



An Exploratory Study on Strategies Adopted by Parents Who Use E-Cigarettes to Negotiate Risk Perceptions of Their Children's Secondhand Exposure and Parental Role Modeling

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Abstract

Existing health messages mainly targeted youth susceptible to vaping or parents who do not have much knowledge about e-cigarettes. This study makes a unique contribution by conducting the first in-depth investigation of e-cigarette-using parents' risk perceptions and parental role modeling and how these two factors affect their vaping behaviors at home or implementation of any strategies to reduce their children's risk. Fifteen parents who used e-cigarettes participated in a semi-structured interview. Interview transcripts were coded and analyzed through a deductive approach of thematic analysis. This study demonstrates the need to develop and disseminate future health messages for e-cigarette-using parents who may have low-risk perceptions of secondhand exposure or who have adopted ineffective strategies to reduce their children's exposure. This study also identifies some possible targets for future intervention efforts through these parents including increasing their knowledge about the health risk of secondhand exposure to e-cigarettes, emphasizing the caregiver role, and effective communications with children about the consequences of vaping.

Keywords E-cigarette use · Secondhand exposure · Risk perception · Parenting · Qualitative research

In 2019, more than 5.2 million youth in the USA reported current use of e-cigarettes, including 27.5% of high school students and 10.5% of middle school students (Buu et al., 2021; Cullen et al., 2019). National survey data has also shown that among youth who never used tobacco products, 18.3% reported secondhand exposure from e-cigarette use in public places in the past 30 days, which was associated with decreased odds of perceiving

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e-cigarettes as harmful and increased susceptibility to using e-cigarettes and cigarettes (Agaku et al., 2020). Existing studies on youth's secondhand exposure to e-cigarettes have focused on exposure in public domains. However, the impact of parental vaping behavior within the home should not be overlooked given both that there are an estimated 8.1 million adult e-cigarette users in the USA and that children spend a larger proportion of their time in private homes as opposed to public spaces (Afifi et al., 2022; Creamer et al., 2019; Dai, 2020). In fact, previous studies have shown that nicotine levels in children, who were nonusers of tobacco products and lived with e-cigarette-using adults, were significantly higher than those in children without secondhand exposure at home (Quintana et al., 2021; Tackett et al., 2021). Another study, which used a set of representative human airway replicas and a pair of ultrafine particle spectrometers to estimate the respiratory deposition of chemicals in e-cigarette aerosol through secondhand exposure in a real-life setting, found that nicotine and other harmful chemicals tended to deposit in the alveolar region (deep lung) and thus may pose health risks with long-term exposure (Su et al., 2021). Furthermore, survey studies indicated that secondhand exposure to e-cigarette use at home was associated with youth's asthma symptoms (Alnajem et al., 2020; Fedele et al., 2016). Taken together, children's exposure to parental e-cigarette use in the home is a critical public health issue that needs to be addressed.

The risk perceptions of parents regarding their children's exposure to tobacco smoking have been studied extensively (Chen et al., 2013; Farber et al., 2008). One study actually found that the relationship between parental risk perceptions and smoking behavior in the home was not significant after adjusting for parents' sociodemographic background (Rosen & Kostjukovsky, 2015). A systematic review and meta-analysis of the results of 18 randomized controlled trials, which aimed to reduce or stop parental smoking for reducing their children's health risk, found that quit rates in the intervention groups across the trials was only about 23% (Rosen et al., 2012). This result suggests that implementing rules within the home with regards to smoking, as opposed to smoking cessation on its own, may increase the potential to protect children by providing a healthier environment. Additionally, the prior literature has suggested that comprehensive smoke-free rules rather than partial rules were most effective (Blackburn et al., 2003; Parks et al., 2019).

Although the prevalence of vaping in the USA has risen drastically while the rate of smoking has declined in recent years, the literature on the relationship between parental risk perceptions of children's secondhand exposure to e-cigarettes and home rules for vaping is sparse (Substance Abuse & Mental Health Services Administration, 2020). A recent study comparing three types of caregivers (cigarette-exclusive, e-cigarette-exclusive, and nonusers) found that e-cigarette users rated e-cigarette products as less harmful than the other two groups and reported greater child secondhand exposure than caregivers using cigarettes (Tackett et al., 2021). Furthermore, recent results of the 2018 Minnesota Adult Tobacco Survey showed that only 29% of e-cigarette-using adults who lived with children banned vaping in their homes, whereas 82% of smokers with children had smoke-free homes (Helgertz et al., 2020). These findings suggest that parents may have lower risk perceptions about children's secondhand exposure to vaping within the home compared to risk perceptions regarding secondhand tobacco smoking. Yet, these survey studies did not provide a fine-grained exploration of the complex relationships between parental risk perceptions, parental vaping behavior at home, and the implementation of home rules for vaping. The exploration of these relationships could potentially inform the development of interventions targeting e-cigarette-using parents who live with children.

Being a smoker could have the potential to interfere with children's understanding of their parents as a caregiver, an adult figure who prevents his/her own children from harm while setting a "good" example (Mahabee-Gittens et al., 2014). In fact, child health benefits have been used as the major motivator in many parental smoking cessation trials with some success (Rosen et al., 2012). To the best of our knowledge, there is only one other study that examined this relationship between e-cigarette-using parents' representation of their role as caregivers and their vaping behavior within the home. Ward et al. (2021) conducted qualitative interviews with 14 parents who had used e-cigarettes to quit smoking and found that their vaping behavior around children was associated with their motivation to use e-cigarettes. Specifically, parents who vaped for medicinal purposes (e.g., replacing or reducing smoking to improve health) attempted to limit vaping in front of their children to avoid role modeling, whereas parents who vaped for recreational purposes perceived their e-cigarette use as a responsible choice that protected children from secondhand exposure to cigarette smoking and thus should not be hidden away (Ward et al., 2021). Though both interesting and valuable, this study only reflected the views of parents who used e-cigarettes as a smoking cessation aid, limiting its utility in the development of intervention strategies.

In summary, the current gaps in the extant literature include (1) focus on youth's secondhand exposure to e-cigarettes in *public domains* and (2) sparse literature on the *complex relationships* between parental risk perceptions of children's secondhand exposure to e-cigarette use within the home, parental vaping behavior at home, and the implementation of home rules for vaping. This study used qualitative methods to begin filling in these gaps by investigating (1) the perceptions of parents who use e-cigarettes regarding their children's health risks associated with secondhand exposure within the home, and what strategies these parents may develop for risk reduction including quitting vaping, and (2) how the potential breakdown of the parental role as both a caregiver and a role model to their children produces particular behavioral patterns around e-cigarette use within the home, as well as influences communications with their children about vaping.

Theoretical Background

Although risk perception has been conceptualized or measured differently across studies, the current qualitative study was guided by the three dimensions proposed by Rosen & Kostjukovsky (2015) based on their comprehensive literature work: (1) perceived likelihood, the probability that one will be harmed by the exposure; (2) perceived susceptibility, the vulnerability of one with exposure compared to others; and (3) perceived severity, the extent of harm the exposure would cause. According to the Health Belief Model (Conner & Norman, 2015), an individual's beliefs (e.g., perceived susceptibility) could lead to health behavior (e.g., vaping behavior). Thus, a higher level of parental risk perception of their children's secondhand exposure to e-cigarette use at home is expected to be associated with a reduction in parental vaping behavior around the children. Unlike quantitative research that tends to focus on establishing this association, our qualitative approach has more emphasis on the detailed strategies adopted by parents for risk reduction.

Methods

This study used qualitative methodology and analysis to gain an in-depth understanding of participants' experiences within their specific, subjective contexts. Interviews were conducted by the first author between November 2021 and February 2022. Participants were recruited at the University of Texas Health Science Center, Houston, and at the Indiana University, Bloomington. The process of recruitment involved obtaining and contacting e-mail listservs, advertising on various social media, and posting paper flyers in public spaces on campuses. Eligibility was determined with a brief online screening survey. Inclusion criteria were as follows: (1) living with at least one child aged 5–14 and (2) used e-cigarettes at least 2 days per week in the past 4 weeks. Potential participants who were using tobacco products other than e-cigarettes or traditional cigarettes in the past 4 weeks were excluded.

Fifteen parents were included in this study. Interviews took place after determining eligibility, obtaining informed consent, and confirming the completion of a brief online survey. These interviews were conducted and recorded virtually via WebEx and lasted 30–45 min. WebEx was chosen because the University had a license that ensured security and uninterrupted connection. The interview guide was developed to elicit both objective and subjective information, opinions, and thought processes to ultimately better understand the complex interactions among their risk perceptions, parental responsibilities, and behavioral patterns within their homes. For each topic, the interviewer started asking an opening question such as “Do you think that there is a possibility that your children will be negatively affected by secondhand exposure to e-cigarettes?”, and then asked some follow-up questions (e.g., “if so, in what ways?”) based on their response to obtain more detailed information. Recruitment and interviewing were ongoing until theoretical and thematic saturation was reached.

Interviews were recorded and transcribed verbatim by study staff. NVivo qualitative data management software was used to create the codes, organize the quotations under the codes, and clarify the emerging themes. Using this tool, the researchers were able to analyze transcripts effectively and reduce redundant work or bias resulting from difficulties in retrieving information from their memory. The development of the codebook and the coding process was key in identifying and extracting emergent themes, behavioral and thought patterns, and an overall fuller and deeper understanding of the complicated relationships and interactions among these. The codebook was developed by the first author with close supervision by two faculty members with expertise in qualitative research methods. Coded transcripts were then manipulated within the software to best represent the data in ways that facilitated the identification of common themes, patterns, and conceptual relationships.

Results

Sample

Of the 15 individuals who participated, 13 identified as male and 2 as female. The age range of the participants was 24–41. Four participants self-reported their race as white, and 11 as Black (Table 1). All the participants were exclusive e-cigarette users (i.e., none of them were current smokers). The 15 participants had used e-cigarettes

Table 1 Demographics and household compositions

Variable	Mean (or number)	Standard deviation (or percent)
Gender: male	13	87%
Age (range = 24–41)	31.93	3.92
Race: Non-Hispanic White	4	27%
Non-Hispanic Black	10	67%
Hispanic Black	1	7%
Education: Associate degree	2	13%
Bachelor's degree	12	80%
Master's degree	1	7%
Number of years using e-cigarettes (range = 3–11)	6.07	2.38
Number of days per week using e-cigarettes (range = 3–7)	5.93	1.29
One child in the household ($N=15$)		
Gender: male	10	67%
Age (range = 5–17)	8.71	3.58
Two children in the household ($N=5$) ^a		
Gender: male	2	40%
Age (range = 3–12)	6.4	4.28

^aThere was only one participant who had a third child who was an 11-year-old girl

for an average of 6 years at the time of the interview and were currently using them on average 6 days per week. Most participants used e-cigarettes recreationally and/or for enhancing mental alertness. The idea that e-cigarettes were generally much less harmful (even innocuous) was present in most of the parents interviewed. When asked how many hours on average they spent with their children inside their homes, 73% reported spending most of the entire day with their children on the weekends. The majority of participants were in the home when their children were during the week.

Risk Perception and Risk Reduction Strategies

Acknowledgement of Risk and Benefit

Most participants readily acknowledged the possibility of their vaping behaviors as risks to their children's health, particularly when asked to compare the risks their children were exposed to versus other children living in homes with no exposure. Nevertheless, a pattern that emerged throughout the interviews was the thought that the possibility and severity of secondhand exposure to vaping was low. Particularly, this risk was perceived as far lower than if their children were exposed to secondhand cigarettes. On the other hand, many participants mentioned about benefits of vaping to themselves such as alertness, stress reduction, and sleep management (see quotes of risk and benefit in Table 2).

Table 2 Quotes to support the themes in the results section

Themes	Quote
Risk perception and risk reduction strategies	
Acknowledgement of risk and benefit	<p><i>Risk</i></p> <ul style="list-style-type: none"> • “Vaping is still...about tobacco. It simply means they will be exposed to, maybe exposed to tobacco, and then it should be worse because they are much younger, very young. You know, they don’t have something that adults do, so I think it, how it comes into effect for them, would be, um, inhaling the tobacco. Yeah, which is the content of the e-cigarette” <p><i>Benefit</i></p> <ul style="list-style-type: none"> • “It gives people alertness. It keeps people smart.” • “It helps me to relax my mind and then... every time I use it I become better.” • “I’m able to get sleep, like, I’m able to sleep well, every time I take my e-cigarettes.”
Strategies to reduce child risk associated with secondhand exposure	<p><i>Strategies</i></p> <ul style="list-style-type: none"> • “...because, personally, my child is not usually around when I vape. That means my child is not usually exposed to vaping. I don’t think my child will be affected in any way.” • “I hold the vape inside my lungs as long as possible. And when I exhale, there is hardly anything visible.” <p><i>Reasons against quitting</i></p> <ul style="list-style-type: none"> • “For me, quitting vaping would mean that I may not be really productive at work or even in the house because whenever I vape I work really hard.” • “It’s just like a fun thing because I see the time out with friends as a recreation window, and these are things that happen in that circle. (inaudible) I will unlikely quit vaping.” <p><i>Reasons for quitting</i></p> <ul style="list-style-type: none"> • “If I quit vaping, the major reason would be for the sake of my kids.” • “If I see it’s beginning to affect the mind and get in the way of my child, I would quit.”
Parental role modeling and e-cigarette use behavior	
Changes in frequency	<p><i>Same</i></p> <ul style="list-style-type: none"> • “Being a parent has not actually affected my vaping behavior because I always vaped even before I became a parent. It’s mostly been the same.” <p><i>Vaping Less</i></p> <ul style="list-style-type: none"> • “[Becoming a parent] actually has a lot of impacts, of course. [...] I don’t have the liberty to vape or smoke at home.” <p><i>Vaping More</i></p> <ul style="list-style-type: none"> • “Vaping more because it just gives me the drive to carry out the innumerable tasks in the house and in the office.”

Table 2 (continued)

Themes	Quote
Concealment	<p><i>Hide</i></p> <ul style="list-style-type: none"> • “Yes, it won’t be good for his health, or two he could become addicted to it. So that’s why I wouldn’t want my kids to see me vaping.” • “Because I believe it directly impacts their attitude towards vaping and the content of vaping affects their lungs, like I told you, because one of them (children) cough.” <p><i>No Hide</i></p> <ul style="list-style-type: none"> • “(I vape in front of my children) freely. [...] when I actually smoked regular cigarettes, I would remove myself. [...] But when it comes to vaping, it was like I threw that behavioral pattern out the window.” • “But by not coming close to me, they might see me, but they are not exposed to vaping itself, the nicotine itself yes. They can just see me from distances where they are not actually exposed to vaping.”
Communication/education	<p><i>Avoid</i></p> <ul style="list-style-type: none"> • “Considering my child is very young, I just don’t see any reason I should be discussing the subject of vaping with my child anyway.” <p><i>Did not Avoid</i></p> <ul style="list-style-type: none"> • “I always tell them that, you know, I don’t do this because it’s flashy. I don’t do it because ‘oh, look at this. I do it because I’m tied to this thing. I am a slave to this thing.’ I try to give them that lesson.” • “So I’m actually communicating, my child knows I vape. So, it’s a thing of telling her she can’t vape until she has to become of age to make certain choices that adults make. So that’s how it’s been.” • “My wife and I have been very open with my kids and we’ve been having the discussion on different subjects, generally. We discuss different subjects, and vaping has been one of them. We’ve tried to instill in my kids what is right and what is wrong and what I would really want them to be. I’ve tried really hard to discourage vaping.”

Strategies to Reduce Child Risk Associated with Secondhand Exposure

A common strategy adopted by participants to reduce their children’s risk associated with secondhand exposure to e-cigarettes was to vape when their children were not present or when they were studying in their room or went to bed (see quotes of strategies in Table 2). When discussing their intentions to quit or lack thereof, many participants continued to downplay the risks they were incurring. Table 2 shows some quotes that provided reasons against quitting.

Where there existed a desire or intention to quit vaping, it was more often than not for the sake of their children (see quotes of reasons for quitting in Table 2).

Parental Role Modeling and E-Cigarette Use Behavior

Changes in Frequency

One pattern of thought that was often present was a competing desire to *simultaneously* continue vaping while maintaining their identification with the socially constructed “role model” for their children. Although some parents did not see a need to change the habit that was already well-developed before becoming a parent, others reduced or avoided vaping at home as a result of being a parent. Still others wanting to increase their consumption mainly cited the positive aspects of the habit that enabled themselves to carry out parental responsibilities, including stress relief, increased energy and stamina, and e-cigarettes’ potential as a smoking cessation aid. Table 2 provides some quotes for these three types.

Concealment

Another strategy adopted by parents was to conceal that they used e-cigarettes and/or to ensure that their children did not see them using e-cigarettes. In this way, they thought they may eliminate potential negative impact on their children’s health or attitude towards vaping (see some quotes in Table 2). Few participants who were former smokers or had a low-risk perception about e-cigarettes were in the “No hide” group. A parent vaped freely in front of his children because he perceived relatively low risk associated with vaping in comparison to smoking. Another parent thought vaping at a distance from the children would be sufficient to “protect” them. The corresponding quotes are included in Table 2.

Communication/Education

Within the data, there was a clear relationship between the choice to conceal e-cigarette use from children and an aversion to having this discussion with their children. Factors that were cited as reasons to avoid communicating with and providing information were age, their perception of how often their children truly were exposed to their vaping, and a general lack of knowledge on their part to facilitate this type of interaction (see a quote in Table 2). For those who did vape in front of their children within the home, the value of discussing the behavior and the downsides to vaping and substance abuse more generally was recognized (see some quotes in Table 2).

Discussion

This is the first in-depth investigation of parental risk perceptions about children’s second-hand exposure to vaping, parental role modeling, and how these two factors affect their vaping behaviors or implementation of any strategies to reduce their children’s risk. Overall, participants acknowledged that their children carried a higher risk than other children whose parents did not vape, although such a risk perception was not necessarily translated to an intention to quit vaping because the perceived benefits of quitting vaping for themselves (e.g., financial, health) were lower than the perceived benefits of vaping, particularly mental alertness. Nevertheless, most parents showed the intention to quit for their children’s benefits, which could potentially serve as a motivator for parents to change their vaping behavior, especially at home,

in future intervention programs. In fact, this strategy has been adopted by many smoking cessation trials with moderate success (Rosen et al., 2012). It is an open question though whether such success applies to vaping cessation, given that parental risk perceptions about vaping are generally lower relative to smoking, and some parents have already adopted vaping as a harm reduction strategy to reduce/stop smoking (Helgertz et al., 2020; Tackett et al., 2021).

The parental role as a caregiver mainly affected their vaping behavior *in front of* their children which was directly related to their communication with children about vaping, although its effect on overall consumption was complicated by child-raising stress. Most parents avoided vaping in front of their children for the concerns of their health or vulnerability to become addictive like themselves. As expected, these parents did not want to talk about vaping with their children, either. An important factor for this avoidance tendency was their young age, as some of them did plan to open up the conversation when they become teenagers. Although few participants who were former smokers or had lower risk perceptions tended to vape freely in front of their children, the key point of their communication with children about vaping was to build their negative perceptions of vaping (e.g., “it makes people slaves to them”). Moreover, most of the participants in this study used e-cigarettes for recreation or mental alertness and yet they chose to conceal vaping from their children. This may seem inconsistent with a previous qualitative study (Ward et al., 2021) finding that parents who vaped for recreation purposes perceived their e-cigarette use as a responsible choice and thus should not be hidden away. Yet, that study recruited caregivers who had used e-cigarettes to quit smoking and thus their decision on whether to vape in front of children probably had already taken into account their perceived risk of vaping *relative to* smoking.

Some of the common strategies adopted by participants may fall short of comprehensive protection against the negative impact of e-cigarettes on child health. Although vaping at home when children were out for school or in the evening when children were sleeping or studying in their own rooms may reduce children’s *secondhand* exposure through breathing e-cigarette aerosol in the air, this common strategy did not prevent children from other routes of exposure such as dermal and ingestion exposures. Such exposure to *thirdhand* vape residue built up on surfaces over time is particularly relevant to small children due to activities such as crawling and putting nonfood items in their mouths. In fact, a recent study that had children wear a silicone wristband to measure toxic chemicals resulting from their exposure to caregivers’ e-cigarette use at home for 7 days suggested this possibility (Quintana et al., 2021). Another strategy adopted by a participant was to hold the vape inside the lung long enough to make the exhaled air “invisible.” Unlike combustible cigarettes, e-cigarettes do not produce side stream emissions so secondhand exposure primarily stems from the aerosol exhaled by an active vaper (Protano et al., 2017). Due to evaporation, the size of aerosol particles is reduced after being exhaled out of the active vaper’s lung. A considerable amount of the resulting particles are ultrafine particles (particle diameter < 100 nm), which can easily enter into the alveoli (i.e., deep lung) of the person exposed to secondhand aerosol (Schripp et al., 2013; Su et al., 2021). Thus, just because vaping parents cannot see it, it does not mean that it is not harmful to their children.

Strengths and Limitations

This study has multiple strengths as a unique and needed contribution to the sparse literature on secondhand exposure to e-cigarettes. This exploratory study has highlighted the ways that behaviors around e-cigarette use can be produced through the interaction of

thought processes, such as risk perceptions, and identifications with the role of a parent as a model for their children with respect to shaping their future behaviors and ultimate health outcomes. Some limitations of this study are important to note. Because of the COVID-19 pandemic, all the interviews were conducted using a virtual platform rather than in person. Body language, rapport, and various other nuances that are vital aspects of any communication were potentially missed. This interview method may also potentially alter the ways participants and the interviewer interacted with each other. Furthermore, only the parents were interviewed in this study so the data are not adequate for studying their children's perspectives or potential impacts of parental vaping on children's behavior. Given that a recent longitudinal study showed that implementing home e-cigarette rules may reduce youth's vulnerability to initiate and sustain e-cigarette use (Buu et al., 2022), future studies may further examine the dynamics between parents and children in the context of secondhand exposure to vaping. Moreover, the sample was relatively homogenous, with 13 of the 15 participants identifying as male and 11 identifying as Black. While generalizability is not the goal of qualitative research, future studies would benefit from a more diverse sample. Despite these limitations, this study offers a look at the ways thought processes and attitudes interact and produce behavioral patterns, clarifying where to target potential interventions. Future systematic research is needed, and this study has the potential to make clear the needs and methodologies of this area for future studies and interventions.

Conclusion

This study demonstrates the need to develop and disseminate future health messages for e-cigarette-using parents who may have low-risk perceptions of secondhand exposure or who have adopted ineffective strategies to reduce exposure. The study results identify some possible targets for future intervention efforts through these parents including (1) increasing their knowledge about the health risk of secondhand exposure to e-cigarettes; (2) emphasizing the caregiver role; and (3) promoting effective communications with children about the consequences of vaping. Given that existing health messages mainly targeted youth who may be susceptible to vaping (e.g., the Real Cost e-cigarette prevention ads developed by the Food and Drug Administration; Rohde et al., 2021), or parents who do *not* use e-cigarettes (e.g., the parent/community presentation video produced by the CATCH Global Foundation; <https://catch.org/program/vaping-prevention#parents>), our contribution to future health messaging is unique and timely.

Although our study is not able to inform public policies due to our focus on parental vaping in private homes, our results have some implications for implementing effective home rules for vaping. Empirical findings from recent studies (Quintana et al., 2021; Su et al., 2021; Tackett et al., 2021) indicate that the common strategy adopted by parents—vaping when their children are not home or are in their own rooms—may not eliminate their children's secondhand or thirdhand exposure to e-cigarette aerosol or residue. Banning indoor or in-car vaping may be more protective for children who live in the same household.

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Author Contribution Buu and Nam conceptualized and designed the study. Nam, Wong, Lin, and Su acquired the data. Nam, Buu, and Zatlhoff analyzed and interpreted the data. Nam, Buu, and Zatlhoff drafted the manuscript. Wong, Lin, and Su revised the manuscript critically for important intellectual content. Each author certifies that their contribution to this work meets the standards of the International Committee of Medical Journal Editors.

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Declarations

Ethics Approval and Consent to Participate All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all participants for being included in the study.

Conflict of Interest The authors declare no competing interests.

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