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Science & Technology in childhood Obesity Policy



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Abbreviation	Definition
BI	Behavioural insights
BMI	Body mass index
CBA	Controlled before-after
MSSB	Meals, snacks, sides and beverages
Non-RCT	Non-randomised controlled trial
PICO	Population, intervention, comparison and outcome
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
PROSPERO	Prospective register of systematic reviews
RCT	Randomised controlled trial
SES	Socioeconomic status

Abstract

Background: Childhood overweight and obesity has increased by 47% since 1980. A primary driver of obesity is the energy imbalance caused by poor diets consisting of more energy-dense foods and less fruits and vegetables. Interventions utilising behavioural science have shown promise in improving children's diet-related outcomes. **Aim:** The aims of this review are twofold 1) to assess the effectiveness of interventions using behavioural insights to improve children's diet-related outcomes and 2) to assess the health-equity implications of these interventions. **Methods:** A comprehensive search strategy retrieved 5,671 unique articles, from which, 277 were eligible for full-text screening. **Results:** In total, 138 unique interventions were included from 109 articles. Evidence of intervention effectiveness was mixed, with 74% of interventions demonstrating a statistically significant effect on at least one diet-related outcome. However, there was limited evidence available of differential effects of interventions, the sustainability of intervention effects or impact on BMI outcomes. **Discussion:** Definitive conclusions about intervention effectiveness are limited given the over-reliance on studies with a high risk of bias and the lack of evidence of intervention sustainability. For policy makers, the lack of evidence on the sustained effectiveness, costs of implementation, impact on children's weight status and health equity implications severely limit the policy implications of the current evidence on interventions using behavioural insights.



1 Background

Childhood overweight and obesity has increased by 47% since 1980 (1). Childhood obesity has long-term consequences on health, social and economic outcomes (2). For example, obesity is directly linked with a number of childhood morbidities including gastrointestinal, orthopaedic complications and early onset of cardiovascular disease and type-2 diabetes (3). Obesity affects children's psychosocial well-being and self-esteem, increasing their susceptibility to a reduced quality of life (4, 5). Childhood obesity is also an independent risk factor for adult obesity and its related complications (6, 7).

A primary driver of obesity is an energy imbalance often caused by poor diets that consist of too much energy-dense foods and too little fruits and vegetables (8). Many children live in an obesogenic environment, in which, consumption of energy-dense foods is encouraged through increased availability, affordability and promotion. To combat the obesogenic environment, multiple policy levers are required to improve children's environments and address the global problem of childhood obesity (8). In addition to traditional public health policy approaches (8), advances in behavioural science have informed interventions aiming to improve children's diets (9-12). The term behavioural insights (BI) is a broad term that encompasses different elements of behavioural science in a policy context (13), which will be used throughout this review. Interventions using BI draw on a range of theories, including Kahneman's Dual Process Theory (14) and Thaler's and Sunstein's Nudge Theory (15), which are largely premised upon the idea that individuals often do not make decisions in their best interests. Rather, individuals' decisions are influenced by contextual elements and cognitive biases. Thus, interventions using BI change elements of the social and physical environment to influence these biases and ultimately change an individual's decision without actively restricting their options. It is this latter component that differentiates BI interventions from more traditional interventions as the focus is on influencing choices rather than restricting them, which has led to BI interventions being defined as a form of 'libertarian paternalism' (15).

Evidence of the health equity implications of BI interventions is still emerging. Dolan, Hallsworth (16) argue BI interventions may promote health equity as they can influence behaviour without necessarily changing people's preferences or attitudes. For example, the application of BI to US pension plans saw greater uptake from employees of lower socio-economic status (SES) (17). However, there is still limited analysis of the health equity implications of BI interventions for diet-related outcomes, particularly for children. Given that obesity is socially patterned (8), the health equity implications of BI interventions is a major concern.

The objectives of this systematic review are two-fold: firstly, to examine the effectiveness of BI interventions at improving children's diet-related outcomes, and secondly, to assess the health equity



implications of BI interventions, giving attention to differences by SES, age, ethnicity, sex and BMI (body mass index).

The current review addresses the use of behavioural insights to improve diet. We had planned to cover interventions aimed at creating demand for health in two areas: (1) behavioural insights and (2) social marketing. However, while compiling the search strategy for this review it became obvious that both concepts could not be included within a single review. As other work is currently under way in WP5 on social marketing campaigns, we have given priority to assessing the role of behavioural insights in this systematic review, which ensures a more efficient use of the available time and resources. However, a review on social marketing interventions is also underway and will form part of a STOP publication further down the line.

2 Methods

We followed the PICO framework (population, intervention, comparison and outcome) to formulate our search strategy, as shown in Table 1. The search strategy was designed in consultation with a specialist subject (health) librarian from Imperial College London and members of the British Cabinet Office's Behavioural Insights Team. We searched for relevant articles published in scholarly journals from January 1994 until January 2019 through keyword searches on EMBASE, MEDLINE, CENTRAL, PsycINFO SCOPUS, and Global Health (the full search strategy for each database is available in Supplementary Material 1). The search strategy was refined by conducting a sensitivity analysis in EMBASE with a test set of 20 key papers selected from existing systematic reviews. Adjustments to the search strategy concluded once 90% of the key papers were identified. In addition to database searches, we included all references from 10 relevant systematic reviews (9, 11, 12, 18-24). The protocol was registered with Prospective Register of Systematic Reviews (PROSPERO, http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42019123065) in January 2019. Abstract and title screening were conducted using the reference managing software, *Rayyan*. A second reviewer conducted a reliability check on 500 abstracts, of which, there were only two conflicts that were unresolved after discussion and were subsequently included for full-text review.

Table 1: PICO table

PICO feature	Criteria
Population	Children <18 years of age. Excluded studies include those designed for children with a critical illness or severe co-morbidities (e.g. Diabetes) or special populations (e.g. blind, physically disabled).
Intervention(s)	Interventions using BI to improve children's diet-related outcomes. Interventions will be categorised using Bauer and Reisch's framework which classifies interventions into one of five categories; 1) provision of information; 2) use of salience and social norms; 3) changes in the default; 4) changes to the physical environment; and 5) incentives and pre-planning.
Comparison(s)	Comparators may include no intervention or a pre/post comparison of the same group.
Outcomes	Limit to studies focused on behaviour change to improve diet-related outcomes. Primary outcomes: changes in food or beverage selection or consumption. Secondary outcomes: Cost of intervention, cost for participation, food waste. Excluded outcomes: Changes in awareness, knowledge or beliefs, hypothetical food choices. Adverse outcomes: Detrimental effects on primary outcomes, cost to participants (financial or time), health inequity.

The main analysis is conducted at the intervention-level. Unique interventions were defined as different experimental conditions within an intervention or a separate intervention reported within the same article. Intervention effectiveness was defined as having one or more statistically significant finding ($p \leq 0.05$ level) that changed children's selection or consumption of food or beverages. Outcomes were classified into four categories 1) fruit and vegetables; 2) total energy intake; 3) healthy meals, snacks, sides and beverages (MSSB); and 4) unhealthy MSSB. The nutrient profile of the foods under analysis were frequently not available which forced subjective classifications. However, most foods were easily categorised since most unhealthy MSSB included candy, sugary beverages or fast food, while healthy MSSB included milk, whole meal bread or a healthier meal option. The effectiveness variable was treated as a binary variable, either 1 for significant or 0 for non-significant findings. Comparisons of effectiveness were conducted by the following: BI term used, setting, study design, BI type, health equity characteristics, consumer behaviour, follow-up length and food outcome type. Comparisons for differences were conducted using chi-squared and Fisher's exact tests ($p \leq 0.05$ significance level).



3 Results

3.1 Search strategy and study synthesis

The review was conducted and reported in adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (25). Figure 1 shows the PRISMA flow diagram outlining the study identification, screening and exclusion processes. The search strategy yielded 5,671 unique titles published between January 1994 and January 2019. In total, 5,394 were excluded after title and abstract screening, leaving 277 articles eligible for full-text screening. During full-text screening, 185 articles were excluded. An additional 17 articles were included from manual searching of the included articles ($n = 92$). The final analytic sample for the qualitative synthesis included 109 articles (See Supplementary Material 2 for a full list of included studies). From these 109 articles, there were 138 unique interventions. Over half of the included studies were retrieved from EMBASE (57%), with additional database searches of Global Health (7%), Scopus (4%), MEDLINE (2%), PsycINFO (1%) and CENTRAL (0%) collectively contributing 14% of the included studies.

3.2 BI interventions characteristics and effectiveness

The characteristics and effectiveness of the 138 unique BI interventions are displayed in Table 2. In total, 103 (74%) of interventions had a statistically significant effect on the targeted diet-related outcome. Only 25% of BI interventions included a reference to a BI term in the full-text. However, compared to studies that used BI terms, studies that did not include BI terms were no less effective ($p = 0.461$).

Education settings were the predominate setting for interventions, covering 77% of all included interventions. The remaining studies were equally spread out in different settings (six percent of studies per remaining setting, respectively). In terms of effectiveness within settings, the BI interventions in labs (100%) and primary schools (80%) showed the most consistent effectiveness compared to the food retail (25%) and home settings (57%), respectively ($p = 0.016$).

Over half of the interventions were RCTs (57%), followed by before-after studies (20%) and controlled before-after studies (CBA) (14%). Of all study designs, the before-after studies produced statistically significant results 96% of the time, compared to CBA studies and non-RCT studies that had statistically significant results only 53% and 69% of the time, respectively ($p = 0.003$).

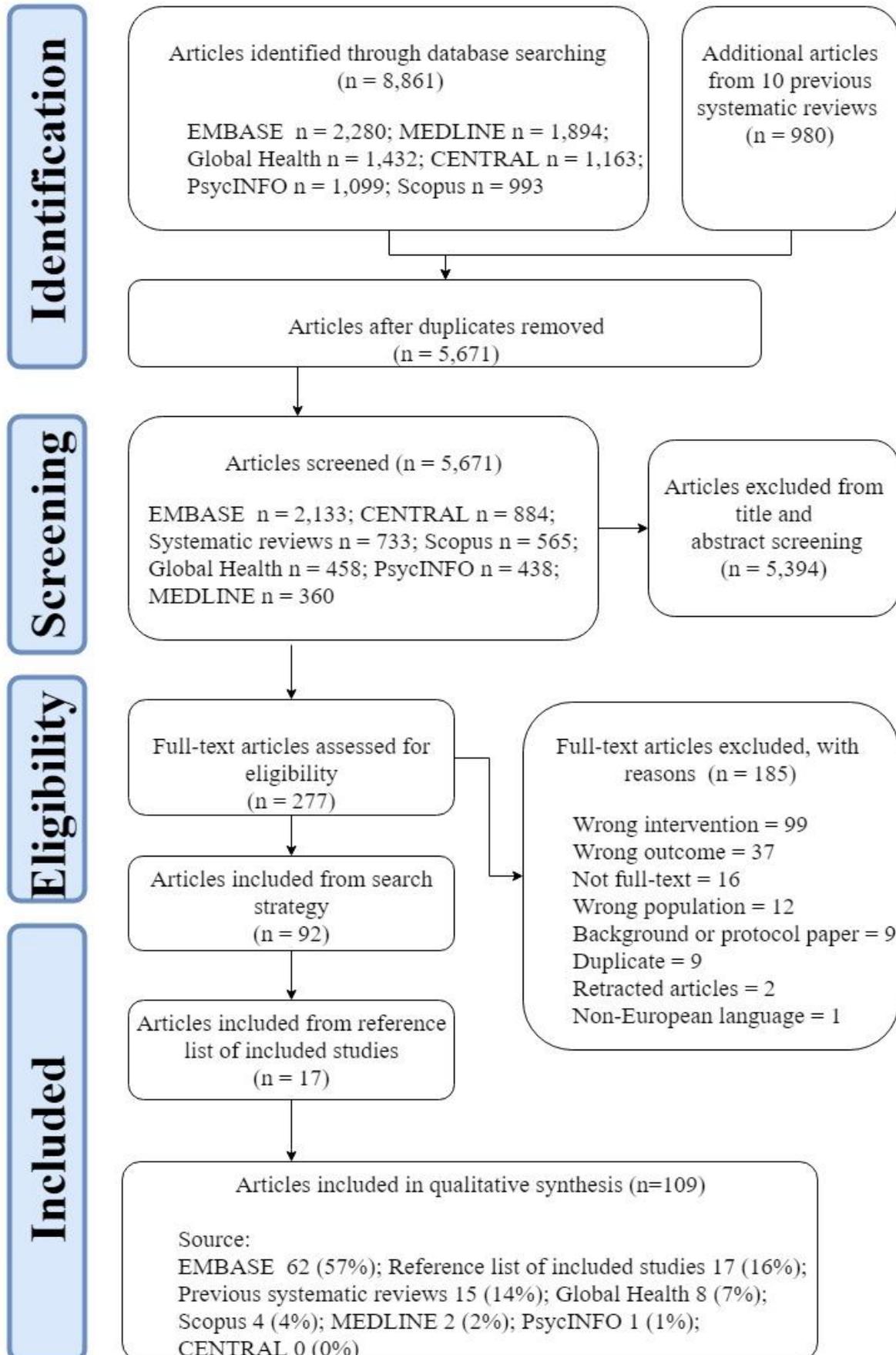


Figure 1: PRISMA flow chart



One-third of BI interventions employed multiple behavioural insights, while another third focused on changes to the physical environment. There is limited evidence of interventions manipulating default options (4%) or information provision (4%) in this context. No statistically significant differences were detected by BI type ($p = 0.120$). More interventions focused on consumption ($n=104$) rather than selection ($n=54$). However, interventions focusing on selection produced slightly more statistically significant results compared to that of the consumption interventions (78% compared to 72%, $p = 0.441$).

Just under half (46%) of the interventions tested for differential effects by one or more sociodemographic characteristics; 44 interventions investigated differences by sex, 41 by age and 32 by BMI. There were 23 examples of differential effects, with the most evidence showing slight differences by age ($n = 11$). For example, four interventions using incentives had more influence on younger children (e.g. five to nine years of age) compared to that of older children (e.g. 10+ years of age) (26-30). Likewise, interventions changing the physical environment through manipulation of portion size tended to influence children aged five to nine, but not children under five years of age (31-33).

Only four interventions showed any differential effects by SES (34-36). Two of these effects came from two different conditions in the same article. The first showed that children from high income families were 17.5% less likely to select fruit than children from low income families when required to pre-order lunchtime meals (34). Further, when pre-ordering was combined with a prompt to consume healthy foods, 46% of children from low income families changed their order to healthier options compared to only 21% of children from high income families (34). In another intervention, introducing incentives for fruit and vegetable consumption in school cafeterias was more effective in schools with more low-income children compared to schools with less low-income children (36). Finally, children's total energy intake when provided larger dishware was higher in those children from low-income families than children from high-income families (35).

Evidence of the lasting effects of BI interventions is limited. Only 21 interventions had long-term follow ups (greater than one month) and 17 interventions had short-term follow ups (less than one month) were included in this review. This limited evidence suggests a time-sensitive effect of BI interventions as only 59% of short-term and 48% of long-term interventions showed sustained effectiveness after the intervention concluded (12 of the interventions with long-term follow ups used multiple BI and eight focused on incentives, with equal rates of effectiveness (50%)).

Table 2: Characteristics and effectiveness of BI interventions

Study Characteristics		N (%)		Significant (%) ^a		P value ^b
Total		138	100	103/138	74	
behavioural insights terms^c	No	104	75	76/104	73	0.461
	Yes	34	25	27/34	79	
Setting	Primary school	81	58	65/81	80	0.016
	Early childhood	18	13	13/18	72	
	Secondary school	9	6	6/9	67	
	Food retail	8	6	2/8	25	
	Community venue	8	6	6/8	75	
	Lab	7	5	7/7	100	
	Home	7	5	4/7	57	
Study design	RCT	79	57	58/79	73	0.003
	Before-after	27	20	26/27	96	
	CBA	19	14	10/19	53	
	Non-RCT	13	9	9/13	69	
Behavioural insight	Multiple	43	31	34/43	79	0.120
	Physical environment	41	29	32/41	78	
	Salience	26	19	19/26	73	
	Incentives	18	13	13/18	72	
	Information provision	5	4	1/5	20	
	Defaults	5	4	4/5	80	
Consumer behaviour^d	Consumption	104	75	75/104	72	0.441
	Selection	54	39	42/54	78	
Health equity^d	Sex	44	32	5/44	11	0.007
	Age	41	29	11/41	27	
	BMI	32	23	1/32	3	
	SES	10	7	4/10	40	
	Ethnicity	8	6	2/8	25	
Follow up^d	Long	21	15	10/21	48	0.691
	Short	17	12	10/17	59	
Food type^d	F&V	100	72	74/100	74	0.089
	Healthy MSSB ^e	25	18	21/25	84	
	Unhealthy MSSB ^e	23	17	12/23	57	
	Total energy Intake	22	16	16/22	73	

^a Defined as a significant difference at $p \leq 0.05$ level.

^b P-value for significant differences calculated using Chi-squared or Fisher's exact tests.

^c Terms include: nudge, prospect theory, choice architecture, behavioural economics or insights and libertarian paternalism.

^d Percentages add up to more than 100% because interventions could analyse one or more of the categories.

^e MSSB = Meals, Snacks, Sides and Beverages (not including fruits or vegetables).

Interventions targeting healthy foods were more prevalent than for unhealthy foods. The most commonly reported intervention outcome was fruits and vegetables (F&V) (n=100, 72%). The other intervention outcomes included total energy intake (16% of studies reported this outcome), healthy MSSB (18%) and unhealthy MSSB (17%). There were no statistically significant differences detected in effectiveness by food type. Nonetheless, our results show that influencing children's consumer behaviour via BI interventions may be more difficult for unhealthy food (57% of studies reported significant positive findings) compared to healthier food products (74-84% significant positive



findings). This finding is reinforced when the effectiveness of interventions for healthy foods (F&V and healthy MSSB combined) are directly compared to unhealthy MSSB (76% v 57%, $p = 0.019$).

Preliminary risk of bias assessment, using the Cochrane Risk of Bias tool, suggests that the majority of studies are subject to a high risk of bias due to the large number of studies that used non-randomised methods. Studies that utilised RCT methods often lacked information regarding the randomisation process, which contributed to the high risk of bias rating.

3.3 Secondary outcomes: cost and waste

The cost-effectiveness of interventions, when reported, demonstrated that behaviour could be changed at low-cost. However, only seven of the interventions reported either their implementation costs or provided some cost effectiveness analysis (29, 36-41). All interventions were based in the USA and all, but one, occurred within school cafeterias. The budget in one BI intervention that implemented changes to school cafeterias was US\$2,000 per school (38), while another intervention cost only 3 cents per cafeteria tray but significantly increased vegetable consumption (41). Additionally, one food retail intervention actually increased profits (42), demonstrating the revenue potential of nudging consumers towards healthier products. Multiple interventions estimate the cost per additional serving of fruits and vegetables between US\$0.01 and US\$1.72 (29, 36, 37, 40).

A substantial barrier to implementing interventions is the potential waste produced when children select but do not consume the targeted products. For example, serving larger portions of fruits and vegetables led to substantial increases in consumption, but it also led to larger increases in food waste (43, 44). However, other interventions reduced waste below pre-intervention levels (36, 45, 46) when incentives were conditional on consumption instead of selection. Other examples to reduce food waste included providing smaller bowls (47) or cutlery (48).

4 Discussion

Overall, this systematic review included 109 articles, spanning 138 unique interventions. Just under three-quarters of included interventions demonstrated at least one statistically significant effect on children's diet-related outcomes. Findings show that even small changes in children's physical and social environment can significantly influence their food choices. However, limitations related to risk of bias, lack of follow-up measures and health equity leave many questions about the efficacy of these interventions.

Expectedly, most of the interventions in this review took place within educational settings. This makes sense as schools provide greater accessibility to large numbers of children and control over some environmental conditions that reduce potential sources of confounding. However, the overemphasis on school settings has left a sizable gap in the literature, particularly in the home and



food retail environments, which are settings where a substantial amount of children's food choices are made and calories consumed (49, 50).

Interventions using a before-after study design consistently reported statistically significant findings relative to the RCTs and CBA study findings. However, before-after studies tend to overestimate intervention effects due to the uncontrolled biases inherent in such designs (51). In contrast, the findings in highly controlled lab-based RCTs (n=7) may not translate into real-life settings (18). As such, the study design seems to have a significant role in the efficacy of BI interventions and should be considered when examining the evidence base overall.

More interventions used multiple BI or focused solely on changing the physical environment than information provision or changing defaults. The favouring of changes to the physical environment and use of social norms/salience is partly due to the low implementation costs. The lack of evidence of information provision interventions may be due to existing evidence with adults showing these types of interventions have limited effect (18). While few studies directly examined the impact of defaults alone, defaults were often part of the interventions that employed multiple BI. Therefore, the efficacy of defaults is an aspect of BI interventions that deserve further investigation, especially given their low cost of implementation.

There is limited evidence of differential effects of BI interventions by sociodemographic characteristics. Only ten interventions investigated differences by SES, which is concerning given the wide-spread patterning of childhood obesity by SES (8). Further, the lack of analysis of SES differences limits the policy relevance of BI interventions as SES-related health equity is a key consideration for policy makers (52). Sex and age were most commonly tested for differential effects, as these characteristics are typically readily available during data collection. Even when differences were tested for, many interventions showed no differential effects between sociodemographic characteristics, though these interventions may have lacked the power to detect significant differences within subgroups. While some researchers advocate the equity potential of BI interventions (16, 17), this review makes clear more evidence is needed to determine the health equity implications of these interventions, particularly for policy makers.

A small proportion of interventions included a follow up period, which highlights a major limitation in the literature. Only 12% and 15% of interventions had a follow up of less or greater than one month, respectively; of these studies, only about half showed a statistically significant effect on the diet-related behaviour. Consequently, more evidence of the long-term effects of these interventions is required to make conclusions about their sustainability for policy makers. However, within the limited follow-up evidence, there was no evidence of adverse 'crowding out effect' whereby children's behaviour declines past baseline levels once incentives for behaviour change are removed (29, 36, 53).



The lack of follow-up and short duration of the interventions also makes examination of BMI-related outcomes difficult, hence the emphasis on diet within this current review. While changing children's consumption of fruits and vegetables is likely to improve children's diet and nutrition, it does not necessarily simply translate to improved BMI-related outcomes. First, individuals can compensate for an increase in a healthy behaviour by increasing a less healthy behaviour (54). For example, increasing fruit and vegetable consumption may also be associated with consumption of less healthy foods at other times as individuals feel justified due to their commitment to the new healthier behaviour. Second, increasing fruit and vegetable consumption is not directly linked with less overall caloric intake (55). Thus, the lack of BMI-related outcomes severely limits the policy relevance of the current evidence for policy makers.

Fruits and vegetables were the most common outcome under investigation. When fruits and vegetables and healthy MSSB outcomes were combined and compared against unhealthy MSSB, we found that interventions targeting healthier options were more effective than unhealthy options. This result contrasts to a previous systematic review, which included adult populations, that showed reducing unhealthy eating was easier than increasing healthier eating (18). However, children often struggle to evaluate the long-term health consequences of their decisions against short-term rewards (56). Therefore, it is less surprising that children may not be able to appropriately weigh up the short-term reward of eating tasty unhealthy foods against the intangible reward of long-term health, particularly when the consequences of a poor diet are slow to develop.

There were a number of methodological strengths of this review. Firstly, the search strategy was designed by conducting a sensitivity analysis that ensured target papers were identified. A sensitivity analysis is particularly pertinent given the majority of papers contained no reference to BI terms, which means previous reviews creating search concepts using single phrases such as 'behavioural economics' may be inadequate. Secondly, a second reviewer ensured that the inclusion and exclusion criteria were being applied consistently during the title and abstract screening process. Thirdly, this review included search strategies for six databases and 10 systematic reviews as well as backward searching of included studies.

While this review provides a comprehensive examination of BI interventions targeting children's diet-related outcomes, it is not without limitations. First, our categorisation of intervention effects into a binary variable, either significant or non-significant finding, is crude. Categorising an intervention as significant when it contained multiple non-significant findings may overstate the effectiveness of such interventions. Further, without accounting for the effect size of the interventions we do not obtain an accurate picture of the true effectiveness of the interventions. Second, our review excluded all multi-component studies that included a non-BI aspect, such as an education curriculum, which led to the exclusion of many studies that used BI to inform their interventions. Considering that obesity is a pervasive problem, it is likely that effective obesity prevention programmes must include



multiple policy approaches and that interventions using BI alone are insufficient to make substantial changes in childhood obesity. However, the results of this review highlight aspects of BI that may be more effective to inform future interventions and may be applicable to more traditional policy approaches, e.g. regulating food availability.

Future research on BI interventions should focus on providing evidence of the sustained effectiveness. Interventions with long-term follow-ups as well as interventions of different lengths are required to produce robust evidence on how to induce and sustain behavioural change. Second, there is an urgent need for evidence of the health equity implications of BI interventions, particularly for SES and ethnicity. Future studies should attempt to obtain sufficient power to test for differential effects of their interventions by sociodemographic characteristics. Third, there is currently an over-emphasis on interventions in education settings, thus additional studies in food retail and home settings would provide a substantial contribution to the existing evidence. Fourth, there is a need for additional interventions utilising a non-lab based RCT study design to overcome the reliance on studies with a high risk of bias, such as before-after studies, that may misrepresent the effectiveness of these interventions.

This review highlights areas where BI may be useful for developing and implementing obesity-related policy. Importantly, this review has reinforced previous findings suggesting that information provision alone is insufficient for changing behaviour. It is clear more effective BI, such as changing defaults or the physical environment, are required to induce and sustain behaviour change. The large numbers of studies in the school environment with significant findings, coupled with governments' ability to regulate most school settings, suggest that this is a setting where government can most easily affect behaviour change. Secondary findings in this review demonstrate that such interventions can be implemented at very low cost and can increase efficiencies by decreasing food waste. However, in sum, the current evidence does not provide strong evidence for policy makers as there is a lack of evidence of sustained effectiveness, impact on BMI-related outcomes or implications for health equity. Additionally, only seven interventions reported either their implementation costs or a cost effectiveness analysis which highlights a major barrier to effectively summarising the policy relevance of BI interventions.

5 Conclusion

Overall, there is evidence that BI interventions can influence children's diet-related outcomes. However, definitive conclusions are limited given the reliance on before-after studies, interventions with no follow-up and over-representation of interventions in education settings. Future studies should investigate the impact of interventions using more comprehensive study designs in a range of settings. Further, these studies should focus on the health equity implications of such interventions, have long follow-up periods to allow for investigation of sustained effects and include



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an obesity-related outcome. The lack of evidence on the sustained effectiveness, impact on children's weight status, implementation costs and implications for health equity of BI interventions severely limits the policy implications of the current evidence.

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7 Supplementary Material 1: Search Strategy

PICO Table

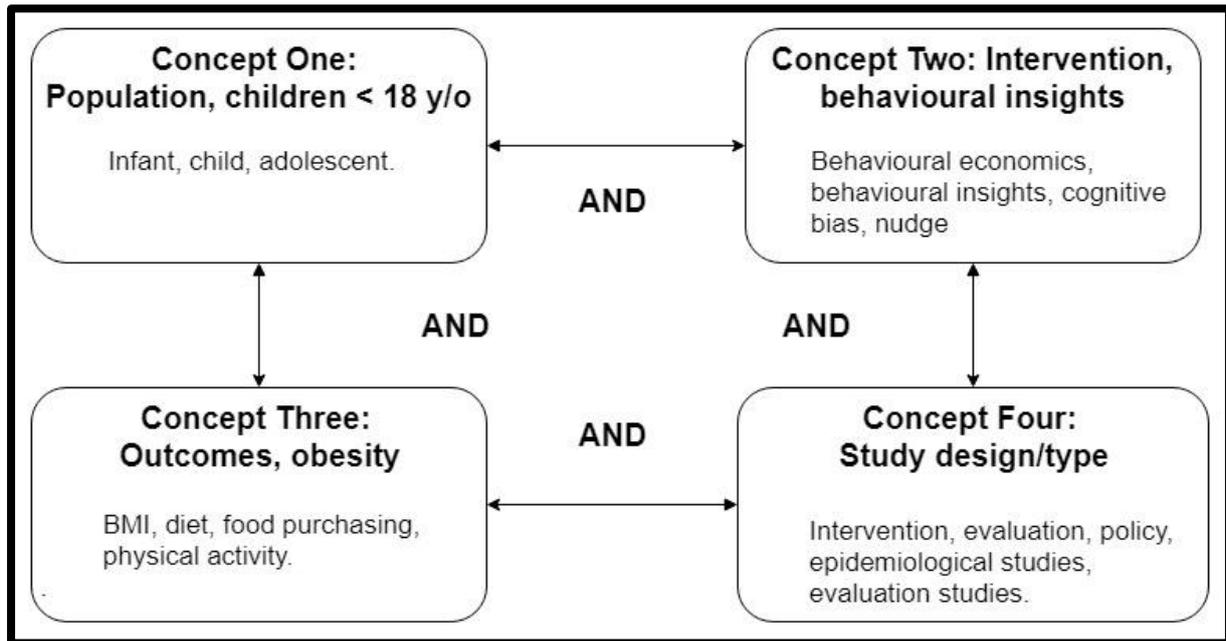
PICO feature	Criteria
Population	Children <18 years of age. Excluded studies include those designed for children with a critical illness or severe co-morbidities (e.g. Diabetes) or special populations (e.g. blind, physically disabled).
Intervention(s)	Interventions using BI to improve children's diet-related outcomes. Interventions will be categorised using Bauer and Reisch's framework which classifies interventions into one of five categories; 1) provision of information; 2) use of salience and social norms; 3) changes in the default; 4) changes to the physical environment; and 5) incentives and pre-planning.
Comparison(s)	Comparators may include no intervention or a pre/post comparison of the same group.
Outcomes	Limit to studies focused on behaviour change to improve diet-related outcomes. Primary outcomes: changes in food or beverage selection or consumption. Secondary outcomes: Cost of intervention, cost for participation. Excluded outcomes: Changes in awareness, knowledge or beliefs, hypothetical food choices. Adverse outcomes: Detrimental effects on primary outcomes, cost to participants (financial or time), health inequity.

Research Questions

What are the effects of interventions using behavioural insights [**intervention**] on children's [**population**] diet-related outcomes [**outcomes**]?

What are the health equity implications of interventions using behavioural insights, giving attention to differences in effectiveness by SES, age, ethnicity, sex and BMI?

Search Strategy Conceptual Model



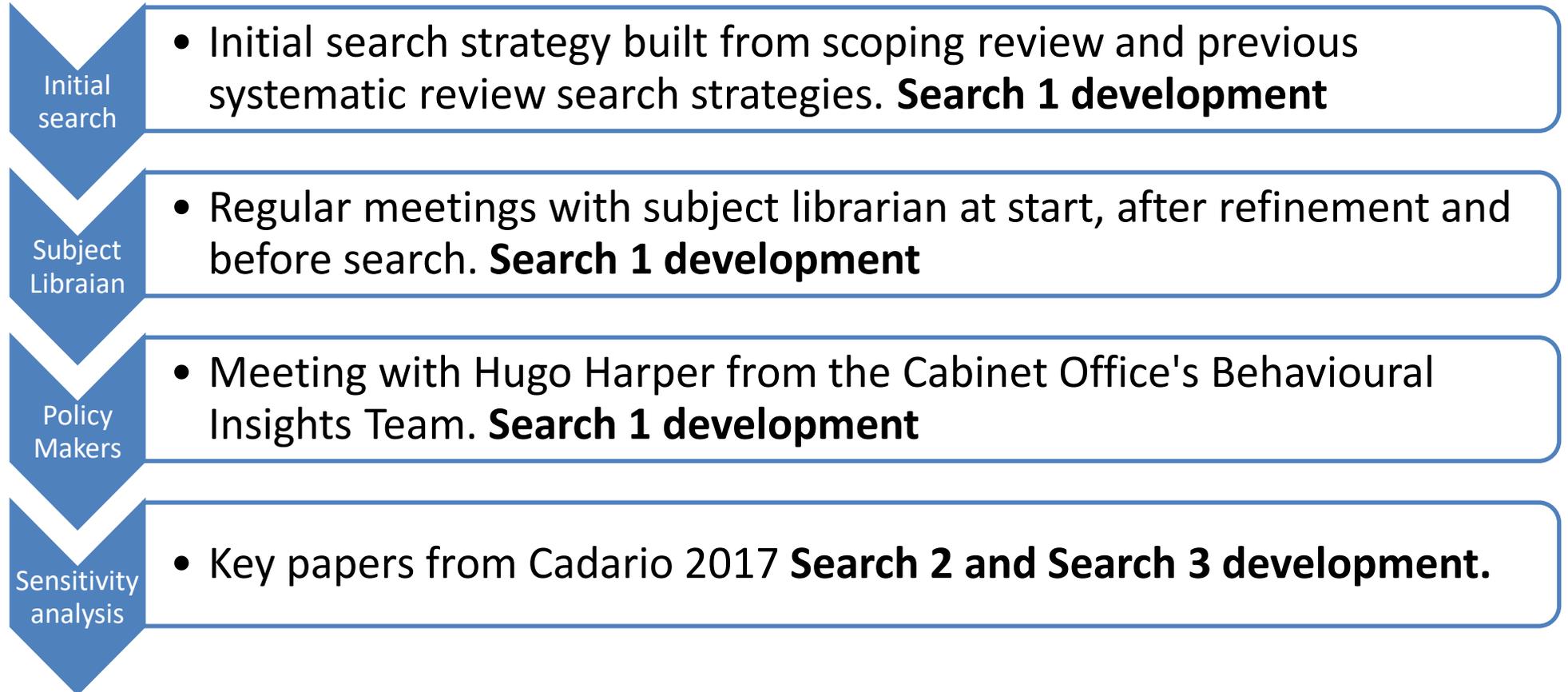
Record Retrieval Overview

Records received from each data and final number of records to undergo abstract and title screening

Data source	Total titles before duplicates	Total titles after duplicates removed*
EMBASE (Ovid)	2,280	2,280
MEDLINE (Ovid)	1,894	360
Global Health (Ovid)	1,432	458
CENTRAL	1,163	884
PsycINFO (Ovid)	1,099	438
SCOPUS	993	565
Systematic reviews	980	773
Total	9,841	5,671



Search Strategy Design Process





Search strategy progressions in EMBASE

Search number (EMBASE)	Records retrieved	Proportion of key papers retrieved	Proportion of key SRs retrieved	Changes to search strategy
Search 1	1,810	6/20	5/5	Initial search based on previous systematic reviews and scoping
Search 2	2,594	10/20	5/5	Addition of search “((consumption or meal) and (portion or Serving))”.mp based on common terms in missing studies
Search 3	2,280	18/20	5/5	Addition of search 1) “(Intervention and Consum* and food)”.mp 2) “((choice* and (child* or Kid* or student*) and intervention* or regulation))”.mp 3) peer-modelling added to behavioural insights concept 4) student* added to population concept based on common terms in missing studies

List of key papers used for the sensitivity analysis

	Author	Year	Title	Retrieval status
Systematic review				
1	Corepal et al	2018	Behavioural incentive interventions for health behaviour change in young people (5-18years old): A systematic review and meta-analysis	Search 1
2	DeCosta et al	2017	Changing children's eating behaviour - A review of experimental research	Search 1
3	Lycett et al	2017	'Nudge' interventions for improving children's dietary behaviors in the home: A systematic review	Search 1
4	Stok et al	2016	The potential of peer social norms to shape food intake in adolescents and young adults: a systematic review of effects and moderators	Search 1
5	Nornberg et al	2015	Choice architecture interventions for increased vegetable intake and behaviour change in a school setting: A systematic review	Search 1
Empirical studies				
1	Anzman-Frasca et al	2018	Effects of a randomized intervention promoting healthy children's meals on children's ordering and dietary intake in a quick-service restaurant.	Search 1
2	Bartholomew et al	2006	Increasing frequency of lower-fat entrees offered at school lunch: An environmental change strategy to increase healthful selections.	Search 1 but not found in Search 3
3	Cohen et al	2015	Effects of choice architecture and chef-enhanced meals on the selection and consumption of healthier school foods: A randomized clinical trial.	Search 1
4	Hanks et al	2012	Healthy convenience: Nudging students toward healthier choices in the lunchroom	Search 1



5	Wansink et al	2013	Pre-sliced fruit in school cafeterias: Children's selection and intake	Search 1
6	Cravener et al.	2015	Feeding strategies derived from behavioral economics and psychology can increase vegetable intake in children as part of a homebased intervention: Results of a pilot study.	Search 1
7	Elsbernd et al	2016	Serving vegetables first: A strategy to increase vegetable consumption in elementary school cafeterias.	Search 2
8	DiSantis et al	2013	Plate size and children's appetite: Effects of larger dishware on self-served portions and intake.	Search 2
9	Schwartz	2007.	The influence of a verbal prompt on school lunch fruit consumption: A pilot study.	Search 2
10	Miller et al.	2015	Increasing portion sizes of fruits and vegetables in an elementary school lunch program can increase fruit and vegetable consumption	Search 2
11	Elbel et al.	2011	Child and adolescent fast-food choice and the influence of calorie labeling: A natural experiment.	Search 3
12	Tandon et a;	2011	The impact of menu labelling on fast-food purchases for children and parents.	Search 3
13	Redden et al.	2015	Serving first in isolation increases vegetable intake among elementary schoolchildren.	Search 3
14	Horne et al.	2004	Increasing children's fruit and vegetable consumption: a peer-modelling and rewards based intervention	Search 3
15	Baranowski et al.	2000	Gimme 5 fruit, juice, and vegetables for fun and health: outcome evaluation	Search 3
16	Upton et al.	2013	Increasing children's lunchtime consumption of fruit and vegetables: an evaluation of the Food Dudes programme	Search 3
17	Presti et al.	2015	Increased classroom consumption of home-provided fruits and vegetables for normal and overweight children: results of the food dudes program in Italy	Search 3



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18	Hardman et al.	2011	Effects of rewards, peer-modelling and pedometer targets on children's physical activity: a school-based intervention study.	Search 3
19	Greene et al.	2017	Fruit-promoting smarter lunchrooms interventions: Results from a cluster rct.	Search 3
20	Perry et al	2014	Randomized school trial of environmental strategies to encourage fruit and vegetable consumption among children.	Not Found

EMBASE Search Strategy (Ovid)

Database(s): **Embase Classic+Embase** 1947 to 2019 January 11

Search Strategy:

#	Searches	Results
1	(Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or (choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavio?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? or intertemporal choice or framing or confirmation bias or choice architect* or behavio?ral economics or behavio?ral insights).ab,ti.	105383
2	exp behavioral economics/	780
3	(student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child*).ab,ti.	2718168
4	exp adolescent/ or exp child/ or exp infant/	3570282
5	(physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill* beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeat* or BMI or Body Mass index or healthy eating or low calori* or calorie control*).ab,ti.	2472593
6	exp obesity/	474900
7	(allocate* or assign* or randomi?* or placebo or (experimental adj2 design) or cross-over stud* or comparative stud* or RCT or double blind* or intervention stud* or clinical trial* or intervention* or quasi experiment* or quasiexperiment* or multicent?? or multi cent?? or (before adj5 after) or (pre adj5 post) or repeated measur* or time series or (pretest or pre test) or (posttest or post test) or control group* or randomly).ab,ti.	3920198
8	exp evaluation study/ or comparative study/ or comparative effectiveness/ or epidemiology/ or causality/ or clinical study/ or case control study/ or clinical trial/ or community trial/ or family study/ or intervention study/ or longitudinal study/ or prospective study/	2862656
9	1 or 2	105670
10	3 or 4	4391012
11	5 or 6	2671017
12	7 or 8	5814553
13	9 and 10 and 11 and 12	2959
14	sexual development/ or sex/ or sex allocation/ or sex determination process/ or sex differentiation/ or sexual maturation/ or sexual maturity/ or exp pregnancy/ or reproduction/ or exp drug therapy/ or exp diabetes mellitus/ or exp qualitative research/	4213484
15	(emergency or ED or hospital or Perinatal or prenatal or fetal or prenan* or Maternal or Gestational or cancer or patient or diabet?? or Dental or oral health or immunization or vaccination or dehydration or epilepsy or hygiene or sanitation or asthma or influenza or HIV or hepatitis or malnutrition or tobacco or breastfeeding or antibiotic or cerebral palsy or viral or autism).ti.	3722609
16	sexual development/ or sex/ or sex allocation/ or sex determination process/ or sex differentiation/ or sexual maturation/ or sexual maturity/ or exp pregnancy/ or reproduction/ or exp drug therapy/ or exp diabetes mellitus/ or exp qualitative research/	4213484
17	(emergency or ED or hospital or Perinatal or prenatal or fetal or prenan* or Maternal or Gestational or cancer or patient or diabet?? or Dental or oral health or immunization or vaccination or dehydration or epilepsy or hygiene or sanitation or asthma or influenza or HIV or	3722609



	hepatitis or malnutrition or tobacco or breastfeeding or antibiotic or cerebral palsy or viral or autism).ti.	
18	16 or 17	6821966
19	(exp animal/ or nonhuman/) not exp human/	6781258
20	exp review/ or (literature adj3 review\$.ti,ab. or exp meta analysis/ or exp Systematic Review/	2745827
21	(medline or medlars or embase or pubmed or cinahl or amed or psychlit or psyclit or psychinfo or psycinfo or scisearch or cochrane).ti,ab. or RETRACTED ARTICLE/	242302
22	20 and 21	183297
23	((systematic\$ adj2 (review\$ or overview)) or (meta?anal\$ or meta anal\$ or meta-anal\$ or metaanal\$ or metanal\$)).ti,ab.	295269
24	22 or 23	359610
25	18 or 19 or 24	13141391
26	13 not 25	2280
27	(Effects of a randomized intervention promoting healthy children's meals on children's ordering and dietary intake in a quick-service restaurant).m_titl.	1
28	Increasing frequency of lower-fat entrees offered at school lunch: An environmental change strategy to increase healthful selections.m_titl.	2
29	(Effects of choice architecture and chef-enhanced meals on the selection and consumption of healthier school foods: A randomized clinical trial).m_titl.	2
30	Healthy convenience: Nudging students toward healthier choices in the lunchroom.m_titl.	1
31	(Pre-sliced fruit in school cafeterias: Children's selection and intake).m_titl.	1
32	(Feeding strategies derived from behavioral economics and psychology can increase vegetable intake).m_titl.	1
33	strategy to increase vegetable consumption in elementary school cafeterias.m_titl.	1
34	(Effects of larger dishware on self-served portions and intake).m_titl.	1
35	The influence of a verbal prompt on school lunch fruit consumption.m_titl.	1
36	(Increasing portion sizes of fruits and vegetables in an elementary school lunch program can increase fruit).m_titl.	1
37	(Child and adolescent fast-food choice and the influence of calorie labeling).m_titl.	1
38	(Randomized school trial of environmental strategies to encourage fruit and vegetable consumption).m_titl.	1
39	Serving first in isolation increases vegetable intake among elementary.m_titl.	1
40	(fast-food purchases for children and parents).m_titl.	1
41	(Increasing children's fruit and vegetable consumption: a peer-modelling).m_titl.	1
42	(Gimme 5 fruit juice and vegetables for fun and health outcome evaluation).m_titl.	1
43	(Increasing children's lunchtime consumption of fruit and vegetables an evaluation of the Food Dudes programme).m_titl.	1
44	(Increased classroom consumption of home-provided fruits and vegetables for normal and overweight children: results of the food dudes program in Italy).m_titl.	1
45	(Effects of rewards, peer-modelling and pedometer targets on children's physical activity a school-based intervention study).m_titl.	1
46	Fruit-promoting smarter lunchrooms interventions Results from a cluster rct.m_titl.	1

47	27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46	22
48	"Increasing frequency of lower-fat entrees offered at school lunch An environmental change strategy to increase healthful selections Editor's comments.".m_titl.	1
49	(Erratum Effects of choice architecture and chef-enhanced meals on the selection and consumption of healthier school foods: A randomized clinical trial).m_titl.	1
50	48 or 49	2
51	47 not 50	20
52	26 and 51	18

Intervention

Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or (choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavio?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? Or intertemporal choice or framing or confirmation bias or choice architect* or behavio?ral economics or behavio?ral insights or **exp behavioral economics/**

Population

student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child* or **exp adolescent/ or exp child/ or exp infant/**

Outcomes

physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill*beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeat* or BMI or Body Mass index or healthy eating or low calori* or calorie control* or **exp obesity/**

Study design

allocate* OR assign* OR randomi?* OR placebo OR (experimental adj2 design) OR cross-over stud* OR comparative stud* OR RCT OR double blind* OR intervention stud* OR clinical trial* OR intervention* OR quasi experiment* OR quasiexperiment* OR multicent?? OR multi cent?? OR (before adj5 after) OR (pre adj5 post) OR repeated measur* OR time series OR (pretest or pre test) OR (posttest or post test) OR control group* OR randomly or **exp evaluation study/ OR comparative study/ OR comparative effectiveness/ OR epidemiology/ OR causality/ OR clinical study/ OR case control study/ OR clinical trial/ or community trial/ OR family study/ OR intervention study/ OR longitudinal study/ OR prospective study/**



MEDLINE Search Strategy (Ovid)

Database(s): **Ovid** **MEDLINE(R)** **ALL** 1946 to January 11, 2019
Search Strategy:

#	Searches	Results
1	(Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or (choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavio?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? or intertemporal choice or framing or confirmation bias or choice architect* or behavio?ral economics or behavio?ral insights).ab,ti.	86670
2	exp behavioral economics/	359
3	(student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child*).ab,ti.	2016778
4	exp adolescent/ or exp child/ or exp infant/	3360449
5	(physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeate* or BMI or Body Mass index or healthy eating).ab,ti.	1922402
6	exp obesity/	192654
7	(allocate* or assign* or randomi?* or placebo or (experimental adj2 design) or cross-over stud* or comparative stud* or RCT or double blind* or intervention stud* or clinical trial* or intervention* or quasi experiment* or quasiexperiment* or multicent?? or multi cent?? or (before adj5 after) or (pre adj5 post) or repeated measur* or time series or (pretest or pre test) or (posttest or post test) or control group* or randomly).ab,ti.	2777761
8	exp evaluation study/ or comparative study/ or comparative effectiveness/ or epidemiology/ or causality/ or clinical study/ or case control study/ or clinical trial/ or community trial/ or family study/ or intervention study/ or longitudinal study/ or prospective study/	2853702
9	1 or 2	86804
10	3 or 4	3969558
11	5 or 6	1949633
12	7 or 8	4905368
13	9 and 10 and 11 and 12	2446
14	(exp animal/ or nonhuman/) not exp human/	4535562
15	review.pt.	2470790
16	(medline or medlars or embase or pubmed or cochrane).tw,sh.	181108
17	(scisearch or psychinfo or psycinfo).tw,sh.	27038
18	cinahl.tw,sh.	22097
19	((hand adj2 search\$) or (manual\$ adj2 search\$)).tw,sh.	11616
20	(electronic database\$ or bibliographic database\$ or computeri?ed database\$ or online database\$).tw,sh.	30268
21	(pooling or pooled or mantel haenszel).tw,sh.	90589
22	(peto or dersimonian or der simonian or fixed effect).tw,sh.	6324



23	(retraction of publication or retracted publication).pt.	13098
24	or/16-23	289781
25	15 and 24	145045
26	meta-analysis.pt.	96080
27	meta-analysis.sh.	96080
28	(meta-analys\$ or meta analys\$ or metaanalys\$).tw,sh.	167304
29	(systematic\$ adj5 review\$).tw,sh.	147884
30	(systematic\$ adj5 overview\$).tw,sh.	1809
31	(quantitativ\$ adj5 review\$).tw,sh.	6993
32	(quantitativ\$ adj5 overview\$).tw,sh.	292
33	(quantitativ\$ adj5 synthesis\$).tw,sh.	2398
34	(methodologic\$ adj5 review\$).tw,sh.	5551
35	(methodologic\$ adj5 overview\$).tw,sh.	371
36	(integrative research review\$ or research integration).tw.	132
37	or/26-36	262739
38	25 or 37	317193
39	(emergency or ED or hospital or Perinatal or prenatal or fetal or prenan* or Maternal or Gestational or cancer or patient or diabet?? or Dental or oral health or immunization or vaccination or dehydration or epilepsy or hygiene or sanitation or asthma or influenza or HIV or hepatitis or malnutrition or tobacco or breastfeeding or antibiotic or cerebral palsy or viral or autism).ti.	2840247
40	sexual development/ or sex/ or sex allocation/ or sex determination process/ or sex differentiation/ or sexual maturation/ or sexual maturity/ or exp pregnancy/ or reproduction/ or exp drug therapy/ or exp diabetes mellitus/ or exp qualitative research/	2540334
41	14 or 38 or 39 or 40	8913401
42	13 not 41	1959
43	limit 42 to yr="1994 - 2019"	1894

Intervention

Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or (choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavio?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? Or intertemporal choice or framing or confirmation bias or choice architect* or behavio?ral economics or behavio?ral insights or **exp behavioral economics/**

Population

student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child* or **exp adolescent/ or exp child/ or exp infant/**

Outcomes

physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeate* or BMI or Body Mass index or healthy eating or **exp obesity/**

Study design

allocate* OR assign* OR randomi?* OR placebo OR (experimental adj2 design) OR cross-over stud* OR comparative stud* OR RCT OR double blind* OR intervention stud* OR clinical trial* OR intervention* OR quasi experiment* OR quasiexperiment* OR multicent?? OR multi cent?? OR (before adj5 after) OR (pre adj5 post) OR repeated measur* OR time series OR (pretest or pre test) OR (posttest or post test) OR control group* OR randomly or **exp evaluation study/ OR comparative study/ OR comparative effectiveness/ OR epidemiology/ OR causality/ OR clinical study/ OR case control study/ OR clinical trial/ or community trial/ OR family study/ OR intervention study/ OR longitudinal study/ OR prospective study/**

Global Health Search Strategy (Ovid)

Database(s): **Global Health** 1973 to 2019 Week 01
Search Strategy:

#	Searches	Results
1	(Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or (choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavio?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? or intertemporal choice or framing or confirmation bias or choice architect* or behavio?ral economics or behavio?ral insights).ab,ti.	14239
2	(student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child*).ab,ti.	419622
3	exp adolescent/ or exp children/ or exp infants/	330214
4	(physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeat* or BMI or Body Mass index or healthy eating).ab,ti.	770451
5	obesity/	106552
6	(allocate* or assign* or randomi?* or placebo or (experimental adj2 design) or cross-over stud* or comparative stud* or RCT or double blind* or intervention stud* or clinical trial* or intervention* or quasi experiment* or quasiexperiment* or multicent?? or multi cent?? or (before adj5 after) or (pre adj5 post) or repeated measur* or time series or (pretest or pre test) or (posttest or post test) or control group* or randomly).ab,ti.	461326
7	epidemiology/ or clinical trial/ or nutritional intervention/ or intervention/ or exp longitudinal studies/	323725
8	2 or 3	452092
9	4 or 5	772530
10	6 or 7	721418
11	1 and 8 and 9 and 10	1619
12	(emergency or ED or hospital or Perinatal or prenatal or fetal or prenan* or Maternal or Gestational or cancer or patient or diabet?? or Dental or oral health or immunization or vaccination or dehydration or epilepsy or hygiene or sanitation or asthma or influenza or HIV or hepatitis or malnutrition or tobacco or breastfeeding or antibiotic or cerebral palsy or viral or autism).ti.	455991
13	systematic review.ti.	17930
14	12 or 13	469329
15	11 not 14	1458
16	limit 15 to yr="1994 - 2019"	1432

Intervention

Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or

(choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavior?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? Or intertemporal choice or framing or confirmation bias or choice architect* or behavior?ral economics or behavior?ral insights

Population

student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child*

exp adolescent/ or exp children/ or exp infants/

Outcomes

physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeate* or BMI or Body Mass index or healthy eating

obesity/

Study design

allocate* OR assign* OR randomi?* OR placebo OR (experimental adj2 design) OR cross-over stud* OR comparative stud* OR RCT OR double blind* OR intervention stud* OR clinical trial* OR intervention* OR quasi experiment* OR quasiexperiment* OR multicent?? OR multi cent?? OR (before adj5 after) OR (pre adj5 post) OR repeated measur* OR time series OR (pretest or pre test) OR (posttest or post test) OR control group* OR randomly

epidemiology/ Or clinical trial/ or nutritional intervention/ or intervention/ or exp longitudinal studies/



PsycINFO Search Strategy (Ovid)

Database(s): **PsycINFO** 1806 to January Week 1 2019
Search Strategy:

#	Searches	Results
1	(Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or (choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavio?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? or intertemporal choice or framing or confirmation bias or choice architect* or behavio?ral economics or behavio?ral insights).ab,ti.	73269
2	exp behavioral economics/	1887
3	(student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child*).ab,ti.	1274562
4	(physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeate* or BMI or Body Mass index or healthy eating).ab,ti.	334326
5	exp obesity/	22619
6	(allocate* or assign* or randomi?* or placebo or (experimental adj2 design) or cross-over stud* or comparative stud* or RCT or double blind* or intervention stud* or clinical trial* or intervention* or quasi experiment* or quasiexperiment* or multicent?? or multi cent?? or (before adj5 after) or (pre adj5 post) or repeated measur* or time series or (pretest or pre test) or (posttest or post test) or control group* or randomly).ab,ti.	668626
7	exp intervention/ or program evaluation/	105669
8	1 or 2	74214
9	4 or 5	334662
10	6 or 7	686915
11	3 and 8 and 9 and 10	1170
12	(emergency or ED or hospital or Perinatal or prenatal or fetal or prenan* or Maternal or Gestational or cancer or patient or diabet?? or Dental or oral health or immunization or vaccination or dehydration or epilepsy or hygiene or sanitation or asthma or influenza or HIV or hepatitis or malnutrition or tobacco or breastfeeding or antibiotic or cerebral palsy or viral or autism).ti.	226152
13	systematic review.ti.	15622
14	12 or 13	239440
15	11 not 14	1099

Intervention

Dual process theory or relative reinforcing value or reinforcing value or delayed reward discount* or delay discount* or precommit* or pre-commit* or nudg* or social proof or (anchoring adj2 bias) or cognitive bias* or ((consumption or meal) and (portion or Serving) and (child* or Kid* or studen*)) or (intervention* and (child* or Kid* or student*) and (consumption adj3 fruit?)) or peer-modelling or (choice* and (child* or Kid* or student*) and (intervention* or regulation) and (food or fruit or vegetable)) or defaults or default choice or default option or salience or behavio?ral science or priming or time discounting or status quo bias or social norm* or mental accounting or loss aversion or incentive? Or

intertemporal choice or framing or confirmation bias or choice architect* or behavior?ral economics or behavior?ral insights

exp behavioral economics/

Population

student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child*

Outcomes

physical activit* or exercis* or sedentar* or (physical adj2 fitness) or (physical adj2 exertion) or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or obes* or (weight adj2 gain*) or (weight adj2 loss*) or overweight or overeate* or BMI or Body Mass index or healthy eating

exp obesity/

Study design

allocate* OR assign* OR randomi?* OR placebo OR (experimental adj2 design) OR cross-over stud* OR comparative stud* OR RCT OR double blind* OR intervention stud* OR clinical trial* OR intervention* OR quasi experiment* OR quasiexperiment* OR multicent?? OR multi cent?? OR (before adj5 after) OR (pre adj5 post) OR repeated measur* OR time series OR (pretest or pre test) OR (posttest or post test) OR control group* OR randomly

exp intervention/ or program evaluation/

CENTRAL Search Strategy

Intervention

nudg* or cognitive bias* or defaults or social norm* or incentive? or choice architect* or behavio?ral economics or behavio?ral insights

Population

student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child*

Outcomes

physical activit* or exercis* or sedentar* or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or overweight or overeat* or BMI or Body Mass index or healthy eating or low calori* or calorie control* or obes*

Study design

allocate* OR assign* OR randomi?* OR placebo OR cross-over stud* OR comparative stud* OR RCT OR double blind* OR intervention stud* OR clinical trial* OR intervention* OR quasi experiment* OR quasiexperiment* OR multicent?? OR multi cent?? OR repeated measur* OR time series OR control group* OR randomly

1163 Trials matching on 'nudg* or cognitive bias* or defaults or social norm* or incentive? or choice architect* or behavio?ral economics or behavio?ral insights in Abstract AND student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or school child* in Abstract AND physical activit* or exercis* or sedentar* or energy expenditure or motor skill* or beverag* or unhealthy diet* or sugar intake or soft drink* or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable or overweight or overeat* or BMI or Body Mass index or healthy eating or low calori* or calorie control* or obes* in Abstract AND allocate* OR assign* OR randomi?* OR placebo OR cross-over stud* OR comparative stud* OR RCT OR double blind* OR intervention stud* OR clinical trial* OR intervention* OR quasi experiment* OR quasiexperiment* OR multicent?? OR multi cent?? OR repeated measur* OR time series OR control group* OR randomly in Abstract - with Publication Year from 1994 to 2019, in Trials (Word variations have been searched)*

Scopus Search Strategy

Intervention

“nudg*” or “cognitive bias” or “defaults” or “social norm” or “incentive?” or “choice architect*” or “behavio?ral economics” or “behavio?ral insights”

Population

student* or Child* or adolescen* or infant* or preschool* or teenage* or schoolchild* or boy* or girl* or youth* or “school child*”

Outcomes

“physical activit*” or exercis* or sedentar* or “energy expenditure” or “motor skill*” or beverag* or “unhealthy diet*” or “sugar intake” or “soft drink*” or soda or SSB* or nutrition or food or feed* or eat* or diet* or fruit or vegetable

overweight or overeat* or BMI or “Body Mass index” or “healthy eating” or “low calori*” or “calorie control*” or obes*

Study design

allocate* OR assign* OR randomi?* OR placebo OR “cross-over stud*” OR “comparative stud*” OR RCT OR “double blind*” OR “intervention stud*” OR “clinical trial*” OR intervention* OR “quasi experiment*”

quasiexperiment* OR multigent?? OR “multi cent??” OR “repeated measur*” OR “time series” OR “control group*” OR randomly

994 document results (TITLE-ABS-KEY ("nudg*" OR "cognitive bias" OR "defaults" OR "social norm" OR "incentive?" OR "choice architect*" OR "behavio?ral economics" OR "behavio?ral insights") AND TITLE-ABS-KEY (student* OR child* OR adolescen* OR infant* OR preschool* OR teenage* OR schoolchild* OR boy* OR girl* OR youth* OR "school child*") AND TITLE-ABS-KEY ("physical activit*" OR exercis* OR sedentar* OR "energy expenditure" OR "motor skill*" OR beverag* OR "unhealthy diet*" OR "sugar intake" OR "soft drink*" OR soda OR ssb* OR nutrition OR food OR feed* OR eat* OR diet* OR fruit OR vegetable) OR TITLE-ABS-KEY (overweight OR overeat* OR bmi OR "Body Mass index" OR "healthy eating" OR "low calori*" OR "calorie control*" OR obes*) AND TITLE-ABS-KEY (allocate* OR assign* OR randomi?* OR placebo OR "cross-over stud*" OR "comparative stud*" OR rct OR "double blind*" OR "intervention stud*" OR "clinical trial*" OR intervention* OR "quasi experiment*") OR TITLE-ABS-KEY (quasiexperiment* OR multigent?? OR "multi cent??" OR "repeated measur*" OR "time series" OR "control group*" OR randomly))

8 Supplementary Material 2: Included Studies

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