



What drives public perceptions of e-cigarettes? A mixed-methods study exploring reasons behind adults' perceptions of e-cigarettes in Northern England

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ABSTRACT

Background: Despite growing evidence that e-cigarettes are likely less harmful than cigarettes, perceptions of equal or more harm have increased worldwide. This study aimed to identify the most common reasons behind adults' perceptions of the (i) relative harm of e-cigarettes compared with cigarettes and (ii) effectiveness of e-cigarettes for smoking cessation.

Methods: Adults ($N = 1646$) from Northern England were recruited through online panels from December–March 2017/2018, using quota sampling to guarantee socio-demographic representativeness. Qualitative content analysis of open-ended responses was performed with codes representing reasons for a given perception about e-cigarettes. Percentages of participants who gave each reason for each perception were calculated.

Results: 823 (49.9%) participants agreed that e-cigarettes were less harmful than cigarettes, 283 (17.1%) disagreed, and 540 (32.8%) were undecided. The most common reasons for agreeing that e-cigarettes were less harmful than cigarettes were that they produce no smoke (29.8%) and fewer toxins (28.9%). Those who disagreed were most concerned about a perceived lack of trustworthy research (23.7%) and safety issues (20.8%). Lacking knowledge (50.4%) was the most common reason for being undecided. 815 (49.5%) of participants agreed that e-cigarettes were an effective smoking cessation aid, 216 (13.2%) disagreed, and 615 (37.4%) were undecided. The most common reasons participants gave for agreeing were related to e-cigarettes being successful smoking replacements (50.3%) and advice from family, friends or health professionals (20.0%). Respondents who disagreed were most concerned about e-cigarettes being addictive (34.3%) and containing nicotine (15.3%). Lacking knowledge (45.2%) was the most common reason for being undecided.

Conclusions: Negative perceptions of e-cigarette harm were driven by concerns about a perceived lack of research and safety issues. Adults who viewed e-cigarettes as ineffective for smoking cessation feared that they perpetuate nicotine addiction. Campaigns and guidelines that address these concerns may help promote informed perceptions.

1. Background

Over the past decade, electronic cigarettes (e-cigarettes) have surpassed nicotine replacement therapies (NRT) as the most commonly used aids for stopping cigarette smoking across Europe and North America (West et al., 2021). While they are not risk free, e-cigarettes expose people to fewer harmful chemicals than cigarettes (Farsalinos and Lagoumintzis, 2019; Flouris et al., 2013; Romagna et al., 2013;

Shahab et al., 2017). Despite this, an increasing proportion of people in England and the United States perceive e-cigarettes to be equally or more harmful than cigarettes (East et al., 2018; Tattan-Birch, Brown et al., 2020; Tattan-Birch, Jackson et al., 2020; Xu et al., 2016). Similarly, while a growing body of evidence has shown that e-cigarettes are effective in helping adults to stop smoking conventional cigarettes, many people believe they are ineffective (Action on Smoking and Health, 2022; Hartmann-Boyce et al., 2022; King et al., 2018). Little

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research has been done to understand why people hold these perceptions. This information could help guide the development of interventions to promote more informed perceptions about e-cigarettes.

Most of the damage from smoking cigarettes arises from inhalation of toxins and carcinogens in tobacco smoke (Hajek et al., 2019; Shahab et al., 2017; Villanti et al., 2019). Switching from cigarettes to e-cigarettes, which do not contain tobacco or produce smoke, lowers one's exposure to these harmful chemicals and may help people remain abstinent from smoking by delivering nicotine while mimicking the act of smoking (e.g. hand-to-mouth action and inhalation) (Notley et al., 2019). E-cigarette use should be discouraged in people who have never smoked, including younger people who would otherwise avoid nicotine entirely (National Academies of Sciences, Engineering, and Medicine et al., 2018). When e-cigarette use first became popular, most people perceived it to be less harmful than smoking, but these perceptions deteriorated over time from 2012 to 2020 (Action on Smoking and Health, 2022; East et al., 2022; Yong et al., 2017). People may continue to smoke cigarettes instead of switching if they perceive e-cigarettes to be equally or more harmful than cigarettes, which could damage public health (Perski et al., 2020).

Many people also view e-cigarettes as ineffective for helping people quit smoking (Etter and Bullen, 2011; Ofei-Dodoo et al., 2017; Vasconcelos and Gilbert, 2018). A recent Cochrane review concluded with high certainty that e-cigarettes are more effective for smoking cessation than nicotine replacement therapy (Hartmann-Boyce et al., 2022). Previous studies have also shown that people with negative perceptions about the effectiveness of stop smoking medication — such as nicotine patches or gum — are less likely to use it as prescribed and more likely to recommence smoking (Pacek et al., 2018; Villanti et al., 2019). Similarly, negative perceptions about the effectiveness of e-cigarettes for smoking cessation might deter adults from using them to stop smoking. Instead, they might continue to smoke or try to stop via less effective methods (Jackson et al., 2019). Therefore, negative perceptions about the effectiveness of e-cigarettes for smoking cessation could have a substantial public health harm through smoking-related disease and death.

Interventions may be necessary to tackle these negative perceptions in the general public. In early 2018, Cancer Research UK — the world's largest cancer research charity — ran a mass media campaign that aimed to promote well-informed perceptions about the relative harm of e-cigarettes compared with tobacco cigarettes, and thus increase the number of adults stopping smoking by switching to e-cigarettes (Tattan-Birch, Jackson et al., 2020). Public Health England ran an advertising campaign with a similar aim: to encourage e-cigarette use for smoking cessation (James, 2017). For campaigns such as these, it is important to understand the most common concerns that drive public perceptions around e-cigarettes, as these concerns can be addressed in educational materials.

Several qualitative and quantitative studies have investigated people's perceptions of e-cigarettes, each with their own benefits and limitations. Qualitative studies have investigated perceptions about e-cigarettes' harms among small groups of people who smoke, used to smoke, and smoke and use e-cigarettes together (Barbeau et al., 2013; Bowker et al., 2018; King et al., 2018; Pokhrel et al., 2015; Sherratt et al., 2016; Smith et al., 2021). Among those interviewed, people's perceptions of e-cigarettes' harms appeared to be shaped by concerns about the damaging chemicals in e-cigarettes, distrust of evidence on health effects, and lack of endorsement from the government and healthcare professionals (Barbeau et al., 2013; Bowker et al., 2018; Pokhrel et al., 2015; Sherratt et al., 2016). Studies have also examined perceptions about the effectiveness of e-cigarettes for aiding smoking cessation. Frequently mentioned reasons for viewing e-cigarettes as ineffective cessation aids were: they do not satisfy cravings to smoke and people who use e-cigarettes remain addicted to nicotine and may therefore eventually recommence to smoking (Etter and Bullen, 2011; King et al., 2018; Romijnders et al., 2018). These qualitative studies

gave insights into the reasons underlying perceptions about e-cigarettes among certain subgroups. They benefit from allowing participants to provide open-ended responses to questions, rather than requiring them to choose from prespecified options. On the other hand, quantitative studies provide more generalisable estimates about public perceptions in the population, but they lack depth to explore the reasons behind these perceptions (Brose et al., 2015; Persoskie et al., 2017).

The present study adopted a mixed-methods approach using a large sample of adults in Northern England, where smoking prevalence is particularly high (Beard et al., 2017), with sociodemographic and smoking characteristics that are representative of their regions and similar to England as a whole. Participants were asked for reasons why they held certain perceptions of e-cigarettes. Content from their open-ended responses was qualitatively coded into categories of reasons. The proportion of participants who gave each reason was then calculated to identify which were most prevalent.

Specifically, we aimed to identify the most common reasons underlying adults' perceptions about (i) the relative harm of e-cigarette use compared with cigarette smoking and (ii) the effectiveness of e-cigarettes as an aid for smoking cessation.

2. Methods

2.1. Design

The data were collected from December 2017 to March 2018 as part of two cross-sectional surveys in Northern England. Cancer Research UK originally ran the surveys to evaluate the impact of an educational advertising campaign (Tattan-Birch, Jackson et al., 2020). The research team received anonymised records from a market research agency who collected data on behalf of Cancer Research UK in accordance with the Market Research Society Code of Conduct (Market Research Society, 2014) and obtained appropriate informed consent and permissions from participants. Data were collected and stored in compliance with previous data protection legislation as well as current General Data Protection Regulation (GDPR) requirements.

2.2. Participants

Participants ($N = 1646$) from Northern England (Greater Manchester, Yorkshire & Humber and the North East) were recruited through online panels. They were given points for participating which, when accrued, could be exchanged for cash or store vouchers. Quota sampling was used so that the participants recruited approximately represented the population of these localities in terms of sex, smoking status, age, and social grade.

2.3. Measures

Harm perceptions: Participants were asked, "To what extent do you agree or disagree that e-cigarettes are less harmful than cigarettes?" They could select one of the following responses strongly agree, agree, neither agree nor disagree, disagree, strongly disagree or don't know. For the analysis, we split these responses into three groups: we combined those who agreed and strongly agreed into an "agreed" group, those who disagreed and strongly disagreed into a "disagreed" group, and those who neither agreed nor disagreed or didn't know into an "undecided" group.

Effectiveness perceptions: To measure perceptions of the effectiveness of e-cigarettes for smoking cessation, participants were asked, "To what extent do you think e-cigarettes are an effective aid to stop smoking regular cigarettes?" They could select one of the following responses: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, don't know. For the analysis, these responses were combined into "agreed", "disagreed", and "undecided" groups, as described above for harm perceptions.

Reasons for perceptions: Each of the above questions were followed up with the prompt, “Why did you say that?”, where participants were able to give open-ended responses listing reasons underlying their perceptions about (1) the harm of e-cigarettes compared with cigarettes and (2) the effectiveness of e-cigarettes for smoking cessation.

E-cigarettes use: Participants were asked whether they had tried an e-cigarette or vaping device in the past month. Those who had were then asked, “How often, if at all, do you currently use an electronic cigarette or vaping device?”. People who used an e-cigarette daily were labelled as *people who use e-cigarettes*.

Smoking status: People were considered to currently smoke if they reported “I smoke, but not every day” or “I smoke every day”. People who formerly smoked were defined as those who previously smoked but no longer did so.

Sociodemographic variables included: sex (female, male, other); age (16–29, 30–44, 45–59, 60+ years); and occupation-based social grade (ABC1, C2DE based on the National Readership Survey categorisation (National Readership Survey, 2016). ABC1 includes managerial, professional and intermediate occupations whereas C2DE includes small employers and own-account workers, lower supervisory and technical occupations, and semi-routine occupations, never worked and long-term unemployed.

Full details of questionnaire measures are available on the Open Science Framework (<https://osf.io/2emk3/>).

2.4. Analysis

This analysis plan was pre-registered on the Open Science Framework (<https://osf.io/buwes/>). Participants' sociodemographic characteristics and perceptions about e-cigarettes are reported in Table 1. Content analysis was used because the study categorises short, open ended responses that would be unsuited for thematic analysis.

Table 1
Sample sociodemographic characteristics and perceptions of e-cigarettes.

Category	N = 1646 (%)
Sex	
Female	905 (54.9)
Male	737 (44.8)
Other	4 (0.3)
Age	
16–29	361 (21.9)
30–44	465 (28.3)
45–59	487 (29.6)
60+	333 (20.2)
Ethnicity	
White	1529 (92.8)
Other	117 (7.1)
Social grade	
C2DE	877 (53.3)
ABC1	769 (46.7)
E-cigarette use	
Daily	166 (10.1)
Non-daily	264 (16)
No use	1174 (71.3)
Don't know/Missing	21 (2.6)
Smoking status	
Current	422 (25.6)
None	765 (46.5)
Former	459 (27.9)
Perception of e-cigarettes being less harmful than cigarettes	
Agree	823 (50)
Undecided	540 (32.8)
Disagree	283 (17.2)
Perception of e-cigarettes being effective for smoking cessation	
Agree	815 (49.5)
Undecided	615 (37.4)
Disagree	216 (13.1)

Total N = 1646

An iterative content analytic approach was used to code participants' open-ended responses into a set of reasons underlying their perceptions of e-cigarette harm and effectiveness (Erlingsson and Brysiewicz, 2017; Neuendorf, 2017). Initially, two researchers (HA and HTB) created a draft coding guide by identifying key reasons provided in responses from a randomly selected 10% of participants. The lead researcher, HA, then used this guide to assign one or more codes to responses from all other participants. Reasons that were not identified in the initial draft coding guide were subsequently added, and the lead researcher read back through responses to check whether any needed to be re-coded.

The second researcher, HTB, then used this updated guide to code a randomly selected 50% of responses. Cohen's Kappa was used to assess interrater reliability for each reason (McHugh, 2012). We followed a standard rough interpretation of kappa, where .41–.60 indicated “moderate agreement”, .61–.80 indicated “substantial agreement” and .81–.99 indicated “almost perfect agreement” (Viera and Garrett, 2005).

A table was created with example quotes that were deemed typical for each reason. To display the most common reasons for perceptions about e-cigarette harm relative to cigarettes and effectiveness of e-cigarettes for smoking cessation, tables were created to show the proportion of participants who gave each reason, both overall and restricted to those who (i) agreed, (ii) disagreed, or (iii) were undecided about whether e-cigarettes were less harmful than smoking/effective for smoking cessation.

3. Results

A total of 1646 participants were recruited. Table 1 shows the sociodemographic characteristics and e-cigarettes perceptions of these participants.

3.1. Harm relative to cigarettes

Table 2 shows the most common reasons underlying participants' perceptions of the harm of e-cigarettes relative to cigarettes, alongside examples of typical responses. 105 (6.4%) participants gave non-interpretable responses. There was high agreement ($\kappa = .81-.92$) between coders for all categories of reasons other than safety and disease, where there was moderate agreement ($\kappa = .45-.56$). Less common reasons, endorsed by up to 5.5% of respondents, were also identified and are available in the supplementary material (Table S1).

Half of participants 823 (49.9%) agreed that e-cigarettes were less harmful than cigarettes. The most common reasons for agreeing were linked to e-cigarettes producing no smoke or tar (29.8%) and lower levels of toxins (28.9%). For instance, respondents mentioned that “it (e-cigarettes) doesn't have as many toxic chemicals” and “the vapour produced by e-cigs does not contain the harmful substances found by burning tobacco”.

Conversely, 283 (17.1%) participants disagreed with the claim that e-cigarettes were less harmful than cigarettes. The most common reasons for disagreeing were related to the perceived scarcity of trustworthy research into e-cigarettes (23.7%), alongside concerns about their safety (20.8%) and toxin production (18.7%). For example, one participant claimed that “not enough clinical research has taken place and inhaling the chemicals used for flavours could be as harmful”. Others perceived there to be a lack of adequate safety regulation (e.g. “you are still inhaling something and it's not regulated enough to be 100% sure that it's safe”), which meant that e-cigarettes were “dangerous or may explode”.

Lastly, 540 (32.8%) respondents were undecided about the harm of e-cigarettes relative to cigarettes. The most common reasons for being undecided were linked to participants having a lack of knowledge about e-cigarettes (50.4%) and being concerned about the perceived scarcity of trustworthy research (18.9%). Typical responses were “I do not know enough about e-cigarettes” and “not enough research has been done on them”.

Table 2
Categories of reasons for e-cigarettes harm perceptions relative to cigarettes* .

Categories (Cohen's Kappa)	Verbatim quotes	N = 1646 [95% CI]	"Do you agree or disagree that e-cigarettes are less harmful than tobacco cigarettes"		
			Agree % [95%CI]	Disagree % [95%CI]	Undecided % [95%CI]
Lack of knowledge ($\kappa = .85$)	"I don't quite know enough about them to give a different answer" "I don't know the facts, but it's just what I think about e-cigarettes." "I know next to nothing about these devices." "I don't know what is in them - could be chemicals that are just as harmful"	20.2 [18.3–22.2]	5.7 [4.3–7.5]	4.6 [2.7–7.7]	50.4 [46.2–54.6]
Toxins ($\kappa = .83$)	"They don't contain half as many chemicals as cigarettes." "Still have harmful chemicals" "There are less chemicals in the electronic cigarette" "It (e-cigs) doesn't have as many toxic chemicals"	19.0 [17.1–20.9]	28.9 [25.9–32.1]	18.7 [14.6–23.7]	3.9 [2.6–5.9]
Smoke ($\kappa = .81$)	"Contains no smoke or burnt carcinogens" "They don't contain the tar and toxic substances associated with tobacco" "The vapour produced by e-cigs does not contain the harmful substances found by burning tobacco" "They don't contain all the harmful things that cigarettes do like tobacco and tar, and the vapour they emit isn't as harmful"	16.4 [14.7–18.3]	29.8 [26.7–33.0]	5.3 [3.2–8.6]	1.9 [1.0–3.4]
Research ($\kappa = .92$)	"Until more research is done and it proves that e cigarettes are as harmful as ordinary cigarettes I will keep using them (cigarettes)" "Not enough clinical research has taken place and inhaling the chemicals used for flavours could be as harmful in my opinion" "Lack of research / independent studies" "Research took years to show the harm cigarettes caused so it will be years to see the potential harm or benefits of e-cigarettes"	15.4 [13.7–17.2]	10.1 [8.2–12.3]	23.7 [19.1–29]	18.9 [15.8–22.4]
Safety ($\kappa = .45$)	"It's not regulated enough to be 100% sure that it's safe" "They're unregulated and we don't have an idea of what they contain" "E-cigarettes dangers depends mostly on the liquid and the charger/battery used" "They seem to be quite unregulated, so who knows what is in some of them?"	11.3 [9.8–12.9]	11.8 [9.8–14.2]	20.8 [16.5–26.9]	5.6 [3.9–7.8]
Disease ($\kappa = .56$)	"Inhalation of steam/water is very damaging to the lungs" "I'm hearing now they can also lead to cancer. Really it's not healthy to smoke anything into your lungs" "They cause other problems to the lungs - different problems to regular cigarettes but just as damaging in a different way" "One thing they do cause is Popcorn lung"	7.4 [6.2–8.8]	8.0 [6.4–10.0]	14.5 [10.9–19.1]	2.8 [1.7–4.5]

† **Statement classifications:** agree includes "strongly agree" and "somewhat agree"; disagree includes "strongly disagree" and "somewhat disagree"; undecided includes "don't know" and "neither agree nor disagree"

*105 (6.4%) participants gave non-interpretable responses. All verbatim quotes are from different participants

3.2. Effectiveness for smoking cessation

Table 3 shows the most common reasons underlying participants' perceptions of the effectiveness of e-cigarettes as a smoking cessation aid, alongside examples of typical responses. There was substantial agreement ($\kappa = .60$ –.78) between coders for all categories of reasons other than smoking replacement ($\kappa = .59$), where there was moderate agreement, and lack of knowledge, where there was high agreement ($\kappa = .82$). Less common reasons, endorsed by up to 8.9% of respondents, were also identified and are available in the supplementary material (Table S2).

Of the sample, 815 (49.5%) participants agreed that e-cigarettes were effective smoking cessation aids. The most common categories of reasons for agreeing were related to the ability of e-cigarettes to successfully replace smoking (50.3%), advice from peers or health professionals (20.0%), and their nicotine content (19.8%). For example, respondents highlighted how "it (e-cigarette) still has nicotine in and allows users to put something in their mouth and hands like a cigarette". Some people noted that their friends or family members had successfully used e-cigarettes to stop smoking: "they have helped my partner stop smoking regular cigarettes". Others mentioned seeing "NHS advice" and that "doctors' surgeries promote them".

In contrast, 216 (13.2%) participants disagreed with the claim that e-cigarettes were effective smoking cessation aids. The most common reasons for disagreeing were related to e-cigarettes maintaining addiction (34.3%), containing nicotine (15.3%), and being unable to successfully replace smoking (14.4%). Many participants believed e-cigarettes perpetuate addiction, mentioning that "you are still performing the smoking action and the e-cigs contain addictive elements" and "I think

it's not cutting the habit out; it's just replacing it with a different habit". These participants often suggested quitting nicotine use entirely, rather than switching to an e-cigarette: "if you're going to stop may as well use nothing". Participants were concerned that e-cigarettes contain nicotine; one respondent mentioned that "because some liquids contain nicotine leading people to become addicted to e-cigarettes".

Finally, 615 (37.4%) respondents were undecided about the effectiveness of e-cigarettes as a smoking cessation aid. The most common reasons for being undecided were related to participants lacking knowledge (45.2%) or personal experience with e-cigarettes or smoking (12.5%). The addictiveness of e-cigarettes and cigarettes was often equated: one participant mentioned that e-cigarettes were "just as addictive", while another suggested that "you either want to quit or you don't". Some respondents in this group were undecided as they lacked personal experience with e-cigarettes or cigarettes: "never smoked or used one so can't say".

4. Discussion

The most common reasons given for agreeing that e-cigarettes were less harmful than cigarettes were that they produce no smoke and fewer toxins. Those who disagreed were concerned about the perceived scarcity of trustworthy research into e-cigarettes, safety issues, and toxin production. Lacking knowledge and concerns about a perceived scarcity of trustworthy research were also the most common reasons for being undecided about relative harms. People who agreed that e-cigarettes were effective cessation aids mentioned their utility as a smoking replacement and advice from health professionals, family and friends as reasons for their perceptions. Conversely, those who disagreed were

Table 3
Categories of reasons for e-cigarettes perceived effectiveness as a smoking cessation aid* .

Categories (Cohen's Kappa)	Verbatim quotes	N = 1646 [95%CI]	"Do you think e-cigarettes are an effective cessation aid to stop smoking regular cigarettes"		
			Agree % [95%CI]	Disagree % [95%CI]	Undecided % [95%CI]
Smoking replacement ($\kappa = .59$)	"It simulates smoking in its action."	29.3	50.3	14.4	6.7
	"It gives them an alternative to curb the cravings"	[27.1–31.5]	[46.9–53.7]	[10.3–19.7]	[5.0–8.9]
	"Replaces the need to have something in your mouth"				
Lack of knowledge ($\kappa = .82$)	"It still has nicotine in and allows users to put something in their mouth and hands like a cigarette"				
	"Never smoked or used one so can't say"	20.2	5.3	5.6	45.2
	"Don't know how effective they are"	[18.4–22.2]	[3.9–7.0]	[3.2–9.5]	[41.3–49.2]
	"Have not seen any statistics"				
Nicotine ($\kappa = .64$)	"Don't know enough about them"				
	"Because some liquids contain nicotine leading people to become addicted to e-cigarettes"	13.1	19.8	15.3	3.4
	"The nicotine hit produced by the e-cigarettes are useful as a substitute in cigarette smoking"	[11.5–14.8]	[17.2–22.6]	[11.1–20.7]	[2.2–5.2]
Addictive ($\kappa = .78$)	"Less nicotine"				
	"You are still performing the smoking action and the e-cigs contain addictive elements"	12.5	9.6	34.3	8.8
	"I do not see the point in replacing one addiction with another"	[11–14.2]	[7.7–11.7]	[28.3–40.8]	[6.8–11.3]
	"People are using them far more than normal tobacco products and I believe most people would revert back to tobacco products should they run out of the liquid and not be able to purchase it easily where they are"				
Advice ($\kappa = .76$)	"Most family members who smoked regular cigarettes made the transition to e-cigarettes easily."	12.0	20.0	6.0	3.6
	"Recommended in the media by health professionals"	[10.5–13.7]	[17.4–22.9]	[3.6–10]	[2.4–5.4]
	"Because doctors' surgeries promote them."				
Experience ($\kappa = .60$)	"Have loads of positive feedback when ask friends and family who use them [e-cigarettes]"				
	"It has helped me in the past to cut down significantly"	11.0	11.3	5.0	12.5
	"I know people that it has helped"	[9.5–2.5]	[9.3–13.6]	[2.9–8.9]	[10.1–15.4]
	"Never smoked or used one so can't say"				

† **Statement classifications:** agree includes "strongly agree" and "somewhat agree"; disagree includes "strongly disagree" and "somewhat disagree"; undecided includes "don't know" and "neither agree nor disagree"

*118 (7.2%) participants gave non-interpretable responses. All verbatim quotes are from different participants

most concerned about e-cigarettes being addictive and containing nicotine. Lacking knowledge of or experience with e-cigarettes were the most common reasons for being undecided about their efficacy as a cessation aid.

4.1. Harm relative to cigarettes

Harm perceptions may affect whether adults who smoke cigarettes choose to switch completely to e-cigarette or continue to smoke (Perski et al., 2020). This is why many public health bodies and charities are interested in promoting more informed perceptions of the risk of different nicotine products, with some already investing in educational advertising campaigns (Tattan-Birch, Jackson et al., 2020). But to promote informed perceptions effectively, these organisations must first understand the reasons why people hold misperceptions.

Our results show that adults who perceived e-cigarettes as at least as harmful as smoking were most concerned about the perceived lack of trustworthy research into e-cigarettes. Many mentioned that, as e-cigarettes are relatively new to the market, they think there has been insufficient time to determine their safety. Others were sceptical about claims of reduced exposure to harm coming from sources within the e-cigarette or tobacco industry. This is similar to what has been found in previous qualitative studies among people who smoke and health professionals (Erku et al., 2020; Sherratt et al., 2016). Campaigns aimed at promoting informed harm perceptions among adults who smoke should communicate the quantity and quality of research from sources without commercial interests showing that while e-cigarettes are not harmless, they expose people to fewer toxicants and carcinogens than cigarettes. Disseminating this information through trusted institutions and charities may be more effective, as literature on persuasion shows the source of a message is often more important than its content (Eastin, 2006; Stafford, 1994). Indeed, some people mentioned NHS guidance as a reason for viewing e-cigarettes as less harmful than cigarettes, suggesting that messaging from trusted organisations may help promote more informed perceptions.

Adults with negative harm perceptions also had concerns about e-cigarette safety, mentioning that they perceived e-cigarettes to be unregulated. For instance, several participants were concerned about e-cigarettes causing "popcorn lung". Popcorn lung is a nickname for bronchiolitis obliterans, a disease caused by inhalation of the buttery flavouring diacetyl. Diacetyl is banned from use in e-cigarette liquids under European Union (EU) law — along with other potentially harmful additives (this law still remains active in the UK) (European Parliament and the Council of the European Union, 2014). Nonetheless, misinformation that e-cigarettes cause popcorn lung has been widely reported in the media, which fuelled these incorrect beliefs (East et al., 2018, 2022). In order to address these safety concerns, messaging from organisations in the EU and UK could highlight that the safety of e-cigarette liquids and devices are tightly regulated. Note that, in the US, several anti-vaping campaigns have been broadcasted on popular media platforms, which have likely influenced public perceptions. Moreover, other governments should guarantee that e-cigarettes are adequately regulated to ensure that adults who smoke are confident about the safety of these products and thus might consider switching.

We also found that people with negative perceptions were concerned about toxic chemicals in e-cigarette aerosol, and the most common reason for agreeing e-cigarettes were less harmful than cigarettes was that they produce no smoke and fewer toxins. This indicates that beliefs about the chemical composition of e-cigarette aerosol is a key driver of both positive and negative perceptions of e-cigarette harm. Therefore, alongside addressing concerns about the safety of and research into e-cigarettes, messaging from public health bodies and charities (e.g. through advertising campaigns) could highlight that e-cigarettes produce lower levels of toxins than cigarettes (National Academies of Sciences, Engineering, and Medicine et al., 2018).

4.2. Effectiveness for smoking cessation

We found that people who perceived e-cigarettes as ineffective aids were most concerned about them being addictive and containing

nicotine. These themes were also common in previous qualitative studies. For instance, in interviews, people who smoked or vaped feared that e-cigarettes might perpetuate or even amplify their addiction to nicotine (Bowker et al., 2018; King et al., 2018; Notley et al., 2019). Similar results were found in quantitative studies: a survey of adults in Great Britain found that a concern about “substituting one addiction for another” was the most common reason why people who smoke avoided trying e-cigarettes (Action on Smoking and Health, 2022). Messaging about e-cigarettes, on warning labels and official statements, has the potential to either magnify or calm these concerns.

Current UK and EU regulation requires that e-cigarette and e-liquid packaging are labelled with specific warnings. These warning labels state: “*This product contains nicotine which is a highly addictive substance*”. Similar messages are required on packaging in other countries such as the US (FDA, 2022). Such warnings about addiction may inadvertently signal to people who smoke that e-cigarettes are more addictive than cigarettes, given that cigarettes are not required to have warning labels about addictiveness. Indeed, experimental evidence shows that, in comparison with people who smoke shown comparative risk messages (which highlight that e-cigarettes are less harmful than cigarettes), those shown warnings that emphasise the addictiveness of e-cigarettes report being less willing to try e-cigarettes to help them quit (Cox et al., 2018). Our results showed that fears about e-cigarettes’ addictiveness were common. Therefore, replacing these warning labels with comparative harm messages may motivate — or at least not discourage — adults who smoke from using e-cigarettes to quit smoking. However, it is important that new messages do not encourage young people who have never smoked cigarettes to start using e-cigarettes.

Alongside avoiding magnifying misperceptions, messaging from public health bodies and charities could actively promote informed perceptions through educational advertising campaigns and official guidance. We found that the majority of adults who perceived e-cigarettes as effective for smoking cessation viewed them as useful cigarette replacements, with many people emphasising their ability to deliver nicotine and mimic the act of smoking. Similarly, in previous interview studies, people reported using e-cigarettes because, unlike pharmacotherapy, they closely replicate the experience of smoking (Barbeau et al., 2013). Future educational advertising campaigns aimed at promoting smoking cessation could highlight the ability of e-cigarettes to replicate the behavioural aspects of smoking (e.g., hand-to-mouth actions and inhalation). Several participants mentioned that their perceptions were shaped by advice from their doctor or nurse. Therefore, it may be especially important to communicate the ability of e-cigarettes to replace cigarettes in channels read by these health professionals — such as in official smoking cessation guidelines (Ferrey et al., 2019). More generally, messaging that emphasises how e-cigarette use can replicate, and therefore replace, the experience of cigarette use may promote more positive perceptions about the effectiveness of e-cigarettes for smoking cessation among adults who smoke.

4.3. Limitations, strengths, and future directions

There are some limitations to this study. Participants were given cash or vouchers for completing the survey, and some may have rushed through to receive these incentives. However, >90% of participants provided valid responses to both open-ended questions, which suggests this was not a substantial issue. Data were collected before the US “EVALI” outbreak of lung injury linked to illicit cannabis vaping (Tat-tan-Birch, Brown et al., 2020) — though often misreported as resulting from nicotine e-cigarettes — and the COVID-19 pandemic. These crises likely influenced people’s perceptions about e-cigarettes (East et al., 2022; Kale et al., 2022). Future research could use our methodology to explore how and why perceptions changed following these crises. Finally, while there was excellent inter-coder agreement between researchers on the most common reasons identified, some of the less prevalent reasons only had fair agreement. These may be less reliable

categories.

Nonetheless, this study had several strengths. Its mixed-methods design allowed in-depth analysis on the factors that underlie public perceptions of e-cigarettes. Whereas previous qualitative studies examined small groups of individuals, we recruited a large sample of adults (N = 1646) with socio-demographic characteristics that were broadly representative of the population in Northern England. In addition, unlike previous quantitative studies, we were able to do this without constraining participants to choose from a predetermined set of answers. While these results may not directly generalise across cultures, they can be used to generate hypotheses to be tested in different countries and contexts. For instance, the reasons identified may be adapted into questions for quantitative survey studies. Moreover, future qualitative research can utilize these themes to guide conversations with participants.

5. Conclusion

In this study, using open-ended responses from a large sample of adults in Northern England, we found that negative perceptions of e-cigarette harm relative to cigarettes were driven by concerns about a perceived lack of research and safety issues. Negative perceptions about e-cigarettes effectiveness for smoking cessation were guided by fears that e-cigarettes would perpetuate nicotine addiction. Collective efforts with governments, health professionals and charities are needed to communicate the relative harm of different nicotine products to adults who smoke, allowing them to make informed decisions about their use of e-cigarettes. Communication that addresses the concerns and fears we identified may be most effective at promoting well informed perceptions.

Registration

This study was pre-registered with the Open Science Framework (<https://osf.io/buwes/>).

Data sharing

R script used to generate the findings can be obtained by requesting from the primary author. Data were obtained from Cancer Research UK.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.drugalcdep.2023.109806](https://doi.org/10.1016/j.drugalcdep.2023.109806).

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