

Efficacy of interventions to improve public support for evidence based public health and climate change policy measures: a systematic review.

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Abstract

Background Policies which reduce affordability and availability of alcohol are known to be effective in reducing alcohol harms. Public support is important in policy decision making and implementation, and it may be possible to intervene to improve public support for alcohol policy measures. This systematic review aims to explore the effects of interventions to increase public support for evidence based policy measures in relation to either public health or climate change, and to examine underpinning theory and content of effective interventions.

Methods The electronic search strategy was built around the constructs "public support or opinion", "health or climate change policies" and "interventions". Backward and forward searching was conducted, and authors of included papers contacted. Studies were included if they aimed to intervene to improve public support for public health or climate change policy measures, were controlled trials, and targeted the general public.

Results Sixteen studies were included in this review, of which 13 had sufficient data for inclusion in meta analyses. The pooled effect estimates for continuous and binary data both show improvements in public support for policy measures as a result of evaluated interventions. The pooled standardised mean difference (n=8 studies) is 0.13 (95% C.I. 0.08-0.17), and the pooled odds ratio (n=5 studies) is 1.72 (95% C.I. 1.33-2.21). Careful attention to message framing, with or without narrative persuasion, appears particularly important content for efficacious interventions.

Conclusion This systematic review demonstrates the efficacy of interventions to improve public support for public health policies.

Background

The World Health Organisation (WHO) estimates that non-communicable diseases such as cardiovascular diseases, cancers and diabetes, are responsible for more than 40 million deaths a year (1). It is well known that smoking, alcohol and unhealthy diet- including the consumption of sugary or processed food and drink- are risk factors for non-communicable diseases (1). Such risk factors may also be implicated in communicable diseases and in aggregate terms make large contributions to the global burden of disease (2, 3).

In 2013 The Global Action Plan for Prevention and Control of Non-Communicable Diseases set out voluntary global targets and outlined the need to create "health-promoting environments" to reduce risk factors (4). Subsequently, in the "Time to Deliver" report the WHO has been encouraged to make a "serious change in approach to non-communicable diseases" if the global target of reducing one third of pre-mature deaths from non-communicable diseases by 2030 is to be met (5). Public health policies can be the key effective approach to reducing the prevalence of harmful behaviours. For alcohol, the most effective and cost-effective policies are those aimed at reducing the affordability and accessibility of alcohol (6). Similarly, for tobacco policies including increasing taxation of cigarettes and prohibiting

smoking in public places have been shown to be effective (7). Restrictive policies, which limit access to health harming products, can be expected to be met with opposition by the affected industry, and potentially also by the public (8). Failure by governments to adopt and implement known effective policy measures to combat the harmful effects of health behaviours will probably mean that the health burden will grow.

Public opinion generally, and the extent of public support for particular measures, are considered by policy makers. This may be important for policy actor views on the need for change, which in turn can impact on policy decisions made, and their subsequent implementation (9).

This study was designed to look broadly at the research literature on interventions to improve public support for evidence based policy measures. As well as examining public health research, the study focus was extended to include climate change policies, as the climate change arena is similarly affected by attempts by corporate vested interests to influence public policies (10). The possible effects of interventions to enhance public support for climate change measures are thus very relevant to assessment of the potential of interventions to enhance public support for public health policy measures.

Aim

The aim of this systematic review is to explore the effects of interventions to increase public support for evidence based policy measures in relation to either public health or climate change, and to examine the theoretical underpinning and components of effective interventions. The rationale for the latter was to inform thinking about the design of novel interventions to enhance public support, to the extent that this may be needed. This meant the review purposefully and pragmatically sought to identify evidence that could be applicable in contexts other than those of the evaluation study.

Research Questions

Are interventions designed to improve public support for public health and climate change policy measures effective, and what is the theory behind, and content of, effective interventions?

1. Are interventions effective in improving public support for public health and climate change policy measures?
2. What are the components of effective interventions, whilst also taking into consideration the components of ineffective interventions?
 - a. What is the theoretical basis of the intervention?
 - i. How has theory been used in intervention development?
 - b. What are the contents of effective interventions?

- i. For which kinds of policy measures have public support enhancement interventions been successfully developed?
- ii. Has salience of the policy measure been considered?
- iii. Which media are used?
- iv. How has the public been identified for targeting?
- v. Are there process data linking exposure to intervention content and outcomes i.e. on possible key content or 'active ingredients' of the intervention?
- vi. What communications strategies, messaging techniques, or frames have been used?
- vii. Has competition from corporate vested interests been addressed directly, and if so how?
- viii. Are there other characteristics of effective interventions?
- ix. Have potential users of the intervention been considered, and if so, how?

Methods

Eligibility Criteria

Studies were included if they:

- Were formal research reports in peer-reviewed journals
- Were published in the English language
- Targeted the general adult population (18+), or sub-groups within the general population.
- Involved any intervention aimed at increasing public support for policy measures in relation to public health or climate change
- Were randomised or non-randomised controlled trials only
- Had outcomes which measured public support for evidence based public health and climate change policy measures

Studies were excluded if they:

- Targeted policy actors specifically, as interventions with this group would be expected to involve distinct characteristics beyond the scope of the present study
- Involved interventions which seek to stimulate health behaviour change rather than support for policy measures
- Did not provide public support outcome data comparing intervention and comparison groups

The broad scope of this review and the permissive selection criteria employed has resulted in an 'apples and oranges' review that was expected at the outset to include heterogeneous primary studies. This is judged appropriate given the stage of development of this literature, with no prior systematic reviews having been undertaken in this area.

Information Sources

Electronic searches were conducted using MEDLINE (OVID interface, 1946 onwards), EMBASE (OVID Interface 1974 onwards), CINAHL Complete (EBSCO interface), PsycINFO (Ovid interface, 1806 onwards), Web of Science (Clarivate Analytics interface, 1900 onwards), GreenFILE (EBSCO interface). To collect further data, backward searching of included reference lists and forward searching of citations of included references was performed. Authors of included papers and experts in the field were contacted to identify relevant studies which had not been identified in database searches, and for more detail on intervention content where necessary.

Search Strategy

The search strategy was developed around the constructs of “public support or opinion”, “health or climate change policies” and “interventions” using medical subject headings (MeSH) and key words. Once the MEDLINE search was completed, the strategy was refined to include the syntax and subject headings required by each subsequent database. An example of the search strategy as operationalised in one database is included as appendix 1, as required by the PRISMA reporting guidance.

Study Records

The outputs of the searches were exported to, and managed using EndNote (Clarivate Analytics, version X8.20). Duplicates of studies were removed prior to screening.

Selection Process

The first two authors independently screened titles and abstracts of studies identified from the database searches against the inclusion criteria. Full texts of studies were obtained and assessed for eligibility by both researchers independently. Studies deemed to meet the inclusion criteria were discussed, with any disagreements being discussed with the last author. Reasons for exclusion of all full text papers are reported in the PRISMA diagram (Figure 1).

Data Collection Process

Using dedicated forms, two researchers independently extracted data from each study. To ensure reliability, at least 20% of studies had data extraction conducted by both of the first two authors. This was checked and deemed not to require further double extraction.

Data Items

Population: baseline characteristics (including average age, gender, ethnicity)

Intervention Group(s): number of interventions delivered; intervention type; theoretical basis underpinning the intervention (including key references); intervention aims along with the media/communication techniques used to deliver the intervention.

Control Group: details of control/comparator intervention

Policy: health policy/climate change policy addressed including the content delivered and the salience of the policy area or measure.

Corporate Competition: methods used to address competition from corporate vested interests.

Outcomes: methods used for measuring public support for policy; change in public support per group; data linking exposure to the content of the intervention and public support.

Methodological: study design; method of randomization; study duration; follow up duration; sample size and funding source.

Outcomes

The primary outcome of interest was defined as any measure of change in public support for a public health or climate change policy measure in comparison with a control group. This was often quantified using a Likert scale.

Risk of Bias

An adapted Cochrane Risk of Bias Assessment was completed for all included full texts. 10% of assessments were carried out by the first two authors and checked for reliability by the final author.

Data Synthesis

In order to answer Question 1, two meta analyses were conducted using Review Manager 5.0 (RevMan), to provide a pooled estimate of the effects of interventions compared with a non-intervention control. The studies included in the review varied in the number of intervention groups, often incorporating a range of intervention elements (e.g. a condition with each separate intervention component, and one condition which incorporated all components). Where there was an intervention group which incorporated all components of the intervention, the effect estimate for that group was used for meta analysis. Where there was not a single intervention group being compared against a control group as the principal object of study, the effect estimates for multiple intervention groups were combined for inclusion in the meta analysis using standard formulae (11). Similarly, for studies which had several policy support outcome measures reported, the key outcomes were combined for incorporation in the meta analysis. If the mean and standard deviation of the intervention effect was not available in the paper, this was calculated from the data available (mean difference, standard error, confidence intervals and p values) using the standardised formulas in the Cochrane Handbook (11).

Research Question 2 required a narrative synthesis of the features of these interventions. Grouping criteria (1-5) were developed to determine whether interventions evaluated showed any evidence of effectiveness, through to offering no such evidence as follows:

1. Some evidence of effect compared with a non-intervention control. At least one of the study intervention groups showed a statistically significant increase in public support compared with the non-intervention control group
2. Some evidence of effect identified in comparison with another intervention group. At least one of the study intervention groups showed a statistically significant increase in public support compared to another intervention group
3. Evidence of interactions between intervention groups. Some evidence of a statistically significant interaction between intervention groups
4. Evidence of subgroup effects of the intervention. No main effects of the intervention, but some evidence of statistically significant subgroup effects
5. No effects. No statistically significant results reported

The narrative summary presented is organised by research question.

Results

The PRISMA diagram in Figure 1 outlines the data collection steps leading to the inclusion of 16 papers in the review (12-27). Table 1 provides an overview of the intervention and design characteristics of each included study. All are randomised studies. Table 2 provides information on the study participants. All studies were undertaken in the U.S., apart from one conducted in Australia (25). Most examined effects immediately after exposure to interventions, though three studies did involve additional follow-up investigations of the durability of the effects up to 2 weeks post exposure (20, 21, 25).

Two meta-analyses were conducted to provide a pooled estimate of intervention effect estimates for studies with continuous data (Figure 2) and binary data (Figure 3) respectively. Three studies were not suitable for inclusion in either meta analysis due to insufficient data (14, 16, 19). Barry and colleagues (14) reported public support for 10 policy measures as outcomes for their intervention, however this was reported in the text as a significant improvement, with only a p value reported. Frederick and colleagues (16) used 16 policy items as their outcome measures, which they collapsed into three types and reported on a graph as cohen's d, with confidence intervals only available as lines on a graph, and the p values reported in the text were not exact. McGlynn and McGlone (19) reported outcomes for public support for 7 policy measures, which they reported as a summary measure for all seven using cohen's d. Confidence intervals and p values were unavailable. The findings of the risk of bias assessment are presented in Table 3.

The pooled effect estimates for both continuous and binary data both show improvements in public support for policy measures as a result of the evaluated interventions in comparison with controls. The pooled standardised mean difference is 0.13 (95% C.I. 0.08-0.17) (Figure 2), and the pooled Odds Ratio is 1.72 (95% C.I. 1.33-2.21) (Figure 3). The meta analysis for the continuous data shows no evidence of heterogeneity between the studies ($I^2=0\%$), however the studies in the meta analysis of binary data were

highly heterogeneous ($I^2=88\%$). Given the number of studies in the meta analysis ($n=5$) a random effects model was used to incorporate the heterogeneity into the analysis as it was not possible to explore this further quantitatively. Beyond the statistical heterogeneity it is worth noting that the 5 studies in figure 3 were focussing on different policy measures, whereas 5/8 studies in figure 2 were concerned with obesity. As can be seen from figures 2 and 3, most included studies provided evidence of effects prior to pooling.

Promising interventions

12/16 included studies provide some evidence of effect in comparison with a non-intervention control (12, 13, 15-21, 24, 25, 27). These studies are hereafter deemed as promising as there are usually more than two randomised study conditions (see Table 1), and many also include null findings, thus producing mixed evidence of effects. These features complicate detailed interpretation of the results, notwithstanding the findings on overall effects. There were two studies which showed no effects (14, 26) and two others which produced other kinds of evidence of effects (22, 23).

Theoretical basis

5/16 studies did not explicitly identify a theoretical basis for the intervention evaluated (12-14, 18, 27). Framing theory (not including inoculation theory, see below) was used in developing 6/12 promising interventions, 5 of which focussed on obesity policies (15, 16, 19, 20, 24) and one of which focussed on opioid pain reliever addiction policies (17). Skurka (26) also conducted an obesity framing study which showed no effect. Framing in this context involves communicating a particular meaning in a particular way in any medium, identifying some aspect of the information presented as more important than others (19). Frames may be essentially different versions or formulations of the same message, and the influence of the frame is determined by which information is highlighted or emphasised (16, 19), so that “any alteration to a message that influences perspective can be considered a frame” (28). Members of the public are often exposed to competing frames when it comes to policy issues (20), which carries implications for the ways in which frames should be formulated to be most impactful.

Inoculation theory is a sub-category of framing and is predicated on the idea that individuals are subject to competing public health and policy messages particularly in fields where there are vested interests in opposition to public health. Inoculation theory involves an attempt to protect individuals from future attempts at persuasion from vested interests by warning them about competing messages and exposing them to, and refuting, anticipated opposing arguments (21). Exposure to versions of opposing arguments can encourage development of counterarguments which can protect against the effects of opposing arguments when faced in the future (20, 25). Inoculation theory was used in 3 promising studies (20, 21, 25), all focussed on obesity policies, though one (Niederdeppe, Heley (21) also focussed on smoking and prescription painkiller policies, and another (Scully, Brennan (25) also focussed on alcohol. Two of these studies used inoculation theory in conjunction with narrative persuasion (21, 25) (see below).

Narrative persuasion theory was used in developing 2 promising interventions (21, 25) and the two interventions with other kinds of evidence of effects (22, 23), with the former study producing stronger evidence in the form of effects observed in a randomised comparison with a narrative persuasion intervention. All four studies focussed on obesity policies. Narrative persuasion involves the use of stories to allow individuals to engage and connect with characters who live in challenging environments (which may differ significantly from their own), and can contain implicit and explicit messages about a particular topic being addressed (21, 25). They may thus be more or less informed by framing theory.

Intervention Content

Promising studies focused on diverse policy areas, though no studies of climate change were included (see Table 1). Inoculation theory informed studies directly involved attention to salience of the policy issue, as did framing theory based studies which intrinsically involve efforts to influence the salience of particular issues within a given policy area. For example, some studies highlighted the importance of changing salience of beliefs about soda companies/industry (20), or the ways the food industry engineers its products to promote overconsumption (24), or the salience of issues which members of the public may feel strongly about, such as provision of abortion care in Conservative US states (27).

Niederdeppe, Roh (22) found that it was essential to acknowledge individual responsibility whilst communicating the social determinants of obesity in comparison with a narrative that did not acknowledge individual responsibility in a U.S. nationally representative sample. Those randomised to a study condition which acknowledged individual responsibility engaged in less counterargument and had more empathy for the character in a narrative persuasion intervention (see below) and demonstrated greater support for obesity policies than the narrative persuasion comparison group in which there was no acknowledgement of individual responsibility. The authors emphasise that individual responsibility is a deeply held American value, thus calling into question whether this finding may apply in other cultural contexts. In another study Niederdeppe, Shapiro (23) identified that whereas communicating a high level of individual responsibility for obesity did not enhance support for obesity policies, communicating moderate or no personal responsibility alongside societal cause attributions increased public support specifically among conservatives.

Niederdeppe, Gollust (20), Niederdeppe, Heley (21) and Scully, Brennan (25) all address vested interests by being based on inoculation theory with dedicated components within the intervention, to pre-emptively refute potential future competing messages from vested interests. Allen, Davis (12) and Ortiz, Zimmerman (24) addressed vested interests in a similar way, without being explicitly based on inoculation theory. Allen, Davis (12) exposed participants to a series of TV, radio and text messages, and included reference to the implications of placement of point of sale tobacco promotions and the potential impacts on children who may view them. Ortiz, Zimmerman (24) made direct reference to using the food engineering techniques used by the food industry in an attempt to counteract the impact of industry messages.

Text was the most common form of communication used, perhaps partly reflecting that the method of recruitment in the majority of studies was via online survey panels (see Table 1). No other key features of effective interventions emerged during the course of the study, and none of the included studies reported involving prospective users of the intervention in its development. This reflects the nature of this emerging literature, best characterised as comprising efficacy studies designed to identify possible effects, and to a lesser extent content development studies and investigations of causal pathways to effects, rather than effectiveness studies designed to evaluate the real world effects of such interventions should they be disseminated more widely.

Discussion

The findings of this systematic review have provided pooled estimates of the effects of interventions to improve support for public health policy measures, demonstrating overall effects and providing 'proof of concept' that it is possible to increase public support for evidence based public health policy measures. The broad inclusion criteria resulted in an 'apples and oranges' review, which was judged necessary as this is the first review in this area. This resulted in a heterogeneous group of included studies. As such, this study is not designed to give fine grained attention to the nature of individual constituents of effects, and a more overarching consideration is appropriate. This review captures an emerging literature at an early stage of development, which uses high quality randomised designs as evaluation methods, with studies reported in ways which demonstrate generally low risk of bias, with the exception of sequence generation. It is possible to influence public support immediately after exposure to framing and narrative persuasion based interventions, though the durability of any such effects warrants careful consideration.

The key theoretical characteristics of promising interventions thus far appear to be grounded in framing theory, with narrative persuasion and inoculation theories also promising. In some cases this involves drawing attention to the issues that individuals face, as well as pointing out the responsibility of governments, industries and environments for creating or acting on such issues. Promising interventions tend to frame issues in ways which attribute responsibility for public health issues to the individuals in question, but not only these individuals (22). Some studies also seek to inoculate individuals against future messages from vested interests by exposing them to industry messages in particular ways to protect from the effects of such messages. They thus work in somewhat similar ways, identifying social causes and solutions rather than individualising the issues.

Among the many randomised comparisons made in these studies, there are also conflicting findings reflecting the complex object of study, and clearly many issues that require further investigation. These can be summarised as belonging to the specific content of the messages being developed and how they work in, or are targeted at, sub-populations. For example, precisely how the balance between individual and societal responsibility is struck, appears to matter greatly in its own right and according to the political leanings or affiliations of study participants (15, 17-19, 22, 26, 27). This is because the study of the psychological mechanisms involved in public support is still developing to engender better understanding of the inherent complexities (23). Careful attention to the findings from head to head

comparisons in experimental studies may be particularly valuable and in due course will permit meta regression studies of components and their contributions to overall effects, and their longevity. Such studies risk, however, null findings unless the experimental contrasts are well judged. Alternatively, comparisons with non-intervention groups may be combined in network meta analyses.

The literature reviewed required rigorous application of the inclusion and exclusion criteria, as well as careful handling of studies that were included. In many cases making inclusion/exclusion decisions was very clear cut, however there were other more borderline exclusions. For example, Bertolotti and Catellani (29) conducted a study of whether individual identification with national or supranational entities made a difference to their agreement with climate change policy measures. This study was excluded because it was not a study of an intervention to improve public support per se, but rather a study of congruence between individual identity and support for climate change policies. Two studies were excluded based on a lack of public support outcome measures (30, 31). In the first (31) the public support outcome was not reported separately from seven other items which included attitudes and beliefs, and in the second (30) the focus was on public acceptability of financial incentives to support smoking cessation during pregnancy, but did not provide any public support outcome data.

Screening, eligibility assessments and data collection for this study were all conducted by two researchers independently, with duplication taking place to cross check use of the eligibility criteria and data collection forms. Adapted versions of data collection and risk of bias forms from the Cochrane handbook were used (11). This review only included studies of interventions which included data from a comparator group. Therefore uncontrolled studies of interventions to increase public support for public health or climate change policy measures were excluded. For example, studies which examine public support before and after the introduction of a new policy measure were excluded. This review also did not look at grey literature as part of the search strategy, largely because of the wide coverage of policy areas included here. The lack of inclusion of studies of interventions to enhance public support for climate change policies may indicate a need to develop more specific search strategies for such studies. Future reviews could examine in more depth areas such as interventions to enhance public support for obesity policies as the literatures in distinct policy areas develop.

Conclusions

It is clearly possible to increase public support for evidence based public health policy measures immediately after exposure to theory-based interventions designed for this purpose. Further research in this innovative area thus appears to have strong potential to engender globally relevant, larger and more durable effects on public opinion.

Abbreviations

MeSH - Medical Subject Headings

PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

WHO - World Health Organisation

Declarations

Ethics Approval and Consent to Participate

Not applicable

Consent to Publish

Not applicable

Availability of Data and Materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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Author's Contributions

The study was designed by RCo with supervisory support and input from JM. RCo and RCl conducted searching, screening and data extraction. RCo completed the meta-analysis with support and input from CH, and the narrative synthesis with support and input from JM. RCo led writing of the final manuscript with supervision from JM, who also drafted text. All authors read and approved the final manuscript.

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Not Applicable

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Tables

Table 1. Overview of Included Studies

Author & Year	Intervention Content	Policy Issue	No of Study Conditions ^a	Effects Grouping ^b
Gollust et al. (2013)	Text	Obesity Prevention	6	1
McGinty et al. (2013)	Text	Gun control policy	4	1
Barry et al. (2014)	Video	Obesity Prevention	4	5
Niederdeppe, Shapiro, et al. (2014)	Text	Obesity Policies	4	4
Niederdeppe, Gollust, et al. (2014)	Text	Childhood obesity prevention (soda tax)	8	1
Allen et al. (2014)	TV advertisements (4), radio (2), text (1)	Ban on point of sale (POS) tobacco promotion	2	1
Bachhuber et al. (2015)	Text	Naloxone provision	5	1
Niederdeppe, Heley, et al. (2015)	Text	Obesity (soda), Smoking, Prescription Painkiller Policies	6	1
Niederdeppe, Roh, et al. (2015)	Text	Obesity Policies	9	2
Frederick et al. (2016) ³	Text	Obesity Prevention	3	1
Kennedy-Hendricks et al. (2016)	Text	Opioid pain reliever addiction during pregnancy	6	1
Ortiz et al. (2016)	Text	Food industry related obesity prevention policies	6	1
Scully et al. (2017)	Radio	Sugary drinks/alcohol health policies	5	1
Skurka (2017)	Text	Obesity policies	5	5
White et al. (2017)	Text	Medically unnecessary abortions	2	1
McGlynn and McGlone (2018)	Text followed by full colour health message	Obesity Policies	6	1

a. Including control group

b. 1 - some evidence of effect compared with non-intervention control; 2 - some evidence of effect compared with an intervention control group; 4 - evidence of subgroup effects; 5 - no effects

Table 2. Study Participants

Author & Year	Selection Criteria	No. randomised (N)	Gender %	Age %	Ethnicity %	Representative Sample Y/N
Gollust et al. (2013)	Age 18+	2494	49% M 51% F	Mean = 41.52	White - 65% (no other ethnicities reported)	Y
McGinty et al. (2013)	None	1959	50% M 50% F	18-29 - 13.8% 30-44 - 20.8% 45-59 - 31.6% 60+ - 49.5%	White Non Hispanic - 76.8% Black, Non Hispanic - 9% Other, Non Hispanic - 4% 2+ Races, Non Hispanic - 2.3% Hispanic - 7.9%	Y
Barry et al. (2014) ^a	Age 18+	1677	49% M 51% F	18-29 years 25% 30-44 years 32% 45-59 years 34% 60+ years 9%	White, non-Hispanic 65% Black, non-Hispanic 12% Other, non-Hispanic 4% 2+ race, non-Hispanic 16% Hispanic 3%	Y
Niederdeppe, Shapiro, et al. (2014)	Those who took an average of <2 seconds to answer each question	500	43% M 57% F	18-83 years (<i>M</i> = 36.4, <i>SD</i> = 16.3)	80% non-Hispanic White	N
Niederdeppe, Gollust, et al. (2014)	Able to complete in English	5147	52% M 48% F	18-24 - 7.2% 25-34 - 11.2% 35-44 - 17% 45-54 - 24.5% 55-64 - 40.1%	White, Non-Hispanic - 74.4% Black, Non-Hispanic - 10.1% Other, Non-Hispanic - 2% Hispanic - 10.8% 2+ Races, non-Hispanic - 2.6%	Y
Allen et al. (2014) ^b	Age 18+, non-smokers, able to view the online video	863	44.5% M 55.5% F	< 40 36.6% 40-64 46.9% 65+ 16.5%	White 68.8% Black 12.7% Hispanic 10.7%	N
Bachhuber et al. (2015)	Age 18+	1685	52% M 48% F	18-24 12.3% 24-34 17.6% 35-44 16.3% 45-54 16.1% 55-64 20.5% 65+ 17.3%	White only 66.1% Black only 11.5% Other 22.5% Hispanic ethnicity 15.1%	Y
Niederdeppe, Heley, et al. (2015)	None	5007 (t1) 3901 (t2)	36.6% M	18-24 - 15.8% 25-34 - 23.9% 35-44 - 15.8%	White - 82.2% Black - 11.5%	N

			63.4% F	45-54 - 13.6% 55-64 - 17.7% 65+ - 13.2%	Hispanic/Latino - 9.4% Asian - 5.9% American Indian/Alaska Native - 2.2% Hawaiian or Other Pacific Islander - 1.1%	
Niederdeppe, Roh, et al. (2015)	None	718	47% M 53% F	Mean 48.26; SD (17.02)	White Non-Hispanic - 74% Black Non-Hispanic - 9% Other Non-Hispanic - 4% Hispanic - 9% 2+ Races Non-Hispanic - 4%	Y
Frederick et al. (2016) ^c	Age 18+	1750	42% M 57% F	1. M=21.2 (SD=2.7) 2. M=35.4 (SD=11.7) 3. M=37.2 (SD=12.7)	White - 31%, 75%, 81% Asian - 43%, 8%, 5% Hispanic - 6%, 6%, 4% Black - 1%, 7%, 6% Other - 19%, 4%, 4%	N
Kennedy-Hendricks et al. (2016)	Age 18+	1620	48% M 52% F	18-24 - 12.2% 25-34 - 18.4% 35-44 - 15.9% 45-54 - 16.5% 55-64 - 19.7% 65+ - 17.4%	White only - 65.4% Black only - 11.4% Other - 23.1% Hispanic - 15.2% Non-hispanic 84.8%	Y
Ortiz et al. (2016)	None	2580	45% M 55% F	18-29 - 23.5% 30-44 - 24.6% 45-60 - 31% 60+ - 20.9%	American Indian - 0.9% Asian - 4.7% African American - 3.4% Latino - 4.3% Non-Latino White - 86.8%	N
Scully et al. (2017)	Participants who hadn't worked in industries such as marketing, health promotion, market research, sugary drinks etc	6000	40.8% M 59.2% F	18-24 (7%) 25-34 (14.2%) 35-44 (14.1%) 45-54 (15.5%) 55-64 (21.5%) 65+ (27.2%)	Not reported	Y

Skurka (2017)	95% or higher approval rating on previous MTurk (survey panel) tasks	653	40.1% M 59.3% F 0.5% T 0.2% other	M=37.16 (SD=12.65) Range 18-83	White - 81.6% Black - 9.5% Chinese - 3.1% American Indian - 3.1% Asian Indian - 2.3%	N
White et al. (2017)	None	1183	44% M 56% F	18-29 - 16% 30-45 - 28% 46-64 - 38% 65+ - 19%	White - 61% Black - 12% Hispanic - 22% Other - 4%	Y
McGlynn and McGlone (2018)	Completion of 1000 previous panel tasks with 98% or higher rating	211	47% M 53% F	19-82 years (M=38.6, SD=12.48) 18-29 - 28.4% 30-39 - 30.3% 40-49 - 21.3% 50-59 - 11.8% 60+ - 8%	White Non Hispanic - 86.7% African American - 7.1% Hispanic - 4.7% Asian - 4.3% American Indian - 2.4% Pacific Islander/Hawaiian - 0.5%	N

a. Unweighted sample characteristics: males 51%, females 49%; age 18-29 17%, age 30-44 29%, age 45-59 39%, age 60+ 16%; White non Hispanic 72%, Black non Hispanic 10%, Other non Hispanic 4%, 2+ race non Hispanic 11%, Hispanic 3%

b. Unweighted sample characteristics: males 68.4%, females 31.6%; age 18-24 8.8%, age 25-39 16.9%, age 40-64 57.6%, age 65+ 16.7%; white 82.1%, Black 6.6%, Hispanic 4.6%, Other 6.7%

c. Paper reported four experiments in one paper, three relevant experiments reported here

Table 3. Risk of Bias Assessment for included studies*

Author & Year	Sequence Generation	Allocation Concealment	Baseline Characteristics	Incomplete Outcome Data	Blinding	Protection from contamination	Selective Outcome Reporting
Gollust et al. (2013)	?	□	□	?	□	□	□
McGinty et al. (2013)	?	□	□	□	□	□	□
Barry et al. (2014)	?	□	X	?	□	□	□
Niederdeppe, Shapiro, et al. (2014)	?	?	?	□	?	?	□
Niederdeppe, Gollust, et al. (2014)	?	□	?	?	□	□	?
Allen et al. (2014)	?	□	?	□	□	□	□
Bachhuber et al. (2015)	□	□	□	□	□	□	□
Niederdeppe, Heley, et al. (2015)	?	□	□	□	□	□	□
Niederdeppe, Roh, et al. (2015)	?	□	□	□	□	□	□
Frederick et al. (2016)	?	?	X	?	?	?	□
Kennedy-Hendricks et al. (2016)	?	□	□	□	□	□	□
Ortiz et al. (2016)	□	□	□	□	□	□	□
Scully et al. (2017)	?	□	□	□	□	□	□
Skurka (2017)	?	□	X	□	□	□	□
White et al. (2017)	□	□	□	□	□	□	□
McGlynn and McGlone (2018)	?	□	□	□	□	□	□

*□=Low, X=High, ?=Unclear

Figures

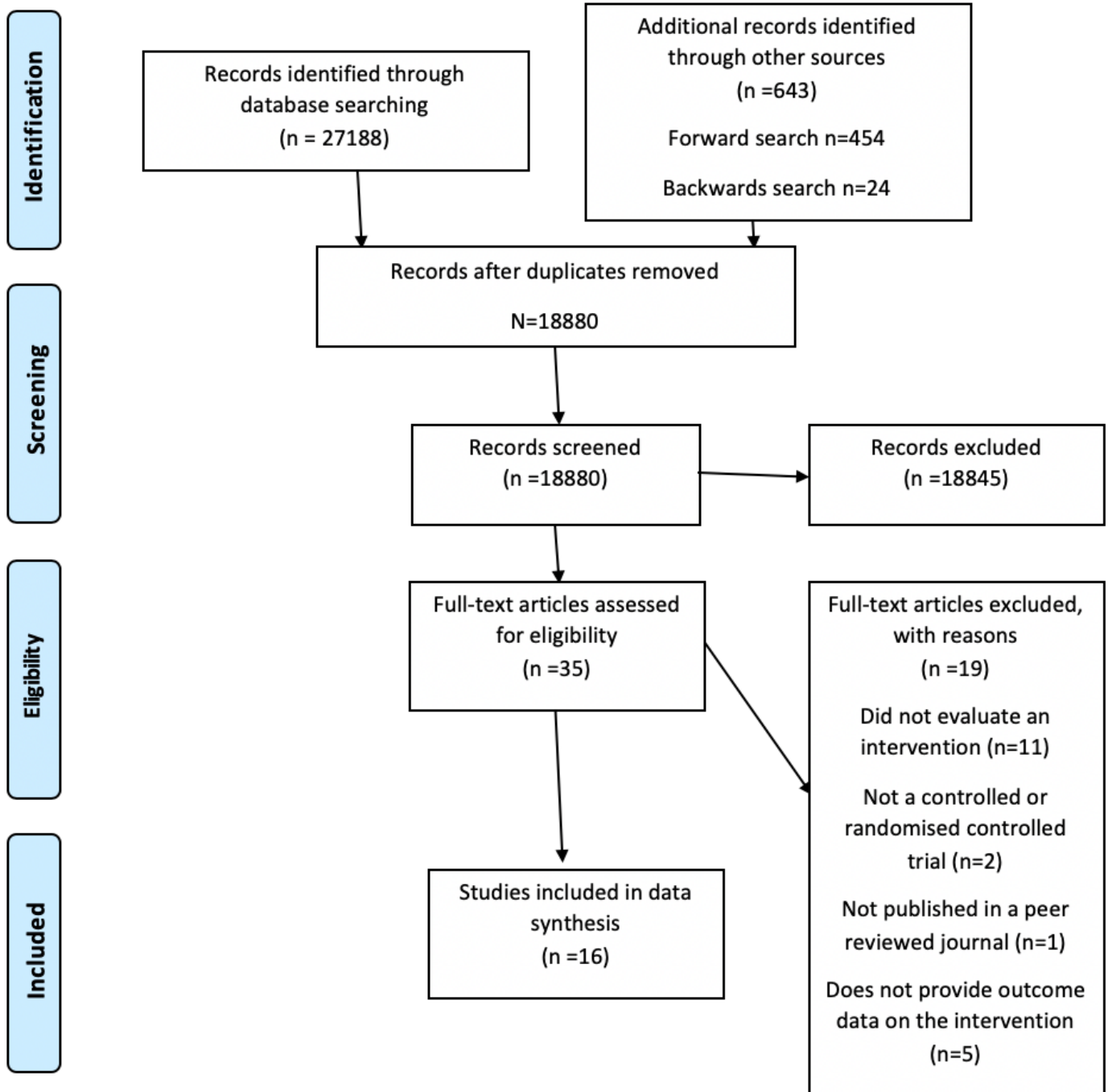
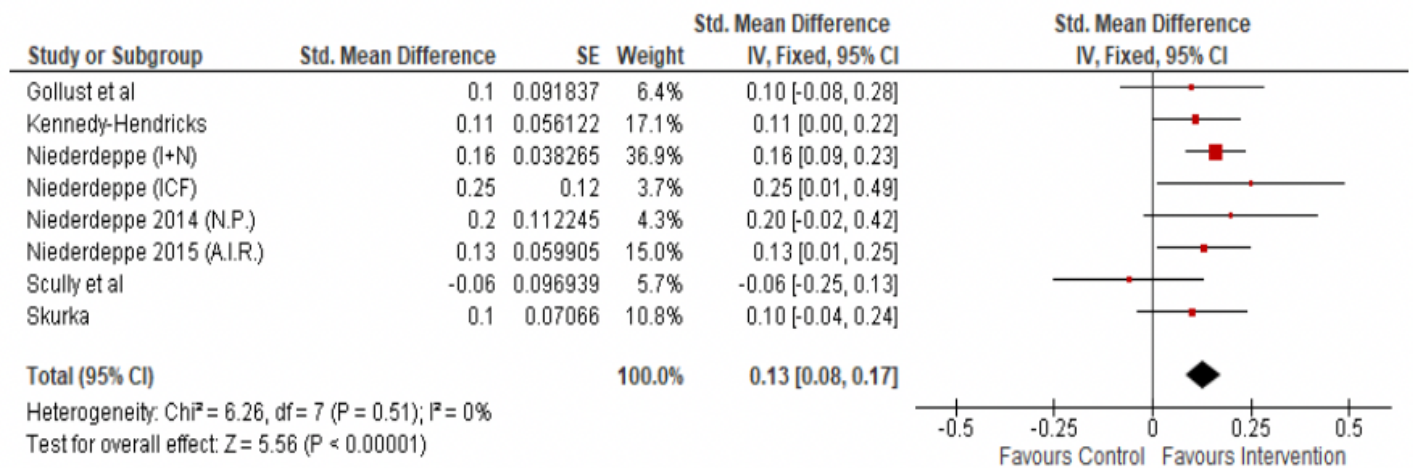


Figure 1

PRISMA Flowchart



* measured both 1-5 and 1-7 likert scales

Figure 2

Meta analysis of intervention effect estimates with continuous outcomes

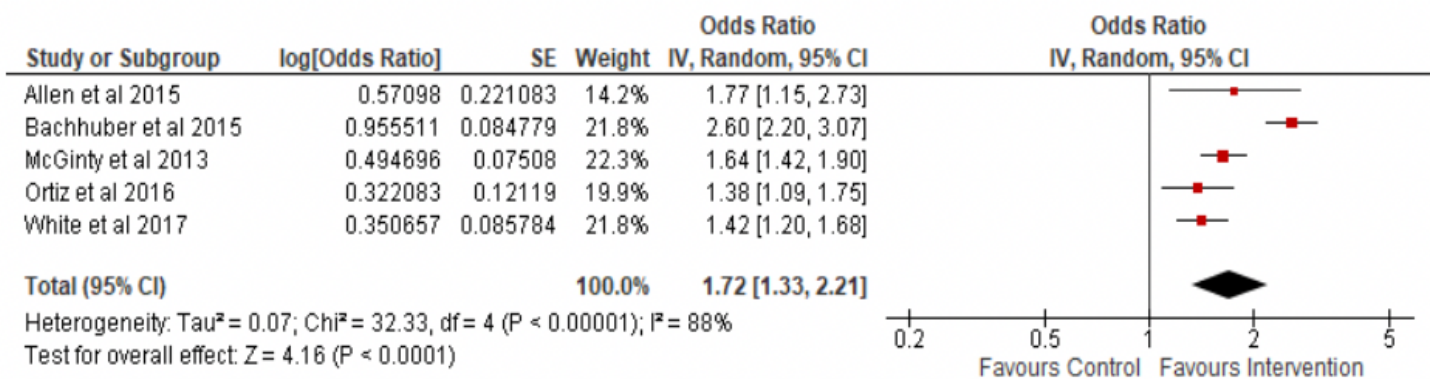


Figure 3

Meta analysis of intervention effect estimates on binary outcomes

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [PRISMA Checklist Feb 2020.doc](#)