Addictive Behaviors 82 (2018) 189–194

Contents lists available at ScienceDirect

Addictive Behaviors

journal homepage: www.elsevier.com/locate/addictbeh

Adolescents' perceptions of flavored tobacco products, including E-cigarettes: A qualitative study to inform FDA tobacco education efforts through videogames

Camenga D.R.[a,*], Fiellin L.E.[b], Pendergrass T.[b], Miller Erica[a,c], Pentz M.A.[c], Hieftje K.[b]

[a] Department of Emergency Medicine, Yale University School of Medicine, New Haven, CT 06519, USA
[b] play2PREVENT Lab at the Yale Center for Health & Learning Games, Department of Internal Medicine, Yale Child Study Center, Yale University School of Medicine, New Haven, CT 06510, USA
[c] Department of Preventive Medicine, University of Southern California, Los Angeles, CA 90032, USA

HIGHLIGHTS

- Adolescents discussed flavored tobacco products in focus groups.
- Adolescents report peer approval of flavored tobacco product use.
- Flavors are a salient aspect of tobacco product marketing for youth.
- They also perceive easy access to flavored tobacco products, including e-cigarettes.

ARTICLE INFO

Keywords:
Adolescent health
Tobacco use prevention
Qualitative research
Tobacco regulation

ABSTRACT

Introduction: Flavored tobacco products have been shown to appeal to youth, however tobacco control strategies have traditionally not focused on these products. To inform the adaptation of an existing videogame to focus on the prevention of flavored tobacco product use, this study explored adolescents' perceptions, beliefs, and social norms surrounding these products, including flavored e-cigarettes.

Methods: We conducted and analyzed transcripts from seven focus groups with 11–17-year-old adolescents (n = 33) from after-school programs in CT and CA in 2016. Participants discussed flavored tobacco product beliefs and experiences, and how these compared to traditional cigarettes.

Results: Thematic analysis of transcripts revealed that participants could name flavors in tobacco products, even though few discussed first-hand experience with the products. Most groups perceived that flavored tobacco product and flavored e-cigarette use facilitated peer approval and acceptance. All groups discussed how youth could easily access flavored tobacco products, including e-cigarettes. Flavoring was a salient aspect of e-cigarette advertisements; however the groups did not recall exposure to other types of flavored tobacco product counter-marketing.

Conclusions: These data can help inform the development of tobacco control strategies, novel interventions (such as videogames), and future FDA efforts to prevent adolescent tobacco product use through education and risk communication.

1. Introduction

The majority of U.S. adolescents who use currently use tobacco report using flavored tobacco products (Singh, Arrazola, Corey, et al., 2016). Although the 2009 Family Smoking Prevention and Tobacco Control Act bans the use of "characterizing flavors" (e.g., candy, fruit, and chocolate), other than tobacco and menthol flavor, in cigarettes, flavored tobacco can be used in hookah, smokeless tobacco, cigars and cigarillos (U.S. Food and Drug Administration, 2013). Flavors can also be added to e-liquids that are used in e-cigarettes. E-cigarettes have been deemed by the Food and Drug Administration (FDA) to be subject to tobacco product regulation, however the 2016 FDA deeming rule does not include e-liquid flavors (Food and Drug Administration, 2016). Multiple studies have demonstrated that flavored tobacco products tend

* Corresponding author at: 464 Congress Avenue, Suite 260, Department of Emergency Medicine, Yale University School of Medicine, New Haven, CT 06519, USA.
E-mail address: deepa.camenga@yale.edu (D.R. Camenga).

https://doi.org/10.1016/j.addbeh.2018.03.021
Received 1 October 2017; Received in revised form 8 March 2018; Accepted 12 March 2018
Available online 13 March 2018
0306-4603/

to be used more by younger than older individuals, (Feirman, Lock, Cohen, Holtgrave, Li, 2015) and most US adolescents initiate tobacco use with a flavored product (Ambrose, Day, Rostron, et al., 2015; Harrell, Weaver, Loukas, et al., 2017). As of 2016, e-cigarettes were one of the most commonly used tobacco products with flavoring among youth, and their prevalence has surpassed that of traditional cigarettes (Jamal, Gentzke, Hu, et al., 2017; Singh, Kennedy, Marynak, et al., 2015).

The rising prevalence of e-cigarette use has been attributed to multiple factors, including the palatability and appeal of sweet flavors to youth (Hoffman, Salgado, Dresler, Faller, Bartlett, 2016; Kim, Lim, Buehler, et al., 2016) the availability of a variety of attractive e-liquid flavors, (Harrell et al., 2017) perceptions that flavored tobacco products are "safer" than cigarettes, (Kowitt, Meernik, Baker, et al., 2017) and aggressive and appealing marketing strategies (Duke, Allen, Eggers, Nonnemaker, Farrelly, 2016; Harrell et al., 2017; Kong, Morean, Cavallo, Camenga, Krishnan-Sarin, 2015; Pepper, Ribisl, & Brewer, 2016; Roditis, Delucchi, Cash, et al., 2016). Although the health risks of some flavored tobacco products are well-established, including those related to hookah to cigar use, (Baker, Ainsworth, Dye, et al., 2000; Kadhum, Sweidan, Jaffery, Al-Saadi, Madden, 2015; Kim, Kabir, & Jahan, 2016) there is ongoing debate within the scientific community as to whether e-cigarettes will have the same level of harm as other tobacco products (Middlekauff, 2015; Nutt, Phillips, Balfour, et al., 2016). Regardless, evidence suggests that adolescent e-cigarette use increases the risk for subsequent cigarette smoking (Barrington-Trimis, Urman, Berhane, et al., 2016; Hua & Talbot, 2016; Leventhal, Strong, Kirkpatrick, et al., 2015; Soneji, Barrington-Trimis, Wills, et al., 2017). Thus, there is a need to generate empiric evidence to determine how to prevent flavored tobacco use (including flavored e-cigarette use) in young adolescents; a population group inherently vulnerable to tobacco initiation and the development of life-long tobacco use (U.S. Department of Health and Human Services, 2012). Specifically, qualitative data on how adolescents perceive flavored tobacco products may help inform content development for youth-oriented prevention interventions. Although young adolescents are an ideal target for tobacco prevention, recent systematic reviews of the qualitative literature have demonstrated that existing studies are limited in that they focus on exploring perceptions of one specific type of flavored tobacco product (i.e. hookah) or older adolescents or young adults.

The overall epidemiology of tobacco use has greatly changed since the 1990s, when cigarettes were the preferred tobacco product among youth (U.S. Department of Health and Human Services, 2012). These epidemiological shifts are partly due to the implementation of comprehensive tobacco control strategies that target both the individual and their environment. The ecological systems theory of Bronfenbrenner highlights how immediate settings (including peers, family, school and neighborhood) as well as the larger social systems (culture, laws etc.) impact human development and behavior (Bronfenbrenner, 1992, 1994). Protective processes at different levels of the socio-ecological system can foster resilience and promote positive behaviors in adolescence. Not surprisingly, successful health promotion strategies, including those related to tobacco prevention, impact perceptions, beliefs and social norms within multiple levels of the adolescent's socio-ecological environment (Eisenberg, Toumbourou, Catalano, Hemphill, 2014; Ennett, Foshee, Bauman, et al., 2010). There are two types of social norms: "descriptive" norms refer to perceptions of what others do, and "injunctive" norms refer to perceptions of others' expectations and values of the behavior, and these have both been associated with behavioral intentions (Rimal, 2008). For example, tobacco prevention programs may influence descriptive norms and injunctive norms through smoke-free policies, and policy factors such as youth access laws, tobacco taxation, regulation of advertising, and mass-media campaigns (Kozlowski & Sweanor, 2017). These strategies have largely focused on traditional cigarettes, and, to date, have not comprehensively targeted flavored tobacco products, such as flavored hookah, cigars, smokeless tobacco, and flavored e-cigarettes.

Videogames offer a unique opportunity to influence perceptions, beliefs, and social norms among adolescents. Through interactive gameplay and the simulation of real-world experiences, videogames offer the opportunity to engage and educate youth through skill building and role-playing (Fiellin, Hieftje, & Duncan, 2014; Hieftje, Edelman, Camenga, et al., 2013). The play2PREVENT Lab at Yale University has previously developed and evaluated in a large randomized controlled trial a videogame, *PlayForward: Elm City Stories* (*PlayForward*), aimed at reducing sexual risk behaviors among young adolescents (Fiellin, Kyriakides, Hieftje, et al., 2016). In an effort to inform the modification of key storylines and skill-based mini-games of *PlayForward* to focus on flavored tobacco, including flavored e-cigarettes, we conducted focus groups with the *PlayForward* target audience- young adolescents. This qualitative study aimed to inductively identify current perceptions, beliefs, and social norms within different levels of the adolescents' socio-ecological environment, namely the Intrapersonal (knowledge and risk perceptions), interpersonal (peer influences), community (i.e. sale locations), and policy (around marketing and counter-marketing) levels of the environment. These data add to the literature by focusing on young adolescents' perceptions of a wide variety of flavored tobacco products, and thus can help inform the FDA's efforts to improve existing tobacco control, education, and risk communication strategies that directly address flavored tobacco and flavored e-cigarette use.

2. Materials and methods

2.1. Participants

We conducted focus groups to explore young adolescents' perceptions of and experiences with flavored tobacco and flavored e-cigarettes. We chose to conduct focus groups (rather than individual interviews) as they are an excellent tool to gauge social norms and group perceptions (Harrell & Bradley, 2009). We recruited 11–17 year old adolescents who attended after-school programs that served secondary schools in New Haven, CT, and Los Angeles, CA with the assistance of afterschool program's leadership. Inclusion criteria were that participants were English-speaking and between 11 and 17 years old. Although we included a wide range of ages in our inclusion criteria to gather a wider range of perceptions, 88% of the participants were between the ages of 11 and 15, which was the target age group for the videogame intervention. The Institutional Review Boards at Yale University School of Medicine and at the University of Southern California approved the research protocol. All participants provided verbal assent, and participants' parents or legal guardians were provided a description of the study and were asked to contact the team if they did not want their child to participate in the focus group. Participants were reimbursed with gift cards.

2.2. Focus group procedure

We developed our focus group guide in an iterative process with input from members of our multidisciplinary research team, which included experts in qualitative research, adolescent development, and tobacco research. Two research team members conducted the focus groups using semi-structured focus group guides. First, participants were informed that we were interested in developing a videogame to prevent flavored tobacco product use in youth. The focus groups began with a warm up discussion wherein participants were asked to discuss traditional cigarettes. Participants were then asked to describe their understanding of e-cigarettes and their health and social impact, their experiences with e-cigarettes, and where they have seen e-cigarettes (Table 1). The same set of questions was then posed for "flavored tobacco products." We used the example of flavored tobacco in hookah to start the conversation, and then asked if they knew of other products. Examples of focus group questions included, "What do teens think

Table 1
Focus group guide.

Socio-ecological factors addressed	Intrapersonal	Interpersonal	Community	Policy
What are e-cigarettes?	x			
What is flavored tobacco?				
Are teens using e-cigarettes		x		
Are teens using flavored tobacco products?				
What do teens think about e-cigarettes?		x		
What do teens think about flavored tobacco products?				
What are the benefits of e-cigarettes?	x	x		
What are the benefits of flavored tobacco products?				
Are there health consequences to e-cigarettes? If so, what are they?	x	x		
Are there health consequences to flavored tobacco products?				
Is using flavored tobacco safer than using e- cigarettes? Why or why not?	x	x		
Where do they buy/get e-cigarettes?		x	x	
Where do they buy/get flavored tobacco products?				
Do you see any messages about the products? Where do you see them, and what do you think of them?				x

about vaping/e- cigarettes?", "Why do teens vape and what are the benefits?", and "What do teens know about flavored tobacco products?" Probes were used to encourage clarification and expansion of discussion. Focus groups were audiotaped, professionally transcribed, and reviewed by a research team member to ensure accuracy. Focus groups included mixed gender groups, each including three to seven participants.

2.3. Data analysis

A four-person multidisciplinary team, composed of individuals with expertise in pediatrics, flavored tobacco and e- cigarettes, qualitative methods, videogame development, and health behavior, conducted analysis of the focus group data. For the analysis, we used the framework analysis technique (Kadhum, Sweidan, Jaffery, et al., 2015) to allow for the analysis of a priori themes identified by the researchers and emergent themes. In the first step (i.e., the familiarization process), four team members reviewed the transcripts to identify recurrent codes. We developed the codes in a stepwise fashion Hoffman, Salgado, Dresler, et al., 2016, beginning with the creation of an initial code, and then relevant sub codes. To reach consensus, the team met regularly to negotiate code structure and discuss emergent codes. Once a final code structure was established, one of the team members (EM) systematically applied the codes to the Dedoose Version 7.6.6 web application, a program for managing, analyzing, and presenting qualitative data (Los Angeles, CA) (SocioCultural Research Consultants, 2017).

We then sorted the codes into groups based on the levels of the socio-ecological model that they best described: (1) Intrapersonal Factors (Knowledge and Risk Perceptions); (2) Interpersonal Factors (Peer Approval and Acceptance); (3) Community Factors (Ease of Access); and (4) Policy Factors (exposure to marketing and counter-marketing). We analyzed both group data and group interaction data (interactive data between focus group participants) using the same methodological approach and then integrated the findings (Duggleby, 2005). The unit of analysis for the interpretive analysis was the group (rather than the individual), and we present data that reached saturation about flavor perceptions, beliefs and social norms. The most salient quotes are presented, labeled with the focus group (FG) number, and male (M) or female (F) participant number.

3. Results

3.1. Demographics

Our study team conducted a total of seven focus groups with adolescents ages 11–17 (total n = 33, mean age = 13; 88% between ages 11 and 15). Each focus group had 4 to 6 participants. Four focus groups were conducted in New Haven, CT and three in Los Angeles, CA. Fifty-four percent of the participants were male. Thirty-nine percent identified as Hispanic/Latino, 36% as black, 18% as biracial, and 6% as "other".

Table 2
Summary of research themes.

Social-ecological factor	Themes
Intrapersonal	• Knowledge of flavored products • Varied perceptions of risk of flavored products
Interpersonal	• Peer Approval and Acceptance
Community	• Ease of Access
Policy	• Exposure to marketing and counter-marketing

We identified the following themes describing perceptions, beliefs and social norms about flavored tobacco products, including flavored e-cigarettes, within different levels of the adolescents' social-ecological environment: Intrapersonal: (Knowledge of Flavored Products, and Varied perceptions of Risk); (2) Interpersonal (Peer Approval and Acceptance); (3) Community (Ease of Access); and (4) Policy (Exposure to marketing and counter-marketing) (Table 2).

3.2. Research themes

3.2.1. Intrapersonal theme: knowledge of flavored products

Overall, only one of the focus group participants discussed first-hand experiences with a flavored tobacco product (a watermelon-flavored e-cigarette). However, groups were able to discuss the types of flavors that peers use in tobacco products:

> FG3, Moderator: "Do you guys know about the different flavors? Can you tell me some of them?"
> FG3, M7: "There's like, there's like chocolate, like bubble gum, like grapes, cherries, strawberries, gummy bears."

In general, groups discussed sweet flavors and could name multiple types of sweet flavors. There were some groups, however, wherein participants were unclear as to what constituted flavored tobacco:

> FG 6 Moderator: 'What do teens know about flavored tobacco?'
> FG 6, F9: "Oh wait, what?"
> FG 6. Moderator: "Flavored tobacco?" [pause].
> FG 6, F9: "What's that?"

Despite the differing levels of knowledge about flavored tobacco products, adolescents were able to describe some aspects of flavored tobacco use as it related to the socio-ecological environment.

3.2.2. Intrapersonal theme: varied perceptions of the risk of flavored tobacco products

Overall, there were a range of perceptions regarding the risks of using flavored, as compared to unflavored tobacco products. In the context of discussing why e-cigarettes are safer than cigarettes, one group discussed how added flavor increased the perception of safety:

> FG2, M6: "They probably like it because that's their favorite type of fruit so they probably think if they smoke that kind of fruit, that won't have such an impact than the regular [tobacco]."

On the other hand, some groups questioned whether flavors may make flavored tobacco products similarly dangerous to cigarettes because they recognized that the flavorings were chemicals:

> FG1, Moderator: "Do you think there's any other reasons why flavored products might be better for you? Or worse for you?"
> FG1, F2: "I think they might be worse cuz they're adding more chemicals?"

Other participants said "I don't know" (FG2, M2; FG2, M4) when asked whether flavored tobacco was more or less harmful than unflavored tobacco.

3.2.3. Interpersonal theme: peer approval and acceptance of flavored tobacco products

When asked why adolescents use flavored tobacco products, several focus groups also discussed how flavored tobacco products were used for social benefit, specifically to increase the likelihood of being perceived as "cool".

> FG4, M13: "It's probably getting to look cool, like fit in."

One group discussed how youth are more likely to vape when they are around peers than alone, suggesting that youth use e-cigarettes for social reasons:

> FG1, F3: They mostly do it when they're with their friends cuz when they're not with their friends they like don't really do it as much. But when they're like with their friends, they like they do it more and they think about like, they have more confidence when they do it with friends than when they do it alone.

Several groups discussed "vape tricks" as an aspect of e-cigarettes' social benefits. For example, this group became lively when discussing how youth "compete" with each other to create the largest vapor cloud:

> FG4 M1 Interviewer: what do you think teens think about vaping?
> M2: It's fun.
> M1: Probably fun…
> M3: Probably, they probably try and blow like the biggest cloud… [many voices speaking at once excitedly]
> M4: They try to do the coolest tricks. [many voices speaking excitedly
> M1: Because of all these vape (memes), we… people have done them, try to imitate or do better than what they've seen to try to make themselves better than they seen.

3.2.4. Community theme: ease of access

Most focus groups discussed how they perceived that it was easy to buy flavored e-cigarettes and other types of flavored tobacco from corner stores, or to receive or buy them from friends or older adults:

> FG6, F10: "Like you can get them anywhere. You can get them from a corner store or something."
> FG6, F9: "You can even buy them at grocery stores."
> FG7, F12: "Their friends, you know. When you're in high school or middle school it's easy to connect with friends that are older. Like I have a lot of older friends because of my sister. She's in high school so she has all these friends that I know from high school so it's just easy for me."

The participant and others also knew that it was easy for underage youth to buy e-cigarettes online. The participants had a sophisticated knowledge of online purchasing of e-cigarettes, as demonstrated by their knowledge of lack of age verification with online sales, the use of "fake accounts", and use of prepaid credit cards that are not specifically linked to a credit card account. In contrast, none of the groups discussed the ability to buy other types of flavored tobacco products online.

> FG7, F12: "It's easy to get them online to be honest because you can sneak a card or whatever, like that prepaid [card] from the gas station, put money on it, and use it."
> FG1, F1: "Or maybe online …they could make a fake account, eighteen years old and pretending to, and get it."

3.2.5. Policy theme: exposure to marketing and counter-marketing

Groups discussed how they had seen flavored e-cigarettes mentioned on television, either through marketing (commercials) or counter-marketing messages. For example, this participant recalled an advertisement that attempted to prevent e-cigarette use as well as another that describing flavors which appealed to youth:

> Moderator: "Do you guys see any messages, like on an ad or like a billboard or a commercial or a sign maybe about vaping?"
> FG3, M 7: "Commercials. I seen, that's the one I see, there's one that prevents it. It's like how many are flavors and things. And then it shows like all the flavors you need and there's like a bunch of like chocolate and blueberries and stuff that kids would like."

Another participant recalled a counter marketing commercial wherein flavors were described as a facilitator of e-cigarette use in youth:

> FG1, F2: "They gave them tobacco products and the kids were asking, like 'oh is this kinda, is this candy or different types of candy?"
> FG1, Moderator: "Really?"
> FG1, F2: "Yeah, and they were like this is how kids start consuming tobacco products."

When asked about advertising for other types of flavored tobacco, two of the groups mentioned that they had never seen advertisements or counter-marketing messages about any other types of flavored tobacco products (such as cigars or hookah).

4. Discussion

In an effort to modify an existing videogame to focus on the prevention of flavored tobacco product use, including flavored e-cigarette use, this qualitative study explored flavored tobacco product perceptions, beliefs and social norms within different levels of the adolescents' social-ecological environment. This study uniquely adds to the literature by focusing on younger adolescents and a variety of different flavored tobacco products. Focus group participants were able to name flavors in tobacco products even though few discussed first-hand experience with the products. Overall, groups expressed great variability in their levels of knowledge and risk perceptions of flavored tobacco products. Focus group participants discussed how flavored tobacco product use facilitated peer approval and acceptance. All the groups were aware that youth could easily access the flavored tobacco products, including e-cigarettes. Flavoring was a salient aspect of *e-cigarette* advertisements and counter-marketing; however, the groups did not recall exposure to counter-marketing around other types of flavored tobacco products.

Intrapersonal factors include factors within the individual that may influence addiction or the psychology of use, including risk perceptions and knowledge. Many of the focus group participants were middle

schoolers, and in accordance with national prevalence estimates, few adolescents had first-hand experience with the products (Preventing Tobacco Addiction Foundation, 2017). Participants were unable to describe or define "flavored tobacco product", indicating an opportunity for education and the need to further determine the how to best describe these products to youth. The focus groups had varied opinions about the risks of flavored tobacco products, with some groups feeling that they were less harmful than cigarettes and others questioning whether they were similarly harmful. Systematic reviews of qualitative and quantitative studies similarly have found that flavors are a reason why adolescents and adults perceive certain tobacco products as less harmful than cigarettes, perhaps due to flavor descriptors that are associated with palatable foods (fruit flavors) or sweet aromas, however this is one of the first to document this finding in younger adolescents (Feirman, Lock, Cohen, Holtgrave, Li, 2016; Kowitt et al., 2017). Importantly, some groups did not know whether they were harmful, highlighting a gap in adolescent's knowledge that could be addressed through prevention interventions.

As supported by previous research, (de Andrade, Angus, & Hastings, 2016; Kong et al., 2015) the focus groups also perceived that flavored tobacco product use was "cool" and facilitated peer approval or social acceptance. Previous studies have shown that younger adolescents are more likely than older adolescents to perceive a social benefit with e-cigarette use in particular, which supports the need to develop targeted prevention interventions that focus on altering perceptions, beliefs and social norms for this age group (Roditis et al., 2016). Multiple longitudinal and cross-sectional studies have also shown that injunctive norms around peer smoking influence use by reinforcing the perception that there are social advantages for those who use tobacco products (U.S. Department of Health and Human Services, 2012).

The groups also described the perception that there was easy community access to flavored tobacco products in stores, using similar mechanisms that are used to purchase traditional cigarettes, such as through an older friend. A previous focus group study of 12–17 year old Canadian youth also found that adolescents perceived that e-cigarettes were visible and accessible in stores and online (Hammal & Finegan, 2016). A 2015 study found that 76.5% of purchase attempts by 14 to 17 year old minors resulted in successful deliveries of e-cigarette products, despite laws requiring age verification upon purchase, indicating that adolescents can purchase e-cigarettes with ease online (Williams, Derrick, & Ribisl, 2015). However, despite the existence of specialty stores that sell flavored e-liquids in the communities from which we recruited, participants in this study and in our study did not view "vape stores" as a place where adolescents purchase flavored e-cigarettes.

The description of the perceptions, beliefs and social norms within the socio-ecological levels of influence can inform tobacco control strategies that aim to incorporate flavored tobacco products and flavored e-cigarettes into their comprehensive strategies, and subsequent prevention research and interventions, such as videogame interventions (Kothari, Edwards, Yanicki, et al., 2007). For example, videogames may provide a venue wherein adolescents can engage in interactive learning processes that increase knowledge about the definition of flavored tobacco products and their associated risks; a need that is evidenced by our finding that some youth may not understand the term flavored tobacco product. Videogames can address Intrapersonal factors by altering perception of peer approval of flavored products by creating scenarios wherein flavored tobacco product use is not socially accepted by peers. In terms of community influences, young adolescents are highly aware of their ability to purchase and access flavored tobacco products, however videogames can allow adolescents to virtually experience potential consequences of purchasing flavored tobacco products, such as legal consequences and parental disapproval.

These findings can also inform tobacco control efforts and suggest that stronger enforcement of youth access laws, online marketing, and age verification is needed to alter the perception that these products are easy to access. Our data demonstrate that easily recall flavors in e-cigarette commercials, and given the role of flavors in intrapersonal and interpersonal factors that promote tobacco use, authorities should consider regulations that limit the discussion flavors in flavored tobacco product advertisements. Lastly, our data suggest that young adolescents have less knowledge about non e-cigarette flavored tobacco products, suggesting that greater efforts should be made to disseminate countermarketing efforts around flavored tobacco products, such as hookah, cigars, or smokeless tobacco.

This study has several limitations. The focus groups were conducted in two specific regions of the country with a small sample of predominantly Black and Hispanic young adolescents, which may limit the transferability of the results. We do not have specific data about the type of tobacco prevention education that the participants had received in school, and therefore cannot interpret how such education may have influenced their beliefs. Finally, these data do not allow us to make conclusions about how or whether perceptions or beliefs influences tobacco product use, as we did not collect data about the participants' individual tobacco use behaviors.

5. Conclusions

Despite these limitations, this is one of the first studies to explore young adolescents' perceptions of a variety of flavored tobacco products, including e-cigarettes, cigars, and hookah. Young adolescents perceived positive (i.e. peer acceptance, easy to access) and negative (i.e. potential health consequences) perceptions, beliefs, and social norms around flavored tobacco and flavored e-cigarettes across multiple levels of the socio-ecological environment. Given that many adolescent tobacco users use flavored products, these exploratory data provide unique insights into this populations' knowledge gaps that may be addressed by tobacco control strategies and novel interventions, such as videogames, that aim to inform and empower this audience to remain tobacco-free.

Role of funding

This work was supported by The National Institute of Drug Abuse at the National Institutes of HealthP50DA036151 (Yale Tobacco Center of Regulatory Science); the National Cancer Institute at the National Institutes of HealthP50CA180905 (USC Tobacco Center of Regulatory Science for Vulnerable Populations); and the U.S. Food and Drug Administration's Center for Tobacco Products (CTP). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH or the Food and Drug Administration.

Contributors

LF, MP, and KH designed the study and obtained grant study. KH, TP, and EM performed the data collection. DC, MP, KH and EM conducted data analyses and DC wrote the first draft of the manuscript. All authors have approved the final manuscript.

Conflict of interest

The authors declare no conflicts of interest.

Acknowledgements

The authors would like to acknowledge Drs. Krishnan-Sarin and O'Malley for their input into the design and presentation of the data. We thank Stephanie Brito for her assistance with data collection.

References

Ambrose, B. K., Day, H. R., Rostron, B., Conway, K. P., Borek, N., Hyland, A., et al. (2015). Flavored tobacco product use among us youth aged 12–17 years, 2013–2014. *JAMA, 314*, 1871–1873.

de Andrade, M., Angus, K., & Hastings, G. (2016). Teenage perceptions of electronic cigarettes in Scottish tobacco-education school interventions: Co-production and innovative engagement through a pop-up radio project. *Perspectives in Public Health, 136*, 288–293. First published on 2015/11/07 https://doi.org/10.1177/1757913915612109.

Baker, F., Ainsworth, S. R., Dye, J. T., Crammer, C., Thun, M. J., Hoffmann, D., et al. (2000). Health risks associated with cigar smoking. *JAMA, 284*, 735–740.

Barrington-Trimis, J. L., Urman, R., Berhane, K., Unger, J. B., Cruz, T. B., Pentz, M. A., et al. (2016). E-cigarettes and future cigarette use. *Pediatrics, 138*. pii: e20160379. First published on 2016/06/15 https://doi.org/10.1542/peds.2016-0379.

Bronfenbrenner, U. (1992). *Ecological systems theory*. Jessica Kingsley Publishers.

Bronfenbrenner, U. (1994). Ecological models of human development. *Readings on the Development of Children, 2*, 37–43.

Duggleby, W. (2005). What about focus group interaction data? *Qualitative Health Research, 15*, 832–840. First published on 2005/06/18 https://doi.org/10.1177/1049732304273916.

Duke, J. C., Allen, J. A., Eggers, M. E., Nonnemaker, J., & Farrelly, M. C. (2016). Exploring differences in youth perceptions of the effectiveness of electronic cigarette television advertisements. *Nicotine & Tobacco Research, 18*, 1382–1386. http://dx.doi.org/10.1093/ntr/ntv264.

Eisenberg, M. E., Toumbourou, J. W., Catalano, R. F., & Hemphill, S. A. (2014). Social norms in the development of adolescent substance use: A longitudinal analysis of the international youth development study. *Journal of Youth and Adolescence, 43*, 1486–1497. http://dx.doi.org/10.1007/s10964-014-0111-1.

Ennett, S. T., Foshee, V. A., Bauman, K. E., Hussong, A., Faris, R., Hipp, J. R., et al. (2010). A social contextual analysis of youth cigarette smoking development. *Nicotine & Tobacco Research, 12*, 950–962. http://dx.doi.org/10.1093/ntr/ntq122.

Feirman, S. P., Lock, D., Cohen, J. E., Holtgrave, D. R., & Li, T. (2015). Flavored tobacco products in the United States: A systematic review assessing use and attitudes. *Nicotine & Tobacco Research*. http://dx.doi.org/10.1093/ntr/ntv176.

Feirman, S. P., Lock, D., Cohen, J. E., Holtgrave, D. R., & Li, T. (2016). Flavored tobacco products in the United States: A systematic review assessing use and attitudes. *Nicotine & Tobacco Research, 18*, 739–749. http://dx.doi.org/10.1093/ntr/ntv176.

Fiellin, L. E., Hieftje, K. D., & Duncan, L. R. (2014). Videogames, here for good. *Pediatrics, 134*, 849–851. First published on 2014/10/08 https://doi.org/10.1542/peds.2014-0941.

Fiellin, L. E., Kyriakides, T. C., Hieftje, K. D., Pendergrass, T. M., Duncan, L. R., Dziura, J. D., et al. (2016). The design and implementation of a randomized controlled trial of a risk reduction and human immunodeficiency virus prevention videogame intervention in minority adolescents: PlayForward: Elm City Stories. *Clinical Trials, 13*, 400–408. First published on 2016/03/26 https://doi.org/10.1177/1740774516637871.

Food and Drug Administration (2016). Deeming tobacco products to be subject to the federal food, drug, and cosmetic act, as amended by the family smoking prevention and tobacco control act. *Restrictions on the Sale and Distribution of Tobacco Products and Required Warning Statements for Tobacco Products* (pp. 28973–29106). U.S. Department of Health and Human Services.

Hammal, F., & Finegan, B. A. (2016). Exploring attitudes of children 12–17 years of age toward electronic cigarettes. *Journal of Community Health, 41*, 962–968. First published on 2016/03/10 https://doi.org/10.1007/s10900-016-0178-6.

Harrell, M. B., Weaver, S. R., Loukas, A., Creamer, M., Marti, C. N., Jackson, C. D., et al. (2017). Flavored e-cigarette use: Characterizing youth, young adult, and adult users. *Preventive Medicine Reports, 5*, 33–40. First published on 2016/11/30 https://doi.org/10.1016/j.pmedr.2016.11.001.

Harrell, M. C., & Bradley, M. A. (2009). *Data collection methods: Semi-structured interviews and focus groups*. Santa Monica, CA: RAND Corporation.

Hieftje, K., Edelman, E. J., Camenga, D. R., & Fiellin, L. E. (2013). Electronic media-based health interventions promoting behavior change in youth: A systematic review. *JAMA Pediatrics, 167*, 574–580 First published on 2013/04/10. 10.1001/jamapediatrics.2013.1095.

Hoffman, A. C., Salgado, R. V., Dresler, C., Faller, R. W., & Bartlett, C. (2016). Flavour preferences in youth versus adults: A review. *Tobacco Control, 25*(Suppl 2), ii32–ii39. First published on 2016/09/17 https://doi.org/10.1136/tobaccocontrol-2016-053192.

Hua, M., & Talbot, P. (2016). Potential health effects of electronic cigarettes: A systematic review of case reports. *Preventive Medicine Reports, 4*, 169–178. http://dx.doi.org/10.1016/j.pmedr.2016.06.002.

Jamal, A., Gentzke, A., Hu, S. S., Cullen, K. A., Apelberg, B. J., Homa, D. M., et al. (2017). Tobacco Use Among Middle and High School Students - United States, 2011–2016. *Morbidity and Mortality Weekly Report, 66*, 597–603. First published on 2017/06/16 10.15585/mmwr.mm6623a1.

Kadhum, M., Sweidan, A., Jaffery, A. E., Al-Saadi, A., & Madden, B. (2015). A review of the health effects of smoking shisha. *Clinical Medicine (London, England), 15*, 263–266. First published on 2015/06/03 https://doi.org/10.7861/clinmedicine.15-3-263.

Kim, H., Lim, J., Buehler, S. S., Brinkman, M. C., Johnson, N. M., Wilson, L., et al. (2016). Role of sweet and other flavours in liking and disliking of electronic cigarettes. *Tobacco Control*. http://dx.doi.org/10.1136/tobaccocontrol-2016-053221.

Kim, K. H., Kabir, E., & Jahan, S. A. (2016). Waterpipe tobacco smoking and its human health impacts. *Journal of Hazardous Materials, 317*, 229–236. First published on 2016/06/11 https://doi.org/10.1016/j.jhazmat.2016.05.075.

Kong, G., Morean, M. E., Cavallo, D. A., Camenga, D. R., & Krishnan-Sarin, S. (2015). Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. published online ahead of print Dec 6 2014 *Nicotine & Tobacco Research, 17*, 847–854. First published on 2014 Dec 6 https://doi.org/10.1093/ntr/ntu257.

Kothari, A., Edwards, N., Yanicki, S., & Hansen-Ketchum, P. (2007). Socioecological models: Strengthening intervention research in tobacco control. *Drogues, Santé Et Société, 6*, iii1–iii24.

Kowitt, S. D., Meernik, C., Baker, H. M., Osman, A., Huang, L. L., & Goldstein, A. O. (2017). Perceptions and experiences with flavored non-menthol tobacco products: A systematic review of qualitative studies. *International Journal of Environmental Research, 14*. First published on 2017/03/24 https://doi.org/10.3390/ijerph14040338.

Kozlowski, L. T., & Sweanor, D. T. (2017). Young or adult users of multiple tobacco/nicotine products urgently need to be informed of meaningful differences in product risks. *Addictive Behaviors, 76*, 376–381. First published on 2017/02/06 https://doi.org/10.1016/j.addbeh.2017.01.026.

Leventhal, A. M., Strong, D. R., Kirkpatrick, M. G., Unger, J. B., Sussman, S., Riggs, N. R., et al. (2015). Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. *JAMA, 314*, 700–707. First published on 2015/08/19 https://doi.org/10.1001/jama.2015.8950.

Middlekauff, H. R. (2015). Counterpoint: Does the risk of electronic cigarettes exceed potential benefits? *Chest, 148*, 582–584. First published on 2015/04/04 https://doi.org/10.1378/chest.15-0540.

Nutt, D. J., Phillips, L. D., Balfour, D., Curran, H. V., Dockrell, M., Foulds, J., et al. (2016). E-cigarettes are less harmful than smoking. *Lancet, 387*, 1160–1162. First published on 2016/03/31 https://doi.org/10.1016/s0140-6736(15)00253-6.

Pepper, J. K., Ribisl, K. M., & Brewer, N. T. (2016). Adolescents' interest in trying flavoured e-cigarettes. *Tobacco Control, 25*(Suppl 2), ii62–ii66. First published on 2016/09/17 https://doi.org/10.1136/tobaccocontrol-2016-053174.

Preventing Tobacco Addiction Foundation (2017). *Tobacco twenty-one: State by state*.

Rimal, R. N. (2008). Modeling the relationship between descriptive norms and behaviors: A test and extension of the theory of normative social behavior (TNSB). *Health Communication, 23*, 103–116. First published on 2008/04/30 https://doi.org/10.1080/10410230801967791.

Roditis, M., Delucchi, K., Cash, D., & Halpern-Felsher, B. (2016). Adolescents' perceptions of health risks, social risks, and benefits differ across tobacco products. *The Journal of Adolescent Health, 58*, 558–566. First published on 2016/04/25 https://doi.org/10.1016/j.jadohealth.2016.01.012.

Singh, T., Arrazola, R. A., Corey, C. G., et al. (2016). Tobacco use among middle and high school students - United States, 2011–2015. *Morbidity and Mortality Weekly Report, 65*, 361–367. First published on 2016/04/15 10.15585/mmwr.mm6514a1.

Singh, T., Kennedy, S., Marynak, K., Persoskie, A., Melstrom, P., & King, B. A. (2015). Characteristics of electronic cigarette use among middle and high school students - United States. *Morbidity and Mortality Weekly Report, 65*, 1425–1429. First published on 2016/12/30 10.15585/mmwr.mm655051a2.

SocioCultural Research Consultants (2017). *LLC. Dedoose*.

Soneji, S., Barrington-Trimis, J. L., Wills, T. A., Leventhal, A. M., Unger, J. B., Gibson, L. A., et al. (2017). Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. *JAMA Pediatrics, 171*, 788–797. First published on 2017/06/28 https://doi.org/10.1001/jamapediatrics.2017.1488.

U.S. Department of Health and Human Services (2012). *Preventing tobacco use among youth and young adults: A report of the surgeon general*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

U.S. Food and Drug Administration (2013). *Overview of the family smoking prevention and tobacco control act: Consumer fact sheet*.

Williams, R. S., Derrick, J., & Ribisl, K. M. (2015). Electronic cigarette sales to minors via the internet. *JAMA Pediatrics, 169*, e1563. First published on 2015/03/03 https://doi.org/10.1001/jamapediatrics.2015.63.