Effects of e-cigarette advertising, promotion, and sponsorship on people's attitudes, beliefs, perceptions, intentions, and behaviours: a mixed-methods systematic review

EVIDENCE EVALUATION REPORT

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Abstract

Background:

Tobacco smoking in Australia is at an historic low, primarily owing to the implementation of evidence-informed tobacco control measures. However, there are now concerns about the uptake of electronic cigarettes (e-cigarettes) in Australia, particularly among young adults. The way in which e-cigarettes are being promoted is an important issue globally, and is likely to be a factor driving uptake of the products. However, while primary studies are available, to date there does not appear to be a robust systematic review on the topic of the impacts of e-cigarette advertising and other forms of e-cigarette promotion.

Objectives:

The objective of this review was to systematically appraise both quantitative and qualitative evidence on the effects of e-cigarette advertising, promotion, and sponsorship on a range of attitudinal and behavioural outcomes. The specific research questions addressed in the systematic review were:

1. What is the impact of advertising, promotion, and sponsorship on knowledge, attitudes, belief, intentions, and behaviours related to e-cigarettes?
2. What are people's perceptions of e-cigarette advertising, promotion, and sponsorship and the effects of these activities?

Search methods:

The following databases were searched on 28th June 2021: PubMed, EMBASE, CINAHL, PsycINFO, Cochrane Central Register of Controlled Trials and clinicaltrials.gov. The search terms are listed in Appendix 2 of the accompanying technical report. The reference lists of studies that met eligibility criteria were manually screened to identify newer studies.

Selection criteria for quantitative studies:

Studies that met the following criteria were included:

- Population:
  Studies involving at least one of the following population groups, with no age restrictions were included:
  - General population, regardless of smoking status
  - Current e-cigarette smokers (nicotine or non-nicotine) (used within the past 30 days
  - Former e-cigarette smokers (nicotine or non-nicotine) (tried/used e-cigarettes but not in the past 30 days)

- Never e-cigarette users
- Current tobacco-only smokers (not e-cigarette users) (used within the past 30 days)
- Former smokers (tried/used any form of smoking tobacco, but not in the past 30 days)
- Never smokers (never used any form of smoking tobacco)
- Non-tobacco smokers (never and former users together)
- Dual users (used both e-cigarettes and combustible cigarettes in the past 30 days)

- Exposures:
  Studies on exposure to any type of e-cigarette advertising, promotion, and sponsorship were included, irrespective of the media of dissemination. Studies on regulations of e-cigarette advertising, promotion, and sponsorship were considered for inclusion.

- Comparators:
  Studies were included irrespective of whether there was a defined comparator group used in analyses.

- Outcomes:
  Studies reporting the following outcomes were included:

  - **Primary Outcomes**
    Behaviours among the specified population groups:
    - Uptake/initiation of e-cigarette use (nicotine or non-nicotine) and/or combustible cigarette use
    - Frequency and/or intensity/quantity of consumption of e-cigarettes (nicotine or non-nicotine) and/or combustible cigarettes use
    - Continuation or maintenance of e-cigarette use and/or combustible cigarette use
    - Quitting combustible cigarette use and/or e-cigarette use

  - **Secondary Outcomes**
    - Total nicotine consumption
    - Knowledge, attitudes, and beliefs about e-cigarettes among the specified population groups
    - Intentions to use e-cigarettes (nicotine or non-nicotine) among the specified population groups

- Study Design:
  Primary studies with the following study designs were eligible for inclusion:

- Intervention study designs:
  - Randomised controlled trials, cluster-randomised trials, quasi-randomised trials
  - Non-randomised controlled trials
  - Controlled before and after studies
  - Interrupted time series (with multiple time points before and after an intervention)
  - Pre-post study designs
- Observational study designs:
  - Cohort studies
  - Cross-sectional studies or surveys (analytical)
  - Case-control studies
- Quantitative components of mixed methods studies provided they had any of the following afore-mentioned quantitative designs

- Setting

  Only studies from Australia, Canada, the European Union, New Zealand, the UK, and the US were included. Multi-country studies were excluded that did not present data in a disaggregated manner to provide access to results from the specified countries/regions.

- Other restrictions

  Studies published in non-English languages (where a publicly available translation was not available), studies that were published in abstract form only (with no full-length publication available), and non-peer reviewed studies were not included as pre-specified in the protocol.

Selection criteria for qualitative studies

Studies meeting the following criteria were included:

- Types of phenomena of interest:

  Studies with a specific focus on beliefs, perceptions, and attitudes towards the advertising, promotion, and sponsorship of e-cigarettes were included.

- Study design:

  Studies that used qualitative approaches considered valid and relevant for both data collection and data analyses were included. Focus groups, individual in-depth interviews, and ethnographic interviews were considered as valid and relevant tools for qualitative data collection; narrative analysis, thematic analysis, and grounded theory were considered relevant and valid methods for qualitative analyses. Studies that used qualitative methods for data collection but did not analyse the data qualitatively were excluded.

- Participants:

  Studies involving at least one of the following population groups were included:

  - General population, regardless of smoking status
  - Current e-cigarette smokers (nicotine or non-nicotine) (used within the past 30 days
  - Former e-cigarette smokers (nicotine or non-nicotine) (tried/used e-cigarettes but not used in the past 30 days)
  - Never e-cigarette users
  - Current tobacco-only smokers (not e-cigarette users) (used within the past 30 days)
  - Former smokers (tried/used any form of smoking tobacco, but not in the past 30 days)
  - Never smokers (never smoked any form of smoking tobacco)
  - Non-tobacco smokers (never and former users together)
  - Dual users (used both e-cigarettes and combustible cigarettes in the past 30 days)

- Setting:
  Only studies published from January 01, 2015 onwards and from Australia, Canada, the European Union, New Zealand, the UK, and the US were included.

- Other restrictions:

  Studies published in non-English languages (where a publicly available translation was not available), studies that were published in abstract form only (with no full-length publication available), and non-peer reviewed studies were not included as pre-specified in the protocol.

Data collection and analysis:

We used standard evidence synthesis methods wherein screening and data extraction was undertaken by at least two independent review authors. Any discrepancies were resolved by consensus with a third review author acting as arbiter. A data extraction form, designed a priori, was used to extract data, with some modifications for ease of extraction made in the initial phase. Standard risk of bias assessment tools of Cochrane, Joanna Brigs Institute and CASP were used. Meta-analysis was conducted whenever it was appropriate to pool results. If meta-analysis was not appropriate, a narrative synthesis was conducted. Where possible, the association between the exposures and outcomes of interest was investigated by combining similar measures of risk pooled in statistical meta-analysis using inverse variance. Effect estimates (odds ratios, as reported in the majority of the studies) and 95% confidence intervals (CIs) were extracted and entered in the calculator in RevMan, which then converted

these values into natural logarithms (as a log odds ratio and CIs, and the standard error (SE) of the log odds ratio). Sub-group and sensitivity analyses were performed if an adequate number of studies was available.

A thematic synthesis analysis was conducted on the included qualitative studies.

The certainty of evidence for quantitative and qualitative studies was assessed using the GRADE and GRADE CERQual approach.

Results:

The electronic databases search resulted in 4224 records, which were screened to identify 68 records that met selection criteria. A hand search of the reference lists of included records identified a further eight records, resulting in the inclusion of a total of 76 records in the systematic review (69 quantitative studies and seven qualitative studies).

Of the 69 quantitative studies included in the review, most were cross-sectional in design (n = 43), with cohort studies (n = 15) and randomised controlled trials (n = 10) being the next most common study designs. One quasi-experimental study was included. Most of the studies (n=51) focussed on school-aged adolescents (12-17 years) and young adults (18-25 years), and 18 studies focussed on adults in general. A large majority of the studies were conducted in the US (n = 56), and only four were multi-country studies.

Of the seven qualitative studies included in the review, six were conducted in the US and one in Australia. Two studies were conducted with young adults (aged 18-24 or 18-29), two with adolescents (aged 12-17 or 10-18), one with adults, and one with adolescents with hearing impairments and key staff working at their schools.

The review found evidence relating to numerous individual and combinations of media: radio, television, television + radio (combined), television + movies (combined), billboards/posters, print media, social media, point of sale, internet, mail (e-mail and/or postal), and 3+ media combined. For most media types/combinations, the evidence was of low to very low certainty and effect sizes often varied. The significant results found in quantitative studies assessed as having moderate or high certainty of evidence for primary outcomes are as follows.

Among adolescents, exposure to e-cigarette advertising in **print media** was associated with increased odds of current e-cigarette use (OR 1.33, 95% CI 1.19-1.48, 2 studies, 43,602 participants, moderate certainty evidence), frequency of e-cigarette use (OR 3.40 , $p < 0.001$, 21,491 participants, high certainty of evidence), and ever use of e-cigarettes (OR 1.22, 95% CI 1.07-1.39, 22,007 participants, moderate certainty evidence). Exposure to advertising in **websites and social media** (combined) was associated with higher odds of current e-cigarette use (OR 2.57, 95% CI 2.02-3.27, 12,064 participants, high certainty evidence). Exposure to **social media**

advertisements alone was associated with increased odds of e-cigarette uptake (OR 2.60, 95% CI 1.56-4.35, 2 studies, 22,604 participants, moderate certainty evidence). Exposure to e-cigarette advertising in **retail stores** was associated with greater odds of current use of combustible cigarettes (OR 1.69, 95% CI 1.06-2.68, 2 studies, 391,395 participants, moderate certainty evidence).

Among adolescents, there was moderate certainty of evidence that greater exposure (sometimes/most of the time/always) to e-cigarette advertisements across **multiple media sources (3+media)** was associated with higher odds of e-cigarette initiation compared to those who were never/rarely exposed (OR 1.64, 95% CI 1.45-1.86, 3 studies 27,025 participants), greater odds of current e-cigarette use (OR 6.42, 95% CI 2.28-18.11, 71,702 participants), and greater odds of current combustible cigarette use compared to no exposure or exposure rarely (OR 1.40, 95% CI 1.27-1.55, 4 studies, 58,320 participants).

Among adolescents and young adults, exposure (sometimes/most of the time/always) to advertisements on 2-3 media increased the odds of current e-cigarette use compared to no exposure (OR 2.11, 95% CI 1.77-2.52, 3 studies, 16,117 participants, high certainty of evidence).

Three themes emerged from the thematic analysis of the included qualitative studies: (1) Exposure to e-cigarette advertising occurred both actively and passively, resulting in changed perceptions of the risk profile of e-cigarettes (moderate confidence in findings); (2) Strategies used to enhance the appeal and believability of advertisements are effective in influencing perceptions (moderate confidence in findings); and (3) Exposure to individuals doing ‘vape tricks’ on social media (moderate confidence in findings).

Authors’ conclusions:

The available evidence is largely confined to cross-sectional studies conducted in the US. However, the size of the body of evidence and the general consistency in results across the assessed studies supports the contention that e-cigarette advertising across a wide range of media is positively associated with e-cigarette use among young people. This finding is consistent with outcomes in related substance use areas and supports the implementation of appropriate restrictions on e-cigarette marketing to reduce harms among young people.

Registration:

The protocol was registered a priori with PROSPERO (CRD42021264018) and Open Science Registry (DOI 10.17605/OSF.IO/8U2QT).

Introduction to the report

This report assesses the evidence on the effects of e-cigarette advertising on a range of attitudinal and behavioural outcomes. The primary outcome variables relate to behavioural outcomes of initiation, ever use, current use, and frequency of e-cigarette use. The secondary outcome variables focus on e-cigarette-related knowledge, attitudes, beliefs, and intentions. The work has been commissioned by the National Health and Medical Research Council (NHMRC) to inform the revision and update of the NHMRC 2017 CEO Statement on E-cigarettes.

The structure of this report is as follows:

- Background: provides a brief outline of the evolution and status of e-cigarette marketing
- Methodology: describes the process undertaken to identify and analyse relevant studies
- Findings: summarises the results across the various assessed outcomes
- Discussion: outlines the main findings and identifies gaps and limitations
- Comprehensive appendices

Background

Electronic cigarettes (e-cigarettes) are devices that produce aerosols by heating a liquid that usually contains flavourings, other chemicals, and, depending on the specific product, nicotine.[1] They are also commonly known as 'e-cigs,' 'e-hookahs', 'mods', 'vape pens', 'vapes', and 'electronic nicotine delivery systems (ENDS)'.[1] E-cigarettes were first introduced in China in 2004, and entered global markets in 2007,[2] with their use steadily increasing over time.

The results of the most recent National Drug Strategy Household Survey indicated that 2.6% of Australians aged 14 and over were current e-cigarette users in 2019, up from 1.2% in 2016.[3] Ever use prevalence is substantially higher; in 2019, 11.3% reported having ever used e-cigarettes, with the highest rate (26.1%) found among young adults aged 18-24 years.[3] Overall, the uptake of e-cigarettes in Australia is lower than in many culturally similar countries such as the United States (US) and the United Kingdom (UK), where current use levels are at 4.4% and 5.7%, respectively.[4 5] This difference in uptake is likely to be attributed to Australia's tobacco prevention control measures covering the sale and supply of nicotine-containing e-cigarettes.[6] Australia's low tobacco smoking rates may have also contributed to the relatively low uptake of e-cigarettes.[7]

Although e-cigarette usage rates in Australia are low by international standards, more recent evidence indicates that uptake and usage may be increasing quickly. For example, the seizure of illegal e-cigarette products in NSW alone increased 10-fold between March 2020 and March 2021.[8] and a study of e-cigarette users found that 43% reported increasing their use between March 2020 and mid 2021.[9] There is also a growing number of e-cigarette device options,[10] potentially providing more affordable alternatives for price-sensitive youth.

While some proponents of e-cigarettes argue they are an effective smoking cessation tool,[11] the benefits remain equivocal[12] and a growing body of research supports the proposition that e-cigarettes can act as a gateway to cigarette smoking, particularly among youth.[13 14] Due to the relatively recent emergence of e-cigarettes, there is a lack of evidence from longitudinal studies on health effects,[11] however shorter-term studies have identified harmful respiratory and cardiovascular outcomes.[15] On the basis of the available evidence, the World Health Organization recommends "preventing or restricting advertising, promotion, and sponsorship" of e-cigarettes.[16]

Regulatory environment

The regulation of e-cigarettes in Australia is currently a shared responsibility of both the Commonwealth and state and territory governments, through laws across tobacco control, therapeutic goods, poisons, and consumer protection. E-cigarettes that contain nicotine currently cannot be sold due to nicotine being classified as a

dangerous poison under the *Standard for the Uniform Scheduling of Medicines and Poisons* ('Poisons Standard') Schedule 7.[17] E-cigarettes that do not contain nicotine can be purchased by anyone over the age of 18 in all states except Western Australia, where any items that resemble tobacco products are prohibited.

Under the National Therapeutic Goods Act, nicotine e-cigarettes are regulated as prescription medications, and thus cannot be advertised to consumers. There are also regulations at the state and territory level that prohibit the advertising, promotion, and sponsorship of both nicotine and non-nicotine e-cigarettes. These laws encompass most types of advertising, including print, tv, and radio to point of sale.[18] Additionally, they restrict the display of any e-cigarette product at point of sale, except in Victoria, where certified specialist e-cigarette retailers, defined as businesses whose primary business is the sale of e-cigarettes, can display products in their stores.[19]

Online marketing

Australian surveillance data indicate that 70% of e-cigarette purchases are made online.[20] Currently, only non-nicotine e-cigarettes can be purchased online through Australian vendors, and nicotine e-cigarettes can be purchased online through international vendors. Despite the bans on advertising of e-cigarettes in Australia, Australian online retailers of e-cigarettes are not subject to the same point-of-sale marketing restrictions as brick and mortar retailers except in South Australia, where the online marketing and sale of e-cigarette products was banned in April 2019.[21] While the marketing of e-cigarettes on websites selling e-cigarettes has not been systematically studied, a scan of websites such as Vaperempire (www.vaperempire.com.au) and Vapeking (www.vapeking.com.au) demonstrates that price promotions, such as online games and discounted products, are being used, as well as advertisements that promote different aspects of vaping products, such as flavours of e-juices (e-liquids) and specifications of vape tanks. Australian regulations also do not prevent exposure to online marketing of both nicotine and non-nicotine e-cigarettes on international websites.

Studies show that e-cigarettes are marketed on a range of online platforms including Twitter,[22 23] Instagram,[22] YouTube,[22 24] TikTok,[25] Facebook,[26 27] Pinterest,[22] Internet search engines, and banner/video advertisements[28]. Due to the borderless nature of social media, posts from any country can be viewed in Australia on these platforms and, as such, international practices are relevant here.

The major global social media platforms have enacted policies regarding tobacco marketing that in most cases extend to e-cigarettes. Paid marketing of tobacco products and related paraphernalia, including private sales, trades, and transfers, is banned on Facebook, YouTube, Instagram, Reddit, Twitter, LinkedIn, Pinterest, and TikTok.[29] Facebook, however, does allow the marketing and sale of clothing that features a tobacco brand logo.[27] While non-specific, this exemption would seem to also apply to e-cigarette brands.

The policies for the majority of these platforms do not extend to the accounts of individuals, including influencers and fan pages/groups.[23] This means social media users are still exposed to e-cigarette marketing, primarily through the accounts of individual users, including sponsored posts by influencers or non-sponsored posts by individuals via fan pages/groups.[22 23 26 27] The exception is Instagram, which from December 2019 banned the use of product endorsements such that social media influencers are no longer able to promote e-cigarettes through hashtags or posts showing that they were gifted the devices.[30]

While social media platforms have banned paid advertising, the difficulties associated with monitoring and policing the content of almost 3 billion users means such policies are not always consistently enforced. Studies have shown that e-cigarette companies are circumventing Facebook's advertising bans by establishing brand-sponsored profile pages[27] and encouraging the creation of, or directly creating themselves, brand fan pages.[31] These pages have been found to have purchase links and sales promotions,[27] despite these tactics falling under the remit of paid advertising. Companies are also increasingly circumventing bans on paid advertising by using covert strategies such posting memes, links to sponsored events, and contests on their brand pages.[32 33] Additionally, studies have shown that many of these pages do not have age gates, despite Facebook's policy requiring that only those over 18 can view e-cigarette products for sale.[27] Facebook's current method of prohibiting e-cigarette promotions relies largely on individuals reporting violations of these advertising policies.[27]

Influence of international regulations on content seen in Australia

Due to the borderless nature of social media and the internet more broadly, some regulations in the US are applicable to the Australian context. For example, The United States' Master Settlement Agreement of 1998 restricts the use of cartoons for cigarette marketing, but not for e-cigarette marketing, which means e-cigarette packaging with cartoons can be located and purchased online by Australians.[34] This same legislation restricts the use of product placement for tobacco products but not e-cigarettes, and as such videos on YouTube and other social media platforms may display e-cigarette products or merchandise.

Common messages used to promote e-cigarettes on social media

The most recent review summarising international evidence on the types of messages being used to market e-cigarettes on social media was published in 2019.[22] The review included 18 studies of Twitter promotions, four of YouTube promotions, three of Instagram promotions, and one of Pinterest promotions.

The most common messages in online posts were found to be about health, safety, and harms. This content typically referred to e-cigarettes as being less harmful than conventional tobacco products. The second most common messages were those

promoting the use of e-cigarettes as a smoking cessation tool, and the third were those emphasising certain product types and characteristics such as brands, flavours, and nicotine content. Other identified common message themes were: promoting discounts, giveaways, and competitions; highlighting that e-cigarette use is more economical, cleaner, and environmentally friendly than tobacco smoking; information about how to customise e-cigarettes; and describing vaping tricks.

A study that specifically looked at promotions of e-cigarettes on Australian Twitter accounts similarly found that many posts detailed the putative health benefits of e-cigarettes and used promotional tactics such as contests, giveaways, and free shipping, and displayed/discussed e-liquid products with a particular focus on the appeal of different flavours.[23] The study also found that many posts emphasised a sense of community and shared identity around the use of e-cigarettes, such as by employing the hashtags #vapecommunity and '#vapefam.[23]

A study that examined how disposable e-cigarettes, specifically the 'Puff Bar' brand, were depicted on TikTok between November 2019 and May 2020 found that the 10 most viral videos, based on the number of views, had between 2.8 million and 42.4 million views.[25] Two of these videos included sale or promotional content and two explicitly portrayed youth using the product. The study was unable to determine, however, whether these videos were sponsored.[25]

Marketing techniques used to promote e-cigarettes

Use of cartoons

E-juice (also known as e-liquid) bottles are an important promotional tool for e-cigarettes because they are one of the components of e-cigarettes that can be customised with branding and imagery. A 2020 study examined the presence of cartoons on bottles of e-juice available for sale on a popular e-cigarette website, eliquid.com. The study found that of 1587 brands offering 7135 products, 311 brands (19%) offered 1359 products (19%) that had cartoons on the label.[34] Similarly, a study of Instagram posts over a 2-week period with the hashtag #ejuice or #eliquid found that 723 posts (21%) contained a cartoon and 479 posts (14%) contained brand logos that included a cartoon.[35]

Product placement

The use of product placement, which involves incorporating e-cigarettes, e-cigarette-branded merchandise, clothing, or other products into film, television, or other forms of media (e.g., short videos), has not been extensively studied. While e-cigarette product placement is not permissible in content produced in Australia, countries that produce large volumes of global media and entertainment content, such as the US, do not have such regulations.

A study examining e-cigarette product placement in popular music videos on YouTube found that 2.2% of the 180 sampled videos featured e-cigarette branded merchandise, 3.3% featured e-cigarette devices being used or held, and 0.5% featured an aerosol cloud.[20] Although this only amounted to 7 music videos in total, the combined views for these 7 videos on YouTube was 1.6 billion.[24]

Overall, exposure to e-cigarettes occurs across multiple mediums. Due to e-cigarette regulations in Australia, exposure is most likely to occur online, including on social media, and through product placement in videos, films, and television shows that are produced overseas. In Victoria (a jurisdiction within Australia), individuals may also be exposed to e-cigarette promotion at the point-of-sale at specialist e-cigarette retailers. As exposure can occur via multiple channels, it is important to study the impact of exposure to both individual and combined forms of media.

Review objective

The objective of this review was to systematically appraise both quantitative and qualitative evidence on the effects of e-cigarette marketing, promotion, and sponsorship on a range of attitudinal and behavioural outcomes. This review is required due to a growing body of evidence suggesting that e-cigarette marketing influences a range of e-cigarette-related outcomes including knowledge, intentions, and behaviours, yet no summary of the findings of this evidence base and its quality is currently available to inform policy decisions. In particular, this review provides insights into the relative impacts of different types of e-cigarette advertising, which can assist in the prioritisation of regulatory efforts.

Research questions

This systematic review aimed to understand the influence of advertising, promotion, and sponsorship of e-cigarettes on:

- Knowledge, attitudes, perceptions, and beliefs (what people think)
- Intentions (what people think they will do)
- Behaviours (what people have done, e.g. uptake and use of e-cigarettes).

The systematic review used a mixed method approach wherein quantitative and qualitative research syntheses were performed in a segregated manner, with a final synthesis done at the end (convergent-segregated approach).[36] Such an approach is useful for examining different aspects of the phenomenon being investigated to provide confirmation/refutation and complementarity that enables a more comprehensive understanding of the literature.

The specific research questions addressed in the review were:

3. What is the impact of advertising, promotion, and sponsorship on knowledge, attitudes, belief, intentions, and behaviours related to e-cigarettes?
4. What are peoples' perceptions of e-cigarette advertising, promotion, and sponsorship and the effects of these activities?

For the review, the term "e-cigarettes" referred to any electronic nicotine delivery system (ENDS), electronic non-nicotine delivery system (ENNDS), or alternative nicotine delivery system (ANDS). This included but was not limited to personal vaporisers, e-hookahs, vape pens, and vapes. Heated tobacco products or any other traditional tobacco products were not within the purview of the review.

The standard definition of e-cigarette advertising, promotion, and sponsorship as per Article 13 of the WHO Framework Convention on Tobacco Control (WHO FCTC)[37] was used for conducting the review:

- E-cigarette advertising and promotion: "any form of commercial communication, recommendation, or action with the aim, effect, or likely effect of promoting e-cigarette use either directly or indirectly".
- E-cigarette sponsorship: "any form of contribution to any event, activity, or individual with the aim, effect, or likely effect of promoting e-cigarette use either directly or indirectly".

Mediums for e-cigarette advertising, promotion, and sponsorship included but were not limited to the following:

- Point of sale (tobacco/e-cigarette retail outlets, duty-free stores)
- Social media platforms (e.g. Facebook, Twitter, Instagram)
- Internet websites
- Print media (e.g. newspapers, magazines)
- Broadcast (e.g. radio, television, movies)
- Streaming services or over-the-top media
- Events (e.g. concerts, sports, fashion shows, etc.)
- Direct marketing channels (e.g. telemarketing, broadcasting, e-mail)
- Commercial communication through health service providers or quit support groups
- Word of mouth or peer group communications

Methodology

The protocol was registered a priori with PROSPERO (CRD42021264018) and Open Science Registry (DOI 10.17605/OSF.IO/8U2QT).

Detailed information on the methods, including the PRISMA reporting checklist, is provided in the Technical Report, a companion document to complement the current evidence evaluation report. Only a short summary of methods is presented here.

Eligibility criteria for quantitative studies

Studies that met the following criteria were included:

- **Population**:

  Studies involving at least one of the following population groups, with no age restrictions were included:

  - General population, regardless of smoking status
  - Current e-cigarette smokers (nicotine or non-nicotine) (used within the past 30 days
  - Former e-cigarette smokers (nicotine or non-nicotine) (tried/used e-cigarettes but not used in the past 30 days)
  - Never e-cigarette users
  - Current tobacco-only smokers (not e-cigarette users) (used within the past 30 days)
  - Former smokers (tried/used any form of smoking tobacco, but not in the past 30 days)
  - Never smokers (never used any form of smoking tobacco)
  - Non-tobacco smokers (never and former users together)
  - Dual users (used both e-cigarettes and combustible cigarettes in the past 30 days)

- **Exposures:**

  Studies on exposure to any type of e-cigarette advertising, promotion, and sponsorship were included, irrespective of the media of dissemination. Studies on regulations of e-cigarette advertising, promotion, and sponsorship were considered for inclusion. Studies that assessed the effects of ads featuring harm-reduction themes to promote e-cigarettes were included, as this is a potential marketing strategy for these products. Studies on the effects of social marketing initiatives designed to prevent harm from e-cigarette use (by health authorities or non-government organisations) were out of scope of the review. Studies were included irrespective of the duration of exposure and/or intensity/frequency of exposure.

- **Comparators**:

Studies were included irrespective of whether there was a defined comparator group used in analyses.

- **Outcomes:**

Studies reporting the following outcomes were included:

  - **Primary Outcomes**

    Behaviours among the specified population groups:
    - Uptake/initiation of e-cigarette use (nicotine or non-nicotine) and/or combustible cigarette use
    - Frequency and/or intensity/quantity of consumption of e-cigarettes (nicotine or non-nicotine) and/or combustible cigarettes use
    - Continuation or maintenance of e-cigarette use and/or combustible cigarette use
    - Quitting combustible cigarette use and/or e-cigarette use

  - **Secondary Outcomes**
    - Total nicotine consumption
    - Knowledge, attitudes, and beliefs about e-cigarettes among the specified population groups
    - Intentions to use e-cigarettes (nicotine or non-nicotine) among the specified population groups

Outcomes related to specific user-behaviour (uptake and consumption) of e-cigarettes or combustible cigarettes were classified as primary outcomes as they are measurable outcomes related to use. All other outcomes were treated as secondary outcomes. No exercise to rank or prioritise outcomes was undertaken as this was beyond the scope of this review.

Outcomes were classified into these categories according to the definitions specified by the primary study authors. The outcome relating to continuation or maintenance of e-cigarette and/or combustible cigarette use was typically reported as current use in studies. Outcomes related to e-cigarette experimentation and susceptibility (irrespective of the modality of measurement) were classified under the intention to use e-cigarette outcome.

The time-points of the outcomes measured were determined by the included studies and were explicitly mentioned in the review report. Outcome time-points were captured up to the longest period of follow-up. An inclusive outcome measurement/definition approach was followed to enable capturing

of maximal evidence such that outcomes measured in terms of frequency/proportion or any other modality were included. Studies that reported exclusively on health outcomes associated with use of e-cigarettes or prevalence of uptake/use of e-cigarettes generally (not associated with the impact of advertising/marketing) were not included.

- **Study Design**:

  Primary studies with the following study designs were eligible for inclusion:

  - Intervention study designs:
    - Randomised controlled trials, cluster-randomised trials, quasi-randomised trials
    - Non-randomised controlled trials
    - Controlled before and after studies
    - Interrupted time series (with multiple time points before and after an intervention)
    - Pre-post study designs
  - Observational study designs:
    - Cohort studies
    - Cross-sectional studies or surveys (analytical)
    - Case-control studies
  - Quantitative components of mixed methods studies provided they had any of the following afore-mentioned quantitative designs

  Observational study designs were included because of the challenges conducting interventional research due to the wide array of factors implicated in behaviours around tobacco and e-cigarette use, and the diffuse and pervasive nature of advertising, promotion, and marketing strategies. We did not include any other study designs (e.g., case-series) as they cannot be used to determine association.

- **Setting**

  Only studies from Australia, Canada, the European Union, New Zealand, the UK, and the US were included. Multi-country studies were excluded that did not present data in a disaggregated manner to provide access to results from the specified countries/regions.

- **Other restrictions**

  Only studies published from January 01, 2015 onwards were included. The cut-off date was determined by the NHMRC Electronic Cigarettes Working Committee on the basis that almost all literature on e-cigarette advertising has been published from 2015 onwards. Studies published in non-English languages (where a publicly available translation was not available), studies that were published in abstract form only (with no full-length publication

available), and non-peer reviewed studies were not included as pre-specified in the protocol.

Eligibility criteria for qualitative studies

Studies meeting the following criteria were included:

- **Types of phenomena of interest:**
  Studies with a specific focus on beliefs, perceptions, and attitudes towards the advertising, promotion, and sponsorship of e-cigarettes were included. There were no limits in terms of the duration of promotion, the intensity (frequency) of the advertising, or the numbers and types of media employed. Content analyses related to audience behaviours/reactions were included. Studies that only analysed the content of advertisements with no analysis of audience behaviours/reactions were excluded as they do not provide any information relevant to the research questions. Studies that primarily focussed on other aspects of e-cigarette use, including the perceived impacts and harms of e-cigarettes, were not included.

- **Study design:**
  Studies that used qualitative approaches considered valid and relevant for both data collection and data analyses were included. Focus groups, individual in-depth interviews, and ethnographic interviews were considered as valid and relevant tools for qualitative data collection; narrative analysis, thematic analysis, and grounded theory were considered relevant and valid methods for qualitative analyses. Studies that used qualitative methods for data collection but did not analyse the data qualitatively were excluded. Qualitative components of mixed-methods study design were included, provided they met other criteria.

- **Participants**:
  Studies involving at least one of the following population groups were included:

  - General population, regardless of smoking status
  - Current e-cigarette smokers (nicotine or non-nicotine) (used within the past 30 days
  - Former e-cigarette smokers (nicotine or non-nicotine) (tried/used e-cigarettes but not used in the past 30 days)
  - Never e-cigarette users
  - Current tobacco-only smokers (not e-cigarette users) (used within the past 30 days)
  - Former smokers (tried/used any form of smoking tobacco, but not in the past 30 days)
  - Never smokers (never smoked any form of smoking tobacco)

779 - Non-tobacco smokers (never and former users together)
780 - Dual users (used both e-cigarettes and combustible cigarettes in the
781 past 30 days)
782
783 • **Setting:**
784 Only studies published from January 01, 2015 onwards and from Australia,
785 Canada, the European Union, New Zealand, the UK, and the US were included.
786 The cut-off date was determined by the NHMRC Electronic Cigarettes Working
787 Committee on the basis that almost all literature on e-cigarette advertising has
788 been published from 2015 onwards. Multi-country studies where results were
789 not presented in a disaggregated manner to report on the specified countries
790 were excluded.

791 • **Other restrictions:**
792 Studies published in non-English languages (where a publicly available
793 translation was not available), studies that were published in abstract form only
794 (with no full-length publication available), and non-peer reviewed studies were
795 not included as pre-specified in the protocol.

796 ## Information sources

797 ### Electronic database search

798 The following databases were searched on 28th June 2021:

799 • PubMed (https://pubmed.ncbi.nlm.nih.gov)
800 • EMBASE (https://www.embase.com/landing)
801 • CINAHL (https://www.ebsco.com/products/research-databases/cinahl-full-text)
802 • PsycINFO (https://www.wolterskluwer.com/en/solutions/ovid/apa-psycinfo-
803 139)
804 • Cochrane Central Register of Controlled Trials
805 (https://www.cochranelibrary.com/advanced-search)
806 • clinicaltrials.gov (https://clinicaltrials.gov)

807 We could not search WHO ICTRP as planned because it was not available by the date
808 data extraction commenced on 5th July 2021. The full search strategies used for all
809 databases are presented as an appendix to the accompanying technical report.

810 ### Other methods for searching

811 The reference lists of studies that met eligibility criteria and were retrieved by other
812 modalities of search were manually screened for identifying newer studies.

Screening process and data management

At least two authors independently screened each reference, extracted data, and conducted the risk of bias assessments. Disagreements were resolved by consensus between two authors, with a third author acting as arbiter if necessary. Authors of studies were not contacted for additional data and only data as reported in published versions was included.

Relevant details of all studies included in the review were extracted. These included the country where the study was conducted, study design, setting, eligibility criteria for study participants, participants' characteristics, type of advertising/marketing medium, exposures and comparators (where applicable), confounders or covariates, exposure and outcome measurement methods, effect estimates and results relevant to the outcomes of interest, source of study funding, and conflicts of interest.

Risk of bias in included quantitative studies

The following risk of bias assessment tools developed by Cochrane (UK) and Joanna Briggs Institute (JBI, Australia) were used (these two entities are norm-setting organisations in evidence synthesis globally):

- For randomised controlled trials, cluster-randomised trials, and quasi-randomised trials: Cochrane Risk of Bias 1.0 tool.[38]
- For other interventional study designs: JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomised experimental studies).[39]
- For observational studies: JBI Critical Appraisal Checklist for cohort, analytical cross-sectional, and case-control studies.[39]

No specific outcome wise assessment is required for JBI tools. For the Cochrane risk of bias tool, we used the primary outcome relevant to the study for assessing risk of domains related to outcomes. In terms of the critical appraisal approach for quasi-experimental and observational studies, the reviewers agreed prior to commencing the appraisal process on what would be deemed an acceptable level of information within a study for it to receive a positive rather than a negative or unclear rating. When determining the quality of a study using the JBI critical appraisal tool, an overall score summarising the individual scores from each item in the checklist is not used as a way to rate the quality of the study. Rather, it is best practice to consider a combination of criteria to rate the overall quality of a study, including the method of selection of participants, the exposure and outcome measurements used, the presence and measurement of confounders and whether appropriate statistical analysis is used. This is the approach taken by the reviewers for this study.

Risk of bias assessment of included qualitative studies

Risk of bias assessment of included qualitative studies was undertaken by using the Critical Appraisal Skills Programme (CASP) tool for qualitative studies (Critical Appraisal Skills Programme 2018).[40]

Synthesis for quantitative studies

The systematic review was broad. Meta-analysis was conducted whenever it was appropriate to pool results. Results were not pooled for studies that had substantial differences in populations (e.g., age-groups – adolescents, young adults, adults in general), exposure types, study designs, or outcome metrics, or had poor reporting (described in the text, e.g., confidence limits were not reported), or if there was methodological heterogeneity that could not be explained. Under such circumstances, a narrative synthesis was conducted with the data arranged in a tabular format to enable inspection and assessment of the potential patterns within the data.

Where possible, the association between the exposures and outcomes of interest was investigated by combining similar measures of risk derived from the included studies in meta-analysis. Where possible, the results have been pooled in statistical meta-analysis using inverse variance method (RevMan 5.4.1, The Cochrane Collaboration). Effect estimates (odds ratios, as reported in the majority of studies) and 95% confidence intervals (CIs) were extracted and entered in the calculator in RevMan, which then converted these values into natural logarithms (as a log odds ratio and CIs, and the standard error (SE) of the log odds ratio).

For cluster-randomised trials, the plan was to report the authors' methods for adjusting their analyses for the intra-cluster correlation coefficient (ICC) if they used individual participants as the unit of analysis. In the case of multi-arm studies, the plan was to combine all relevant exposure groups into a single large group. However, the review did not find any non-standard study designs (cluster RCTs and interrupted time series) and multi-arm studies in the evidence base.

A random effects model with 95% CI as per Cochrane (Chapter 10.3.2) and JBI guidelines (Chapter 3.3.2) for each exposure-outcome pair separately was used for meta-analysis and exploring heterogeneity. Heterogeneity of included studies of a particular exposure-outcome pair was assessed by visual inspection of forest plots, the standard Chi^2 test (p value), or the I^2 statistic.[41] A p value of less than 0.10 was considered statistically significant in terms of heterogeneity for the standard Chi^2 test. For the I^2 statistic, heterogeneity was determined according to the following criteria:

- 0% to 40%: might not be important
- 30% to 60%: may represent moderate heterogeneity
- 50% to 90%: may represent substantial heterogeneity
- 75% to 100%: considerable heterogeneity

Heterogeneity was explored if there was substantial heterogeneity. This was done using various strategies (including but not limited to using fixed-effects models and subgroup analyses) in alignment with the guidance from the Cochrane handbook (Chapter 10.10.2) and JBI guidelines (Chapter 3.3.10.2).

Effect modification (i.e., different effects for different groups) was explored through sub-group analyses. Sub-group analyses were conducted to explain heterogeneity and are described within text. Where possible, the data have been presented relevant to the age subgroups of interest (i.e. adolescents and young adults). In addition, sensitivity analyses were planned based on the quality of the studies (i.e. high or moderate risk of bias). However, as there were not enough studies in the meta-analyses that addressed each of the outcomes, sensitivity analyses based on the quality of studies could not be conducted. We conducted sensitivity analysis based on exposure duration (past 30 days, six months, or 12 months) and the follow-up period (1 year or 2.5 years), which was a deviation from the protocol.

Reporting biases

Publication bias could not be assessed by a funnel plot[41] as originally planned because there were not enough studies (at least 10) for each exposure outcome pair.

Outcome reporting bias was only assessed for studies that had *a priori* registrations or protocols available. Selective reporting within studies was checked for but no instances were found. As specified in the protocol, studies published in non-English language were not considered for inclusion. The searches were restricted to specific locations as determined by the NHMRC in their commissioning of the systematic review.

Synthesis for qualitative studies

The RETREAT framework was used to guide the choice of qualitative evidence syntheses approach.[42] Thematic synthesis as outlined by Thomas and Harden[43] was the appropriate synthesis approach for the review.

Subgroup analyses as originally planned were not undertaken due to the very small number of qualitative studies identified and the resulting inadequate quantity of data for any sub-group of interest.

Certainty of evidence from quantitative studies

For quantitative studies, we used the GRADE approach to assess certainty of the quantitative evidence as per the GRADE handbook.[44] We used the GRADE Pro GDT software (https://gradepro.org) to create a 'Summary of Findings' table for all primary outcomes. In the GRADE approach, certainty of evidence was classified as very low,

low, moderate, or high by the consensus of the review team (involving at least two authors for each study). The certainty levels and their interpretations are:

- High certainty: very confident that the true effect lies close to that of the estimate of the effect.
- Moderate certainty: moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
- Low certainty: confidence in the effect estimate is limited; the true effect may be substantially different from the estimate of the effect.
- Very low certainty: have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of effect.

The certainty level for each primary study is reported in the Summary of Findings Tables in the technical report.

Certainty of evidence from qualitative studies

For qualitative studies, we used the GRADE CERQual (Confidence in the Evidence from Reviews of Qualitative Research) approach[45-51] to summarise the confidence in each finding. After assessing each of the four components, a judgement about confidence in the evidence supporting the review findings as very low, low, moderate, or high in alignment with the GRADE CERQual guidelines[45] was made. The certainty levels and their interpretations are:

- High confidence - Highly likely that the review finding is a reasonable representation of the phenomenon of interest.
- Moderate confidence - Likely that the review finding is a reasonable representation of the phenomenon of interest.
- Low confidence - Possibility that the review finding is a reasonable representation of the phenomenon of interest.
- Very low confidence - Unclear whether the review finding is a reasonable representation of the phenomenon of interest.

All reasons for upgrading and downgrading are provided in the footnotes of the GRADE Summary of Findings tables for quantitative studies and in the tables for qualitative studies in the accompanying technical report

Integration of quantitative and qualitative evidence

The findings of the two different synthesis processes were configured in accordance with the JBI methodology,[36] which involved complementary quantitative evidence and qualitative evidence being juxtaposed and organised into a line of argument to provide an overall configured result. The approach recognised that quantitative and qualitative forms of evidence addressed different aspects the same phenomenon of interest and

hence could not be directly combined but could be organised into a coherent meaning. Where configuration was not possible, only a narrative description of different results (completed in previous steps) was provided. There is currently no guidance on assessing confidence of findings after integration of evidence.[36] As such, the GRADE and GRADE-CERQual assessments for informing recommendations were provided in a segregated fashion.

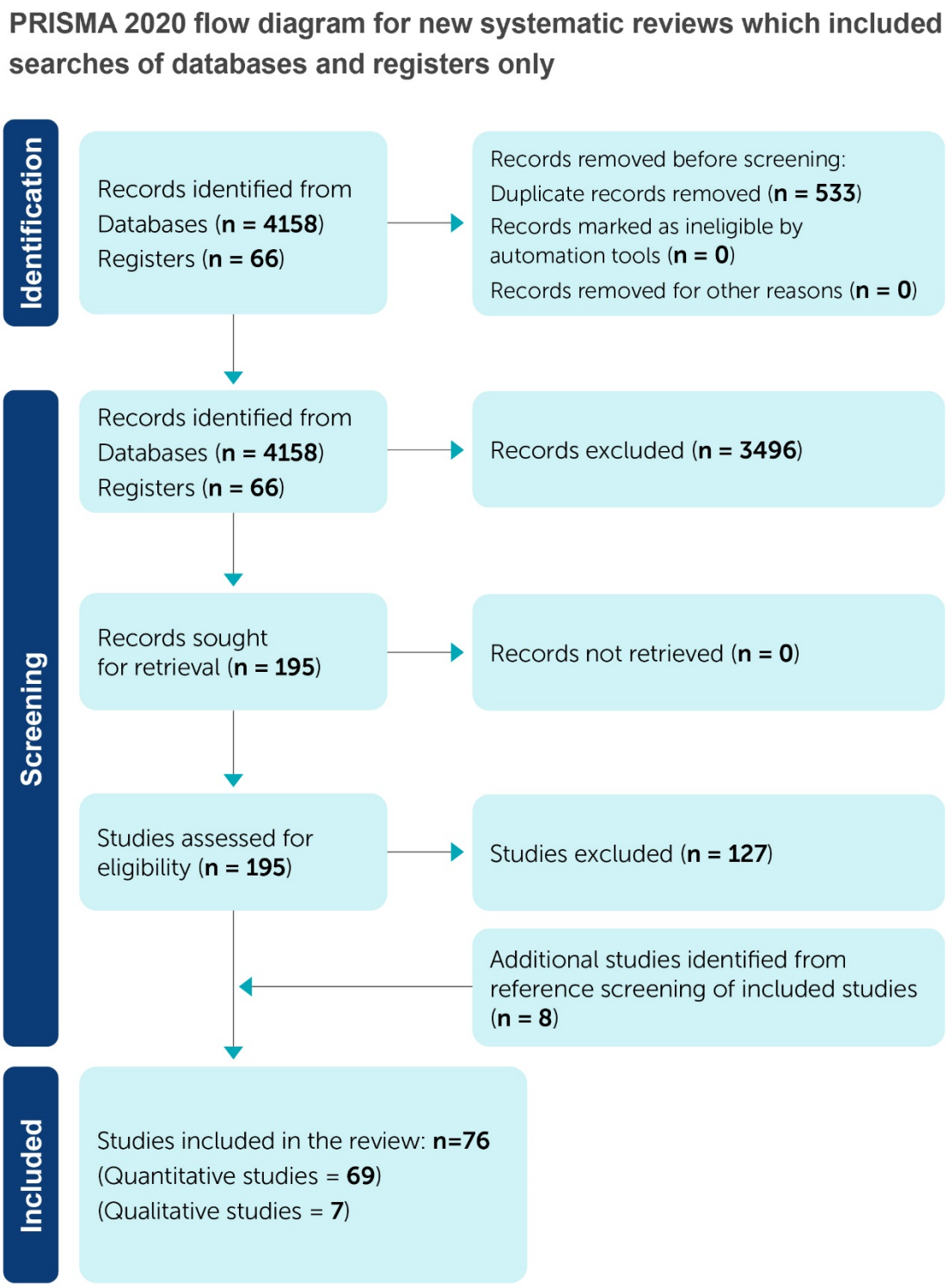
Results

Study selection

The electronic databases search resulted in 4224 records. After removing duplicates, 3691 records remained. During title and abstract screening, 3496 records were excluded. Full-text screening was done on 195 records. Following full text screening, 127 records were excluded that did not meet the eligibility criteria, resulting in 68 records for inclusion. A hand search of the reference lists of included records identified a further eight records, resulting in the inclusion of a total of 76 records in the review (69 records in the quantitative component and seven in the qualitative component). The PRISMA flow chart for included studies is presented in Figure 1.

Reasons for exclusion at full text level are presented in the accompanying technical report (Appendix 3). The most common reasons for excluding studies were wrong exposure of interest (n=51), outcome of interest (n=-35), conference abstracts or articles published in abstract form only with no full-length publication available (n=19), wrong study design (n=11), and wrong phenomenon of interest (n=7). The reasons for four other studies included duplicate study, wrong setting, wrong type of e-cigarette (IQOS) assessed, and lack of clear reporting of data. No ongoing studies were identified in the databases searched (including the Cochrane Central Register of Controlled Trials and clinicaltrials.gov).

983 *Figure 1: PRISMA flowchart showing selection of studies*



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: *www.prisma-statement.org*

984

Characteristics of included quantitative studies

Of the 69 quantitative studies included in the review, most were cross-sectional in design (n = 43), with cohort studies (n = 15) and randomised controlled trials (n = 10) being the next most common study designs. One quasi-experimental study was included. Most of the studies (n=51) focussed on school-aged adolescents (12-17 years) and young adults (18-25 years), and 18 studies focussed on adults in general. A large majority of the studies were conducted in the US (n = 56).[52-107] Four studies were conducted in the UK,[108-111], one in Canada,[112] two in Germany,[113 114] one in Finland,[115] and one in the Netherlands.[116] Four were multi-country[117-120] studies.

All the exposures of interest pre-specified in the protocol were identified and reported in the review, except for sponsorship, streaming services or over-the-top media, commercial communication through health service providers or quit support groups, and word or mouth advertising separately. Just over half of the studies (n = 38) reported aggregated data for e-cigarette advertising disseminated via multiple media sources. Most of the included studies used questionnaires and self-reported exposure and outcome measures. Total nicotine consumption as an outcome was not reported in any of the included studies. For each study design, different measures of association, or estimates of effect, were reported, most commonly odds ratios (ORs) and in some cases relative risks (RRs) or prevalence ratios (PRs). The follow-up period ranged from 6 months to 1 year in most cohort studies, with the maximum being 2.5 years. The outcome of intentions to use e-cigarettes was interchangeably used with susceptibility to use e-cigarettes in the included studies.[80 92 108]

The outcome measurement methods included but were not limited to self-report questionnaires (web-based, postal, face-to-face, email) and observations at tobacco retail outlets. The outcome measures were based on the use of different rating scales, such as Likert scales or dichotomous self-reported responsed (yes/no questions). The outcome measures also included questions related to the duration and frequency of use of e-cigarettes and cigarettes.

Characteristics of included qualitative studies

Seven studies met the inclusion criteria and were included in analyses; six were conducted in the US and one in Australia. Two studies were conducted with young adults (aged 18-24 or 18-29),[121 122] two with adolescents (aged 12-17 or 10-18),[123 124] one with adults,[125] and one with adolescents with hearing impairments and key staff working at their schools[126]. Four studies included participants regardless of their e-cigarette smoking status,[121 124 126 127] one included current e-cigarette smokers,[122] one included current or past e-cigarette smokers,[125] and one included non-e-cigarette smokers.[123]

The detailed characteristic of included studies is presented is presented in Appendix 2.

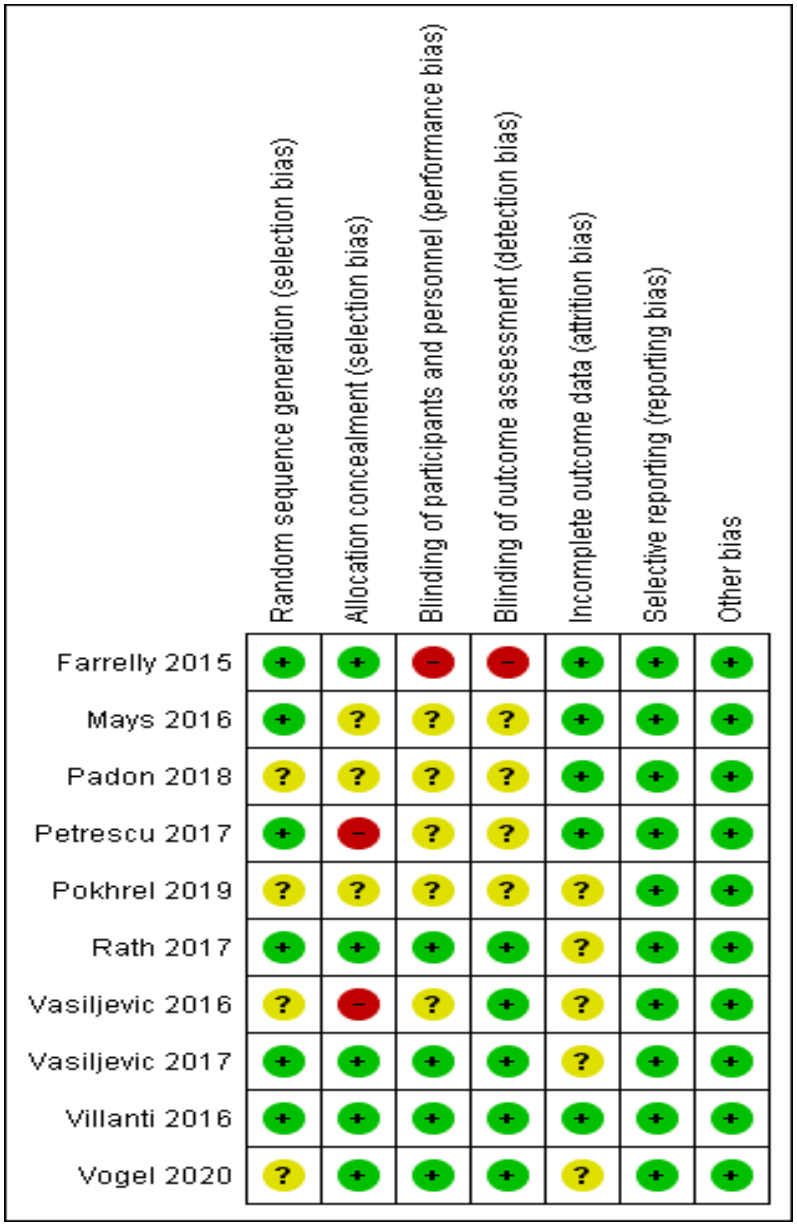
Risk of bias in included randomised controlled trials

The risk of bias summary for the 10 included randomised controlled trials is presented in Figure 2. Additional details are presented in the accompanying technical report.

There was low risk of bias for six studies for random sequence generation, while the remaining studies had unclear risk. For the allocation concealment domain, there was low risk in five studies, high risk in two studies, and unclear risk in the remaining studies. Low risk of performance bias was seen in four studies, high risk was seen in one study, and the remaining studies had unclear risk of bias. Detection bias was low risk in five studies, high risk in one study, and unclear risk for the remaining studies. The risk of attrition bias was judged to be low risk in five studies and unclear in the others. No selective reporting or other biases were detected.

Overall, it was not clearly reported whether allocation concealment, blinding (both related to selection bias and performance bias) and appropriate outcome reporting were addressed in several studies.

Figure 2: Risk of bias summary for included randomised controlled trials



Risk of bias in included quasi-experimental study

The risk of bias summary for the single included quasi-experimental study is presented in Figure 2 Additional details are presented in the accompanying technical report.

There was unclear risk of bias for the domain pertaining to follow-up, due to poor reporting. Multiple measurements for the outcome, both pre and post intervention was not done, thus leading to the corresponding domain being rated high risk. All other domains were at low risk.

Figure 3: Risk of Bias summary of included quasi experimental study

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomised experimental studies)									
Study ID	1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	2. Were the participants included in any comparisons similar?	3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	4. Was there a control group?	5. Were there multiple measurements of the outcome both pre and post the intervention/ exposure?	6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	7. Were the outcomes of participants included in any comparisons measured in the same way?	8. Were outcomes measured in a reliable way?	9. Was appropriate statistical analysis used?
Maloney 2016	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	Yes

Risk of bias in included cohort studies

The risk of bias for the 15 included cohort studies is presented in Figure 4. Additional details are presented in the accompanying technical report.

All the studies were at low risk in terms of group similarity and recruitment from the same population. Twelve studies were at low risk in the domain related to the validity and reliability of the measurement tool used for exposure, and the remaining studies were at unclear risk. Five studies were at low risk for identifying confounders, one study was at high risk as it did not report any confounding factors, and the remaining studies were at unclear risk. Low risk was reported in 13 studies for strategies for dealing with confounders, high risk was reported in one study, and unclear risk in one study.

For the domain pertaining to participants being free of the outcome at the time of exposure, 11 studies were at low risk, three studies were identified at high risk as they included only smokers in the study, and one study was at unclear risk. Ten studies were at low risk in the domain relating to the validity and reliability of the measurement tool used for outcomes and the remaining five studies were at unclear risk. Fourteen studies were at low risk in domain of reporting the follow-up time and whether it was adequately long, and one studies was at unclear risk. Eight studies were at low risk of poor reporting on completion and loss to follow-up, 6 studies were at unclear risk, and 1 was at high risk. Three studies were at low risk for strategies to address incomplete follow-up, 9 studies were at unclear risk, and 3 studies were at high risk. For appropriate statistical analysis, all the studies were at low risk.

Figure 4: Risk of Bias summary of included cohort studies

JBI Critical Appraisal Checklist for Cohort Studies											
Study ID	1. Were the two groups similar and recruited from the same population?	2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	3. Was the exposure measured in a valid and reliable way?	4. Were confounding factors identified?	5. Were strategies to deal with confounding factors stated?	6. Were the groups/ participants free of the outcome at the start of the study (or at the moment of exposure)?	7. Were the outcomes measured in a valid and reliable way?	8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	10. Were strategies to address incomplete follow up utilized?	11. Was appropriate statistical analysis used?
Agaku 2017	Yes	Yes	Unclear	Yes	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes
Belava 2019	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Camenga 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes
Cavazos 2021	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes
Chen-Sankey 2019	Yes	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes
D'Angelo 2020	Yes	Yes	Unclear	No	No	Yes	Unclear	Unclear	Unclear	Unclear	Yes
Etim 2020	Yes	Yes	Yes	Unclear	Unclear	Yes	Unclear	Yes	Yes	Unclear	Yes
Hansen2020	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes
Lee 2019	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes
Loukas 2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes
Mantey 2019	Yes	Yes	Unclear	Unclear	Yes	No	Unclear	Yes	Yes	Yes	Yes
Nagelhout 2016	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Nicksic 2017a	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes
Pierce 2018	Yes	Yes	Yes	Unclear	Yes	No	Yes	Yes	No	No	Yes
Pike 2019	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	No	Yes

Risk of bias in included cross-sectional studies

The risk of bias for the 43 cross-sectional studies is presented in Figure 5. Additional details are presented in the accompanying technical report.

Thirty-two studies were at low risk for the domain of validity and reliability of the tools used for measuring the exposure and 11 studies were at unclear risk. Fifteen studies reported low risk in identifying confounders, 22 studies reported unclear risk, and the remaining studies were at high risk. Thirty-six studies were at low risk in terms of the strategies used for dealing with confounders, four were at high risk, and the remaining studies were at unclear risk. Twenty-seven studies were at low risk in the domain of validity and reliability of measuring outcome variables, while 16 were at unclear risk. Relating to the statistical analysis techniques, all the studies were identified at low risk in terms of statistical analysis techniques.

Overall, the validity and reliability of the tools used for measuring the exposure and outcome variables and for identifying confounding factors was unclear in some of the studies.

Figure 5: Risk of Bias summary of included cross-sectional studies

JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies								
Study ID	1. Were the criteria for inclusion in the sample clearly defined?	2. Were the study subjects and the setting described in detail?	3. Was the exposure measured in a valid and reliable way?	4. Were objective, standard criteria used for measurement of the condition?	5. Were confounding factors identified?	6. Were strategies to deal with confounding factors stated?	7. Were the outcomes measured in a valid and reliable way?	8. Was appropriate statistical analysis used?
Ali 2021	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ashford 2017	Yes	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes
Auf 2018	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Booth 2019	Yes	Yes	Yes	Yes	No	No	Unclear	Yes
Case 2020	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes
Cho 2019	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes
Cho 2020	Yes	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes
Dai 2016	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Dai 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Do 2020	Yes	Yes	Unclear	Yes	Yes	Yes	Unclear	Yes
Donaldson 2017	Yes	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes
Du 2020	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Ebrahimi 2020	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Filippidis 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Giovenco 2016	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Hammig 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hammond 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hansen 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hébert 2017	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes
Herrera 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kim 2015	Yes	Yes	Unclear	Yes	No	No	Unclear	Yes
Kinnunen 2015	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Lienemann 2019	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Little 2016	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes
Majmundar 2021	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Mantey 2016	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Marion 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nicksic 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Papaleontiou 2020	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Pesko 2017	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Pokhrel 2015	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes
Pokhrel 2017	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes
Pu 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ratneswaran 2019	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Reinhold 2017	Yes	Yes	Unclear	Yes	Yes	Yes	Unclear	Yes
Sanders-Jackson 2015	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes
Sawdey 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shadel 2020	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Singh 2016	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Smith 2015	Yes	Yes	Unclear	Yes	Unclear	Unclear	Unclear	Yes
Stroup 2018	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes
Trumbo 2015	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Unger 2018	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes

Risk of bias in qualitative studies

The risk of bias summary for the seven included qualitative studies is presented in Figure 6 Additional details are presented in the accompanying technical report.

There was a clear statement of the research for all seven studies. A qualitative methodology was appropriate for all studies, and all studies used an appropriate research design to address the aims of the research. The recruitment strategy was deemed appropriate for the aims of the research for one study and was unclear for the remaining six studies. The data was collected in a way that addressed the research issue for all seven studies. The relationship between the research and participants was deemed unclear in six studies and appropriate in one study. Ethical considerations were unclear for only one study as ethical status was not reported. The data analysis was sufficiently rigorous in five studies, and in two studies was deemed unclear. There was a clear statement of findings for all seven studies, and all were deemed valuable.

Figure 6 : Risk of bias summary of included qualitative studies

Study ID	1.Was there a clear statement of the research?	2.Is a qualitative methodology appropriate?	3.Was the research design appropriate to address the aims of the research?	4.Was the recruitment strategy appropriate to the aims of the research?	5.Was the data collected in a way that addressed the research issue?	6.Has the relationship between researcher and participants been adequately considered?	7.Have ethical issues been taken into consideration?	8.Was the data analysis sufficiently rigorous?	9.Is there a clear statement of findings?	10. How valuable is the research?
Amin 2020	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes	Yes
Alpert 2020	Yes	Yes	Yes	Unclear	Yes	Unclear	Unclear	Yes	Yes	Yes
Chen 2020	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes	Yes	Yes	Yes
Cogwill 2020	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes	Unclear	Yes	Yes
Kim 2020	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes	Yes	Yes	Yes
Laestadius 2020	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes
Park 2019	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes

Results of syntheses of quantitative studies

The synthesis of the quantitative studies is presented below according to medium of e-cigarette advertising exposure. For each exposure of interest, details of the evidence located from the search are first introduced, followed by the results. Where a reference is made throughout the text to very low, low, moderate, or high certainty of evidence for primary outcomes, this corresponds to the quality of evidence assessed in the Summary of Findings tables that have been developed using the GRADE approach and are in the accompanying technical report.

Almost all the studies reported odds ratios (ORs) along with 95% confidence intervals (CIs). An OR of 1 indicated no effect of exposure on the odds of the outcome. As such, a statistically not significant result is indicated by the confidence limits (i.e. 95% CI) crosses the line of no effect (OR = 1) and reported accordingly in the report, as applicable. In the interpretation of results, it should be noted that a statistically significant result might not necessarily mean the effect is of public health significance.

1. Effect of radio advertising

Three studies examined the effects of e-cigarette radio advertising.[77] [84] [107] All were cohort studies conducted in the US. Two of the studies addressed primary outcome variables and two addressed secondary outcome variables. Both studies examining primary outcome variables were assessed as providing very low certainty of evidence. Across all three studies, only one statistically significant effect was identified: exposure to e-cigarette radio advertising was found in one study to result in increased odds of young adults intending to use e-cigarettes. The GRADE Summary of Findings tables for adolescents and young adults are detailed in the technical report (Tables 2 and 3 respectively).

1.1. Effect of radio advertising on e-cigarette uptake/initiation in adolescents (12-17 years)

One cohort study with a follow-up period of 2.5 years reported on this outcome.[77] Very low certainty evidence was found that exposure to e-cigarette radio advertising increased initiation in never e-cigarette adolescent users compared to those who were not exposed (OR 1.24, 95% CI 0.76–2.01, 2288 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

1.2. Effect of radio advertising on e-cigarette uptake/initiation in young adults (12-29 years)

One cohort study with a follow-up period of 2.5 years reported on this outcome.[77] Very low certainty evidence was found that exposure to e-cigarette radio advertising might be associated with decreased odds of e-cigarette initiation in never e-cigarette young adult users compared to those who were not exposed (OR 0.99, 95% CI 0.77–1.27, 2,423 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

1.3. Effect of radio advertising on current e-cigarette use in adolescents (12-17 years)

One cohort study with a follow-up period of 6 months reported on this outcome among adolescents who at baseline were never, ever, or current users of e-cigarettes.[84] Very low certainty evidence was found of no clear effect of exposure to e-cigarette radio advertising on current e-cigarette use at follow-up compared to non-exposure (OR 0.95, 95% CI 0.51–1.79, 2488 participants). The 95% CI crossed the line of no effect, indicating statistical non-significance.

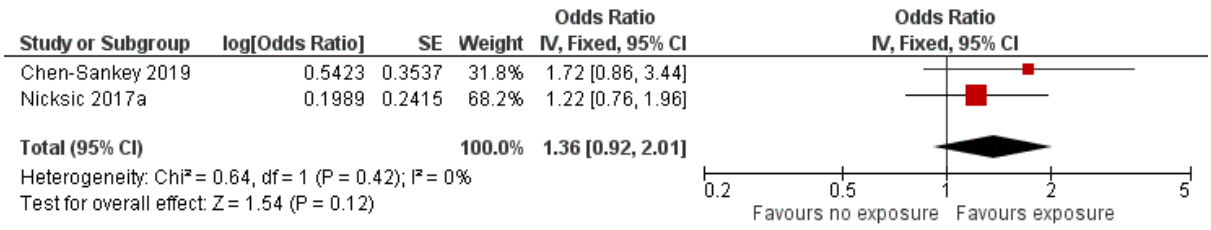
1.4. Effect of radio advertising on e-cigarette ever use in adolescents (12-17 years)

One cohort study with a follow-up period of 6 months reported on this outcome among never, ever, and current adolescent users of e-cigarettes.[84] Very low certainty evidence was found that exposure to e-cigarette radio advertising was associated with decreased odds of being an e-cigarette ever user at follow-up compared to non-exposure (OR 0.82, 95% CI 0.31–2.18, 2,488 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

1.5. Effect of radio advertising on intentions to use e-cigarettes in adolescents (12-17 years)

Two cohort studies reported on this outcome among never, ever and current e-cigarette users, and never users of combustible cigarettes, with follow-up periods of 6 months and 12 months.[84] [107] These studies found that adolescents' exposure to e-cigarette radio advertising was associated with increased intentions to use e-cigarettes compared to non-exposure (OR 1.36, 95%CI 0.92-2.01, 2 studies, 13,711 participants).[84] [107] However, the 95% CI crossed the line of no effect, indicating statistical non-significance. The forest plot is shown in Figure 7.

Figure 7: Forest plot for effect of radio advertising on intentions to use e-cigarettes among adolescents (cohort studies)



1.6. Effect of radio advertising on intentions to use e-cigarettes in young adults (18-25 years)

One cohort study with a follow-up period of 12 months reported on this outcome.[107] It found that exposure to radio e-cigarette advertising resulted in increased odds of intending to use e-cigarettes among young adult never users of e-cigarettes and never users of combustible cigarettes compared to those who were not exposed (OR 6.36, 95% CI 1.57–25.66, 9,804 participants).

2. Effect of television and radio (combined) advertising

One cohort study from the US examined the effect of television and radio (combined) e-cigarette advertising on the primary outcome of ever use.[57] The GRADE Summary of Findings table for adolescents is detailed in the technical report (Table 4).

2.1. Effect of television and radio (combined) advertising on e-cigarette ever use in adolescents (12-17 years)

Very low certainty evidence was found in the cohort study that exposure to e-cigarette advertising on television and radio did not have an effect on ever use in adolescent who were never users of e-cigarettes at baseline (OR 0.85, 95% CI 0.43-1.69,1,742 participants), when compared to those who were not exposed.[57] However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

3. Effect of television advertising

Eleven studies examined the effect of television e-cigarette advertisements.[52 53 68 73 74 77 84 86 94 96 107] All studies were conducted in the US. Two were randomised controlled trials,[68 86] five were cohort studies,[52 74 77 84 107] and four were cross-sectional studies.[53 73 94 96]

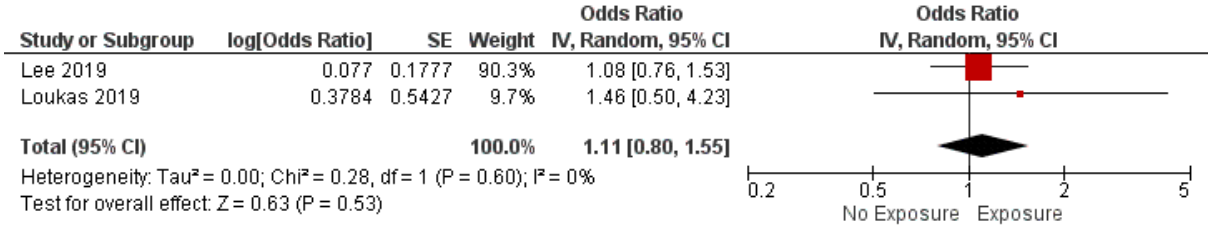
Of the 11 identified studies, six addressed primary outcome variables and eight addressed secondary outcome variables. All studies examining primary outcome variables were assessed as providing low to very low certainty of evidence. Across the 11 studies, exposure to e-cigarette advertising on television was typically found to result in increased odds of the outcomes of interest among adolescents, young adults, and adults. The GRADE Summary of Findings tables for adolescents, young adults, and adults are detailed in the technical report (Tables 5, 6, and 7, respectively).

3.1. Effect of television advertising on e-cigarette uptake/initiation in adolescents (12-17 years)

Two cohort studies[74 77] reported on this outcome for adolescents, with follow-up periods of 2.5 and 3 years. At baseline, the studies included never adolescent users of e-cigarettes and never adolescent users of cigarettes and e-cigarettes, respectively.

Very low certainty evidence was found that exposure to e-cigarette advertising on television was associated with greater e-cigarette uptake compared to non-exposure (OR 1.11, 95% 0.80–1.55, 2 studies, 16,036 participants).[74 77] However, the 95% CI crossed the line of no effect, indicating statistical non-significance. The forest plot is shown in Figure 8.

Figure 8: Forest plot for effect of television e-cigarette advertising on e-cigarette initiation among adolescents (cohort studies)



3.2. Effect of television advertising on e-cigarette uptake/initiation in young adults (18-29 years)

One cohort study[77] with a follow-up period of 2.5 years reported on this outcome. Very low certainty evidence was found that daily exposure to e-cigarette advertising on television increased the odds of e-cigarette uptake in young adult never users compared to those who were unexposed (OR 1.29, 95% CI 1.03–1.63, 2423 participants).

3.3. Effect of television advertising on e-cigarette ever use in adolescents (12-17 years)

One cohort study with a follow-up period of 6 months reported on this outcome among adolescents who were never, ever, or current users of e-cigarettes at baseline.[84] Very low certainty evidence was found of an association between exposure to e-cigarette advertising on television and being an ever e-cigarette user at follow-up (OR 1.36, 95% CI 0.58–3.19, 2,488 participants).[84] However, the 95% CI crossed the line of no effect, indicating statistical non-significance

3.4. Effect of television advertising on ever e-cigarette ever use in adults (≥ 18 years)

One cross-sectional study reported on this outcome.[53] Low certainty evidence was found of an association between exposure to e-cigarette advertising on television and ever e-cigarette use (regression coefficient 0.02, 95% CI 0.0-0.03, 98,746 participants).

3.5. Effect of television advertising on current e-cigarette use in adolescents (12-17 years)

One cohort study with a follow-up period of 6 months[84] conducted among never, ever, and current adolescent users of e-cigarettes and one cross-sectional study[94] reported on this outcome

Very low certainty evidence from both the cohort study (OR 1.09, 95% CI 0.67–1.79, 3,907 participants)[84] and the cross-sectional study (OR 1.38, 95% CI 1.20–1.60, 21,595 participants)[94] indicated increased odds of current e-cigarette use among those reporting exposure to television e-cigarette advertising compared to those who were not exposed. However, for the cross-sectional study, the 95% CI crossed the line of no effect, indicating statistical non-significance.

3.6. Effect of television advertising on current e-cigarette use in adults (≥ 18 years)

One cohort study with a follow-up period of 5 months[52] and one cross-sectional study[53] reported on this outcome among never, current, and ever e-cigarette users and never and current cigarette users, respectively.

Both the cohort study (OR 1.57, 95% CI 1.04–2.37, very low certainty of evidence, 2191 participants)[52] and the cross-sectional study (regression coefficient 0.02, 95% CI 0.01-0.04, low certainty of evidence, 98,709 participants)[53] indicated increased likelihood of being a current e-cigarette user among those exposed to television e-cigarette advertising.

3.7. Effect of television advertising on current combustible cigarette use in adults (≥ 18 years)

One cross-sectional study reported on this outcome.[53] Low certainty evidence was found among adults that exposure to television e-cigarette advertising was associated with current cigarette use (regression coefficient 0.02, 95% CI 0.01-0.03, 98,503 participants).

3.8. Effect of television advertising on frequency/intensity of consumption of combustible cigarette use in adults (≥ 18 years)

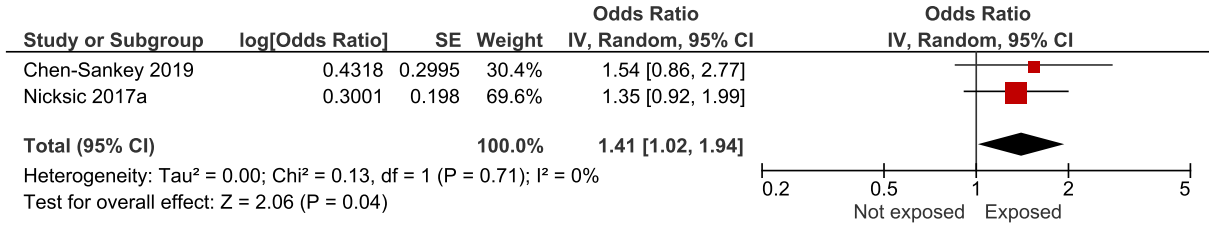
One cross-sectional study reported on this outcome.[53] Low certainty evidence was found among adults that exposure to e-cigarette advertising was not associated with total number of cigarettes smoked per month (regression coefficient 0.00, 95% CI 0.00-0.01, 12,361 participants).

3.9. Effect of television advertising on intentions to use e-cigarettes in adolescents (12-17 years)

Three studies reported on this outcome in adolescents.[84 94 107] Two were cohort studies[84 107] with follow-up periods of six months to 12 months and one was a cross-sectional study.[94]

The cohort studies found that adolescents exposed to television e-cigarette advertising were more likely than those who were unexposed to intend to use e-cigarettes (OR 1.41, 95% CI 1.02-1.94, 2 studies, 13,711 participants).[84 107] At baseline, few participants were ever and current adolescent e-cigarettes users while most were never users of e-cigarettes and combustible cigarettes. The forest plot is presented in Figure 9.

Figure 9: Forest plot for effect of television e-cigarette advertising on intentions to use e-cigarettes among adolescents (cohort studies)



The cross-sectional study found that exposure to television e-cigarette advertising was associated with greater intentions to use e-cigarettes compared to non-exposure (OR 1.31, 95% CI 1.07–1.59, 21595 participants).[94]

3.10. Effect of television advertising on intentions to use e-cigarettes in young adults (18-25 years)

One cohort study with a follow-up of 12 months[107] and one cross-sectional study[73] reported on this outcome.

The cohort study found that exposure to television e-cigarette advertising among never user (e-cigarettes and combustible cigarettes) young adults increased the odds of intending to use e-cigarettes compared to non-exposure (OR 9.22, 95% CI 1.96–43.36, 9804 participants).[107]

Similarly, the cross-sectional study found that e-cigarette current users had greater intentions (urges) to use e-cigarettes (mean=42.1, SD=1.9) compared to non-users (mean=40.3, SD=2.4, 519 participants)[73] after seeing television e-cigarette advertisements.

3.11 Effect of television advertising on intentions to use e-cigarettes in adults (≥ 18 years)

Two randomised controlled trials reported on this outcome.[68 86] The two studies could not be pooled because they used different comparators. The trials found that:

- Never and ever e-cigarette adult users exposed to e-cigarette advertising on television had increased odds of intending to use e-cigarettes compared to a control group (OR 1.54, CIs not reported, p=0.001, 5020 participants).[68]
- Exposure to low youth appeal advertisements (that had more health-related claims) on television increased never e-cigarette and cigarette adult users' intentions to use e-cigarettes compared to those exposed to non-e-cigarette advertisements (OR 1.80, CI not reported, p=0.03, 1267 participants). A similar result was reported for high youth value advertisements (OR 1.30, CIs not reported).[86] However, the p value indicated statistical non-significance for both analyses.

3.11. Effect of television advertising on young adults' (18-25 years) knowledge, attitudes, and beliefs relating to e-cigarettes

One cross-sectional study reported on this outcome.[96] It found that compared to non-exposure, exposure to e-cigarette advertising on television was associated with stronger beliefs among young adults that e-cigarette use is acceptable in bars (OR 1.37, 95% CI 1.20–1.57, 4793 participants), stores (OR 1.33, 95% CI 1.15–1.53, 4784 participants), at work (OR 1.23, 95% CI 1.07–1.41, 4792 participants), in class (OR 1.25, 95% CI 1.07–1.45, 4792 participants), and in dorms (OR 1.33, 95% CI 1.15–1.52, 4799 participants).

3.12. Effect of television advertising on adults' (≥ 18 years) knowledge, attitudes, and beliefs relating to e-cigarette use

Two randomised controlled trials[68 86] and a cross-sectional study[53] reported on this outcome.

The two randomised controlled trials used different comparators and hence could not be pooled. They found that:

- Exposure to television e-cigarette advertising led to greater odds of never and ever e-cigarette adult users agreeing that e-cigarettes are a safer alternative to cigarettes (OR 1.19, p=0.01, 5020 participants) and are less toxic (OR 1.16, p=0.03), and lower odds of agreeing that e-cigarettes are harmful or very harmful (OR=0.84, p=0.009) compared to the non-exposed control group.[68]
- Exposure to low youth appeal advertisements (that had more health-related claims) in never e-cigarette and cigarette adult users was associated with more positive beliefs about e-cigarettes (β = 0.22, p < .001, 465 participants), while exposure to high youth appeal advertisements was associated with marginally increased positive beliefs compared to non-exposure (β = 0.08, p = .09, 428 participants).[86]

The cross-sectional study found that an increase in exposure by one additional e-cigarette advertisement on television was associated with a 0.18 percentage point increase in awareness of e-cigarettes in adults (p< 0.05).[53]

4. Effect of advertising on television and movies combined

Three cross-sectional studies[61 80 100] examined the combined effect of e-cigarette marketing on television and in movies. All the studies were conducted with school-aged adolescents (11-18 years) in the US and addressed primary outcome variables. The studies were assessed as providing very low certainty of evidence. One study also addressed a secondary outcome variable. In the one study assessing the ever use primary outcome, exposure to e-cigarette advertising resulted in increased odds of ever e-cigarette use in adolescents compared to no exposure. However, across all three studies there was no clear evidence that greater exposure in the past 30 days (sometimes/most of the time/always) to e-cigarette advertising on television and movies combined resulted in increased odds of current e-cigarette use compared to

no or rare exposure among adolescents. The GRADE Summary of Findings tables for adolescents and young adults are detailed in the technical report (Table 8).

4.1. Effect of advertising on television and movies (combined) on current use of e-cigarettes in adolescents (12-17 years)

Two studies examined exposure to e-cigarette marketing on television/movies on current use of e-cigarettes with exposure to e-cigarette marketing on television/movies.[61 80] However, they were assessed separately as the data were presented in different formats so pooling was not feasible.

Very low certainty evidence was found that self-reported exposure to e-cigarette marketing on television/movies (sometimes/most of the time/always) was associated with greater odds of current use of e-cigarettes (OR 1.41, 95% CI 1.22-1.62, 22,007 participants) compared to being never/rarely exposed.[80]

Very low certainty evidence found that exposure to e-cigarette ads on television /movies was not significantly associated with current e-cigarette use compared to no exposure or exposure rarely (OR 0.9, p value non-significant, confidence intervals not reported, 21,491 participants).[61]

4.2. Effect of advertising on television and movies (combined) on current e-cigarette use in middle school students (11-13 years)

One study examined current e-cigarette use among middle school students.[100] The total number of participants was 9027. Very low certainty evidence was found that exposure to e-cigarette advertising on television/movies sometimes resulted in greater odds of current e-cigarette use compared to exposure to advertising never/rarely (OR 1.25, 95% CI 0.87-1.80). However, the 95% CI crossed the line of no effect, indicating statistical non-significance. More frequent exposure (most of the time/always) was associated with greater odds of current e-cigarette use compared to exposure never or rarely (OR 1.80, 95% CI 1.30-2.49).[100]

4.3. Effect of advertising on television and movies (combined) on current e-cigarette use in high school students (14-18 years)

Very low certainty evidence was found that more frequent exposure to e-cigarette advertising on television/movies was associated with greater odds of current e-cigarette use. The total number of participants was 10,265. Results for different exposure categories were most of the time/always vs never/rarely (OR 1.24, 95% CI 1.04-1.50) and sometimes vs never/rarely (OR 1.54, 95% CI 1.28-1.86).[100]

4.4. Effect of advertising on television and movies (combined) on e-cigarette ever use in adolescents (12-17 years)

One study found very low certainty evidence that exposure to e-cigarette advertising on television /movies among middle and high school students was associated with increased odds of ever using e-cigarettes (OR 1.20, 95% CI 1.07-1.35, 22,007 participants).[80]

4.5. Effect of advertising on intentions to use e-cigarette in adolescents (12-17 years)

Exposure to e-cigarette advertising on television /movies was associated with greater odds of susceptibility to e-cigarettes among adolescents (OR 1.16, 95% CI 1.07-1.27, 22,007 participants).[80]

5. Effect of billboard/poster advertising

Four studies examined the effect of e-cigarette advertisements on billboards and posters.[57 77 84 107] All four were cohort studies conducted in the US and addressed primary outcome variables, with two also addressing secondary outcome variables. All studies examining primary outcome variables were assessed as providing very low certainty of evidence and produced statistically non-significant findings. One study reported significantly increased odds of intentions to use e-cigarettes among young adults who were exposed to billboard advertising. The GRADE Summary of Findings tables are detailed in the technical report for adolescents and young adults (Tables 9 and 10, respectively)

5.1. Effect of billboard/poster advertising on e-cigarette uptake/initiation in adolescents (12-17 years)

One cohort study with a follow-up period of 2.5 years reported on this outcome among adolescents who were never users of e-cigarettes at baseline.[77] Very low certainty evidence was found that exposure to e-cigarette advertisements on billboards was associated with initiation (OR 1.30, 95% CI 0.89–1.91, 2,288 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

5.2. Effect of billboard/poster advertisements on e-cigarette uptake/initiation in young adults (18-29 years)

One cohort study with a follow-up period of 2.5 years reported on this outcome among young adults who were never users of e-cigarettes at baseline.[77] Very low certainty evidence was found that exposure to e-cigarette advertisements on billboards was associated with initiation (OR 1.10, 95% CI 0.87–1.41, 2,423 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

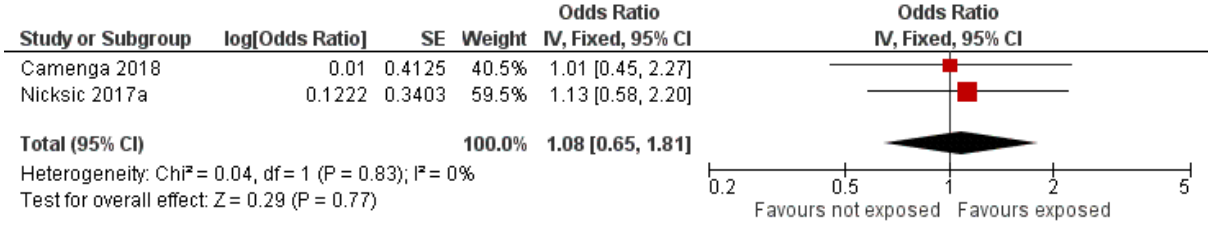
5.3. Effect of billboard/poster advertisements on current e-cigarette use in adolescents (12-17 years)

One cohort study with a follow-up period of 6 months reported on this outcome among adolescents who were never, ever, or current users of e-cigarettes at baseline.[84] Very low certainty evidence was found that exposure to e-cigarette advertisements on billboards decreased the odds of adolescents being current e-cigarette users (OR 0.75, 95% CI 0.42–1.33, 2,488 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

5.4. Effect of billboard/poster advertisements on e-cigarette ever use in adolescents (12-17 years)

Two cohort studies with follow-up periods of 6 months and 9 months, respectively, reported on this outcome.[57 84] The studies included adolescents who were never, ever, or current users of e-cigarettes at baseline. Very low certainty evidence was found that exposure to e-cigarette advertisements on billboards was associated with ever e-cigarette use (OR 1.08, 95%CI, 0.65-1.81, 2 studies, 4,230 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance. The forest plot is shown in Figure 10.

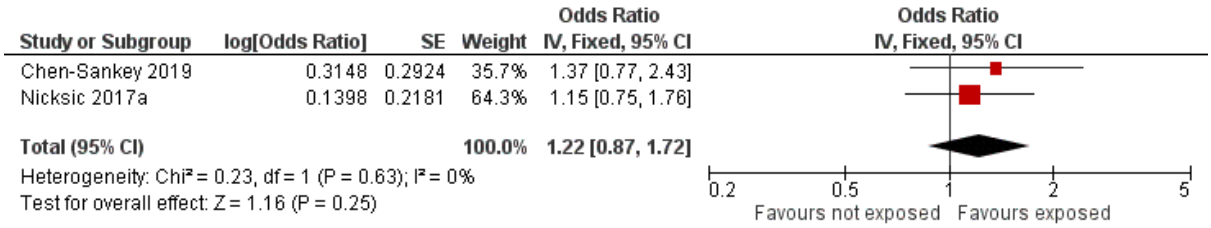
Figure 10: Forest plot for effect of billboard/poster advertisements on e-cigarette ever use among adolescents (cohort studies)



5.5. Effect of billboard/poster advertisements on intentions to use e-cigarettes in adolescents (12-17 years)

Two cohort studies with follow-up periods of 6 months and 12 months, respectively, reported on this outcome.[84 107] At baseline, one of the studies included adolescents who were never, ever, or current users of e-cigarettes while the other included never users of e-cigarettes and cigarettes. Pooled analyses found exposure to e-cigarette advertisements on billboards was associated with intentions to use e-cigarettes (OR 1.22, 95%CI 0.87-1.72, 2 studies, 13,711 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance. The forest plot is shown in Figure 11.

Figure 11: Forest plot for effect of billboard/poster advertisements on intentions to use e-cigarettes among adolescents (cohort studies)



5.6. Effect of billboard/poster advertisements on intentions to use e-cigarettes in young adults (18-25 years)

One cohort study reported on this outcome.[107] It found that exposure to e-cigarette advertisements on billboards increased the odds of intending to use e-cigarettes in young adult never users of e-cigarettes and cigarettes (OR 7.00, 95% CI 1.43–34.43, 9804 participants).[107]

6. Effect of print media advertisements

Twelve studies examined this outcome.[53 57 61 80 94 96 100 101 108 110 107 111] Three were conducted in the UK[108 110 111] and the remaining nine studies were conducted in the US. Two of the 12 studies were cohort studies,[57 107] seven were cross-sectional studies,[53 61 80 94 96 100 101] and three were randomised controlled trials[108 110 111].

Of the 12 identified studies, eight addressed primary outcome variables and eight addressed secondary outcome variables. Five studies examining primary outcome variables were assessed as providing very low certainty of evidence while three each provided high and moderate certainty of evidence and one provided low certainty of evidence. Across eight studies, exposure to e-cigarette advertising on print media was found to result in increased odds of the outcomes of interest among adolescents, young adults, and adults. There was no statistically significant effect of exposure on-ever e-cigarette use in adolescents and adults, current e-cigarette use in adolescents and adults, frequency of cigarette use in adults, intentions to use e-cigarettes in adolescents and knowledge, attitudes, and beliefs relating to e-cigarette use in adolescent users. . The GRADE Summary of Findings tables for adolescents and adults are detailed in the technical report (Tables 11 and 12, respectively)

6.1. Effect of print media advertisements on e-cigarette ever use in adolescents (12-17 years)

Two studies reported on this outcome, one of which was a cohort study with a follow-up period of 9 months[57] and the other was a cross-sectional study.[80]

The cohort study found very low certainty evidence that exposure to e-cigarette advertisements in print media among never e-cigarette adolescent users was associated with decreased odds of e-cigarette ever use compared to non-exposure (OR 0.88, 95% CI 0.59-1.30, 1742 participants).[57] However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

The cross-sectional study found moderate certainty evidence that exposure to e-cigarette advertisements in print media was associated with greater odds of e-cigarette ever use compared to non-exposure (OR 1.22, 95% CI 1.07-1.39, 22,007 participants).[80]

6.2. Effect of print media advertisements on e-cigarette ever use in adults (≥ 18 years)

One cross-sectional study reported this outcome.[53] It found very low certainty evidence that exposure to e-cigarette advertisements in print media was not associated with e-cigarette ever use (regression coefficient 0.01, 95% CI -0.00 to 0.01, 98,746 participants).

6.3. Effect of print media advertisements on current e-cigarette use in adolescents (12-17 years)

Five studies reported on this outcome, one of which was a randomised controlled trial[108] and four of which were cross-sectional studies.[61 80 94 100]

The randomised controlled trial[108] assessed the effects of exposure to e-cigarettes categorised as either 'glamorous' (depicting e-cigarettes as cool, attractive, fashionable, and popular, and featuring attractive young people) or 'healthy' (featuring people wearing white coats and claiming e-cigarettes can aid smoking cessation, do not contain carcinogens found in tobacco cigarettes, and are 'safe and healthy') among never and ever cigarette and e-cigarette adolescent users. The trial reported three comparisons and found:

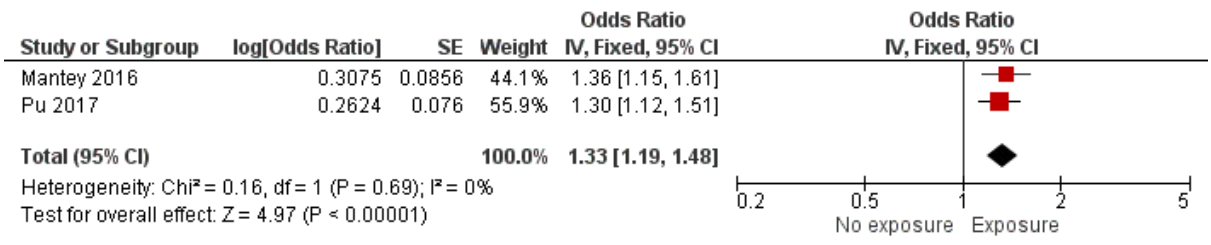
- Very low certainty evidence was found that adolescents exposed to 'glamourous' e-cigarette advertisements in print media had higher levels of current e-cigarette use at follow-up compared to those in a control group who were not exposed to any advertisements (U=7461.000, Z=−2.213, p=0.027, r=0.136, 373 participants). However, the p value indicated statistical non-significance.

- Very low certainty evidence was found that adolescents exposed to 'glamourous' e-cigarette advertisements in print media had higher levels of current e-cigarette use compared to those exposed to 'healthy' e-cigarette advertisements (U=7981.500, Z=−2.334, p=0.020, r=0.140, 377 participants). However, the p value indicated statistical non-significance.

- Very low certainty evidence of no difference in current use between adolescents who were exposed to 'healthy' e-cigarette advertisements in print media and those in a control group who were not exposed to any advertisements (U=9003.000, Z=−0.153, p=0.879, r=0.009, 378 participants). However, the p value indicated statistical non-significance.

Pooling of results from two cross-sectional studies[80 94] found moderate certainty evidence that exposure to e-cigarette advertisements in print media was associated with increased odds of current e-cigarette use compared to non-exposure (OR 1.33, 95% CI 1.19-1.48, 2 studies, 43,602 participants). The forest plot is shown in Figure 12.

Figure 12: Forest plot for effect of print media advertisements on current e-cigarette use among adolescents (cross-sectional studies)



The third cross-sectional study provided disaggregated data for middle and high school adolescents,[100] and hence was not pooled with those reported above. High certainty evidence was found that middle school students with high levels of exposure (exposed most of the time/always) to e-cigarette advertising in print media had higher odds of current e-cigarette use compared to those who were never or rarely exposed (OR 1.87, 95% CI 1.21–2.87, 6,418 participants). The study showed dose response effects. High certainty evidence was also found that high school students with high exposure to e-cigarette advertising in print media had higher odds of current e-cigarette use (OR 1.71, 95% CI 1.25–2.33, 8,312 participants) compared to non-exposure. The study showed dose response effects.

Moderate certainty evidence was found in the fourth cross-sectional that high exposure to e-cigarette advertising in print media (defined as read newspapers or magazines most of the time/always) had no clear effect on current e-cigarette use compared to low exposure (defined as don't read newspapers or magazines) (OR 0.9, 95% CI not reported 21,491 participants). The p value indicated statistical non-significance.[61]

6.4. Effect of print media advertisements on current e-cigarette use in adults (≥ 18 years)

One cross-sectional study reported on this outcome.[53] Very low certainty evidence was found that exposure to e-cigarette advertisements in print media was not associated with current e-cigarette use (regression coefficient -0.02, 95%CI -0.04 to -0.01, 98746 participants).[53]

6.5. Effect of print media advertisements on current cigarette use in adults (≥ 18 years)

One cross-sectional study reported on this outcome.[53] Low certainty evidence was found that exposure to e-cigarette advertisements in print media was associated with current cigarette use compared to non-exposure (regression coefficient 0.02, 95% CI 0.01-0.02, 98,746 participants).[53]

6.6. Effect of print media advertisements on frequency of e-cigarette use in adolescents (12-17 years)

One cross-sectional study reported on this outcome.[61] High certainty evidence was found that high exposure (defined as read newspapers or magazines most of the time/always) to e-cigarette advertising in print media was associated with higher odds of more frequent e-cigarette use (defined as >20 days within the past 30 days) compared to low exposure (defined as read newspapers or magazines never/rarely) (OR 3.40, $p < 0.001$, 2,017 participants).[61] The study showed dose response effects.

6.7. Effect of print media advertisements on frequency of combustible cigarette use in adults (≥ 18 years)

One cross-sectional study reported on this outcome.[53] Very low certainty evidence was found that exposure to e-cigarette advertising in print media had no clear effect

on total number of cigarettes smoked per month compared to non-exposure (regression coefficient -0.00, 95% CI -0.00-0.00, 98,746 participants).

6.8. Effect of print media advertisements on intentions to use e-cigarettes in adolescents (12-17 years)

Six studies reported on intentions to use e-cigarettes among adolescents. Three were randomised controlled trials,[108 110 111] one was a cohort study with a follow-up of 1 year,[107] and two were cross-sectional studies.[80 94]

The three randomised controlled trials[108 110 111] had different types of comparisons and outcome data, thus preventing meta-analysis. These studies found that:

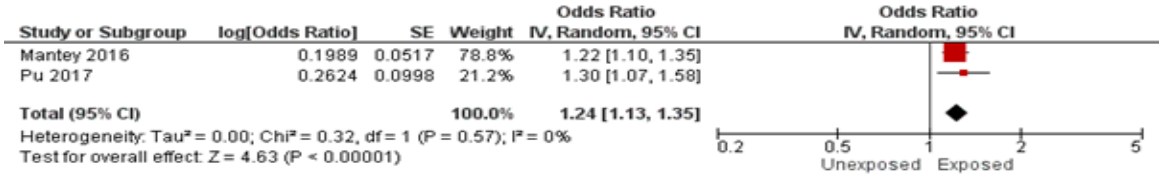
- Exposure to flavoured e-cigarette advertisements in print media was associated with increased intentions to use e-cigarettes among adolescents who never used e-cigarettes and never used combustible cigarettes (Mann-Whitney test, U=9140.000, Z=-3.949, p<0.001, 598 participants).[110]

- Exposure to 'glamourous' e-cigarette advertisements (depicting e-cigarettes as cool, attractive, fashionable, and popular, and featuring attractive young people) in print media was associated with decreased intentions to use e-cigarettes (mean rank=660.39, Mann-Whitney U=69 202.500, Z=−14.298, p<0.001, 1,449 participants) compared to never e-cigarette and cigarette adolescent users who were in the control group and were shown advertisements of pens.[111]

- Exposure to advertisements depicting e-cigarettes as glamourous and healthy in print media had no clear effect on intentions to use e-cigarettes among adolescent never e-cigarette users (Mean (SD): 1.36 (0.49) and 1.44 (0.57), respectively, 278 participants).[108]

The cohort study found exposure to e-cigarette advertisements in print media to be associated with higher odds of intending to use e-cigarettes compared to non-exposure among adolescents who never used e-cigarettes and never used combustible cigarettes (OR 1.38, 95% CI 0.78–2.44, 9804 participants).[107] However, the 95% CI crossed the line of no effect, indicating statistical non-significance. The cross-sectional studies found that exposure to e-cigarette advertisements in print media was associated with greater intentions to use e-cigarettes compared to non-exposure (OR 1.24, 95% CI 1.13-1.35, 2 studies, 43,602 participants).[80 94] The forest plot is show in Figure 13.

Figure 13: Forest plot for effect of print media advertisements on intentions to use e-cigarettes among adolescents (cross-sectional study)



6.9. Effect of print media advertisements on intentions to use e-cigarettes in young adults (18-25 years)

One cohort study with a follow-up of 1 year reported on this outcome in young adult never e-cigarette users and never combustible cigarette users.[107] It found that exposure to e-cigarette advertisements in print media was associated with increased odds of intending to use e-cigarettes compared to non-exposure (OR 6.11, 95% CI 1.21–30.89, 9804 participants).[107]

6.10. Effect of print media advertisements on intentions to use e-cigarettes in adults (≥ 18 years)

One cross-sectional study reported on this outcome.[101] It found that exposure to e-cigarette advertisements in print media was associated with stronger intentions to use e-cigarettes among exposed smokers compared to exposed non-smokers ($\chi 2 = 91.95$, p-value < 0.001, Cramer's V = .554, 600 participants).[101]

6.11. Effect of print media advertisements on adolescents' (12-17 years) knowledge, attitudes, and beliefs relating to e-cigarette use

Two randomised controlled trials[110 111] and one cross-sectional study[101] reported on this outcome.

The two randomised controlled trials had different types of comparisons, thus preventing meta-analysis. These studies found that:

- Flavoured e-cigarette advertisements in print media were considered more appealing by adolescent never e-cigarette users and never combustible cigarette users than ads for non-flavoured e-cigarettes (Mann-Whitney test, U=10,056.500, Z=-2.777, p=0.005, 598 participants).[110]

- Exposure to print advertisements depicting e-cigarettes as glamorous (cool, attractive, fashionable, and popular, and featuring attractive young people) was associated with lower perceived danger of occasional tobacco smoking compared to non-exposure among adolescent never e-cigarette users and never combustible cigarette users (mean rank = 546.84, Mann-Whitney U=129045.500, Z=-2.129, p=0.033, 1449 participants).[111] However, the p value indicated statistical non-significance.

The cross-sectional study reported that exposure to e-cigarette advertisements in print media had a strong relationship with positive attitudes about the product ($\chi 2 = 31.117$, p-value < 0.001, Cramer's V = .322).[101]

6.12. Effect of print media advertisements on adults' (≥ 18 years) knowledge, attitudes, and beliefs relating to e-cigarette use

One cross-sectional study reported on this outcome.[53] An increase in exposure to e-cigarette advertisements in magazines by one unit was associated with a 0.19 percentage point increase in awareness of e-cigarettes in adults ($p < 0.05$).

6.13. Effect of print media advertisements on young adults' (18-25 years) e-cigarette-related knowledge, attitudes, and beliefs

One cross-sectional study reported on this outcome.[96] Compared to non-exposure, exposure to e-cigarette advertisements in print media was associated with the belief that the use of e-cigarettes is acceptable in bars (OR 1.05, 95% CI, 0.91–1.21, 6,819 participants), at work (OR 1.06, 95% CI 0.92–1.23, 6,819 participants), and in dorms (OR 1.06, 95% CI 0.91–1.22, 6819 participants), but not in stores (OR 0.99, 95% CI 0.85–1.15, 6,819 participants) or in class (OR 0.96, 95% CI 0.82–1.13, 6,819 participants). However, for all results the 95% CI crossed the line of no effect, indicating statistical non-significance.[96]

7. Effect of advertisements disseminated via social media

Eight studies examined this outcome.[57 59 71 74 78 98 103 106] All the studies were conducted in the US and studied the effects of e-cigarette advertisements disseminated via social media in general or specific social media platforms (e.g. Facebook, YouTube, Twitter, Pinterest/Google Plus). Three of the eight studies were cohort studies,[57 59 74] four were cross-sectional,[71 78 98 103] and one was a randomised controlled trial.[106]

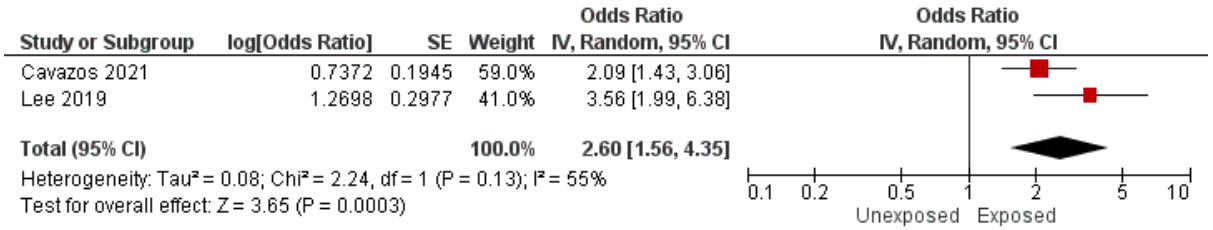
Of the eight identified studies, six addressed primary outcome variables and four addressed secondary outcome variables. Two of the studies were assessed as providing moderate certainty of evidence, with remainder being low or very low certainty of evidence. Across most of the studies, exposure to e-cigarette advertising on social media was found to result in increased odds for various outcomes of interest among adolescents and young adults. The GRADE Summary of Findings tables are detailed in the technical report for adolescents and young adults for advertisements disseminated via Facebook, Twitter, YouTube, and Pinterest/Google Plus (Tables 13, 14, 15, 16, 17, 18, and 19, respectively).

7.1. Effect of social media advertisements on e-cigarette uptake/initiation in adolescents (12-17 years)

Two cohort studies with a maximum follow-up of 3 years reported on this outcome among adolescent never users of e-cigarettes and never users of combustible cigarettes.[59 74] Moderate certainty evidence was found that exposure to social media advertisements among adolescents was associated with increased odds of e-cigarette

uptake compared to those who reported not seeing any online tobacco advertisements (OR 2.60, 95% CI 1.56-4.35, 2 studies, 22,604 participants). The forest plot is shown in Figure 14.

Figure 14: Forest plot on effect of social media advertisements on e-cigarette initiation among adolescents (Cohort studies)



7.2. Effect of social media advertisements on e-cigarette ever use in adolescents (12-17 years)

One cohort study with a follow-up period of 9 months[57] and one cross-sectional study[71] reported on this outcome.

Very low certainty evidence was found in the cohort study that exposure to e-cigarette advertising on Facebook was associated with increased odds of ever e-cigarette use among adolescents who were never e-cigarette users at baseline (OR 2.20, 95% CI 1.37-3.52, 1742 participants).[57] The same cohort study produced very low certainty evidence in favour of the exposure to e-cigarette advertising on other social media platforms (listed below) on e-cigarette ever use in never e-cigarette adolescent users. However, the 95% CI crossed the line of no effect indicating statistical non-significance.

- Twitter: OR 1.23, 95% CI 0.82-1.84, very low certainty of evidence[57]
- YouTube: OR 1.28, 95% CI 0.53-3.09, very low certainty of evidence[57]
- Pinterest/Google Plus: OR 1.30, 95% CI 0.54-3.13, very low certainty of evidence[57]

Very low certainty evidence was found in the cross-sectional study that exposure to e-cigarette advertising on any social media platform was associated with greater odds of ever e-cigarette use compared to non-exposure (OR 1.16, 95% CI .82-1.63, 3907 participants).[71] However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

7.3. Effect of social media advertisements on e-cigarette ever use in young adults (18-25 years)

Two cross-sectional studies reported on this outcome.[78] [98]

Very low certainty evidence was found that exposure to e-cigarette advertising on any social media platform increased the odds of being an e-cigarette ever user compared to non-exposure (3.01; 95% CI 1.63–9.05, 258 participants).[98]

Very low certainty evidence was found that exposure to e-cigarette advertising on YouTube was associated with e-cigarette ever use (OR 2.81,95% CI 1.72-4.59, 1,280 participants).[78]

7.4. Effect of social media advertisements on current e-cigarette use in adolescents (12-17 years)

One cross-sectional study reported on this outcome.[71] Very low certainty evidence was found that the exposure to e-cigarette advertising on social media in general was not associated with current e-cigarette use compared to non-exposure (OR 0.92, 95% CI 0.54–1.55, 3,907 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

7.5. Effect of social media advertisements on current e-cigarette use in young adults (18-25 years)

Two cross-sectional studies reported on ever use outcomes in young adults.[78 98]

Very low certainty evidence was found that exposure to e-cigarette advertisements on social media was associated with being a current e-cigarette user compared to non-exposure (OR 2.63, 95% CI 0.73–9.48, 258 participants).[98] However, the 95% CI crossed the line of no effect, indicating statistical non-significance

Very low certainty evidence was found that exposure to e-cigarette advertisements on YouTube was associated with current e-cigarette use compared to non-exposure (OR 3.64, 95% CI 2.19- 6.04, 1,280 participants).[78]

7.6. Effect of social media advertisements on intentions to use e-cigarettes in adolescents (12-17 years)

Two studies reported on this outcome – a randomised controlled trial[106] and a cross-sectional study.[71]

The randomised controlled trial found that exposed versus non-exposed had increased odds of intending to use e-cigarettes among adolescent never, ever, or current users of e-cigarettes and combustible cigarettes (d=0.36, F (1,126) =12.51, p=0.001, 135 participants).[106]

The cross-sectional study found that exposure to e-cigarette advertising on social media, compared to non-exposure, was associated with increased odds of intending to use e-cigarettes compared to non-exposure (OR 2.08, 95% CI 1.31–3.30, 3,907 participants).[71]

7.7. Effect of social media advertisements on intentions to use e-cigarettes in young adults (18-25 years)

Two cross-sectional studies reported on this outcome.[78 103] Exposure to e-cigarette advertising on social media was associated with higher odds of intending to use e-cigarettes (OR 1.31, 95% CI 0.85-2.01, 1280 participants; B=.01 SE=.01, p=.004, 296

participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

7.8. Effect of social media advertisements on adolescents' (12-17 years) knowledge, attitudes, and beliefs relating to e-cigarettes

One randomised controlled trial study reported on this outcome. The sample comprised adolescent never, ever, and current users of e-cigarettes and combustible cigarettes at baseline.[106] Those reporting heavy exposure to e-cigarette advertising on YouTube had more positive attitudes towards e-cigarettes compared to low exposure [(F (1,126) = 5.62, p = .019]. The study also found that exposure to e-cigarette advertising on social media was associated with greater perceptions of e-cigarettes as being normative compared to exposure to peer-generated posts about e-cigarettes (d=0.28, F (1,126) =7.13, p=0.009).

8. Effect of point-of-sale advertising and marketing

Seventeen studies examined the effect of point-of-sale (POS) e-cigarette advertising and marketing. Eleven were cross-sectional studies,[61 63 65 66 69 80 91 94 100 118 119] and six were longitudinal cohort studies.[56 57 60 77 81 84] All studies involved samples from the US, with two also including participants from other high-income countries.[118 119] Of the 17 identified studies, 16 addressed primary outcome variables and five addressed secondary outcome variables. All studies examining primary outcome variables were assessed as providing low to very low certainty of evidence. Across the assessed studies, in most instances exposure to e-cigarette advertising at POS resulted in increased odds of the outcomes of interest among adolescents and young adults. Among adolescents, greater exposure to e-cigarette advertising at POS (sometimes/most of the time/always) was associated with greater odds of ever e-cigarette use compared to no exposure or exposure very rarely. Similar findings were reported for current e-cigarette use, with greater exposure resulting in greater odds of use compared to no or rare exposure. The GRADE Summary of Findings tables for adolescent, young adults, and adults are detailed in the technical report (Tables 20 and 21, respectively).

8.1. Effect of POS advertising and marketing on initiation of e-cigarettes in adolescents (12-17 years) and young adults (18-25 years)

One cross-sectional study[91] and one cohort study with a follow-up period of 2.5 years[77] reported on this outcome.

In the cohort study, very low certainty evidence was found that adolescents (never e-cigarette users at baseline) who recalled retail store–based e-cigarettes marketing had higher odds of subsequent e-cigarette initiation up to 2.5 years later compared to those with no recall (OR 1.99, 95% CI 1.25-3.1, 2,288 participants).[77] Similarly, very low certainty evidence was found that young adults (18-29 years) who never smoked at baseline who recalled store-based e-cigarette marketing had higher odds of

subsequent e-cigarette initiation up to 2.5 years later compared to those with no recall of e-cigarette advertisements (OR 1.30 95% CI 1.05-1.61, 2,423 participants).[77]

Very low certainty evidence was found in the cross-sectional study that higher frequency of convenience store visits was associated with greater odds of e-cigarette initiation among young adults (OR 1.27, 95% CI 0.79-2.04, 470 participants).[91] However, the 95% CI crossed the line of no effect, indicating non-significance.

8.2. Effect of POS advertising and marketing on e-cigarettes ever use in adolescents (12-17 years)

Two cohort studies[57 84] and two cross-sectional studies[69 80] examined the effects of POS advertising on adolescents' ever use of e-cigarettes. The two cohort studies were not pooled as they included heterogenous populations (only never e-cigarette users[57] vs both never and current users[84]) and the two-cross-sectional studies were not pooled as the outcome measures were different.

In the cohort study with adolescent never and ever users of e-cigarettes, very low certainty evidence was found that those who recalled retail store e-cigarette advertisements had higher odds of ever e-cigarette use at follow-up compared to those who did not recall retail store advertisements (OR 2.99, 95% CI 1.50-5.97, 2,488 participants).[84]

In the cohort study with only adolescent never e-cigarette users, very low certainty evidence was found that those exposed to e-cigarette POS advertising in convenience stores had lower odds of being an e-cigarette ever user nine months later compared to those who were not exposed (OR 0.91, 95% CI 0.38-2.15, 1,742 participants).[57] A similar outcome was reported for exposure to POS advertising for e-cigarettes in tobacco shops (OR 0.80, 95% CI 0.47-1.36, 1,742 participants). However, the 95% CI crossed the line of no effect in both instances, indicating statistical non-significance.[57]

Very low certainty evidence was found in one cross-sectional study that among high school students, the adjusted prevalence ratio (aPR) for ever use of e-cigarettes with frequency of seeing ads in stores (most of the time or always vs never, rarely, or sometimes) was 1.25 (95% CI 1.14-1.36, 3,909 participants).[69] Low certainty evidence was found in the other cross-sectional study that exposure to retail e-cigarette advertising was associated with higher odds of e-cigarette ever use among middle and high school students (OR1.61, 95% CI 1.43-1.80, 22,007 participants.[80]

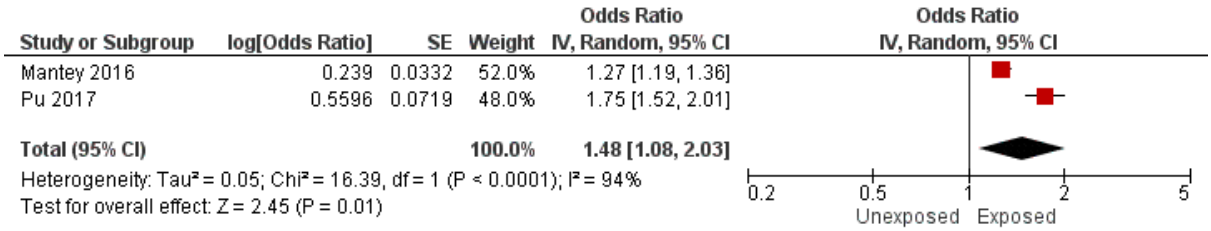
8.3. Effect of POS advertising and marketing on current e-cigarette use in adolescents (12-17 years) and young adults (18-25 years)

Nine studies, including one cohort study,[84] and eight cross-sectional studies,[61 69 80 91 94 100 118 119] examined this outcome.

The cohort study[84] found low certainty evidence that recall of retail store advertisements at baseline, compared to no recall, was associated with higher odds of current e-cigarette use at follow-up (OR 2.03, 95% CI 1.11-3.72, 2,488 participants).

Two cross-sectional studies were included in a meta-analysis.[80 94] Very low certainty evidence was found that adolescents exposed to retail store e-cigarette advertising were more likely to be current users of e-cigarettes compared to those who were not exposed (OR 1.48, 95% CI 1.08-2.03, 2 studies, 43,602 participants).[80 94] Both the studies used data from the 2014 National Youth Tobacco Survey (NYTS). However, there was high heterogeneity between the studies, possibly due to methodological or unexplained heterogeneity. The forest plot is shown in Figure 15.

Figure 15: Forest plot for effect of e-cigarette retail store marketing on adolescents' current e-cigarette use (cross-sectional studies)



The third cross-sectional study found very low certainty evidence that current exclusive e-cigarette users were more likely than never users to report exposure to vaping product advertisements at POS (OR 1.89, 95% CI 1.48-2.41, 12,064 participants).[119]

A fourth cross-sectional study conducted in multiple countries found very low certainty evidence that past 30 days exposure to vaping product advertisements at POS among young adults was associated with greater odds of current e-cigarette use in current users (OR 1.6, 95% CI 1.4-1.9, 12,294 participants) and former smokers (OR 1.0, 95% CI 0.8-1.2, 12,294 participants). However, the 95% CI crossed the line of no effect for former smokers, indicating statistical non-significance.[118]

A fifth cross-sectional study found very low certainty evidence among adolescents that greater exposure to e-cigarette ads in retail stores was associated with greater odds of e-cigarette use (high exposure OR 1.9, $p < .0001$; medium exposure OR 1.3, $p < 0.01$, 21,491 participants).[61] Exposure to ads at POS was categorised as low (never/rarely), medium (sometimes), and high (most of the time/always).[61]

A sixth cross-sectional study found very low certainty evidence that higher frequency of convenience store visits was associated with greater odds of current e-cigarette use (OR 1.97, 95% CI 1.10-3.55).[91]

A seventh cross-sectional study found low certainty evidence that among middle school students, exposure to e-cigarette advertising in retail stores most of the time/always was associated with greater odds of current e-cigarette use compared to exposure never/rarely (OR 2.34, 95% CI 1.70-3.23, 8988 participants).[100] The same

study found very low certainty evidence that among middle school students, exposure to e-cigarette advertising in retail stores sometimes was associated with greater odds of current e-cigarette use compared to exposure never/rarely (OR 1.78, 95% CI 1.30-2.45, 8988participants).[100] Among high school students, very low certainty evidence was found that exposure to e-cigarette advertising in retail stores most of the time/always and sometimes was associated with higher odds of current e-cigarette use compared to exposure never/rarely (OR 1.91, 95% CI 1.56-2.35; OR 1.37, 95% CI 1.08-1.73, respectively, 10,310 participants).[100]

The final cross-sectional study found very low certainty evidence that among high school students, e-cigarette retail exposure was associated with past-month e-cigarette use. For every additional e-cigarette advertisement, the probability of past-month e-cigarette use increased by 1% (p = .031, 3,909 participants).[69]

8.4. Effect of POS advertising and marketing on current e-cigarette use in adults (≥18 years)

A cross-sectional study found very low certainty evidence among adult smokers of little to no difference in current e-cigarette use in states with laws prohibiting self-service displays of e-cigarettes compared to states without prohibition laws (OR 1.04, 95% CI 0.99-1.09, 894,997 participants).[65]

8.5. Effect of POS advertising and marketing on current e-cigarette use in alternative high school students

A cross-sectional study[56] found very low certainty evidence that among alternative high school (AHS) students (adolescents who fall behind in their education or are expelled from the school) who were dual users at baseline, exposure to POS tobacco and e-cigarette advertising (including advertising for e-cigarettes, cigarettes, cigars, and smokeless tobacco) was associated with greater use of e-cigarettes, vaporisers, and vape pens one year later (Beta coefficient regression (β) 0.25, Standard Error (SE)) 0.05, p < 0.001, 609 participants). However, it was unclear whether the effects were due to the combined assessment of e-cigarette and tobacco products advertising or only e-cigarette advertising.

8.6. Effect of POS advertising and marketing on current cigarette use in adolescents (12-17 years)

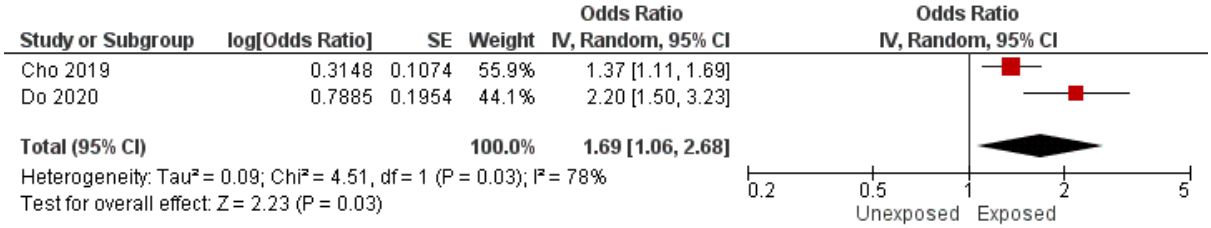
Four studies reported on this outcome. Two were cohort studies.[56 60] and two were cross-sectional studies.[63 119]

One cohort study[56] found very low certainty evidence that among AHS students who were smokers and e-cigarette users at baseline, exposure to POS tobacco advertising was associated with greater combustible cigarette use one year later (β 0.30, SE 0.04, p <.001, 609 participants).

A cohort study[60] found very low certainty evidence that e-cigarette retail store exterior advertising prevalence was associated with state smoking rate (prevalence ratio (PR) 1.03, 95% CI 1.0-1.06, 2,126 participants).

Pooled results from the two cross-sectional studies found moderate certainty evidence that among adolescents, exposure to e-cigarette advertising in retail stores was associated with greater odds of current use of combustible cigarettes compared to non-exposure (OR 1.69, 95% CI 1.06-2.68, 2 studies, 391,395 participants).[63 119] The forest plot is shown in Figure 16.

Figure 16: Forest plot of effect of retail stores marketing in adolescents (cross-sectional studies)



8.7. Effect of POS advertising and marketing on current dual use of e-cigarette and combustible cigarette in adolescents (12-17 years)

Two cross-sectional studies[63 119] reported on this outcome.

Very low certainty evidence was found among adolescents that e-cigarette ad exposures at POS were associated with higher odds of dual use versus never use compared to non-exposure (at retail stores that sell cigarettes: OR 1.83, 95% CI 1.43-2.35; at kiosks: OR 1.88, 95% CI 1.47-2.40, 12,064 participants).[119] Very low certainty evidence was found among high school students that POS tobacco advertising exposure was associated with greater odds of current dual use compared to non-exposure (OR 1.5, 95% CI 1.0-2.1, 379,331 participants).[63]

8.8. Effect of POS advertising and marketing on quitting e-cigarette and combustible cigarette use in young adult smokers (18-25 years)

One cohort study[81] reported on this outcome. Very low certainty evidence was found that young adults' exposure to advertising of e-cigarettes was negatively associated with cigarette smoking abstinence at 6-month follow-up (OR 0.85, 95% CI 0.72-1.01, 813 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

8.9. Effect of POS advertising and marketing on intentions to use e-cigarettes in adolescents (12-17 years)

One cohort study (follow up period 6 months)[84] and three cross-sectional studies[66 80 94] and reported on this outcome.

In a cohort study, adolescent never, ever, and current users of e-cigarettes who recalled e-cigarette advertisements in retail stores at baseline had higher odds of

being susceptible to e-cigarette use at follow-up compared to those who did not recall advertisements (OR 1.77, 95% CI 1.20-2.61, 2,488 participants).[84]

The three cross-sectional studies were not pooled because they measured outcomes differently. Among adolescents who were never smokers and never e-cigarette users, high (most of the time/always) exposure to e-cigarette advertising at POS was associated with higher odds of e-cigarette susceptibility compared to low exposure (never/rarely) (OR 1.45, 95% CI 1.09-1.94, 13,428 participants).[66] Exposure to e-cigarette marketing was associated with susceptibility to e-cigarettes among never users (OR 1.30, 95% CI 1.20-1.41, 22,007 participants).[80] Exposure to e-cigarettes advertising via retail stores was associated with intention to try e-cigarettes among adolescents who had never used e-cigarettes (OR 1.32, 95% CI 1.07-1.62, 22,007 participants).[94]

8.10. Effect of POS advertising and marketing on intentions to use e-cigarettes in young adults (18-25 years)

In a cross-sectional study[91] of young adults, it was found that frequency of convenience store visits was not associated with e-cigarette susceptibility (OR 0.90, 95% CI 0.48-1.69, 470 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

9. Effect of Internet advertising and marketing

Eleven studies examined the effect of Internet e-cigarette advertising and marketing. One was a randomised controlled trial,[95] two were cohort studies,[77 84] and eight were cross-sectional studies.[61 80 82 94 96 100 104 117] Of the 11 identified studies, eight addressed primary outcome variables and seven addressed secondary outcome variables. All studies examining primary outcome variables were assessed as providing low to very low certainty evidence. Across all 11 studies, exposure to e-cigarette advertising on the Internet was found to result in increased odds of the outcomes of interest among adolescents, with the exception of initiation of e-cigarette use for which no significant effect was found in the one study assessing this outcome. The Summary of Findings tables for adolescents and young adults are detailed in the technical report (Tables 22).

9.1. Effect of Internet advertising and marketing on initiation of e-cigarette use among adolescents (12-17 years) and young adults (18-25 years)

One cohort study[77] reported on this outcome. The study sample included participants were never e-cigarette users. Very low certainty evidence was found that among adolescents and young adults who were never users of combustible cigarettes, recall of exposure to e-cigarette marketing via the Internet was negatively associated with e-cigarette initiation among adolescents up to 2.5 years later (OR 0.85, 95% CI 0.61-1.18, 2,288 participants) and positively associated with e-cigarette initiation among young adults up to 2.5 years later (OR 1.20, 95% CI 0.97-1.48, 2,423 participants). The 95% CIs crossed the line of no effect, indicating statistical non-significance.

9.2. Effect of Internet advertising and marketing on e-cigarette ever use among school-aged adolescents (12-17 years)

One cohort study[84] and two cross-sectional studies[80 104] reported on this outcome.

Very low certainty evidence was found from the cohort study[84] which included never, ever and current users of e-cigarettes at baseline that adolescents who recalled e-cigarette advertisements on the Internet (sometimes/most of the time/always) had higher odds of ever e-cigarette use compared to those who did not recall or rarely recalled the advertisements. However, the 95% CI crossed the line of no effect, indicating statistical non-significance (OR 1.24, 95% CI 0.92-1.69, 2,488 participants).

In one cross-sectional study,[80] very low certainty evidence was found that adolescents' exposure (sometimes/most of the time/always) to e-cigarette and cigarette advertising via the Internet was associated with greater odds of ever use of e-cigarettes compared to those who were not exposed or rarely exposed (OR 1.61, 95% CI 1.41-1.83, 22,007 participants).

In the other cross-sectional study,[104] very low certainty evidence was found that adolescents' exposure to e-cigarette and cigarette advertising on tobacco company websites was associated with greater odds of ever use of e-cigarettes compared to non-exposure (OR 3.20, 95% CI 2.30-4.50, 13,651 participants).

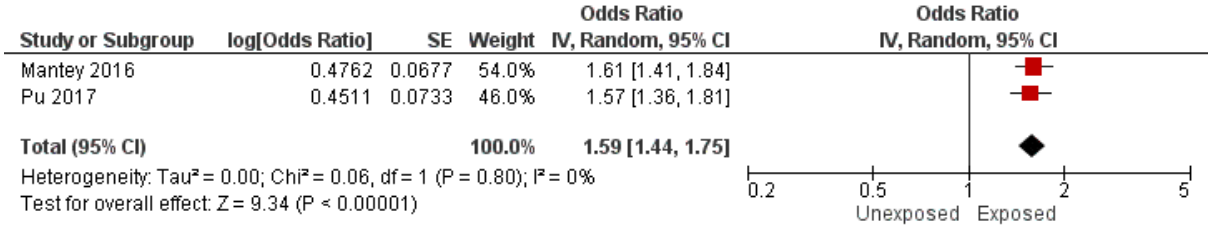
9.3. Effect of Internet advertising and marketing on current use of e-cigarettes in adolescents (12-17 years)

One cohort study[84] and five cross-sectional studies[61 80 94 100 104] reported on this outcome.

The cohort study included never, ever, and current users of e-cigarettes at baseline. Very low certainty evidence was found that adolescents who recalled viewing e-cigarette advertisements on the Internet sometimes/most of the time/always had greater odds of current e-cigarette use compared to those who did not recall or rarely recalled seeing advertisements (OR 1.20, 95% CI 0.70-2.07, 2,488 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.[84]

Two cross-sectional studies[80 94] were sufficiently homogenous to be included in a meta-analysis. Low certainty evidence was found that adolescents' exposure (sometimes/most of the time/always) to e-cigarette and cigarette advertising via the Internet was associated with greater odds of current use of e-cigarettes compared to those who were not exposed or rarely exposed (OR 1.59, 95% CI 1.44-1.75, 2 studies, 43,602 participants). The forest plot is shown in Figure 17.

Figure 17: Forest plot of the effect of exposure to e-cigarette marketing via the Internet vs non-exposure on current e-cigarette use among adolescents (cross-sectional studies)



In the third cross-sectional study, very low certainty evidence was found that adolescents' exposure to e-cigarette and cigarette advertising websites was associated with greater odds of current use of e-cigarettes compared to non-exposure (OR 3.0, 95% CI 1.90-4.70, 13,651 participants).[104] In the fourth cross-sectional study, low certainty evidence was found that greater exposure of adolescents to e-cigarette ads on the Internet was associated with greater odds of using e-cigarettes (high exposure OR 1.9, p < 0.001; medium exposure OR 1.4, p < 0.01, 21,491 participants).[61]

In the fifth cross-sectional study, low certainty evidence was found that current e-cigarette use was greater among middle and high school students with exposure to e-cigarette advertising on the Internet most of the time/always compared to those exposed never/rarely (middle school students: OR 2.91, 95% CI 1.89-4.47, 9009 participants; high school students OR 2.02, 95% CI 1.66-2.46, 10,303 participants).[100] Low certainty evidence was found that current e-cigarette use was greater among middle and high school students exposed to e-cigarette advertising on the Internet sometimes compared to those exposed never/rarely (middle school students: OR 1.44, 95% CI 1.03-2.00, 9009 participants; high school students: OR 1.49, 95% CI 1.22-1.84, 10,303 participants).[100]

9.4. Effect of Internet advertising and marketing on current cigarette use in adolescents (12-17 years)

Very low certainty evidence from a cross-sectional study[104] was found that adolescents viewing tobacco product company brand websites (both cigarettes and e-cigarettes) had greater odds of being current cigarette users (OR 3.2, 95% CI 2.2-4.4, 13,651 participants).

9.5. Effect of Internet advertising and marketing on current dual use among adolescents (12-17 years)

In one cross-sectional study,[82] very low certainty evidence was found that exposure to online multi-product (cigarettes, other tobacco products, and e-cigarettes) promotion was associated with greater odds of dual use among middle and high school students (OR 1.73, 95% CI 1.39-2.17, 15,328 participants).

9.6. Effect of Internet advertising and marketing on e-cigarette-related attitudes and beliefs among young adults (18-25 years)

One cross-sectional study[96] (5,983 participants) reported on this outcome. E-cigarette advertising exposure via the Internet among young adults was associated with beliefs that e-cigarette use is more acceptable in bars (OR 1.33, 95% CI 1.16-1.53), stores (OR 1.20, 95% CI 1.04-1.39), at work (OR 1.16, 95% CI 1.00-1.33), in class (OR 1.25, 95% CI 1.07-1.46), and in dorms (OR 1.35, 95% CI 1.17-1.55).

9.7. Effect of Internet advertising and marketing on e-cigarette-related attitudes and beliefs among adults (18 to 65 years)

One cross-sectional study[117] (964 participants) reported on this outcome. Adult smokers exposed to Internet e-cigarette advertising scored e-cigarettes as healthier than cigarettes (Cohen's d effect (Z) 2.21, p=0.027) but did not consider them more desirable or socially acceptable. Dual users in the sample reported e-cigarettes as healthier (Z 2.53, p=0.011) and more desirable (Z 2.04, p=0.042) than cigarettes.

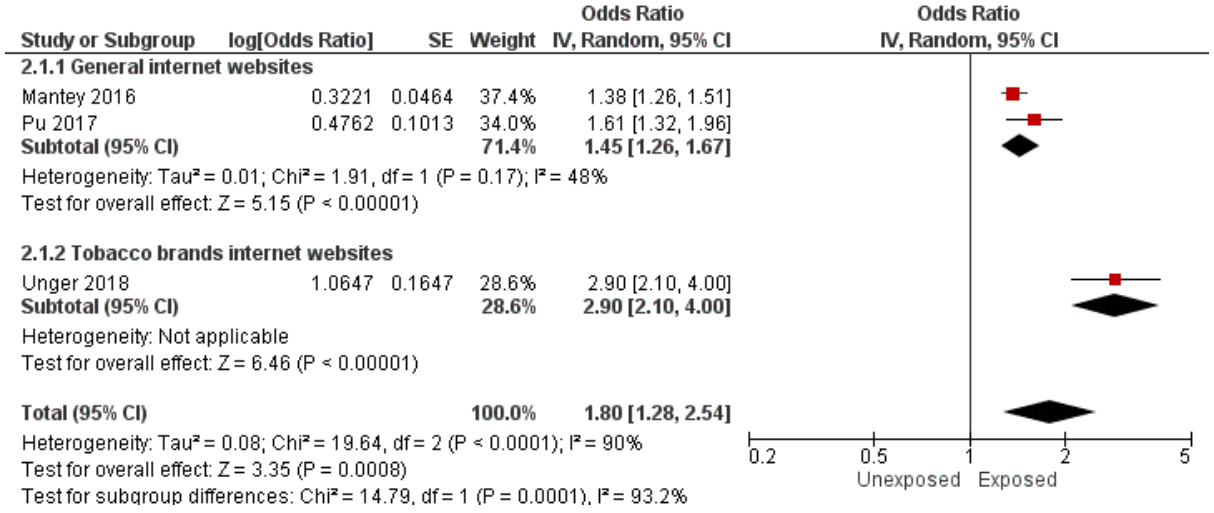
9.8. Effect of Internet advertising and marketing on adolescents' (12-17 years) intentions to use e-cigarettes

One cohort study[84] and three cross-sectional studies[80 94 104] reported on this outcome.

In the cohort study[84] with adolescent never, ever, and current users of e-cigarettes at baseline, the odds of being susceptible to e-cigarette use were higher among those who recalled e-cigarette advertisements on the Internet compared to those with no recall (OR 2.79, 95% CI 1.80-4.33, 2,488 participants).

Results from a meta-analysis of the three cross-sectional studies showed that adolescents' exposure to e-cigarette and cigarette advertising via the Internet was associated with greater odds of intending to use e-cigarettes compared to those who were not exposed (OR 1.80, 95% CI 1.28-2.54, 57,253 participants).[80 94 104] However, there was high heterogeneity across the three studies, possibly due to exposure type. The study by Unger et al.[104] specifically assessed exposure via tobacco brands' Internet websites compared to general Internet websites being assessed in the other two studies. The forest plot is shown in Figure 18.

Figure 18: Forest plot of effect of exposure to e-cigarette marketing via the Internet vs non-exposure on adolescents' intentions to use e-cigarettes (cross-sectional studies)



9.9. Effect of Internet advertising and marketing on adults' (18-34 years) intentions to use e-cigarettes

In a randomised controlled trial,[95] adult current cigarette smokers who had visited or registered on a tobacco company website were found to be more likely to try an e-cigarette than those who were not exposed to the same tobacco company website (OR 1.22, 95% CI 0.34-4.39, 2,110 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.10 Effect of mail (e-mail and/or postal) marketing

10. Effect of mail (e-mail and/or postal) marketing

One study examined the effect of mail marketing of e-cigarettes.[62] The study was cross-sectional in design, included an adult sample, was conducted in the US, and covered both postal and email forms of mail advertising. The GRADE Summary of Findings tables are detailed in the technical report for adults for e-mail advertising, postal mail advertising and, postal and email advertising (Tables 23, 24 and 25, respectively).

10.1. Effect of mail marketing on current e-cigarette use in adults (≥18 years)

Low certainty evidence was found that exposure to mail (postal or e-mail) e-cigarette marketing was associated with higher odds of being a current e-cigarette user compared to non-exposure (OR 2.0, 95% CI 1.7–2.4, 5,382 participants).[62] When assessed by mail type, e-mail marketing had a stronger effect than postal mail (email: OR 2.6, 95%CI 2.1–3.1, low certainty of evidence, 3,422 participants; postal mail: OR 1.2, 95%CI 1.0–1.6, very low certainty of evidence, 1,960 participants).

10.2. Effect of mail marketing on frequency of e-cigarette use in adults (≥18 years)

Low certainty evidence was found that those who received any type of mailed e-cigarette marketing had increased odds of using e-cigarettes daily (OR 1.7, 95% CI 1.2–2.4, 5,382 participants) and on some days (OR 1.6, 95% CI 1.1–2.2, 5,382 participants) compared to those who did not receive such promotions.[62] When analysed separately, the results were stronger for email marketing over postal marketing (email: every day OR 2.0, 95% CI 1.4–3.0, low certainty evidence, 3422 participants; some days OR 1.5, 95% CI 1.1–2.2, low certainty evidence, 3422 participants; postal mail: every day OR 1.7, 95% CI 1.0–2.7, very low certainty evidence, 1,960 participants; some days OR 1.5, 95% CI 1.0-2.3, very low certainty evidence, 1,960 participants).[62]

11. Effect of multiple media advertising

Thirty-nine studies examined the effect of multiple media e-cigarette advertising. Four were randomised controlled trials,[83 92 95 105] one was a non-randomised trial,[79] nine were cohort studies,[64 74 77 84 89 90 107 114 116] and 25 were cross-sectional studies.[54 55 58 64 70 72 75 80 85 87 88 93 91 94 97 99 102 109 112 113 115 118-120 128] Most of the studies were conducted in the US, with the exceptions being studies conducted in the UK,[109] Canada,[112] Germany,[113 114] Finland,[115] and the Netherlands.[116] Three studies were conducted in multiple countries: one in Canada, England, and the US,[119] one in Australia, Canada, England, and the US,[118] and one in multiple countries in the European Union.[120]

Of the 38 identified studies examining the effects of exposure to e-cigarette advertising or marketing via multiple media sources, 28 addressed primary outcome variables and eight addressed secondary outcome variables in adolescents and young adults. Two studies addressed primary outcome variables and eight addressed secondary outcome variables in adults. One study examined ever e-cigarette use in pregnant women. Included studies assessed two or more e-cigarette advertising media exposure sources. In most of the studies, multiple media sources commonly included social media, Internet, print media, retail outlets, and billboards and posters.

Most studies examining primary outcome variables were assessed as providing very low certainty evidence. Across all 28 studies with adolescents and young adults, greater exposure to e-cigarette advertising via multiple media sources resulted in greater odds of initiation of e-cigarettes, ever use of e-cigarettes, and current cigarette use compared to non-exposure. The evidence on current e-cigarette use among adolescents and young adults was mixed, however most studies indicated that exposure to multiple media sources was associated with current use. Cumulative exposure to multiple media sources in the past 30 days and 6 months resulted in greater odds of current cigarette use compared to no exposure among adolescents and young adults. The GRADE Summary of Findings tables for adolescents and young adults, and adults, are detailed in the technical report (Tables 26 and 27, respectively).

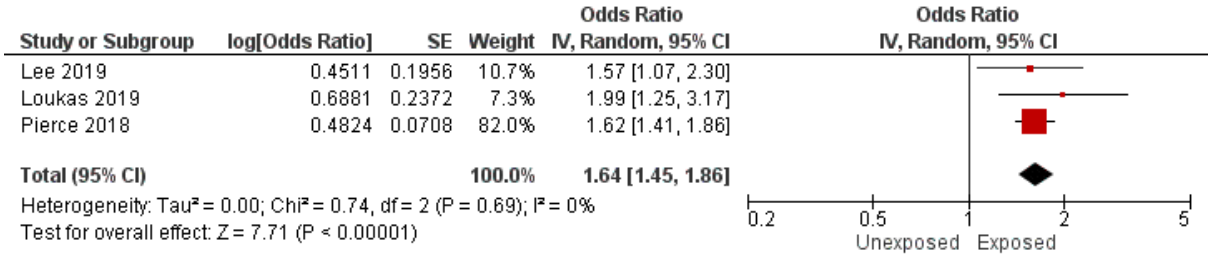
11.1. Effect of multiple media advertising on initiation of e-cigarette use in adolescents (12-17 years)

Six studies examined initiation of e-cigarette use. Three were cohort studies[74 77 89] and three were cross-sectional studies.[58 91 115]

Three cohort studies examined initiation of e-cigarette use among adolescents, with follow-up periods ranging from 1 to 2.5 years.[74 77 89] Two of these studies assessed exposure to six media sources (broadcast, print, events, social media, Internet, POS) [74 77] and one study[89] assessed exposure to three media sources (print, direct mail, and television ads). The participants in the cohort studies were never e-cigarette users[74 77] and never tobacco users[89] at baseline.

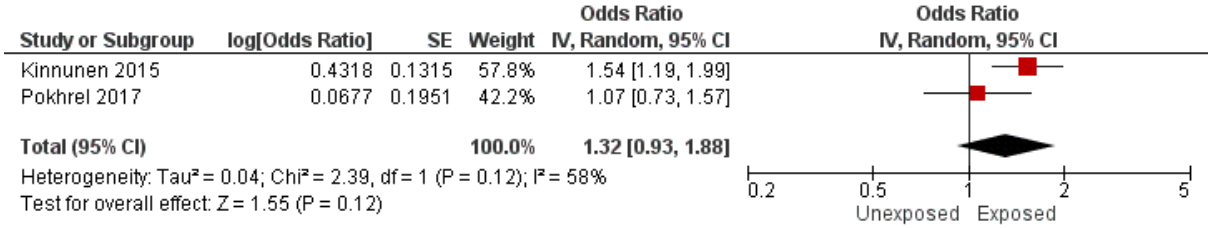
In adolescents, greater exposure (sometimes/most of the time/always) to e-cigarette ads across multiple media sources was associated with higher odds of e-cigarette initiation compared to those who were never/rarely exposed (OR 1.64, 95% CI 1.45-1.86, 3 studies 27,025 participants, moderate certainty of evidence). No heterogeneity was found between the three studies.[74 77 89] The forest plot is shown in Figure 19.

Figure 19: Forest plot of effect of exposure to e-cigarette advertising on ever use of e-cigarettes among adolescents (cohort studies)



Two cross-sectional studies examined e-cigarette initiation among adolescents and young adults.[91 115] Low certainty evidence from pooled analyses of two studies found that more frequent exposure (sometimes/most of the time/always) was associated with e-cigarette initiation compared to no or rare exposure (OR 1.32, 95% CI 0.93-1.88). However, the 95% CI crossed the line of no effect, indicating statistical non-significance. Moderate heterogeneity was reported between the two studies. Kinnunen et al.[115] assessed advertising exposures across multiple media including Facebook, other Internet websites, traditional media, shops, and billboards, and reported greater odds of cigarette initiation with frequent exposure compared to no or rare exposure. Pokhrel et al. assessed exposure to print magazine ads and video still images.[91] The forest plot is shown in Figure 20. .

Figure 20: Forest plot of effect of exposure to e-cigarette advertising on multiple ad sources vs no exposure on e-cigarette initiation among adolescents and young adults (cross sectional studies)



Very low certainty evidence from a cross-sectional study found that among adolescents, higher recall of e-cigarette marketing might be associated with higher risk of initiating use of JUUL e-cigarettes compared to no recall of exposure (Relative risk ratio (RRR) 1.64, 95% CI 1.17-2.29, 1,365 participants).[58]

11.2. Effect of multiple media advertising on initiation of e-cigarette use in young adults (18-25 years)

One randomised controlled trial examined e-cigarette initiation at 6-month follow-up among adults aged 18-34 years.[105] Low certainty evidence was found that there were increased odds of e-cigarette initiation among e-cigarette never users exposed to e-cigarette ads via print media and online displays compared to those who were not exposed (OR 1.53, 95% CI 0.98-2.39, 3,196 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance. The participants included current cigarette smokers who had never used e-cigarettes at baseline.

11.3. Effect of frequency of multiple media advertising exposure on e-cigarette initiation in adolescents (12-17 years)

One cross-sectional study examined e-cigarette initiation.[70] Very low certainty evidence was found that middle and high school students with moderate (sometimes) or high exposure (most of the times/always) were more likely to initiate e-cigarette use compared to those who reported little to no exposure to e-cigarette advertising (moderate exposure: OR 1.23, 95% CI 1.02-1.50; high exposure: OR 1.64, 95% CI 1.07-2.50, 736,158 participants).[70]

11.4. Effect of multiple media advertising on initiation of cigarettes in adolescents (12-17 years)

Two cross-sectional studies examined initiation of cigarette use; one study was conducted with adolescent dual users[58] and one with adolescent never smokers[89].

Very low certainty evidence was found that higher recall of e-cigarette marketing was associated with increased risk of initiating combustible tobacco use compared to those with no recall of exposure (RRR 2.10, 95% CI 1.08-4.07, 1,365 participants).[58]

Very low certainty evidence was found that among adolescents and young adults who have never smoked, exposure to e-cigarette advertising was associated with initiation

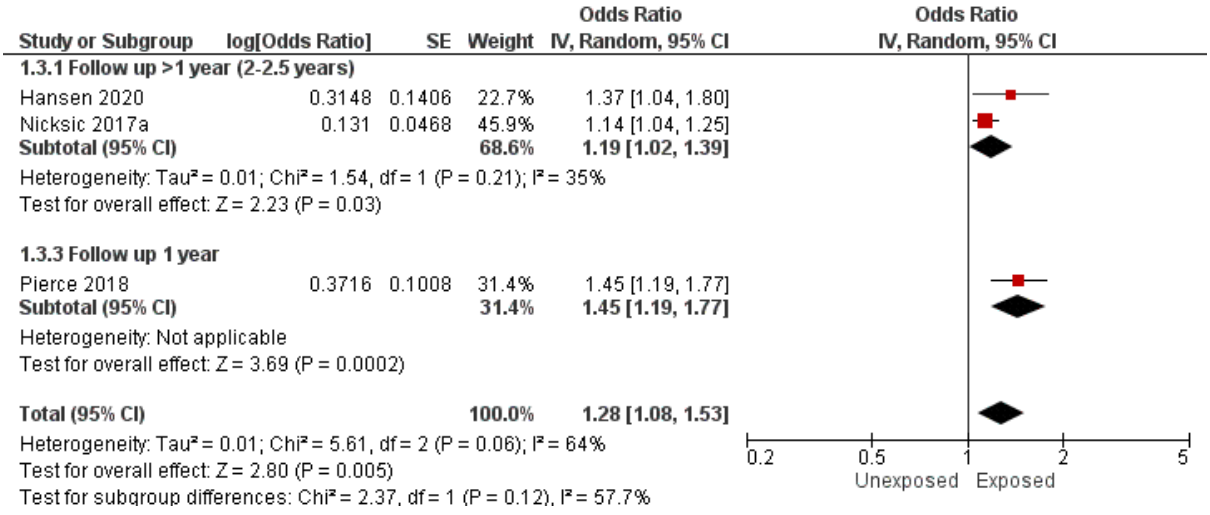
of cigarette use at follow-up after 1 year (OR 1.43, 95% CI 1.23-1.65, 10,989 participants).[89]

11.5. Effect of multiple media advertising on ever e-cigarette use in adolescents (12-17 years) and young adults (18-25 years)

Seven studies examined this outcome.[72 80 84 89 93 113 114] Three were cohort studies[114 84 89] and four were cross-sectional studies.[72 80 93 113]

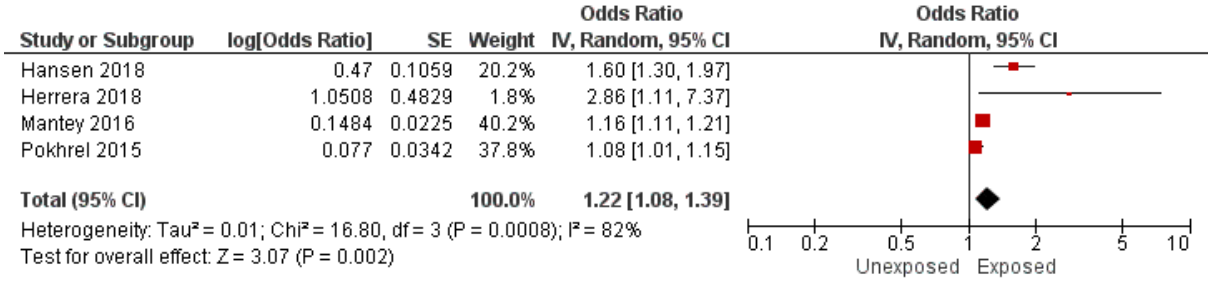
Very low certainty evidence was found from the three cohort studies that exposure (sometimes/most of the time/always vs never/rarely) to e-cigarette ads across multiple media sources increased the odds of e-cigarette ever use (OR 1.28, 95% CI 1.08-1.53, 3 studies, 16,595 participants).[114 84 89] At baseline, two studies included never e-cigarette and cigarette users,[114 84] and one study included never tobacco users.[89] Subgroup analysis by follow-up period showed that for follow-up of less than a year, the effect was OR 1.45 (95% CI 1.19-1.75, 10,989 participants).[89] For follow-up of more than a year, the effect was OR 1.19 (95% CI 1.02-1.39, 5,606 participants).[84 114] The forest plot is shown in Figure 21.

Figure 21: Forest plot of effect of exposure to e-cigarette ads across multiple media sources on ever use of e-cigarettes among adolescents and young adults by follow-up periods (cohort studies)



Very low certainty evidence from the four cross-sectional studies found exposure to advertisements on multiple media was associated with greater odds of e-cigarette use (OR 1.22, 95% CI 1.08-1.39, 4 studies, 28,944 participants).[72 80 93 113] However, considerable heterogeneity was identified between the studies. The study by Herrera et al.[72] had a small sample size and the study by Hansen et al.[113] included only two exposure sources. The forest plot is shown in Figure 22.

Figure 22: Forest plot of effect of exposure to e-cigarette advertising on multiple ad sources vs no exposure on ever use of e-cigarettes among adolescents and young adults (cross-sectional studies)



11.6. Effect of multiple media advertising on e-cigarette ever use among pregnant women (≥18 years)

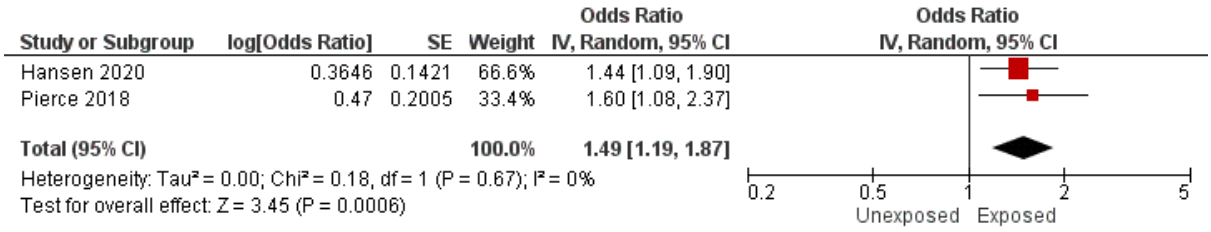
Very low certainty evidence from a cross-sectional study was found indicating that among pregnant women (18 to 45 years) who were dual users, exposure to e-cigarette advertising on multiple media sources was associated with higher odds of ever use of e-cigarettes (OR 1.04, 95% CI 1.00-1.08, 194 participants).[54]

11.7. Effect of multiple media advertising on cigarette ever use in adolescents (12-17 years) and young adults (18-25 years)

Two cohort studies examined cigarette ever use.[89 114] The follow up period in both studies was 12 months. At baseline, the participants in one study[114] were e-cigarette non-users, cigarette non-users, hookah non-users at baseline, and in the other they were tobacco users.[89]

Low certainty evidence from pooled analysis of two studies found that exposure to advertisements from multiple media sources among adolescents and young adults was associated with greater odds of ever cigarette use at follow-up (OR 1.49, 95% CI 1.19-1.87, 2 studies, 14,107 participants). No heterogeneity was identified between the two studies.[89 114] The forest plot is shown in Figure 23.

Figure 23: Forest plot of effect of exposure to e-cigarette advertising on multiple ad sources vs no exposure on ever use of cigarettes in adolescents and young adults (cohort studies)



In a cross-sectional study, very low certainty evidence was found that among adolescents, exposure to e-cigarette marketing increased the odds of ever-use of cigarettes compared to non-exposure (OR 1.2, 95% CI 1.0-1.4, 6,538 participants).[113]

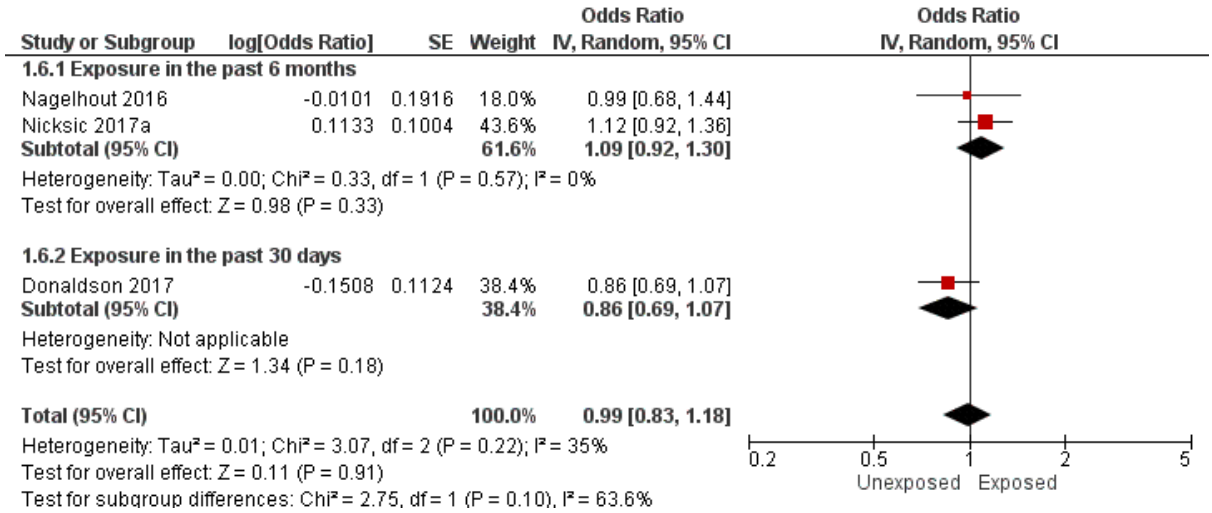
11.8. Effect of multiple media advertising on dual e-cigarette and cigarette current use in adolescents (12-17 years)

In a cross-sectional study, very low certainty evidence was found that among adolescents, exposure to e-cigarette advertisements was associated with higher odds of current use of e-cigarettes and combustible cigarettes (OR 1.6, 95% CI 1.3-1.9, 6,538 participants).[113]

11.9. Effect of multiple media advertising on e-cigarette current use among adolescents (12-17 years) and young adults (18-25 years)

In three pooled cohort studies, very low certainty evidence was found for an effect of e-cigarette advertising exposure across multiple media sources on current e-cigarette use compared to no exposure in adolescents and young adults (OR 0.99, 95% CI 0.83-1.18, 3 studies, 7,064 participants). However, the 95% CI crossed the line of no effect, indicating statistical non-significance.[64 84 116] The follow up period ranged from 6 months[64 84] to 12 months.[116] Participants in the three studies at baseline were never users of e-cigarettes,[116] never users of combustible cigarettes,[84] and tobacco users.[64] Overall, there was moderate heterogeneity between the three studies. In two of the studies, exposure to ads in the past 6 months was associated with increased odds of current e-cigarette use compared to non-exposure (OR 1.09, 95% CI 0.92-1.30, 2,254 participants). No heterogeneity was identified between the two studies.[84 116] When exposure to media sources was assessed over only the past 30 days, lower odds of current e-cigarette use were found compared to no exposure (OR 0.86, 95% CI 0.69-1.07, 3,738 participants).[64] The forest plot is shown in Figure 24.

Figure 24: Forest plot of effect of exposure to multiple ad sources vs no exposure on current e-cigarette use among adolescents and young adults (cohort studies)

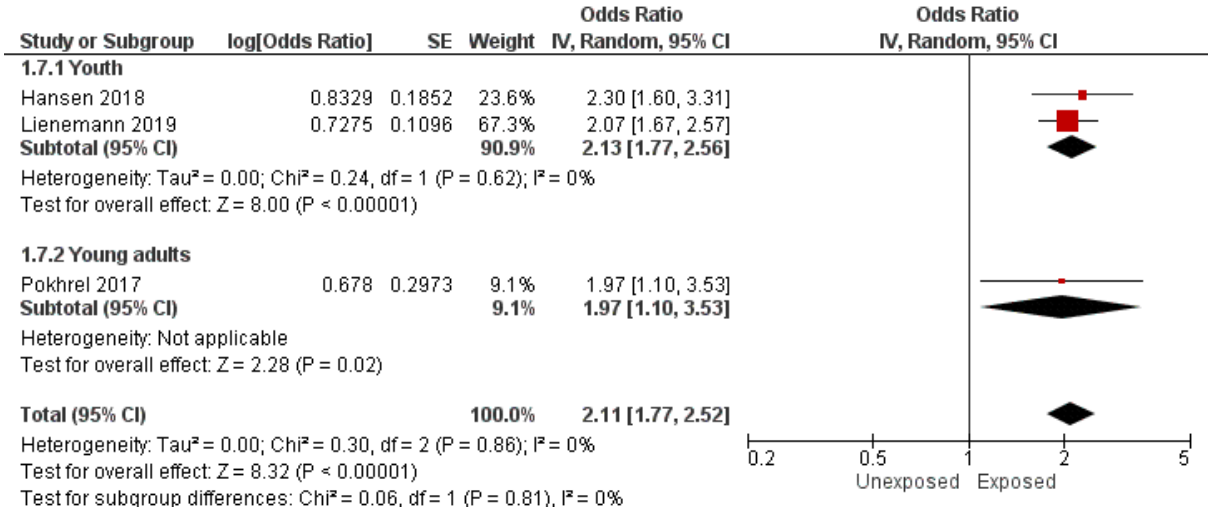


In a cross-sectional study conducted with adolescents aged 16 to 19 years from the US, Canada, and England who only used e-cigarette products, exposure to advertising on websites plus social media was associated with higher odds of current e-cigarette use compared to no exposure (OR 2.57, 95% CI 2.02-3.27, 12,064 participants, high certainty of evidence).[119]

11.10. Effect of multiple media advertising on e-cigarette current use among adolescents (12-17 years) and young adults (18-25 years)

Pooled results from three cross-sectional studies showed that among adolescents and young adults, exposure (sometimes/most of the time/always) to advertisement of 2-3 mediums increased the odds of current e-cigarette use compared to no exposure (OR 2.11, 95% CI 1.77-2.52, 3 studies, 16,117 participants, high certainty of evidence).[75 91 113] No heterogeneity was reported between the studies. The forest plot is shown in Figure 25.

Figure 25: Forest plot of effect of exposure to multiple ad sources (2-3 sources) vs no exposure on current e-cigarette use among adolescents and young adults (cross-sectional studies)

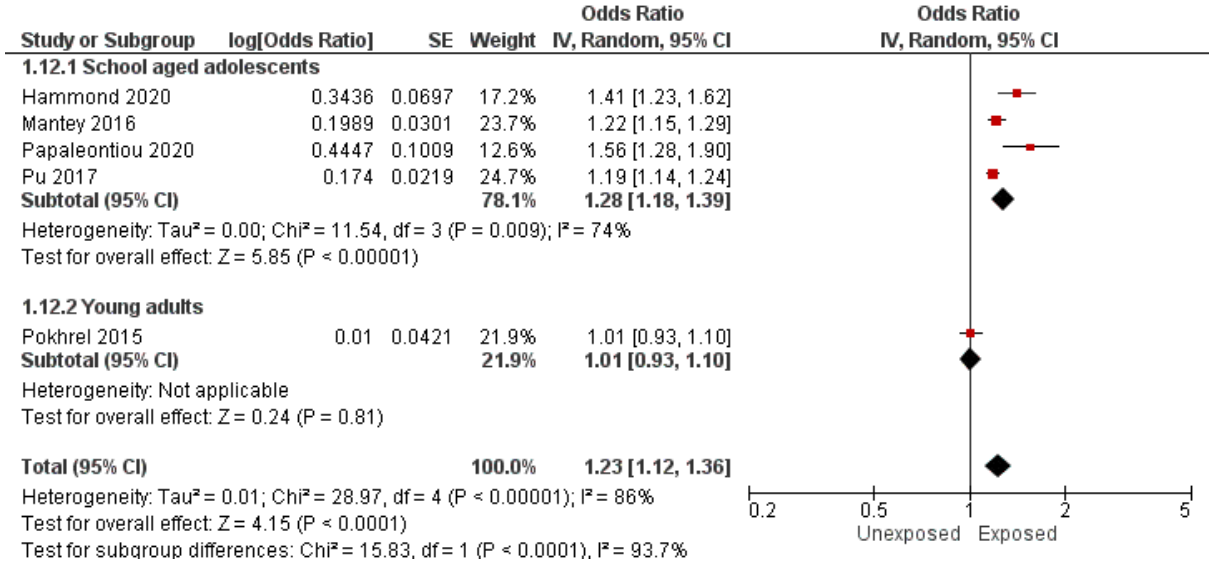


11.11. Effect of multimedia advertising on current e-cigarette use in adolescents (12-17 years) and young adults (18-25 years)

Six cross-sectional studies examined this outcome.[80 87 88 112 93 94]

Low certainty evidence from four cross-sectional studies was found that among adolescents, exposure (sometimes/most of the time/always) to >3 ad sources increased the odds of current e-cigarette use compared to no exposure (OR 1.28, 95% CI 1.18-1.39, 4 studies, 83,317 participants). Considerable heterogeneity was reported between the studies.[80 87 94 112] The forest plot is shown in Figure 26.

Figure 26: Forest plot of effect of exposure to multiple ad sources (>3 sources) vs no exposure on current e-cigarette use among adolescents (cross-sectional studies)



Very low certainty evidence was found that among young adults there was no clear effect of exposure to >3 ad sources versus no exposure on current e-cigarette use (OR 1.01, 95% CI 0.93-1.10, 307 participants).[93]

In one cross-sectional study of adolescents, there was moderate certainty evidence that a one-interval increase on an ad exposure measure was associated with greater odds of current e-cigarette use (OR 6.42, 95% CI 2.28-18.11, 71,702 participants).[88] The tobacco advertisement at the county level exposure score was reported as one-interval increase in exposure measured from rarely to sometimes or sometimes to most of the time.[88]

11.12. Effect of multiple media advertising on current e-cigarette use in adult (≥18 years) exclusive vapers

One cross-sectional study reported on this outcome.[118] Very low certainty evidence was found that in adult exclusive e-cigarette users (who used e-cigarettes but not combustible cigarettes), exposure (sometimes/most of the time/always) to websites and social media was associated with greater odds of current e-cigarette use compared to no exposure or exposure rarely (OR 2.4, 95% CI 1.7-3.2, 12,246 participants).

11.13. Effect of multiple media advertising on current e-cigarette use in adolescents (12-17 years) from alternative high schools

Very low certainty evidence from one cohort study[90] was found that among high school students from AHS, a one-unit change in exposure to e-cigarette advertising from multiple media sources was associated with a 21.8% increase in the number of times adolescents used e-cigarettes one year later (unstandardised beta co-efficient (b) 0.20, standard error (SE) 0.03, p < .001, 923 participants).[90]

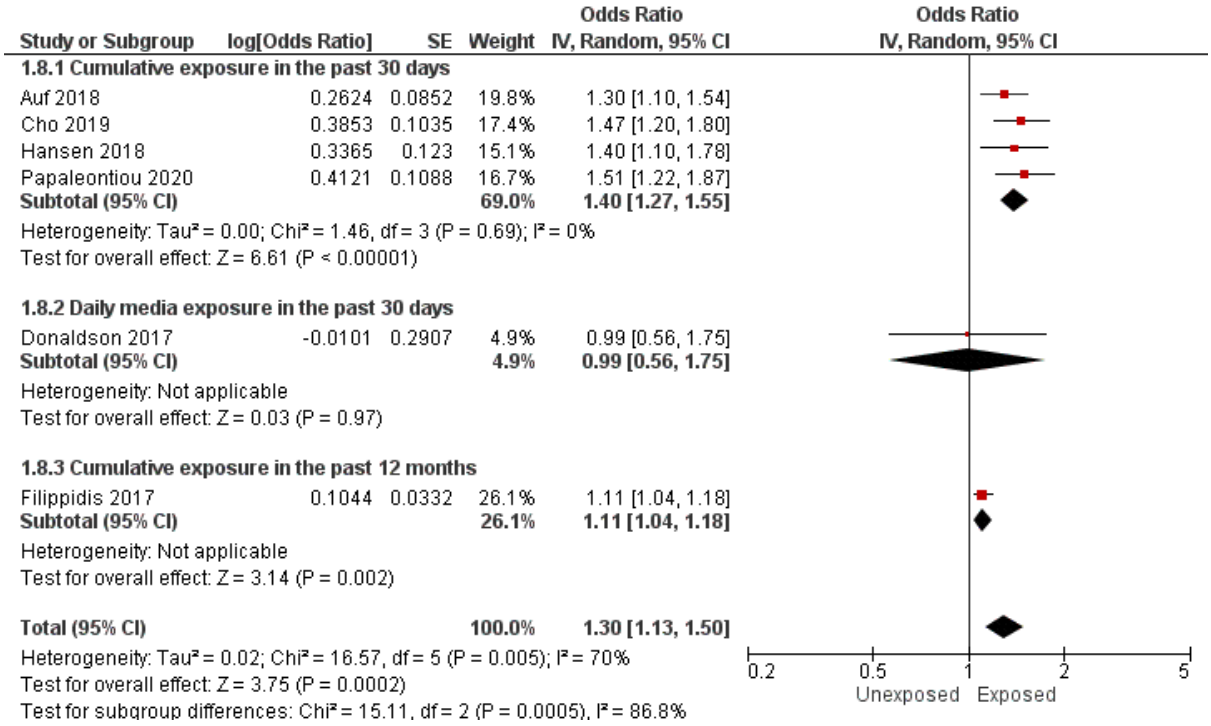
11.14. Effect of multiple media advertising on current cigarette use in adolescents (12-17 years) and young adults (18-25 years)

Six cross-sectional studies[55 64 87 113 119 120] examined this outcome.

Moderate certainty evidence demonstrated that cumulative exposure (sometimes/most of the time/always) to e-cigarette advertising across multiple sources in the past 30 days was associated with greater odds of current combustible cigarette use compared to no exposure or exposure rarely (OR 1.40, 95% CI 1.27-1.55, 4 studies, 58,320 participants).[55 87 113 119] The forest plot is shown in Figure 27.

Very low certainty evidence was found indicating no clear effect of either daily media exposure in the past 30 days or cumulative exposure in the past 30 days on current cigarette use (OR 0.99, 95% CI 0.56-1.75, 3,738 participants). The 95% CI crossed the line of no effect, indicating statistical non-significance.[64] Very low certainty evidence was found that exposure to multiple media sources over a 12-month period was associated with greater odds of current cigarette use (OR 1.11, 95% CI 1.01-1.18, 27,801 participants).[120]

Figure 27: Forest plot of effect of exposure to multiple ad sources vs no exposure on current cigarette use among adolescents and young adults (cross-sectional studies)



Low certainty evidence was found for an association between exposure to tobacco advertisements (including e-cigarette advertisements) assessed at county level and current cigarette use among adolescents aged 11-17 years (OR 3.28, 95% CI 1.96-5.49, 71,012 participants).[88] However, it was not clear whether the effect was due to e-cigarette advertising alone.

11.15. Effect of multiple media advertising on frequency of e-cigarette use in adolescents (12-17 years) from alternative high schools

A cohort study found very low certainty evidence that among high school students from alternative high schools (AHS) who were tobacco product users, every unit change in exposure to e-cigarette advertising was associated with a 10.1% increase in the number of times adolescents used e-cigarettes one year later (b 0.10, SE 0.02, p < .001, 923 participants).[90]

11.16. Effect of multiple media advertising on current dual use in adolescents (12-17 years)

Very low certainty evidence was found in a cross-sectional study for an association between exposure (sometimes/most of the time/always) to e-cigarette advertisements from multiple media sources and higher odds of current dual use of e-cigarettes and cigarettes among adolescents compared to no exposure or exposure rarely (OR 2.4, 95% CI 1.50-4.10, 6,538 participants).[113]

11.17. Effect of multiple media advertising on quitting cigarette use in adults (≥ 18 years)

Very low certainty evidence from a cross-sectional study found that in adults, exposure to e-cigarette advertisements was associated with weaker intentions to quit smoking (Difference or change (Δ) -0.32, p <0.001, 106 participants).[109]

11.18. Effect of multiple media advertising in quitting cigarette use in young adult smokers (18-25 years)

Very low certainty evidence from a cohort study (12-month follow-up) found exposure to e-cigarette advertising to be associated with lower odds of cigarette quit success among young adult smokers (OR 0.92, 95% CI 0.47-1.81, 835 participants).[116] However, the 95% CI crossed the line of no effect, indicating statistical non-significance. A majority of the participants had never used e-cigarettes at baseline.[116]

11.19. Effect of multiple media advertising on knowledge and awareness of e-cigarettes among young adults (18-25 years)

One cross-sectional study reported on this outcome and found that frequent exposure to e-cigarette marketing was associated with a lower likelihood of not knowing that some e-cigarettes contain nicotine compared to no exposure or rare exposure (RRR 0.81, 95% CI 0.76-0.87, 1,247 participants).[97]

11.20. Effect of multiple media advertising on attitudes and beliefs of adolescents (12-17 years) and young adults (18-25 years)

Three studies, including one randomised controlled trial,[83] and two cross-sectional studies[119] [128] examined attitudes and beliefs related to e-cigarettes and cigarettes following exposure to e-cigarette advertisements.

In a randomised trial with non-smokers aged 18-30 years (436 participants), those assigned to a health effects warning-only condition reported higher perceived

addictiveness of e-cigarettes (Least square means (M) 3.25, SE 0.07) than those in an e-cigarette ad-stimuli-only condition (M 2.82, SE 0.07, p<.001). Overall, participants in the warning-only condition reported e-cigarettes to be closer to cigarettes in perceived addictiveness (M 3.61, SE 0.07) compared to those in the ad-only condition (M 3.84, SE 0.07, p = 0.055).[83]

In a multi-country cross-sectional study (12,064 participants) that included adolescents aged 16 to 19 years from Canada, England, and the US, more than 85% of participants across the three countries reported any exposure to e-cigarette ads. More than 70% perceived that e-cigarette ads target e-cigarette users and more than half (56% in the Canada and the US and 58% in England) perceived the target audience for e-cigarette ads to include non-e-cigarette users.[119]

A cross-sectional study of college students found that among young adults aged 18-25 years, exposure to e-cigarette advertising was associated with higher perceived prevalence of e-cigarettes use on campus among college students in both females (b=2.31, SE=0.17, 95% CI=1.97-2.64, 4,142 participants) and males (b=1.96 SE=0.28, 95% CI=1.41-2.50, 1,610 participants) compared to no exposure.[128]

11.21. Effect of multiple media advertising on attitudes and beliefs of adults (≥18 years)

Six studies, including two randomised controlled trials,[92 105] one non-randomised controlled trial,[79] and three cross-sectional studies[64 85 109] examined attitudes and beliefs about e-cigarettes and cigarettes following exposure to e-cigarette advertisements.

In a randomised controlled trial[92] that included adults aged 18–29 years who had never used an e-cigarette and smoked less than 100 cigarettes in their lifetime, exposure to e-cigarette advertising was associated with more favourable implicit attitudes towards e-cigarettes as a safer alternative to cigarettes compared to those who were not exposed ($\chi 2 = 21.4$, p = .16, 95% CI 0.01-0.06, 393 participants).

In the second randomised controlled trial (3196 participants),[105] 69.9% of participants in an ad exposure group perceived that using e-cigarettes could help with quitting the use of regular cigarettes compared to 64.1% in an unexposed group (p = 0.007). In the ad exposure group, 48.6% of participants perceived that e-cigarette smoking was cheaper than smoking regular cigarettes compared to 43.0% in the unexposed group (p=.014).[105]

In a non-randomised controlled trial with adult smokers, no effects of exposure to e-cigarette advertising were reported regarding attitudes towards smoking cessation among daily smokers (Cohen's f statistic (F) 1.152, p = .317, $\eta 2 = .008$) or intermittent smokers (F 2.14, p = .120; $\eta 2 = .016$, 884 participants).[79]

In a cross-sectional study (3,738 participants),[64] female adults were less likely than their male counterparts to believe that e-cigarette use (OR 0.92, 95% CI 0.71-1.20), cigar smoking (OR 0.91, 95% CI 0.70-1.18), and smoking tobacco in a hookah/waterpipe (OR 0.92, 95% CI 0.72-1.18) are very or moderately addictive following exposure to e-cigarette advertisements. However, the 95% CIs crossed the line of no effect, indicating statistical non-significance. In addition, female adults were more likely than their male counterparts to believe that conventional cigarettes (OR 1.24, 95% CI 0.65-2.38) are very or moderately addictive following exposure to e-cigarette advertisements.[64]

In another cross-sectional study,[109] following e-cigarette advertising exposure, participants felt that smoking conventional cigarettes was more socially acceptable (Δ0.82 ± 0.29 95% CI, $p < 0.001$, 106 participants) and non-e-cigarette users felt that conventional cigarette smoking was more socially acceptable (Δ0.89 ± 0.34 95% CI, $p < 0.001$, 82 participants).

The third cross-sectional study found moderate (sometimes) tobacco advertising exposure among adult smokers to be associated with positive perceptions that e-cigarettes could help reduce conventional cigarette use (OR 2.06, 95% CI 1.04-4.08, 1220 participants).[85] High (most of the time/always) tobacco advertising exposure was associated with perceptions that e-cigarettes were less addictive than conventional cigarettes (OR 1.92, 95% CI 1.01-3.65, 1,220 participants).[85]

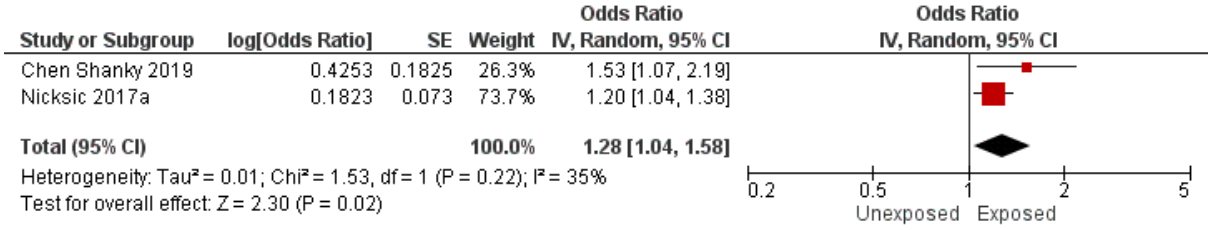
11.22. Effect of multiple media advertising on intentions to use e-cigarettes among adolescents (12-17 years)

Four studies, including one randomised controlled trial,[105] two cohort studies (follow-up range of 6 months to 1 year),[84 107] and one cross-sectional study[102] examined this outcome.

The randomised controlled trial found e-cigarette advertising exposure was positively associated with increased intentions to use e-cigarettes among never users of both e-cigarettes and combustible cigarettes when compared to those who were not exposed (OR 2.85, 95% CI 1.07-7.61, 3196 participants).[105]

In the two cohort studies,[84 107] exposure to e-cigarette advertising from multiple sources versus no exposure was found to result in higher odds of intending to use e-cigarettes (OR 1.28, 95% CI 1.04-1.58, 2 studies, 12,292 participants). The participants in the studies included never tobacco users[107] and never e-cigarette users and combustible cigarette users.[84] Low heterogeneity was identified between the two studies.[84 107] The forest plot is shown in Figure 28.

Figure 28: Forest plot of effect of exposure to e-cigarette advertising via multiple sources vs no exposure on intentions to use e-cigarettes among adolescents and young adults (cohort studies)



In one cross-sectional study (17,286 participants), increased exposures to e-cigarette advertising were found to be associated with increased intentions to use e-cigarettes among non-smokers (b=0.039, p < 0.001), but not among combustible cigarette users. Among smokers, there was no positive association between advertising exposure and intention to use e-cigarettes (b=−0.010, p=0.859).[102]

11.23. Effect of multiple media advertising on intentions to use e-cigarettes among young adults (18-25 years)

In one cross-sectional study[99] with tobacco users, the advertising appeal (in terms of cost, flavours, and taste) of e-cigarette ads was found to be positively associated with homeless tobacco users' future intentions to use e-cigarettes (F 0.38, SE 0.14, p<0.01, 354 participants).

11.24. Effect of multiple media advertising on intentions to use e-cigarettes among adults (≥18 years)

Three studies, including two randomised controlled trials,[83 95] and one cross-sectional study[109] examined adults' intentions to use e-cigarettes.

In one randomised controlled trial with adult non-smokers aged 18-30 years at baseline, exposure to an e-cigarette advertisement was not associated with intentions to use e-cigarettes (F= .02, p=.891, η2 <.001, 436 participants).[83] In the other randomised controlled trial[95] that included adults aged 18-34 years, higher e-cigarette advertisement likeability ratings were associated with greater odds of being curious about trying an e-cigarette (OR 2.33, 95% CI 1.84-2.95, 2,110 participants).

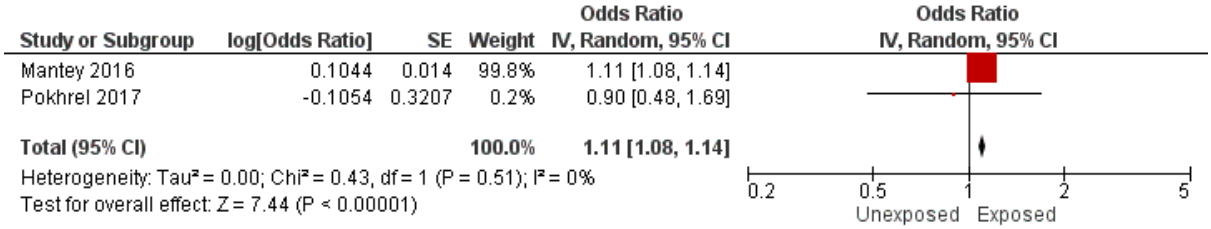
In the cross-sectional study, adults who viewed e-cigarette advertisements were found to have stronger intentions to use e-cigarettes (Δ1.20 ± 0.26 95% CI, p < 0.001, 106 participants).[109]

11.25. Effect of multiple media advertising on intentions to use e-cigarettes (susceptibility) in adolescents (12-17 years) and young adults (18-25 years)

Two cross-sectional studies examined e-cigarette susceptibility among adolescents and young adults.[80 91] Pooled results of the two studies showed that the odds of e-cigarette susceptibility were higher following exposure to e-cigarette advertisements compared to no exposure (OR 1.11, 95% CI 1.08-1.14, 22,477 participants).[80 91] The

forest plot is shown in Figure 29. The sample size in the study by Mantey et al. (2016) was 22,007[80] compared to only 470 in the study by Pokhrel et al.[91] Pokhrel et al.[91] reported lower odds of e-cigarette susceptibility with exposure to advertisements compared to no exposure. However, the 95% CI included the line of no effect, indicating statistical non-significance.

Figure 29: Forest plot of effect of exposure to e-cigarette ads via multiple sources vs no exposure on e-cigarette susceptibility among adolescents and young adults (cross-sectional studies)



11.26. Effect of multiple media advertising on intentions to use e-cigarettes (susceptibility) in young adults (18-25 years)

One randomised controlled trial[92] reported on this outcome. The study compared non-smoking participants who were shown ads that promoted e-cigarettes as cessation aids and control advertisments (of everyday items). The results showed that being shown real-world e-cigarette ads was associated with increased susceptibility to use e-cigarettes (Standardised regression coefficients 0.05, SE 0.02, p = .04, 393 participants).

11.27. Effect of multiple media advertising on e-cigarette susceptibility in adults (≥18 years)

One cross-sectional study[85] reported on this outcome. A high level of tobacco product advertising exposure was associated with greater e-cigarette susceptibility (2.52, 95% CI 1.03-6.15, 1,220 participants).[85]

12. Effect of other forms of e-cigarette promotion

Two studies examined the effect of exposure to e-cigarette marketing at events (e.g., fairs, festivals) and receiving free giveaways (e.g., in bars).

Of the two identified studies, one was a cohort study (with 1-year follow-up) that addressed the secondary outcome variable of intentions to use e-cigarettes.[107] The second study was a cross-sectional study that addressed the primary outcome variable of e-cigarette ever use.[76] It was assessed as providing very low certainty evidence. Both studies were conducted in the US. The GRADE Summary of Findings table for adults is detailed in the technical report for other forms of e-cigarette advertising in adults (Table 28).

12.1. Effect of other marketing and sponsorship mediums on e-cigarette ever use in adults (≥ 18 years)

Very low certainty of evidence from the cross-sectional study was conducted with US Air Force trainees and found that exposure to free giveaways at bars or social events was associated with e-cigarette ever use (OR 1.48, 95% CI 1.21-1.82, 13,873 participants).[76]

12.2. Effect of marketing and sponsorship in events on intentions to use e-cigarette in adolescents (12-17 years)

The cohort study found that among adolescents who were never e-cigarette users and never cigarette smokers at baseline, exposure to e-cigarette marketing at events such as fairs and festivals was associated with lower odds of intending to use e-cigarettes (OR 0.96, 95% CI 0.56–1.63, 9,804 participants).[107] However, the 95% CI crossed the line of no effect, indicating statistical non-significance.

12.3. Effect of marketing and sponsorship events on intentions to use e-cigarette in young adults (18-25 years)

The cohort study found that among young adult never users of e-cigarettes and combustible cigarettes at baseline, exposure to e-cigarette marketing at events such as fairs and festivals was associated with increased odds of intending to use e-cigarettes (OR 9.98, 95% CI 1.44–69.17, 9,804 participants).[107]

Results of syntheses of qualitative studies

The thematic analysis undertaken on the qualitative studies produced three themes. The summary of findings for GRADE CERQual is presented in the accompanying technical report.

Theme 1

Exposure to e-cigarette advertising occurred both actively and passively, resulting in changed perceptions of the risk profile of e-cigarettes (moderate confidence in findings)

Evidence for this theme emerged from six studies.[79 121 123-126] Participants, particularly adolescents and young adults, reported being exposed to e-cigarette advertisements throughout the course of their lives in multiple ways. This exposure occurred passively in the normal course of life and actively when they sought information on the safety and benefits of e-cigarettes.

Passive exposure was commonly reported. Adolescents and young adults discussed being exposed to e-cigarette advertisements on college campuses, in kiosks at malls, on television,[121] as well as in convenience and liquor stores.[126] Multiple studies reported that participants received unsolicited e-cigarette content on social media platforms, particularly Facebook, YouTube, Instagram, and Snapchat.[79 121 123-126]

Some study participants reported actively seeking out advertisements and information about e-cigarettes through web searches or social media platforms – for example, by searching the hashtag '#e-cig' on Instagram.[123] Participants who actively sought out information about e-cigarettes online were particularly interested in information about how e-cigarettes work, recommendations for specific vaping products,[116] and learning vape tricks.[121 124]

Participants noted that e-cigarette advertisements often claimed the products were healthier than combustible cigarettes. Many stated that exposure to such advertisements made them believe e-cigarettes were either less dangerous than cigarettes or not harmful at all.[121] They were persuaded by advertisements that emphasised the lack of second-hand smoke, believing this was a "big selling point" for e-cigarettes.[123] Some participants were able to easily recall the content of e-cigarette advertisements that highlighted the health benefits of e-cigarettes: "I have seen posters that say less nicotine, so it is less harmful to your body".[123]

Not all participants, however, accepted the legitimacy of health messages in e-cigarette advertisements. In one study that explored perceptions of vaping-related hashtags on Instagram, participants who were combustible cigarette users or non-tobacco smokers viewed vaping-related hashtags on Instagram, such as #vapingsavedmyife and #stopsmoking, to be less believable and valid than vapers and dual users.[127] While all participants in this study interpreted the hashtags as attempting to portray positive health messages about e-cigarettes, some were sceptical about the intent of individuals using these hashtags, acknowledging that such Instagram users would likely include these hashtags to obtain more views or make a profit from the sale of e-cigarettes.[127] Similarly, participants in another study involving both users and non-users of e-cigarettes expressed frustration towards advertisements that presented e-cigarettes as less dangerous than cigarettes without providing sufficient information about the potential harms of e-cigarettes.[124]

Theme 2

Strategies used to enhance the appeal and believability of advertisements are effective in influencing perceptions (moderate confidence in findings)

Five studies explored different message and executional aspects of e-cigarette advertisements that influenced participants' liking of the advertisements, perceptions of e-cigarettes, and intentions to use e-cigarettes.[121-124 127]

Visual elements of e-cigarette advertisements

Two studies, both from the US, explored the visual elements of e-cigarette advertisements that appealed to young people.[121 123] Participants responded favourably to the test advertisements and expressed more positive perceptions of e-cigarettes when vibrant colours, bold images, and special effects were used.[121 123]

These advertisement attributes also influenced which e-cigarette brands participants were most interested in using.[121]

In one study, it was the perceived synergy of the e-cigarette device, viewed by participants as sleek and modern, with the perceived calm and sophisticated visuals of the advertisement, that resulted in positive perceptions of e-cigarettes.[121] Visual elements of the e-cigarettes themselves were also mentioned independently as appealing attributes of advertisements, particularly in comparison to cigarettes, with some participants viewing e-cigarettes as a "classy alternative".[123]

Depiction of characters in e-cigarette advertisements

Two studies, both from the US, explored how young adults responded to the types of characters depicted in e-cigarette advertisements.[122] [121] In one study, participants were shown several e-cigarette advertisements from different mediums featuring a variety of characters.[121] Overwhelming, participants found the most appealing advertisement be a Blu e-cigarette advertisement depicting a stylish man in his 20s using an e-cigarette in a swimming pool.[121] Some participants felt that the advertisement was not just selling e-cigarettes, but also promoting a lifestyle: "I think people would want to emulate his style … one of the ways to emulate his style is to smoke e-cigarettes." Conversely, many participants did not relate to the JUUL advertisement shown in this study, as it was deemed visually unappealing and the character looked 'tense' and unhealthy,[121] making him non-aspirational.

Peer-influence strategies

Advertisements often depicted and aimed to influence the peer-crowd, and this was reported in two studies.[121] [122] Participants typically found advertisements more likeable, relatable, identifiable, and convincing if a 'matching' peer group was depicted (i.e. the characters depicted were similar to the own peer-group of the participant, such as 'hipsters' or 'young professionals').[122] Advertisements that felt natural and relaxed and captured a "real slice of life"[122] were favoured.

One study found that regardless of the peer group depicted, participants reacted negatively towards advertisements where the characters did not look like a 'genuine' e-cigarette user, the advertisement looked staged, or characters were depicted using e-cigarettes in unrealistic scenarios (e.g. in bed or in a meeting room at a workplace).[122] A second study found that peer recommendations on social media influenced brand preferences and perceptions of e-cigarettes.[121]

Theme 3

Exposure to individuals doing 'vape tricks' on social media (moderate confidence in findings)

Three studies, one from Australia and two from the US, explored the effect of videos of individuals doing vape tricks on social media on participants' perceptions of e-cigarettes and the appeal of e-cigarettes.[124-126] The tricks included making rings or other shapes out of vapour. Across all three studies, it was not possible to determine whether the individuals or celebrities depicted doing vape tricks online were sponsored by e-cigarette companies or acting independently. Recruited participants watched these videos on Instagram and YouTube or were members of Facebook groups where vape trick content was displayed. Participants who reported having seen social media videos that included tricks or tutorials believed that using e-cigarettes was 'trendy,' 'cool', and 'fun'.[124-126] Additionally, participants who reported viewing social media videos appeared to have greater interest in e-cigarettes.[126] Some participants were particularly drawn to videos featuring celebrities or influencers performing tricks.[125]

Integration of findings of quantitative and qualitative studies

The quantitative studies included in this review primarily assessed the effects of e-cigarette advertising on e-cigarette initiation, intentions to use e-cigarettes, and current use of e-cigarettes, while the few qualitative studies primarily explored reactions to advertisements and exposure to e-cigarette-related content on the Internet, including on social media. These differing foci and the small number of qualitative studies preclude a comprehensive integration of the quantitative and qualitative results.

An important finding from the qualitative studies was that participants reported being exposed to e-cigarette-related content in advertisements and other forms of promotion disseminated via multiple media sources, mainly through social media, other Internet sources, and point-of-sale locations. The evidence from the quantitative studies indicated larger effect sizes for exposures to multiple media types, although the evidence certainty varied. In combination, these results suggest the need for comprehensive efforts across media types to address the effects of cumulative exposure.

In the qualitative studies, school-aged adolescents and young adults reported that e-cigarettes are depicted in advertisements as attractive and safer alternatives to conventional cigarettes, potentially influencing their intentions to use and initiation behaviours. In particular, the portrayal of vaping tricks appeared to help normalise e-cigarette use. These findings provide insights into the pathways for the effects observed in the quantitative studies.

Discussion

Summary of main results

The aim of this review was to assess the evidence relating to multiple behavioural and attitudinal outcomes of e-cigarette advertising across a range of media. The primary outcome variables of interest were uptake/initiation, frequency/intensity of use, ever use, current use, and quitting tobacco/e-cigarette use. The systematic review was broad in scope and complex in nature; to the best of our knowledge it is the most extensive review on the topic to date. Overall, it included 76 studies published between January 2015 and June 2021.

This review found evidence relating to numerous individual media and combinations of media. This included radio, television, television + radio (combined), television + movies (combined), billboards/posters, print media, social media, point-of-sale, Internet, mail (e-mail and/or postal), and combinations of 3+ media. For most media types/combinations, the evidence was of low to very low certainty and effect sizes and directions of effect often varied. Where studies were assessed as having moderate or high certainty of evidence for primary outcomes, significant results were always in the direction of exposure to e-cigarette advertising resulting in adverse outcomes among adolescents (see Table 1 overleaf). Similarly, most of the studies deemed as being of low/ very low certainty or that focused on secondary outcome variables also yielded results indicating that exposure to e-cigarette promotion produced more favourable attitudes to e-cigarette use and increased use intentions and use behaviours among the assessed target groups. Overall, the strongest available evidence was found for the effects of e-cigarette advertising on current use of e-cigarettes among adolescents.

Overall completeness and applicability of evidence

This review identifies areas for which data are currently lacking and were therefore inadequately represented in the results. Most of the included studies were deemed to be of low or very low quality, mainly due to combinations of a reliance on observational approaches, self-reported outcomes, and confinement to a single national context, typically the US. Many of these issues relate to the use of cross-sectional study designs that can preclude determination of the direction of effect and identification of reverse causation (e.g., e-cigarette users may be more likely than non-users to notice e-cigarette advertisements).

To overcome these limitations, additional high quality studies are needed to augment the evidence base. In particular, more longitudinal studies are required that involve the recruitment of participants prior to e-cigarette initiation and allocation of sufficient time periods between study waves to provide the opportunity for effects to manifest. Such studies need to recruit adequate numbers of participants to achieve sample representativeness and minimise the adverse effects of loss to follow-up.

Across the examined exposure and outcome types, most studies focused on the population groups of adolescents and/or young adults. Greater attention to differences according to socioeconomic position and other equity indicators would be useful for providing a more detailed understanding of which groups may be most adversely affected by e-cigarette advertising. The majority of the studies controlled for covariates such as age and gender. It is possible that residual factors (e.g. greater access to the Internet, social media, or tobacco retail outlets) may have influenced the results in terms of association between exposure and the outcome.

Table 1: Results for primary outcome studies assessed as providing significant results of high or moderate certainty of evidence

Exposure type	Population group	Study type	OR	95% CI / p value	Outcome^
High certainty of evidence					
Print	Adolescents	Cross-sectional	3.40	p < 0.001	Frequency of use
Print	Adolescents	Cross-sectional	1.87 1.71	1.21-2.87 1.25-2.33	Current use
Websites & social media	Adolescents	Cross-sectional	2.57	2.02-3.27	Current use
Multiple (2-3 media)	Adolescents & young adults	Cross-sectional (3 pooled studies)	2.11	1.77-2.52	Current use
Moderate certainty of evidence					
Print	Adolescents	Cross-sectional (2 pooled studies)	1.33	1.19-1.48	Current use
Print	Adolescents	Cross-sectional	1.22	1.07-1.39	Ever use
Point-of-sale	Adolescents	Cross-sectional (2 pooled studies)	1.69	1.06-2.68	Current use (combustible cigarettes)
Social media	Adolescents	Cohort (2 pooled studies)	2.60	1.56-4.35	Uptake
Multiple (3+ media)	Adolescents	Cross-sectional (3 pooled studies)	1.64	1.45-1.86	Initiation
Multiple (3+ media)	Adolescents	Cross-sectional	6.42	2.28-18.11	Current use
Multiple (3+ media)	Adolescents	Cross-sectional (4 pooled studies)	1.40	1.27-1.55	Current use (combustible cigarettes)

OR = odds ratio
CI = confidence interval (p value provided where CI not available)
^ Relates to e-cigarette outcomes unless specified otherwise

The most commonly assessed forms of advertising media were multiple (i.e. 2+ types of media combined), point-of-sale, Internet, print, and social media. Specific media for which data were lacking include sponsorship, merchandising, and other forms of endorsement. A greater focus on e-cigarette promotion via social media also appears warranted given the importance placed on this medium by participants in the assessed

qualitative studies. Finally, additional research on the relationship between e-cigarette advertising and outcomes such as total nicotine consumption and quitting is needed.

Effect estimates varied widely between studies included in this review. This is unsurprising considering the substantial variation in terms of differing frequency and duration of exposure, level and adjustment of covariates, exposure and outcome measures used, and variation in follow-up periods. In many of the studies, the effect estimates were simply calculated on the exposed compared to non-exposed populations, without detailed consideration of aspects of exposure such as duration or intensity.

Publication bias could not be assessed because of the paucity of studies in each particular exposure type. Some degree of social desirability is likely to exist in the included studies, resulting in participants under-reporting usage of e-cigarettes and combustible cigarettes. In addition, recall bias may have occurred whereby users versus non-users had different abilities to recall e-cigarette promotion. Finally, the reliance on advertising exposure data generated via questionnaires was a limitation of almost all included studies.

Despite these gaps in the literature and study limitations, the volume of studies and the availability of some moderate to high quality studies provide confidence in an overall interpretation that exposure to e-cigarette advertising across a range of media types influences adolescents' and young adults' use of these products.

Potential biases in the review process

This broad scope review was conducted according to a registered *a priori* protocol, with all phases completed over a period of just a few weeks. Data collection was confined to studies conducted in high-income countries that were deemed to be most relevant to the Australian cultural context, and papers published in languages other than English were not included. Only studies reporting on the pre-specified primary and secondary outcomes were included. Given the diverse range of study outcomes assessed and multiple population groups of interest, meta-analysis was not appropriate in many cases. Of note is that some of the larger studies included in the review were based on cohort surveys conducted 2014-2017, potentially limiting the relevance of the findings to current marketplace characteristics.

There are several methodological issues that would benefit from resolution in future research. In the first instance, there are considerable obstacles to objectively assessing exposure to e-cigarette advertising and promotion, both overall and in relation to specific media. Second, complications arise when attempting to isolate the effects of e-cigarette advertising from the effects of other social factors such as peer use and word-of-mouth communications. This is compounded by the nature of digital platforms, where paid advertising and public input co-exist and reinforce each other, making it difficult for both consumers and researchers to disentangle the interwoven

communications. Third, the e-cigarette market is evolving rapidly in terms of product types/attributes and the nature of digital marketing. In this environment, study results can quickly lose relevance.

Agreements and disagreements with other studies or reviews

The identified association between exposure to e-cigarette advertising and e-cigarette use is consistent with the results of major reviews of the effects of tobacco and alcohol advertising on young people's use of these substances.[129-131] It also reflects the basic tenet of advertising theory and practice that marketing communications influence consumer decision making and are an important contributor to product sales.[132] In particular, the reinforcement of marketing messages across multiple media is understood to be an effective method of reaching and influencing target audiences.[133] The results of this review are therefore aligned with existing bodies of evidence in both the substance use and general advertising literatures.

Implications for policy and practice

The association demonstrated in this review between exposure to various forms of e-cigarette promotion and young people's e-cigarette initiation and use supports the World Health Organization's recommendation for these products to be treated the same as tobacco products, including through the implementation of bans/restrictions on advertising, promotion, and sponsorship.[16] The review findings are also generally consistent with Australia's current stance on e-cigarette marketing whereby in most instances the products cannot be promoted directly to consumers. However, the overall finding that exposure to e-cigarette advertising content influences adolescents' vaping-related attitudes and behaviours has implications in the context of the new e-cigarette prescription regulations in Australia. To avoid unintended consequences, the results of this review indicate that point-of-sale communications about e-cigarettes in online and brick-and-mortar pharmacies should be limited to those specified as acceptable for tobacco products in Article 13 of the Framework Convention on Tobacco Control.[37]

The review results relating to Internet-related exposures (such as on social media and websites) highlight the importance of developing effective strategies to prevent exposure to e-cigarette promotion in online contexts.[22] This is a challenging task given the international and often ephemeral nature of the online environment and the many indirect processes by which promotion occurs (e.g. influencer communications and product placement in movies and music clips). This is a problem shared with other unhealthy products, such as tobacco, alcohol, and foods that are high in negative nutrients, indicating the potential utility of a co-ordinated approach.[134]

The ability of e-cigarette promotion to reduce harm perceptions highlights a need to monitor public understanding of the absolute and relative harms of e-cigarettes and implement appropriate educational campaigns to address knowledge deficits. This

approach would be aligned with the World Health Organization's 'Best Buys' for tobacco control that include effective mass media campaigns that educate the public about product harms.[135]

Conclusion

Overall, although more research is needed, the available evidence supports the contention that exposure to e-cigarette advertising across a wide range of media is positively associated with e-cigarette user status among young people. This finding is consistent with outcomes in related substance use areas and supports the implementation of appropriate restrictions on e-cigarette marketing to reduce harms among young people.

Ethics

The systematic review does not involve any living participant and is a review of existing research that has been already published. No ethical approval was required.

Availability of data and other materials

All data associated with the review is presented along with.

Declaration of interests

The authors declare no competing interests.

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