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How Do Adolescent Smoking Prevention Interventions Work in Different Contextual Settings? A Qualitative Comparative Study Between the UK and Colombia

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Abstract

Background Adolescent smoking is associated with significant health and social risks. Previous research has demonstrated the effectiveness of interventions based on behavior change theories in preventing adolescent smoking uptake. However, evidence from the theory-based perspective of evaluation is limited, especially for how such complex interventions work, and how they work when implemented in different contextual settings.

Method A comparative qualitative analysis was conducted to explore various influences on behavior change among participants taking part in two smoking prevention interventions in Northern Ireland and Bogotá. Twenty-seven focus groups were conducted in 12 schools (6 in Northern Ireland and 6 in Bogota, $n = 195$ pupils participated; aged 11–15 years). The Theoretical Domains Framework guided a content analysis of the data.

Results We found similarities across settings in terms of knowledge, skills, and beliefs related to smoking or vaping behavior change, as well as differences in contextual resources and social influence. Different environmental resources included availability to purchase tobacco products in the neighborhoods and previous information about tobacco risk. Participants in both interventions perceived behavioral change outcomes related to personal skills and intention to not smoke or vape.

Conclusion These findings have highlighted how both individual factors and contextual resources influence behavior change for smoking prevention in practice. Local contextual factors and social influences affecting pupils should be taken into account in the implementation and evaluation of health behavior change interventions. In particular, this study supports using social and contextual influence strategies in interventions to reduce the onset of adolescent smoking and vaping.

Keywords Smoking prevention · Qualitative analysis · Behavior change · Health interventions · Adolescent health

Introduction

Globally, adolescent smoking is associated with long-term tobacco use, risky behaviors, and non-communicable diseases [1]. About 90% of smokers begin smoking before they are 19 years old and 43.8 million children aged 13–15 years use tobacco products worldwide [2, 3].

Smoking is considered to be a "socially contagious behavior" and adolescents are particularly susceptible to social influences [4–6]. A wide range of environmental factors increase susceptibility for smoking behavior among adolescents [7, 8]. Current global tobacco control strategies are focused on addressing the effect of emergent nicotine products on adolescent tobacco use [9]. Appeals such as the availability of different flavors for e-cigarettes, social media advertising, and social influences increase adolescents' exposure to tobacco and, consequently, their smoking behavior [10–12].

Different strategies aimed at eliciting social influences are supported by existing theories of behavior change that integrate interpersonal and environmental factors [13]. Studies have assessed the effectiveness of interventions based on a variety of behavioral change theories to prevent or reduce adolescent smoking [14–17]. However, the effectiveness perspective of evaluation would not provide sufficient evidence for intervention implementation [18]. A more theory-based perspective on evaluation focuses on understanding the mechanisms of interventions, *how* an intervention works, and how this may vary across different

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settings and individuals [18, 19]. The mechanisms by which these types of interventions may change participants' behavior are unclear [20], and the pathways at the social network and norms levels are rarely explored [21]. Therefore, understanding how such interventions work, for whom, and why is fundamental to evaluating their implementation and supporting real-world research and decision-making on public health [18].

The MECHANISMS study aims to better characterize the potential mechanisms of action of two smoking prevention interventions in schools (ASSIST and Dead Cool) in two different contextual settings [22]. Both smoking prevention interventions have been shown to be effective in the United Kingdom (UK) for reducing the number of adolescents that initiate smoking [23, 24]. Since both interventions incorporate social influence using different behavioral strategies, the mechanisms by which behavior change occurs may be different in the two contrasting settings. This study compares the interventions in a high-income setting and a middle-income setting using data obtained in Northern Ireland (UK) and Bogotá (Colombia).

Research on the mechanisms of interventions increases understanding of how behavioral changes are achieved, and how these changes may vary across different contexts and groups of participants [18]. Behavior change interventions are typically embedded in complex social systems. Therefore, we expect that the same program will have varying resources, functions, and outcomes across multiple contextual boundaries [25]. Theory-based evaluation of interventions focuses on assessing the interplay of the context on intervention outcomes and facilitates the integration of conceptual and empirical data [18].

The ASSIST and Dead Cool interventions aim to prevent the onset of adolescent smoking in schools, but are based on different behavior change theories. The intervention logic models have been previously published in the MECHANISMS study protocol [22]. The ASSIST intervention is based on the Diffusion of Innovations Theory, which outlines the process by which a novel behavior is spread among the members of a community in order to incorporate the new behavior into the social system [26]. In the intervention, a group of nominated "peer supporters" are trained to understand the dangers and risks of smoking and are subsequently asked to encourage their school peers not to smoke through informal conversations in everyday situations [24]. Therefore, the intervention design explicitly leverages adolescent friendship networks. The Dead Cool intervention is delivered through a more conventional classroom-based pedagogy and is based on the Theory of Planned Behavior, which outlines the process by which individual factors are targeted to develop a behavioral intention, the major determinant of behavior [27]. During the intervention, participants examine their skills and the influences on smoking behavior [23].

The Theoretical Domains Framework (TDF) describes an integrative process for synthesizing the theories and constructs related to behavior change to make them more accessible for various disciplines, and to assist the application of theory in the design and evaluation of interventions [28]. The TDF includes 14 conceptual domains to explain behavior change, and its structure has been validated and updated using conceptual consensus and global empirical data about its applicability [28]. The TDF has been applied in the literature to assess interventions that involve health professionals, patients, and the public population. This literature demonstrates that it is useful to optimize qualitative research to enquire about behavioral determinants [29].

Quantitative analytical techniques have enabled researchers to empirically examine the individual and contextual characteristics of interventions, including those related to the social environment and social norms, which are related to adolescent smoking behavior. In particular, previous research has demonstrated that the ASSIST and Dead Cool interventions effectively reduce the likelihood of adolescents initiating smoking in the UK [23, 24], and how social network structures influenced the changes in social norms for smoking [6]. However, qualitative research methods can explore a wider range of influences for behavioral change, beyond those which can be discerned through quantitative methods alone [30]. Qualitative research can reveal specific local interplays invoking individual agency, which is imperative for understanding behavioral change [30]. Emergent studies have used qualitative techniques to assess health behavior changes during behavioral interventions [31–33]. However, there is limited literature on qualitative research exploring the mechanisms of complex health behavior interventions [34]. Qualitative inquiry has the potential to reveal connections between smoking behavior and interventions, while maintaining a focus on the context of the implementation.

The current study aims to compare the influences on the ASSIST and Dead Cool participants' behavioral change related to smoking or vaping in two different contexts (Bogotá and Northern Ireland). The TDF was used to conduct a theory-based analysis of the behavioral influences involved in the interventions in different contexts using comparable conceptual constructs. We expected the results of this analysis to inform how the interventions worked in the different settings in terms of the mechanisms of action of the smoking prevention interventions.

Study Settings

Bogotá and Northern Ireland provide contrasting contexts that can illuminate underpinning mechanisms of smoking prevention interventions, including the varying social norms, cultures, policies, socioeconomic standing, and

smoking behaviors. Bogotá is the capital city of Colombia, a Spanish-speaking country in Latin America, and has over 7.2 million inhabitants. Northern Ireland is part of the UK, an English-speaking country with approximately 2 million inhabitants [35].

Social differences between the countries are apparent in terms of population composition, economic standing, and available resources. For example, Colombia has an absolute poverty rate of 4.1% while in the UK it is 0.2% [36]. In addition, in Colombia, there are 26 pupils per teaching staff in secondary public institutions, and only 17 in the UK [36].

Both countries have partially fulfilled their commitments under the WHO Framework Convention on Tobacco Control (FCTC). The World Health Organization (WHO) has recognized the UK policies to monitor the tobacco epidemic, create smoke-free environments, include health warning labels, implement anti-tobacco mass media campaigns, and raise taxes on tobacco. Colombia has achieved high levels of implementation of smoke-free environments and regulations to enforce bans on tobacco advertising, promotion, and sponsorship [9]. The Global Tobacco Industry Interference Index is higher in Colombia (ranking 76) than in the UK (ranking 32), which indicates the tobacco industry's attempts to limits the countries efforts to regulate and implement the control tobacco policies [37].

Sub-national implementation of the FCTC contrasts with the current state of the tobacco epidemic. The prevalence of tobacco use among adolescents is higher in Bogotá than in Northern Ireland. In Bogotá, 10.6% of adolescents aged 13–15 years use conventional cigarettes, and 11.2% use e-cigarettes [38]. By contrast, in Northern Ireland, 4% of adolescents aged 11–16 years use conventional cigarettes, and 3% use e-cigarettes [39].

Implementation of school-based smoking prevention programs is also different in both settings. In Northern Ireland, pupils are provided with smoking prevention information as part of the school curriculum from an early age [40]. Conversely, in Bogotá, tobacco education is a suggested (not compulsory) component of the school curriculum [41], and 51% of students (13–15 years) reported having received information about the health risks of tobacco in school [38].

Methods

This research formed part of the MECHANISMS study, a concurrent nested mixed-methods study [22]. Here, we present findings from the qualitative component, a descriptive case study using data collected through focus group discussions. Electronic Supplementary Material 1 shows the Consolidated Criteria for Reporting Qualitative Research (COREQ checklist).

Participants

The MECHANISMS study included 1315 participants aged 11–15 years old in Northern Ireland ($N=677$) and Bogotá ($N=638$) who received either the ASSIST or Dead Cool interventions, and were active in the study. Using a whole school year approach, ASSIST was delivered in three schools in Northern Ireland ($N=393$ students) and three schools in Bogotá ($N=333$ students), meanwhile Dead Cool was delivered in three schools in Northern Ireland ($N=284$ students) and three schools in Bogotá ($N=305$ students).

Out of the 726 students that received the ASSIST intervention, 75 students were recruited to participate in the focus groups (Northern Ireland = 59; Bogotá = 16). Overall, 142 students were trained as peer supporters (75 in Northern Ireland; 67 in Bogotá) and 41 were selected to participate in the focus groups at the end of the intervention (Northern Ireland = 25; Bogotá = 16). Out of the 589 students that received the Dead Cool intervention, 79 were recruited to participate in the focus groups at the end of the intervention (Northern Ireland = 55; Bogotá = 24).

The team followed the logic of maximum variation sampling to guide the recruitment process up to data saturation aiming to ensure the inclusion of participants with varying characteristics in both interventions, including smokers and non-smokers, girls and boys, and students from different school classes. Participants were invited during the data collection sessions, and interested students (and their parents) completed written consent forms before the focus groups. In Bogotá, participants were recruited face-to-face in the classroom. In Northern Ireland, participants were recruited using an invitation sheet in the school.

Ethical approval was granted from the School of Medicine, Dentistry and Biomedical Sciences Ethics Committee at Queens University Belfast in Northern Ireland (reference number 18.43; v3 Sept 2018), and the Research Ethics Committee of the Universidad de los Andes in Bogotá (reference number 937—July 30, 2018).

Procedure and Materials

Both interventions were delivered in the schools according to their respective intervention protocol. In Bogotá, both interventions were culturally adapted before the implementation, including a fidelity assessment [42]. As part of the MECHANISMS study, a sociodemographic questionnaire was completed by all students who received the smoking prevention interventions [43] (see Electronic Supplementary Material 2 which details their sociodemographic characteristics). At the end of the interventions, focus groups were conducted with participants using a semi-structured topic guide. Questions covered domains of behavior change related to smoking and participants' experience with the interventions

according to their role including pupils or peer supporters (see Electronic Supplementary Material 3).

In total, 17 focus groups were conducted with the ASSIST participants (Northern Ireland = 9; Bogotá = 8), and 10 focus groups were conducted with the Dead Cool participants (Northern Ireland = 4; Bogotá = 6). All focus groups were facilitated in the schools by a trained interviewer using English or Spanish according to the participant's native language. The focus groups were audio-recorded with the prior permission of all participants. Then, the recordings were anonymized and transcribed verbatim in their original language.

Data Analysis

A deductive content analysis was used to compare the influences on the ASSIST and Dead Cool participants' behavior change related to smoking in both Northern Ireland and Bogotá [44]. The focus groups were encoded in the original language by three bilingual and independent coders.

The research team used two cycles of coding. The first coding cycle identified the behavior change constructs related to the interventions using the TDF domains [28]. It included 14 categories corresponding to the TDF conceptual domains: knowledge, skills, social role, beliefs about capabilities, optimism, beliefs about consequences, reinforcement, intentions, goals, decision processes, environmental context and resources, social influence, emotion, and behavioral regulation. The second coding cycle disaggregated sub-categories, including separated sub-categories related to vaping behavior when the data were explicit. A total of 24 sub-categories were identified. Also, empty TDF domains were suppressed including optimism, reinforcement, goals, decision processes, emotion, and behavioral regulation. In addition, an emergent category was included that described the perceived behavior changes as intervention outcomes. The final codebook included the following categories: knowledge, skills, social role for health promotion, beliefs about capabilities, beliefs about consequences, intentions, social influences, environmental context and resources, and perceived behavior changes.

To establish inter-coder reliability, the coding team employed debriefing and member checking at the end of each coding cycle. After codification, we compared the content of the categories using axial matrices including setting (Bogotá vs. Northern Ireland) and intervention (Dead Cool vs. ASSIST). NVivo qualitative data analysis software was used (QSR International 193 Pty Ltd. Version 12 Pro). In addition, a descriptive analysis of the sociodemographic characteristics of the students who received the smoking prevention interventions was conducted using the statistical package Stata (StataCorp, 2015; Stata Statistical Software: Release 14; College Station, TX: StataCorp LP).

Results

Electronic Supplementary Material 2 highlights the sociodemographic characteristics of the students who received the smoking prevention interventions. Participants had similar socioeconomic characteristics overall, with the majority of students being categorized in low and middle socioeconomic categories in both settings. A smaller proportion of the students in the Bogotá sample lived with both parents. In addition, students had some varying characteristics derived from contextual differences. For example, Bogotá had some participants who were slightly older (15 years old and older) and more ethnic minority students than Northern Ireland.

It was identified the 9 hierarchical categories that are listed by highest to lowest saturation (number of times that a theme was mentioned by the participants) in Electronic Supplementary Material 4. The meaning of each hierarchical category corresponds to:

- Knowledge: Awareness of tobacco use and associated products, including knowledge of cigarettes, e-cigarettes, and smoking behavior and gaps in knowledge.
- Skills: Interpersonal skills relevant to the interventions acquired through practice, including communication skills and refusal skills.
- Social role for health promotion: Experiences and opinions regarding the student's role in encouraging others not to smoke, through conversations about the risk of smoking. It includes encouraging peers and family members.
- Beliefs about capabilities: Perceived confidence about one's own ability or talent in relation to the prevention of smoking behavior. It includes perceived competence to encourage others not to smoke and self-efficacy to refuse.
- Beliefs about consequences: Recognition of the possible outcomes or consequences of smoking behavior. It includes health and social risk perception, and perception of benefits.
- Intentions: Conscious decision of wanting (or not wanting) to smoke or vape. It includes intentions to smoke, intentions to vape, or intentions to not smoke or vape.
- Social influences: Interpersonal processes that are associated with the changing of thoughts, feelings, or behaviors about smoking, such as social pressure and social norms. It includes family and peer influences, descriptive social norms, and social acceptance.
- Environmental context and resources: elements of the student's environment that act as barriers or facilitators for smoking behavior, including resources in families, schools, and neighborhoods. In addition, we identified availability of tobacco products and exposure to tobacco-related advertising.
- Perceived behavior changes: changes in beliefs, knowledge, skills, behaviors, attitudes, or other constructs that participants report as an outcome of the interventions.

Table 1 presents the comparison of categories obtained in the ASSIST and Dead Cool intervention schools as well as in Bogotá and Northern Ireland. We identified similarities and differences between settings and interventions that are summarized in four main results: (i) knowledge, skills, and beliefs operate in similar way; (ii) social influences are similar but operate in a different way across settings; (iii) adolescents have very different environmental context and resources across settings; and (iv) perceived behavior changes outcomes were different across interventions and settings. Details of each main result are described below.

Knowledge, Skills, and Beliefs Operate in a Similar Way

We identified similarities in knowledge, skills, and beliefs across the interventions in both settings. ASSIST participants mentioned knowledge about components of the cigarettes, communication skills, and encouraging other peers and family members to not smoke. It is important to note that only peer supporters, who were trained, mentioned personal skills and the social role for health promotion. Meanwhile, Dead Cool participants mentioned development of personal skills to refuse offers of cigarettes and increased awareness of advertising. In both programs and both settings, participants mentioned knowledge and perceptions about health consequences, self-efficacy to not smoke or vape, intentions to not smoke or vape, previous experiences using tobacco, encouraging friends to not smoke, and social influences for smoking.

In addition, differences across settings were identified. In Bogotá, all groups reported previous smoking and/or vaping due to curiosity and social pressure. For example, one pupil mentioned: "Well, it has been mostly with e-cigarettes. The first time, I did it out of curiosity and the second time for the flavor, because I liked it" (Dead Cool pupil, 1st October 2019, Bogotá). In addition, Bogotá's pupils wanted more information about other substances and peer supporters mentioned personal skills for freedom of expression and empathy. By contrast, in Northern Ireland, participants reported previous smoking and vaping experiences for stress relief. For example, one participant mentioned: "Normally, if you're stressing out you just light up a fag [cigarette]. It makes everything 10 times better, it's just like a big relief" (ASSIST pupil, 19th June 2019, Northern Ireland). In addition, Northern Irish pupils requested more information about e-cigarettes and mentioned perceptions of peers and social consequences and their awareness of social influences around smoking.

Social Influences Are Similar But Operate in a Different Way

In both settings, participants mentioned that families and peers are important influences for smoking behavior. However, the social influence for smoking and vaping appeared to operate differently across the settings. For example, Bogotá's participants believed most peers are smokers (participants suggested 10–80% of their peers smoked or vaped). By comparison, Northern Irish participants estimated that a smaller proportion of their peers are smokers (participants suggested 2–30% of their peers smoked or vaped). It is important to note that in Northern Ireland, there was a more prevalent perception among participants that using e-cigarettes is more socially acceptable than combustible cigarettes, as illustrated by the following quote: "They [peers] just think it's more appropriate, because most people think it's scientifically proven that it doesn't kill you as much […] Loads of people our age have them so it just seems normal, other than cigarettes, no one smokes them as much as e-cigarettes". (ASSIST pupil, 21st May 2019, Northern Ireland).

Furthermore, in Northern Ireland, peer influence was commonly related to the need to belong and the fear of negative evaluation. For example, a pupil said: "Because if everyone in your friend group doesn't like smoking, you won't want to lose them as friends, especially if they're really close and they're good friends you don't want to lose them if you start smoking" (Dead Cool pupil, 7th June 2019, Northern Ireland). In Bogotá, social influence was commonly related to a combination of the need to belong, the fear of negative evaluation, and social pressure from classmates and friends. For example, a participant explained: "If he is a close friend, you can say 'no' and he would feel you; but there are other friends that push and push. And they say 'chicken, cry baby', they don't talk to you again, and you feel excluded. That is the reason why you do it." (ASSIST pupil, 22nd October 2019, Bogotá).

Adolescents Have Very Different Environmental Contexts and Resources

Participants identified specific contextual resources that were involved in behavioral reasoning to smoke or vape including families, schools, neighborhood, availability to purchase tobacco products, and exposure to advertising. Overall, Bogotá's participants identified susceptibility factors related to smoking or vaping that included social pressure, smokers in families, exposure to advertising on social media, availability of purchasing cigarettes, and consumption of other substances in the neighborhood. They also identified anti-tobacco attitudes within the family as a protective factor that influenced adolescent smoking. Northern Irish participants identified susceptibility factors related to smoking or vaping that include social influence, exposure to second-hand smoke in public spaces, availability of purchasing e-cigarettes online, and social acceptability of e-cigarettes. They also identified previous anti-smoking information as a protective factor that influenced adolescent smoking. Following, we detail the contextual resources of each setting.

Table 1 Identified content of behavioral change domains related to smoking and vaping, and perceived intervention outcomes in Bogotá and Northern Ireland

Content of domains	Setting/intervention			
	Bogotá		N. Ireland	
	A	DC	A	DC
Environmental context and resources				
Availability to purchase cigarettes in neighborhood	x	x		
Adults purchase cigarettes for adolescents			x	x
Smokers in families	x	x	x	x
Smokers at school	x	x		
Smokers in neighborhood	x	x	x	x
E-cigarette advertising in social media	x	x	x	x
Availability to purchase e-cigarettes online			x	x
Consumption of other substances in neighborhood	x	x		
Anti-smoking information in school and neighborhood			x	x
Knowledge				
Knowledge about consequences	x	x	x	x
Knowledge about ingredients	x		x	
Knowledge about e-cigarettes			x	x
Request for more information about e-cigarettes	x	x	x	
Request for more information about other substances	x	x		
Skills				
Communications skills	x		x	
Personal skills for freedom of expression	x			
Personal skills for empathy	x			
Personal skills to refuse		x		x
Personal skills for awareness of advertising		x		x
Social role for health promotion				
Encourage other peers to not smoke	x		x	
Encourage friends to not smoke		x		x
Encourage family members to not smoke	x		x	x
Beliefs about capabilities				
Self-efficacy to not smoke	x	x	x	x
Beliefs about consequences				
Perception of health consequences	x	x	x	x
Perception of social consequences related to the family	x		x	x
Perception of social consequences related to peers			x	x
Intentions				
Intention to not smoke	x	x	x	x
Previous smoking or vaping due to curiosity and social pressure	x	x		
Previous smoking or vaping for stress relief			x	
Social influences				
Beliefs that many other peers smoke	x	x		
Beliefs that few other peers smoke			x	x
Beliefs that many other family members smoke	x	x	x	x
Beliefs that e-cigarettes are more approved of			x	x
Peer pressure and social acceptance to smoke	x	x		
Peer pressure to fit in			x	x
Family do not approve of smoking behavior	x	x	x	x
Perceived change in behavior				
Improved intention to not smoke		x		x
Maintained intention to not smoke				x
Improved knowledge about consequences and ingredients	x	x	x	x

Table 1 (continued)

Content of domains	Setting/intervention			
	Bogotá		N. Ireland	
	A	DC	A	DC
Improved beliefs about health consequences	x	x	x	x
Improved beliefs about social consequences				x
Improved personal skills for empathy	x			
Improved personal skills to refuse		x		x
Improved awareness of social influence		x		x
Improved awareness of tobacco advertising		x		x
Improved encouragement of other peers to not smoke	x		x	

Content corresponds to the qualitative analysis of the structural categories. To see the resulting sub-categories, visit Electronic supplementary material 3

A ASSIST intervention, *DC* Dead Cool intervention

Contextual Resources in Bogotá

Pupils identified greater availability of cigarettes through family members, peer smokers at school, and unsafe neighborhoods. Adolescents also reported being exposed to smokers and tobacco products in public spaces such as streets and parks, and they could directly purchase cigarettes in the neighborhood. A pupil explained high access to tobacco products and social acceptance in the quote: "Well, they [the sellers] do not mind selling cigarettes to minors. For example, my family ask me to buy the Gold Seal [a cheap illicit brand] cigarettes, and the sellers do not tell me anything. – Where do you buy cigarettes most often? – Here in front of the school." (ASSIST pupils, 28th May 2019, Bogotá). In the case of e-cigarettes, participants reported that they could access them through social media "giveaways," or in their homes via other family members or older peers at school.

A further finding in Bogotá was that pupils mentioned that adolescent cigarette consumption in their schools and neighborhoods can be related to the use of other substances in risky contexts. For instance, pupils said: " – Where are you usually exposed to secondhand smoke? – Outside of the school, when you leave it in the afternoon there are people smoking cigarettes and marihuana […] What they [the consumers] do the most is use marihuana, but also cigarettes, tobacco… Or then glue-sniffing." (ASSIST pupils, 28th May 2019, Bogotá). This quote displays that Bogotá's pupils related smoking behavior with exposure to tobacco and use of other substances in their environment.

Contextual Resources in Northern Ireland

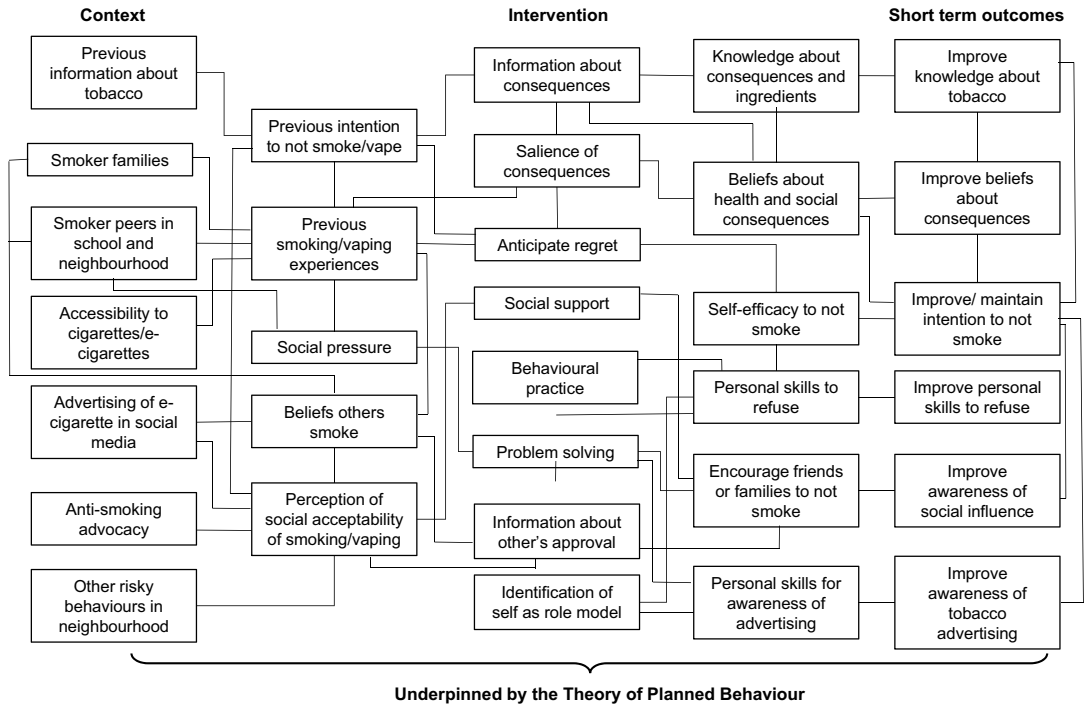
The participants outlined availability of cigarettes, through identification of smokers within families and exposure to second-hand smoke in public places such as leisure centers and neighborhoods. However, participants in Northern Ireland had a greater level of protective resources, including prior smoking information from school and greater exposure to anti-smoking advocacy through community groups. For instance, a participant said: "In my youth club one of the youth workers brought in one of the wee things that are in cigarettes, and there were loads of oil and poisonous stuff in them. – Where did you learn that? – . At youth club." (ASSIST pupil, 5th July 2019, Northern Ireland). This quote demonstrates that the Northern Irish pupils were exposed to anti-tobacco messages in their local environments.

Participants could get access to cigarettes through adults or older peers who purchased the cigarettes for them. For example, a pupil said "Obviously I can't just walk into a shop and just go [say] 'can I have a 12 pack of cigarettes?' But they've got fag [cigarette] houses where people buy fake cigarettes and sell them for like £4 to people, and then the same with e-cigarettes, if someone, like an adult sells it to a child and then the child will sell it to someone else" (ASSIST peer supporter, 21st May 2019, Northern Ireland). Pupils also outlined that they could purchase e-cigarettes online, and mentioned exposure to e-cigarette advertising on social media platforms.

Perceived Behavior Change Outcomes Were Different

Both interventions had a long-term aim to prevent smoking onset among pupils, but the short-term outcomes varied according to the logic model based on the theory perspective of each intervention [22]. Categories reported in this study are graphically represented within the updated logic models of both interventions in order to display the pathways that where activated, based on the results of this study (Fig. 1).

a. Dead Cool intervention



b. ASSIST intervention

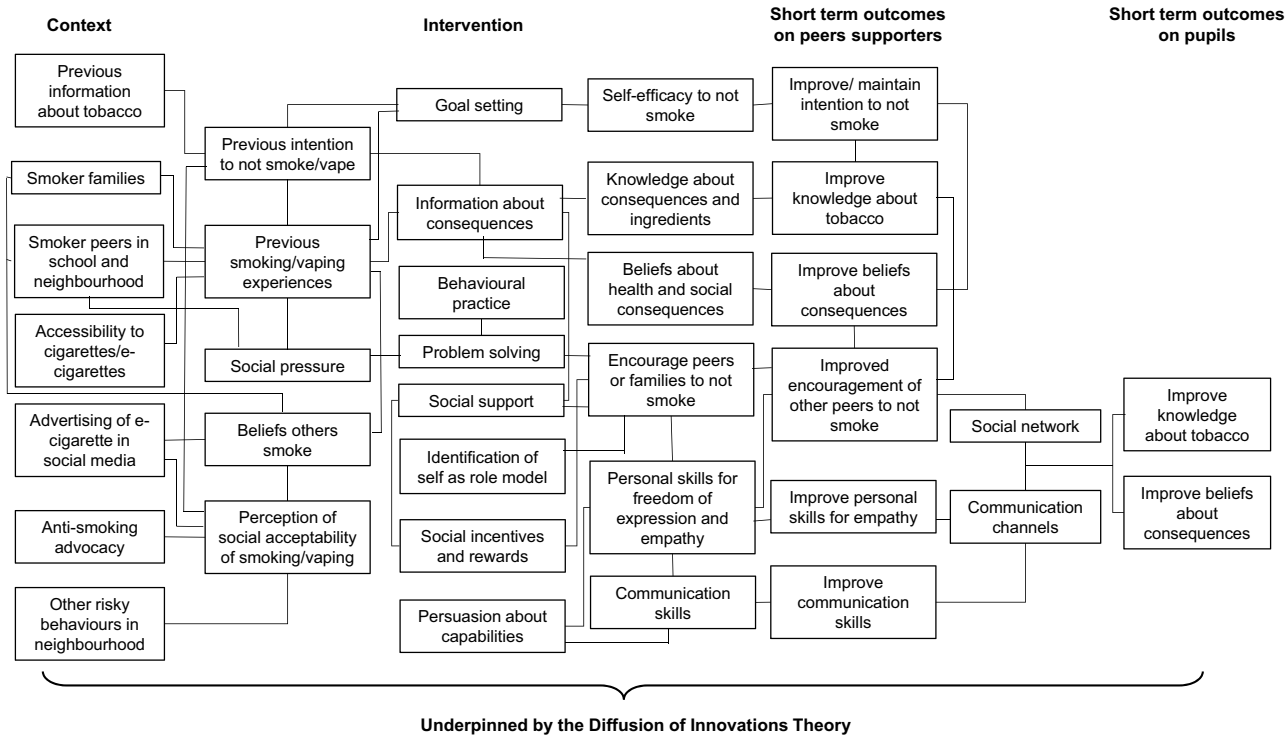


Fig. 1 Representation of the theoretical pathways for interventions identified in focus groups in Bogotá and Northern Ireland. Based on logic models published in Hunter et al. [22]. **a** Dead Cool intervention. **b** ASSIST intervention

Expected Outcomes of the Interventions

Expected outcomes of ASSIST include peer supporters increasing their knowledge about tobacco and health consequences, reducing their smoking intentions, and approaching classmates to communicate information about the risks of tobacco use. Changes in knowledge and attitudes towards tobacco use were expected among ASSIST pupils (non-peer supporters). In addition, increased knowledge about tobacco and health consequences, increased awareness of social influences, skills and social support, and a reduction in smoking intentions was expected among Dead Cool pupils. In 22 out of 27 focus groups, participants identified at least one specific short-term behavioral change as a result of the interventions.

Participants perceived changes related to intended outcomes were identified after the interventions. Participants mentioned improved knowledge and beliefs about the health consequences of smoking irrespective of intervention and setting. In addition, ASSIST peer supporters increased their encouragement of other peers to not smoke, which is illustrated by this quote: "I felt good because we did help some smoker classmates, and if they didn't smoke, told them not to do it. I told them all the things that a cigarette contains" (ASSIST peer supporter, 24th October 2019, Bogotá). Meanwhile, Dead Cool pupils improved their personal skills to refuse tobacco products, as this quote illustrates: "There were scenarios where you rejected the smoking, and ways to say no without hurting their feelings and stuff" (Dead Cool pupil, 25th June 2019, Northern Ireland). This suggests that intended outcomes in both interventions are experienced in both settings.

Spill-Over Outcomes

We found a "spill-over" effect related to families and older peers, who were indirectly encouraged to not smoke by the participants. In Bogotá one pupil said: "I tried to convince my older brother because he has children. I said to him 'why do you smoke? You are ending your life and you won't see them grow'" (Dead Cool pupil, 1st October 2019, Bogotá). In Northern Ireland, participants also related their experience of trying to deter family members from smoking: "I tried to get him [the father] to stop smoking but he'll not stop smoking anymore. I just tell them to stop, because it's like a waste of money" (Dead Cool pupils, 7th June 2019, Northern Ireland). These quotes illustrate that pupils used the resources gained from the interventions, including knowledge and beliefs about consequences, to spread social norms against tobacco within their social context.

Outcomes Related to Contextual Differences

Contextual differences were related to behavioral intentions to not smoke or vape and to the development of personal skills. It is important to note that general intentions to not smoke or vape were more frequently mentioned in Northern Ireland than in Bogotá, suggesting variation in behavior and intentions across the two contexts. Regarding changing intentions to not smoke after the interventions, in Bogotá, participants gave many examples of how the interventions increased their knowledge and perception of the consequences of smoking, causing a change to their intentions to smoke or vape. For example: "It was a change for me because before the program I had the thought that as soon as I turn 18, I was going to smoke my first cigarette. But, after finding out that the cigarette has consequences, well I don't want to do it" (Dead Cool pupil, 1st October 2019, Bogotá). By comparison, participants in Northern Ireland explained how the interventions re-affirmed their intentions to not smoke through increasing their knowledge about the consequences of smoking. For example: "I wasn't planning on smoking anyway […] It's just been the same, because I've already been told not to do it. It hasn't really changed anything, just kind of told me how bad it actually is" (ASSIST pupil, 21st May 2019, Northern Ireland). This suggested the intended outcomes of the interventions could be performed at different levels according to students' previous contextual and personal resources.

A further difference across settings was found regarding the improved skills among participants. In Bogotá, we identified an increase in personal skills for empathy and communication skills. For example: "I learned to listen better, to have a fluent conversation, to listen to my classmates who wanted change" (ASSIST peer supporter, 22nd October 2019, Bogotá). Meanwhile, we identified increasing awareness of social influences for pupils in Northern Ireland. For example: "I learned that some teenagers think it's cool to smoke and think that loads of other people are doing it, even if there is only 4% of people who do smoke" (Dead Cool pupil, 25th June 2019, Northern Ireland). This suggested the perceived short-term outcomes of interventions are also related to interpersonal level behavior changes.

Discussion

This study compared the influences on behavioral change related to smoking of two prevention interventions in two different settings using a theory-driven qualitative approach. We used the TDF to explore the behavior change rationale of the evaluated smoking prevention interventions, facilitating a comprehensive theory-informed approach to uncovering the relationships between individual agency and contextual resources involved in health interventions [29]. Distinct behavioral domains were identified and updated in the logic model for each intervention, which affected participants' reasoning across interventions and settings, including knowledge, skills, social roles for health promotion, beliefs about capabilities and consequences, intentions to smoke or vape, and social influences.

This study explored the pathways through which the smoking prevention interventions worked in settings with different resources as data were focused on participant-centered experiences of the interventions, conditions, and their outcomes [34]. The results help to unravel the complexity of how smoking prevention interventions operate in schools by shedding light on the individual, social, and contextual factors that may affect the design, implementation, scale-up, spread, and sustainability of interventions [45, 46].

In both cultural contexts and interventions, favorable or supportive behavioral resources for smoking prevention include improving participants' beliefs and knowledge about the consequences of smoking. Our qualitative findings allowed us to demonstrate that both interventions improved personal skills. Furthermore, social norms and peer influence were related to smoking in both settings. These findings are consistent with the content of the programs and previous studies on smoking interventions in developing countries [16]. The qualitative findings also complement findings from network-based analysis in the MECHANISMS study, which likewise supported using social influence strategies in interventions to promote smoking behavioral change [6].

Our findings reinforce the notion that cross-contextual differences have implications for the implementation of behavior change programs. Our results suggest that environmental protective factors, such as being exposed to previous information about tobacco from schools, favor the intervention outcomes related to social norms changes. In environments producing high susceptibility for smoking, intervention outcomes related to social norms could be constrained in the short term by factors such as higher levels of access to tobacco products in neighborhoods. However, even in these contexts, interventions provide basic personal skills related to individual agency that can favor smoking prevention outcomes. Previous literature has identified that environmental interventions could have a beneficial impact on adolescent smoking prevention and complement school-based interventions, by increasing efforts to implement and maintain school tobacco policies [17], promoting family support [47], and implementing tobacco control policies at the local level [48].

In particular, this study provided evidence on three environmental factors that could influence the behavioral change for pupils during school-based smoking prevention interventions. First, in both settings, adolescents had previous curiosity-driven experiences of smoking and vaping, and were highly exposed to e-cigarette advertising on social media platforms. Recent literature has shown that young people are highly susceptible and widely exposed to e-cigarette marketing through the media, often targeted at specific demographic groups [49–51]. These findings highlight the importance of strengthening the implementation of tobacco control measures directed at advertising, promotion, and sponsorship through social media [12, 51, 52], and further to include e-cigarettes as tobacco products on the local regulations. There is some evidence that adolescents may be more at risk of initiating smoking following e-cigarette use [53, 54] as they are more socially acceptable than conventional cigarettes [55]. Smoking prevention strategies for adolescents should include information about risks and marketing strategies for e-cigarettes. Future researchers should also consider the role of social media in influencing adolescents' health behavior.

Second, Bogotá's participants are exposed to tobacco products and misuse of other substances in the neighborhood and in schools. This issue draws attention to the need for local prevention programs due to the previously reported risk of nicotine products being a gateway to misuse of other substances [1, 56]. Siquiera and Brook estimated that among Colombian adolescents, tobacco smokers had a two- to threefold higher risk of problem drug use [57]. This highlights the urgent need to implement context-based health education strategies for preventing the onset and co-use of tobacco and other substances [1, 58].

Third, in Northern Ireland, youth clubs were an important contextual resource and source of information for prevention of smoking and vaping. Previous literature has shown that youth clubs, especially (but not limited to) those focused on sports, offer many opportunities for health-promoting activities because they create a supportive environment, can strengthen community action, and can facilitate the development of personal skills [59]. The findings suggest that researchers and interventionists could learn from the resources used to promote health-enhancing behaviors in other contexts. Settings with a higher proportion of adolescents living in deprived or disadvantaged communities could benefit from strategies that target similar informal adolescent smoking prevention. This would be more relevant for LMICs where the tobacco industry has focused its marketing on youth [60] and the prevalence of adolescent smoking remains high [53].

Qualitative inquiry offers a narrative richness about behavior change interventions and their mechanisms. However, we acknowledge that single qualitative or quantitative methods [61] have limitations to (i) identify the diversity of influences on behavior change across a population of pupils; (ii) isolate the influences that may be more important for certain populations; or (iii) demonstrate that synergistic effects of the interventions' components may induce emergent behavioral phenomena expected in a complex social system [62, 63]. As the findings of new quantitative analysis have become available for the MECHANISIMS study, we considered two main strengths of our qualitative findings. First, this study allowed a further refinement of the theory and logic model behind these interventions and the generative mechanisms by which they trigger smoking prevention [34]. Our methodological design provides comparative data on a wide range of contextual circumstances, which are likely to impact the implementation and outcomes of complex interventions [64]. Second, this study provides a

basis for mixed-methods triangulation. Integrating qualitative and quantitative data can highlight areas of dissonance or complementarity that can generate insights into complex behavior change phenomena, such as adolescent smoking [30, 65]. As a consequence, future qualitative studies might explore more deeply the participant-centered experiences of interventions, conditions, and consequences, as well inquiring about participants' theories on how interventions work [34]. Additionally, future lines of inquiry into school-based smoking prevention might usefully adopt a complexity perspective and harness suitably adapted mixed methods [66–68].

A limitation of this study is that focus groups were conducted post-intervention only, whereas a longitudinal qualitative design might more adequately capture behavioral changes over time [69]. Additionally, future qualitative studies aiming to uncover intervention mechanisms in complex behavior change interventions should include data collected from additional roles such as teachers, trainers, families, and stakeholders. This would allow a wider approach to identifying other policy, structural, and temporal contextual factors that could affect the implementation of interventions and their outcomes in practice [70].

In addition, this paper nested vaping behavior into some sub-categories of smoking behavior according to the data because intervention activities delivered mixed information about combustible cigarettes and e-cigarettes. However, our findings suggest that smoking and vaping can have different influences according to contextual factors. Future researchers should inquire about influences for smoking and vaping separately, highlighting the role of social influence and exposure to tobacco advertising.

Conclusion

Our findings outline how individual and contextual resources influence behavioral change for school-based smoking prevention in practice. Local contextual factors and social influences affecting pupils should be considered in the implementation of interventions to prevent smoking. Using a theory-based perspective, this work contributes towards understanding how and why school-based smoking prevention interventions work, as well as offering the potential to help future researchers optimize their implementation, according to their context, to generate the targeted health outcomes.

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Data Availability The aggregated datasets are available from the corresponding author. Individual data would be require IRB approval.

Declarations

Ethical Approval All study procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval was granted from the School of Medicine, Dentistry and Biomedical Sciences Ethics Committee at Queens University Belfast (reference number 18.43; v3 Sept 2018), and the Research Ethics Committee of the Universidad de los Andes (reference number 937—July 30, 2018).

Informed Consent Informed consent was obtained from all individual participants included in the study or their caregivers prior to taking part in the study.

Welfare of Animals This paper does not contain any studies with animals performed by any of the authors.

Conflict of Interest The authors declare no competing interests.

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Electronic Supplementary Material 1 – COREQ checklist (Tong et al., 2007)

The data reported in this checklist correspond to the qualitative component of the MECHANISMS study. The study aims to compare the influences on the ASSIST and Dead Cool participants' behavioral change related to smoking or vaping in two different contexts (Bogotá and Northern Ireland). The A Stop Smoking in Schools Trial (ASSIST) program harnesses peer influence for spreading anti-smoking messages, whilst the Dead Cool program invokes a more conventional classroom pedagogy approach. Both interventions were initially developed in the UK but were culturally adapted to be implemented in a Colombian setting.

Domain 1: Research team and reflexivity	
Personal characteristics	
1. Interviewer/facilitator *Which author/s conducted the interview or focus group?*	SSF in Bogotá; SCM in Northern Ireland
2. Credentials *What were the researcher's credentials? e.g., PhD, MD*	SSF: MPH from Universidad de los Andes SCM: PhD BSc from Queen's University Belfast
3. Occupation *What was their occupation at the time of the study?*	SSF: Professional researcher at Universidad de Los Andes SCM: Research Assistant at Queen's University Belfast
4. Gender *Was the researcher male or female?*	Both researchers were female
5. Experience and training *What experience or training did the researcher have?*	SSF is a psychologist with 5 years of experience as a professional researcher, and experience on the design, management and evaluation of community projects in educational contexts with children and adolescents. SCM is a postdoctoral researcher with prior experience working with adolescent health behavior change in school settings. SCM holds a PhD in Public Health Medicine, during which she undertook training in leading adolescent focus groups and conducting qualitative analysis.
Relationship with participants	
6. Relationship established *Was a relationship established prior to study commencement?*	No

7. Participant knowledge of the interviewer *What did the participants know about the researcher? e.g., personal goals, reasons for doing the research*	None
8. Interviewer characteristics *What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic*	No characteristics were reported
Domain 2: Study design	
Theoretical framework	
9. Methodological orientation and Theory *What methodological orientation was stated to underpin the study? e.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis*	Deductive content analysis
Participant selection	
10. Sampling *How were participants selected?*	Stratified sampling: The research team looked for the same number of boys and girls with different characteristics that form a representative and unbiased sample in the participating classrooms. Participants were in both settings and bot programs.
11. Method of approach *How were participants approached? e.g., face-to-face, telephone, mail, email*	Twelve schools participated at this stage of the MECHANISMS study. Six schools were included in the ASSIST intervention (3 in Northern Ireland and 3 in Bogotá) and six schools were included in the Dead Cool intervention (3 in Northern Ireland and 3 in Bogotá). In Bogotá, focus group participants were selected and approached face-to-face by the research team. In NI, participants were informed about the focus group study component during data collection study visits and provided with study information sheets. Participant consent was obtained from interested students who were willing to take part, and focus group participants were selected at random.

12. Sample size *How many participants were in the study?*	One hundred sixty-five (195) students participated in the focus groups of intervention (N=56 in Bogotá and N= 139 NI). In Bogotá, we conducted 4 focus groups (N=24) among the Dead Cool schools and 6 focus groups (N=32) among the ASSIST schools. In Northern Ireland, we conducted 4 focus groups (N=55) among Dead Cool schools and 9 focus groups (N=84) among ASSIST schools.
13. Non-participation *How many people refused to participate or dropped out? Reasons?*	At the time of the MECHANISIMS study, 127 students did opt-out, left schools or withdrew. During the focus group stage, no students withdrew.
Setting	
14. Setting of data collection *Where was the data collected? e.g., home, clinic, workplace*	Focus groups were held in each of the participating schools.
15. Presence of non-participants *Was anyone else present besides the participants and researchers?*	No
16. Description of sample *What are the important characteristics of the sample? e.g. demographic data, date*	Boys and girls aged 11–15 years in secondary schools (i.e., post-primary, 7th grade in Bogotá and Year 9 in Northern Ireland).
Data collection	
17. Interview guide *Were questions, prompts, guides provided by the authors? Was it pilot tested?*	Questions and prompts where previously designed by the researchers. See the focus group guide in supplement 2. The focus group guide was translated and back translated by bilingual speakers/translators. Yes, there was a pilot. The research team tested all the interventions during the previous stage of the study.
18. Repeat interviews *Were repeat interviews carried out? If yes, how many?*	No
19. Audio/visual recording *Did the research use audio or visual recording to collect the data?*	All focus groups were audio-recorded, then the research team transcribed the recordings. During this process,

	participants remained anonymous to ensure confidentiality agreements.
20. Field notes *Were field notes made during and/or after the interview or focus group?*	No
21. Duration *What was the duration of the interviews or focus group?*	Durations ranged from 26 minutes to one hour and one minute.
22. Data saturation *Was data saturation discussed?*	Yes. After the Focus Groups and during the deductive content analysis, data saturation was discussed, and the researchers agreed that data saturation had been achieved.
23. Transcripts returned *Were transcripts returned to participants for comment and/or correction?*	No
Domain 3: Analysis and findings	
Data analysis	
24. Number of data coders *How many data coders coded the data?*	Four coders in total. The first stage was coded by ETN, PGA and ALM. Then the coding consistency was co-checked by two coders (ETN and AMRV) and the lead authors (SSF and SCM).
25. Description of the coding tree *Did authors provide a description of the coding tree?*	Yes. The codebook was defined based on the Theoretical Domains Framework (TDF)
26. Derivation of themes *Were categories identified in advance or derived from the data?*	Categories were derived from the Theoretical Domains Framework (TDF). The first coding cycle served as an exploratory categorization, second coding cycle desegregated and subdivided data.
27. Software *What software, if applicable, was used to manage the data?*	NVIVO 12 Pro (QSR International Pty Ltd. Version 12 Pro, 2020).
28. Participant checking *Did participants provide feedback on the findings?*	No, there was no process of participant checking of research findings.
Reporting	
29. Quotations presented	Yes, participant quotations are present to illustrate findings with each quotation

Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g., participant number	identified by an anonymized participant (defined by setting, intervention, date of focus group).
30. Data and findings consistent *Was there consistency between the data presented and the findings?*	Yes, the results section shows the findings according to the codebook. A supplement is added to inform the NVivo results.
31. Clarity of major themes *Were major themes clearly presented in the findings?*	Yes, the findings draw upon the content of the hierarchical categories and sub-categories.
32. Clarity of minor themes *Were minor themes clearly presented in the findings?*	Yes, the findings draw upon the content of the hierarchical categories and sub-categories.

References:

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, *19*(6), 349–357. Doi: 10.1093/intqhc/mzm042

Electronic Supplementary Material 2 – Sociodemographic characteristics of students that received smoking prevention interventions

	Northern Ireland			Bogotá			NI vs. Btá
	A	DC		A	DC		
	n (%)	n (%)	*p*[c]	n (%)	n (%)	*p*[c]	*p*[d]
Total	393	284		333	305		
Girl/prefer not to say	171 (47.24)	157 (60.38)	0.001	160 (49.08)	150 (49.18)	0.980	0.202
Age							
11-12 years old	139 (38.4)	104 (40)	0.686	121 (36.34)	100 (32.79)	0.019	<0.001
13-14 years old	223 (61.6)	156 (60)		191 (57.36)	166 (54.43)		
15+ years old	.	.		21 (6.31)	39 (12.79)		
Ethnic minority	39 (10.83)	8 (3.08)	<0.001	38 (11.66)	50 (16.39)	0.086	<0.001
Home composition							<0.001
Single parents	70 (19.44)	37 (14.23)	0.057	129 (39.57)	121 (39.67)	0.969	
Both parents	279 (77.5)	220 (84.62)		174 (53.37)	164 (53.77)		
Other adults	11 (3.06)	3 (1.15)		23 (7.06)	20 (6.56)		
Deprivation Rank[a]							
Low (0-300)	141 (43.65)	115 (49.15)	<0.001	.	.		-
Middle (301-600)	69 (21.36)	105 (44.87)		.	.		
High (601-890)	113 (34.98)	14 (5.98)		.	.		
Socioeconomic level[b]							
Low (1-2)	.	.		186 (56.71)	151 (51.19)	0.385	-
Middle (3-4)	.	.		141 (42.99)	143 (48.47)		

High (5-6)	.	.	1 (0.3)	1 (0.34)

Note: Sample sizes may not sum to total N due to missing data.

A: ASSIST intervention; DC: Dead Cool intervention

[a] Northern Ireland Multiple Deprivation Measure rank derived from NISRA data.

[b] Reported Colombian socioeconomic status, corresponding to an official six-level measurement that includes external characteristics of housing according to the DANE data.

[c] *p-value* of chi-square test for independence of dichotomized variables and interventions

[d] *p-value* of chi-square test for independence of dichotomized variable and setting (Northern Ireland and Bogotá)

Electronic Supplementary Material 3 – Focus group guides

Focus Group Topic Guide - Pupils

At the beginning of the interview, the researcher will introduce himself/herself and give a brief overview of the study. The researcher will discuss confidentiality, group rules, and consent with the participants, and allow for any questions or concerns participants may have to be aired. Participants will be reminded that they are entitled to withdraw at any stage without giving a reason. Participants will be invited to introduce themselves and there will follow a short ice-breaker conversation.

Please note that the following is an indicative topic guide. Each of the six broad categories will be addressed, with letters indicating prompts.

The focus group will address:

1. Pupils' past/current smoking behavior.

a. Do any of you currently smoke or use e-cigarettes?

b. Have you ever smoked or used e-cigarettes (even just a puff or two)?

c. If you have tried a cigarette, what were the circumstances which led to your smoking? Who were you with? Where were you? What were you doing?

2. Pupils' attitudes towards smoking.

a. How do you feel about smoking in general? If you are a current smoker do you intend to quit? If you have never smoked do you intend to start smoking in the future?

b. Do you think smoking should be banned in public places, bars, restaurants, shopping malls etc.?

c. Thinking about the potential risks and benefits of smoking, what do you think are the main **short-term** risks in terms of your health, finances, potentially becoming addicted to smoking, and your relationships with others?

d. What are the **long-term** risks?

e. Thinking about the potential risks and benefits of smoking, what do you think are the main **short-term** benefits in terms of your health, finances, potentially becoming addicted to smoking, and your relationships with others?

f. Are there any **long-term** benefits?

3. Influences on smoking behavior.

a. What do you think are the major influences that might encourage you, or other young people, to start smoking?

b. Have you seen any advertisements for smoking in the media?

c. Can you remember seeing examples of smoking in movies, TV shows, social media, magazines or newspapers? If so, what were they?

4. Social norms for smoking and past/current smoking behavior of family and friends.

a. Roughly what percentage of young people of your age do you **personally** think smoke in Northern Ireland? Why do you think this?

b. Do you think that most people of your age expect a lot of other young people to smoke?

c. Do you **personally** think that it is ever appropriate for young people of your age to smoke?

d. Do you think that most people of your age think it is appropriate/OK for other young people to smoke?
e. Can you estimate how many people smoke in your year at your school?
f. Do any of your family members smoke? If so, who?
g. Do any of your close friends smoke? If so, how many?
h. How often are you exposed to second-hand smoke from friends or family members? How does that make you feel?

5. Social support for smoking from family and friends.

a. If you started smoking and your parents/family found out, how do you think they would feel and react?
b. If you started smoking, how do you think your closest friends would react?
c. If one of your friends were to offer you a cigarette, do you think you could refuse? How would you go about it?
d. If one of your friends were to start smoking, do you think you could intervene to encourage them to stop smoking? How would you go about it?

6. Awareness of and thoughts about the program.

a. Has taking part encouraged you to change your attitudes towards smoking or have you changed your smoking behavior?
b. Was there anything that you learnt which surprised you about smoking?
c. Is there anything that you would change if you were to take part again?
d. How did you feel about completing the experiments and the surveys? How did you feel about using the carbon monoxide monitoring device?
e. Are there any parts of the program which you did not enjoy? Why was this? [Dead Cool only].
f. Would you recommend taking part to other young people your age? [Dead Cool only].
g. Was there anything left out of the program which you felt should have been covered? Was there anything you would like to have seen more of? [Dead Cool only].
h. In the past few weeks, can you remember having a conversation where either you or one of your friends brought up the topic of smoking and discussed the risks and benefits of smoking? How did the conversation go? What was the outcome? How many conversations can you remember? [ASSIST only].
a. Have you seen any posters around your school encouraging you not to smoke? [ASSIST only].

Focus Group Topic Guide – Peer supporter ASSIST

At the beginning of the interview, the researcher will introduce himself/herself and give a brief overview of the study. The researcher will discuss confidentiality, group rules, and consent with the participants, and allow for any questions or concerns participants may have to be aired. Participants will be reminded that they are entitled to withdraw at any stage without giving a reason. Participants will be invited to introduce themselves and there will follow a short ice-breaker conversation.

Please note that the following is an indicative topic guide. Each of the four broad categories will be addressed, with letters indicating prompts.

The focus group will address:

1. Pupils' past/current smoking behavior.

a. Do any of you currently smoke or use e-cigarettes?
b. Have you ever smoked or used e-cigarettes (even just a puff or two)?
c. If you did smoke, were you encouraged to stop smoking by taking part in the peer supporter training?

2. Social norms for smoking and smoking behavior of friends.

a. Roughly what percentage of young people of your age do you **personally** think smoke in Northern Ireland / Colombia? Why do you think this?
b. Do you think that most people of your age expect a lot of other young people to smoke?
c. Do you **personally** think that it is ever appropriate for young people of your age to smoke?
d. Do you think that most people of your age think it is appropriate/OK for other young people to smoke?
e. Do any of your close friends smoke? If so, how many?
f. Can you estimate how many people smoke in your year at your school?

3. Experiences during peer supporter training

a. How did you feel about the amount of time you had to spend away from your usual school activities and lessons for peer supporter training and for the follow-up sessions?
b. Are there any parts of the training which you found particularly enjoyable?
c. Are there parts of the training you did not enjoy? Why was this?
d. Would you recommend taking part to other young people your age?
e. Is there anything you would like to see more of should you take part again in the future?
f. Where there any aspects of the training that you found too demanding?

4. Outcomes and implementation.

a. In the past few weeks, can you remember initiating a conversation with one or more of your friends about the risks and benefits of smoking? How did the conversation go? What was the outcome? How many conversations can you remember?
b. How did you feel approaching your friends to have a conversation about smoking? Were you nervous? Did you feel the training had prepared you well? Did this change over the course of the program as you gained experience and got more feedback from the trainers?
c. Did you make use of the diary to record your conversations? Did you find this useful for monitoring your conversations and improving them?
d. Did you put up any posters around your school to encourage your friends not to smoke?
e. Has this encouraged your friends to change their attitudes towards smoking? Have any of your friends changed their smoking behavior as a result?
f. Do you feel that you could make use of the skills you developed during the peer supporter training in your later education, career or personal life? How?

Electronic Supplementary Material 4 – Saturations of all categories by intervention and setting

Saturation refers to the number of times that a category was mentioned by the participants during the focus groups.

Domains	Total	Intervention		Setting	
		ASSIST	Dead Cool	Bogotá	Northern Ireland
Beliefs about Consequences	**254**	**166**	**88**	**71**	**183**
Health risk perception	168	84	58	37	105
Social risk perception	92	64	28	19	73
Benefits perception	78	50	20	25	45
Social Influences	**188**	**124**	**64**	**58**	**130**
Peer influences	76	44	29	17	56
Family	69	38	27	17	48
Descriptive social norm	72	44	14	27	31
Social acceptance	41	26	13	12	27
Environmental context and resources	**157**	**102**	**55**	**67**	**90**
Exposure to tobacco-related advertising	51	32	19	18	33
Availability of tobacco products	46	26	17	15	28
Family	46	33	13	22	24
Schools	22	14	8	17	5
Neighborhoods	21	14	7	9	12
Knowledge	**102**	**63**	**39**	**46**	**56**
Knowledge of cigarettes and smoking behavior	121	60	36	40	56
Gaps of knowledge	16	10	6	10	6
Intentions	**99**	**61**	**38**	**39**	**60**
To not smoke	54	27	24	14	37
To smoke	42	26	15	23	18
To vape	20	13	6	12	7
Perceived outcomes	**79**	**37**	**42**	**36**	**43**
Change in perception	71	32	39	35	36
No change in perception	14	8	6	1	13
Skills	**76**	**51**	**25**	**33**	**43**
Communication Skills	43	34	7	24	17
Refusing offers to smoke or vape from others	35	17	18	9	26
Promotor role (social role)	**65**	**53**	**12**	**24**	**41**
Peer supporter	35	32	2	19	15

Domains	Total	Intervention		Setting	
		ASSIST	Dead Cool	Bogotá	Northern Ireland
Peers	26	19	7	3	23
Family	10	7	3	3	7
Beliefs about capabilities	**48**	**20**	**28**	**9**	**39**
Self-efficacy to refuse	40	14	17	8	23
Perceived competence to encourage others not to smoke	21	9	12	2	19