]. Two studies which reported significant effects on selection of healthier items were vending machine studies, the presence of nature posters, activity posters and posters with Giacometti sculptures (slim, elongated figures) resulted in significantly greater selection of healthier snacks as compared to when no poster or a fun fair poster was present [35]. The first study showed the percentage of healthy snacks selected was 34% with the nature poster, 28% with the activity poster and 18% with the fun fair poster as compared to 22% with the control condition. The following study reported 58% of healthy snacks were selected when posters with Giacometti figures were present as compared to 21% in the control condition [35].

**Alcohol**

One study investigated the effects of information-based cues on alcohol. This study showed sales varied between the individual bars and corresponded to bar busyness. The study found a significant increase in sales of alcohol when music was played which contained references to alcohol as compared to music which did not refer to alcohol, this was observed in all three bars within the study \((F = 11.05, P < 0.05)\) [34].

**Discussion**

**Principal findings**

The review does not permit firm conclusions to be made for the use of information-based cues at the point of choice to change selection and consumption of food, alcohol or tobacco products, nor to reliably estimate the likely effect sizes of these interventions. The reported results, however, clearly indicate the potential beneficial effect that these interventions have, with ten out of the 13 included interventions reporting significant intervention effects for some or all targeted products. Interventions were typically successful in increasing selection of fruit and vegetables; although studies aiming to increase the selection of other healthier products and decrease selection of unhealthy products provide more mixed results. Importantly, we identified a significant gap in the literature concerning these interventions; no included studies targeted tobacco products, and only one targeted alcohol products. In characterising the evidence base, the types of information-based cues employed, as well as the intervention designs and outcomes were highly variable across studies. Furthermore, suboptimal conduct and reporting of the included studies raises concerns over risk of bias within individual studies and the quality of the overall evidence.

**Interpretation of findings**

The interventions identified within this review fall within a broader set of physical micro-environment interventions which aim to change the proximal environment to change behaviour, and which have been described in the TIPPME intervention typology [7]. More specifically we focused on interventions classed as ‘information’ within that typology, being those that comprise cues containing any combination of words, symbols, numbers or pictures that convey information about a product or its use [7]. Despite this broad classification, the information-based cues in this review varied considerably. In order to better characterise this evidence base, with a more descriptive level of detail we have therefore, attempted to further categorise these interventions into i) Attention cues, ii) Educational cues and iii) Implicit cues. Six of the interventions are categorised as ‘Attention’ cues, where the cues attempted to draw the consumer’s attention to the target products [25, 26, 29–31, 36]. Four studies are categorised as ‘Educational cues’, in that they focused on providing educational information about the products, in this case these studies promoted products as the healthier option [27, 28, 32, 33]. Three studies are categorised as ‘Implicit cues’, acting as primes to drive selection of the product [34, 35]. In these interventions, the link between the cue and the target product is not made explicit to the potential consumer.
| Author, reference and country | Design setting | Study setting | Product and cue category | Information-based cue intervention | Comparison | Duration | Outcome measures | Results |
|-------------------------------|----------------|--------------|--------------------------|-----------------------------------|------------|----------|------------------|---------|
| Achabal 1987 [25] USA         | Randomised controlled trial | Supermarket | Fruit and vegetables | Colour signs | Pictures of produce (broccoli, cabbage, carrots, cauliflower, kiwi, tomatoes), plus purchase selection information | No signs in store | 4 weeks (plus 4 weeks pre-test, and 4 weeks post-test) | Weekly sales data | No variation in sales were observed by the presence of the sign, with no significant effect of the sign (F = 0.684, p = < 0.505). Additional analysis comparing matched store data, found no differences in the number of times the sales were greater in the intervention stores than the control stores. |
| Payne 2015 [29] USA           | Pilot study | Supermarket | Fruit and vegetables | Brightly coloured placards | Graphics of popular fruit and vegetables, plus positive and social norm messages | No intervention | 14 days (plus 57 days matched pre-intervention period) | Weekly sales data | There was an increase in average spending per day per person on produce of 16% (< 0.01) in the intervention store and an increase of 4% (p = n.s.) in the control store. |
| Payne 2016 [30] USA           | Pilot study | Supermarket | Fruit and vegetables | Large green arrows | Green arrows included graphics of fruits and vegetables, an emotion to facilitate social approval and text such as “follow green arrow for health” | No intervention | 14 days (plus 14 days pre-intervention period) | Weekly sales data | There was an increase in produce spending per day per person of 8% (p = 0.01). The authors do not state change in spending in the control store. |
| Hanks 2016 [26] USA           | Randomised controlled trial | School cafeterias | Fruit and vegetables | Brightly coloured vinyl banners and/or TV segments | Branded media vegetable characters with human characteristics and super human strength. | No Intervention | 4 weeks (plus 2 weeks pre-intervention) | Food preparation records and count data of children serving themselves | There was an increase from 60 to 185 daily vegetable servings in the schools with the combined vinyl banner and TV segments intervention. There was a reported increase in servings for the individual intervention arms, but data were |
Table 1 Results of the included interventions (Continued)

| Author, reference and country | Design setting | Study setting | Product and cue category | Information-based cue intervention | Comparison | Duration | Outcome measures | Results |
|------------------------------|----------------|---------------|--------------------------|-----------------------------------|------------|----------|-----------------|---------|
| Morizet 2012 [36] France     | Experimental design (randomised by temporal order and condition) School cafeterias Fruit and vegetables | A white paper easel with text information | A basic label, “new carrot/broccoli recipe” and a model label: “new carrot/broccoli recipe, special mix for superheroes” | Labels were presented at the front of the gastronorm tray where vegetables were located. | No label | Two different days (one per vegetable option) | Choice frequency of vegetables | Children selected the familiar carrot or broccoli dish significantly more often when no label was present. For the carrot dish there was a significant difference in the number of children who selected the novel dish with the basic label (p = 0.012), and the model label (p = 0.002) as compared to no label condition. The patterns were similar for broccoli, but not statistically significant. |
| Folta 2006 [31] USA          | Randomised controlled trial School cafeterias Fruit and vegetables Audio announcement | Messages promoted beans and featured a magical superhero “bean man” | Audio messages were played during the school morning announcements | The same bean dishes were introduced to the school lunch menus. The children received their normal morning announcements, without the | Approximately 3 months | Choice of beans | Overall data showed no difference in frequency of bean selection between intervention and control schools. | +/- |

Count data showed a significant increase in frequency of children taking vegetables from the salad bar; 12.6% to 24% with vinyl banners, 10.2% to 34.6% with vinyl banners and TV segments. There was no significant change with just the TV segments (13.8% to 18.9%) or in the control schools.
Table 1 Results of the included interventions (Continued)

| Author, reference and country | Design | Study setting | Product and cue category | Information-based cue intervention | Comparison | Duration | Outcome measures | Results |
|------------------------------|--------|---------------|--------------------------|-----------------------------------|------------|----------|-------------------|---------|
| Steenhuis 2004 [32] Netherlands | Randomised pre-test post-test experimental design | Worksite cafeterias | Low fat options | Signs (plus brochures, table tents and optional self-help manuals, newsletters and badges (the additional factors were considered as part of the educational programme)). The signs consisted of the program logo, the name of the food item, and an indication that it was a healthy choice. | No intervention Additional arms: Educational programme, Food supply plus education. | One month (with the option to extend to six months) | Sales proportion of low-fat products per product group A self-administered food frequency questionnaire to measure fat, fruit and vegetable intake. | At one and six months there were no significant changes in reported fat, fruit or vegetable consumption. Sales data showed a significant increase in the proportion of low fat desserts sold in the intervention sites as compared to control sites. No other differences in sales were observed. +/- |
| Vyth 2011 [33] Netherlands | Cluster randomised controlled trial | Worksite cafeterias | Low fat options plus fruit | Placards with a logo. Menus explaining the logo were available. The logo consisted of a tick, indicating a healthy choice. The logo was part of "The choices intervention" which assigns its logo to foods which meet a determined sodium, added sugar, saturated fat, trans fats, fibre and energy. | No labelling or any other communication regarding the intervention | 3 weeks (plus 3 weeks pre and 3 weeks post intervention periods) | Daily sales data | There was a significant difference in fruit sales between the intervention and control sites during the intervention period. No other differences in sales of targeted products were observed. +/- |
| Carter et al. BMC Public Health (2018) 18:418 | Cluster randomised controlled trial with | University dining halls | Low fat options | Placards, posters and table tents Colourful photographs, and messages Placards were placed at food stations and on dining tables. | No intervention | 4 weeks (plus 7 days pre and post intervention) | Harvard food frequency questionnaire data | Students in the control halls consumed significantly | +/- |
| Author, reference and country | Design | Study setting | Product and cue category | Information-based cue intervention | Comparison | Duration | Outcome measures | Results |
|--------------------------------|--------|---------------|--------------------------|-----------------------------------|------------|---------|----------------|--------|
| Lee-Kwan 2015 [27] USA        | Quasi-experimental study | Carryout restaurants | Healthy entrees, sides and beverages | Menu boards and posters Paper menus were also available, which were replicates of the menu boards | Digital colour photographs of selected healthier options plus a green leaf logo to indicate the healthier options | No intervention | 8 weeks (plus 4 week pre-intervention, and a further 16 week intervention of additional interventions) | Weekly sales data | In the intervention group the relative odds of healthy entrees were greater during the intervention period to baseline (OR 1.16, 95%CI: 1.08: 1.26). The changes were not significantly different to control sites. The relative odds of healthy sides and beverages was not significantly different over time in the intervention group. There were no significant differences in units sold from baseline in the intervention group or compared to control. |
| Stockli 2016 [35] Switzerland | One-factorial within subjects experimental design study | Vending machines in University and Public Health office buildings | Posters | Study 1: A nature poster, (showing grassland, trees and a blue sky with clouds) and an activity poster (showing running legs in sports shoes and asphalt in the background) | Posters were placed above vending machines | No posters | 4 weeks | Daily sales data | There was a significant association between poster exposure and snack choice in both studies. Study 1: The percentage of healthy snacks selected was, |

Table 1: Results of the included interventions (Continued)

Repeated cross sectional assessment

Information-based cue intervention

- “brain food”
- Posters were placed around the dining halls.
- More junk food and high fat meat products from baseline to intervention relative to students in the intervention halls. No other differences were observed.
| Author, reference and country | Design Study setting | Product category | Information-based cue intervention | Comparison | Duration | Outcome measures | Results | Result |
|------------------------------|----------------------|-----------------|-----------------------------------|------------|----------|-----------------|--------|--------|
| Engles 2011 [34] Netherlands | Experimental design study (evenings were randomised between arms) | Bars Alcohol Audio: Musical playlists | A playlist of 90 songs (with a 5.5 h duration) with contextual references to alcohol. Songs contained lyrics that referred to alcohol in them, for example “red, red, wine”. | The music was played on a fixed day of the week, at a fixed starting time and were played in a random order by the bartenders. | A playlist of songs created by the same artists included in the intervention playlist, but the songs did not refer to alcohol. To ensure a good match, attention was played to timeframe and period of the album, tempo and energetic content of the songs. | The three included bars collected data on 18, (bar A) 12, (bar B) and 16 evenings (bar C). | Sales of alcoholic drinks corresponding to the two hours the music was played | Turnover was significantly higher on nights when music had reference to alcohol played compared to nights when the control playlist was played (\(p \leq 0.05\)) | + |

Reported significant increase in healthier items (including fruit and vegetables) or decrease in unhealthier items for primary data. +/− Mixed results for reported increase in healthier items (including fruit and vegetables) or decrease in unhealthier items for primary data. − No evidence of effect on increasing healthier items (including fruit and vegetables) or decreasing unhealthier items for primary data.
to the intervention for the entire time they were in the supermarket. In addition, children in the study conducted by Hanks et al. [26] were exposed to the vegetable characters for the entire time they were queuing for their lunch. These studies may have provided greater exposure to the intervention as compared to other studies included in the review. Indeed, Achabal et al. suggest a potential explanation for no observable intervention effect in their study may have been because shoppers missed the signs due to their positioning [25].

**Implication of findings in relation to previous research**

The majority of previous reviews that focus on environmental interventions within physical micro-environment have solely examined dietary interventions. This review is novel in examining the effect of information-based cues on food, alcohol and tobacco products. As such, it was able to identify a clear gap in the evidence regarding both alcohol and tobacco products. Only one study concerning alcohol was included, and we did not identify any studies which attempted to change selection or consumption of tobacco products.

Our results are consistent with previous related reviews on nutritional environmental interventions. A review of workplace interventions found more than half (59%) of included studies reported significant effects on behaviour to increase fruit and vegetable intake, increase selection of healthier options and reduce calorie intake [40]. A review of obesity related interventions in grocery stores and supermarkets found they were generally effective in stimulating purchasing and consumption of healthier foods [41]. Within both reviews, the majority of included interventions contained multiple components which the authors acknowledged precluded isolating the independent impact of included intervention components. We purposefully restricted our review to interventions comprising only information-based cues to avoid this problem.

In line with previous reviews, interventions within supermarkets [41] and vending machines [42, 43] appeared to be effective in influencing food selection. In relation to supermarkets, two of the three included studies observed significant increase in sales of fruit and vegetables [29, 30]. It has been proposed that supermarkets are effective locations for environmental interventions as people make a large percentage of unplanned purchases in store [44]. This would likely similarly apply to vending machines which are designed to cater to convenient, small scale purchasing.

**Strengths and limitations**

This review is, to our knowledge novel in its focus, and describes a body of evidence that had not previously been synthesised. While intervention characteristics varied across included studies, precluding quantitative synthesis, we have both described studies in detail and attempted to further
categorise interventions to enhance understanding of the existing evidence. Importantly, the review was conducted in line with the Cochrane Handbook for Systematic Reviews [20] and the PRISMA guidelines [19]. We developed an inclusive search strategy, encompassing multiple databases to capture as many relevant articles as possible, although we cannot exclude the possibility that some eligible articles were missed. The current review is limited by the suboptimal reporting of methods and outcome data of included studies, making evidence synthesis difficult, and disallowing firm conclusions about probable effects of these interventions. Future primary research studies would benefit from adhering to available guidelines for reporting standards [45, 46].

Conclusion

Existing evidence suggests information-based cues can influence selection and consumption of food and alcohol products, although significant uncertainty remains. The current evidence base is limited both in quality and quantity, with relatively few, heterogeneous studies at unclear or high risk of bias. Additional, more rigorously conducted studies are warranted to better estimate the potential for these interventions to change selection and consumption of food, alcohol and tobacco products.

Additional files

**Additional file 1: Table S1.** Example search strategy (MEDLINE In process& other non-indexed citations and OVID MEDLINE (R) 1946 to present). (DOCX 15 kb)

**Additional file 2: Table S2.** Cochrane risk of bias summary details. (DOCX 22 kb)

Abbreviations

POC: Point of choice (POC); POP: Point of purchase; TIPPME: Typology of Interventions in Proximal Physical Micro-environments

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Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Author’s contributions

PC, TM and GJH developed the protocol for the review, PC and GB conducted the review. PC drafted the initial draft of the manuscript, TM, GJH and GB significantly contributed to amending and drafting the final version. All authors read and approved the final version of the manuscript.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

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References

1. World Health Organization. The top 10 causes of death. Factsheet N:310. http://www.who.int/mediacentre/factsheets/fs310/en/. Updated 2014. Accessed 5 Oct 2016.
2. World Health Organization. Global status report of noncommunicable diseases 2014. http://www.who.int/nmh/publications/nccd-status-report-2014/en/. Updated 2014. Accessed 5 Oct 2016.
3. Cohen DB, Babey SH. Contextual influences on eating behaviours: heuristic processing and dietary choices. Obes Rev. 2012;13(9):768–79.
4. Hollands GJ, Marteau TM, Fletcher PC. Non-conscious processes in changing health-related behaviour: a conceptual analysis and framework. Health Psychol. 2016;10(4):381–94.
5. Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: the importance of targeting automatic processes. Science. 2012;337(6101):1492–5. https://doi.org/10.1126/science.1226918.
6. Hollands GJ, Shemilt I, Marteau TM, et al. Altering micro-environments to change population health behaviour: towards an evidence base for choice architecture interventions. BMC Public Health. 2013;13(1):1–6.
7. Hollands GJ, Bignardi G, Johnston M, et al. The TIPPME intervention typology for changing environments to change behaviour. Nature Human Behaviour. 2017;1(8):0140. https://doi.org/10.1038/s41562-017-0140.
8. Glanz K, Yaroch AL. Strategies for increasing fruit and vegetable intake in grocery stores and communities: policy, pricing, and environmental change. Prev Med. 2004;39(Supplement 2):77–80.
9. Mathieu J. Dietetics professionals can use supermarkets to educate consumers. J Am Diet Assoc. 2000;100(7):809.
10. The European Parliament and the Council of the European Union. Labelling of foodstuffs. Summary of: Regulation (EU) no 1169/2011 - food information to consumers. https://eur-lex.europa.eu/legal-content/en ALL/?uri=CELEX%3A32011R1169. Updated 2015. Accessed 5 Sept 2016.
11. Department of Health. Public health responsibility deal. A1. alcohol labelling: Ambition. http://webarchive.nationalarchives.gov.uk/201802021180930/https://responsibilitydeal.dh.gov.uk/a1-factsheet/. Updated 2015. Accessed 14 Sept 2016.
12. Cecchini M, Warin L. Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. Obes Rev. 2016;17(3):201–10.
13. Crockett RA, King SE, Marteau TM, Prevost AT, Bignardi G, Roberts NW, Stubbs B, Hollands GJ, Jebb S.Autritional labelling for healthier food or non-alcoholic drink purchasing and consumption. Cochrane Database Syst Rev. 2018;(Issue 2): Art. No: CD009315. DOI: https://doi.org/10.1002/14651858.CD009315.pub2.
14. Heike S, Harris JL. Nutrition information and front-of-pack labelling: issues in effectiveness. Public Health Nutr. 2016;19(12):2135–5.
15. Kerr MA, McCann MT, Livingstone MB. Food and the consumer: could labelling be the answer? Proc Nutr Soc. 2015;74(2):158–63.
16. Christoph MJ, Ellison B. Correlates of nutrition label use among college students and young adult’s review. Public Health Nutr. 2015;19(12):2135–48.
