Tobacco and E-cigarette Use in Youth with Autism Spectrum Disorders

by

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"Tobacco and E-cigarette Use in Youth with Autism Spectrum Disorders,"
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Abstract

TITLE: Tobacco and E-cigarette Use in Youth with Autism Spectrum Disorders

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While there has been an extensive amount of research on tobacco use in children and adolescents, very little has been conducted in children with developmental delays, particularly Autism Spectrum Disorders (ASD). Similarly, research examining newer methods of nicotine use, such as electronic nicotine delivery systems (ENDS; e-cigarettes) has not yet been conducted in this population. It has previously been assumed that characteristics commonly observed in youngsters with ASDs serve as protective factors for the initiation of tobacco and ENDS use; however, no studies have identified the variables that contribute to a youngster's intention to smoke/use ENDS in this vulnerable population. Previous studies have examined the contributing role of exposure to secondhand smoke in the child's home and vehicle, particularly from parents, to tobacco use among youth but the impact of exposure from parents who use e-cigarettes has not been explored. This study aimed to determine rates of combustible cigarettes and ENDS use, smoking and vaping rates in family homes and vehicles, and identify the factors associated with future intentions to use tobacco/ENDS among youngsters with ASD.

A total of 70 children (ages 10-17 yrs) and their parents/guardians were enrolled on this study and completed an online questionnaire about their smoking and vaping habits. Of the parents who chose to provide their child's demographic information, the mean age of children in the sample was 12.68 years (SD = 2.29; range = 10 to 17 years) and the gender distribution was 78.6% male (n = 55) and 20.0% female (n = 14). Half of children (50%) endorsed a history of cigarette use, 45.7% endorsed a history of ENDS use (n = 32), and 86.5% of children used tobacco also used ENDS products (n = 32). Older children were more likely to smoke , (t (63$)$= -2.36, p = .021), and child smoking status was significantly associated with having a parent who smoked, X^2 (1, N = 70) = 16.95, p = 0.00, having peers who smoked, X^2 (1, N = 70) = 42.13, p = 0.00, and exposure to cigarettes in the home, X^2 (1, N = 70) = 13.83, p = 0.00, and car, X^2(1, N = 70) = 8.00, p = 0.01. Children who vaped were older (t (63) = -2.99, p = .004), and child vaping status was significantly associated with parent vaping status, X^2 (1, N = 70) = 9.11, p = 0.00, peer vaping status, X^2 (1, N = 70) = 4.14, p = 0.05, and exposure to ENDS in the home, X^2 (1, N = 70) = 17.98, p = 0.00, and vehicle, X^2 (1, N = 70) = 8.23, p = 0.01. There were no significant differences in intentions to smoke and vape in the future among current non-smokers and non-vapers based on demographic and tobacco/ENDS-related variables. Less than half of parents reported complete smoking (46%) and

vaping bans (37%) in the home, which is lower than rates reported in prior studies. Similarly, 34% endorsed vaping bans in the vehicle. The collective findings from this study will inform targeted interventions to prevent later tobacco/ENDS use among these at-risk youngsters.

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Background

Tobacco and ENDS Use Among the General Adolescent Population

Adolescent substance use, including tobacco, is a relatively common risky health behavior. Tobacco use is the leading cause of preventable disease, disability, and death in the United States (Center for Disease Control and Prevention [CDC], 2017). According to the 2016 National Youth Tobacco Survey (NYTS), 20.2% of nationally surveyed high school students and 7.2% of middle school students reported current tobacco use (CDC, 2016a). Among current tobacco users, 47.2% of high school students and 42.4% of middle school students used more than two tobacco products. Electronic cigarettes (e-cigarettes) were the most commonly used alternative tobacco products among high (11.3%) and middle (4.3%) school students. Similarly, the 2016 Youth Risk Behavior Surveillance Survey noted that 31.4% of students nationwide had reported current cigarette, cigar, smokeless tobacco, or electronic vapor product use (CDC, 2016b). Use of menthol cigarettes is also more common among newer and younger teen smokers because they are perceived as less harsh and easier to smoke (Hersey, Nonnemaker, & Homsi, 2010; Klausner, 2011).

Adolescence is a developmental stage characterized by an increased risk of drug use, including tobacco use (Sussman, Unger, & Dent, 2004). Approximately 3,800 children under the age of 18 try their first cigarette, with more than 400 of these children becoming regular, daily smokers (CDC, 2014; Substance Abuse and Mental Health Services Administration [SAMHSA], 2015). Smoking habits and

addiction that develop during youth often persist into and throughout adulthood (CDC, 1994). Among adult smokers, 87% of those who smoke daily had tried their first cigarette by the time they were 18 years old and 85% had done so by age 21 (SAMHSA, 2014). Furthermore, individuals who begin smoking at an earlier age are more likely to develop a severe addition to nicotine than those who start at a later age.

Tobacco use in adolescence is also associated with higher rates of other substance use disorders across all tobacco users, especially among youth who use cigarettes in addition to other tobacco products (Cavazos-Rehg, Krauss, Spitznagel, Grucza, & Bierut, 2014). Adolescents who use multiple tobacco products are more likely to continue using multiple tobacco products over time (Kaufman, Land, Parascandola, Auguston, & Backinger, 2015) and are at higher risk for developing nicotine dependence (Arrazola et al., 2015; Cavazos-Rehg, Krauss, Spitznagel, Grucza, & Bierut, 2014). Studies have found an association between nicotine dependence and polysubstance use that is not as evident among single product users in both youth and adults (Dutra & Glantz, 2014). In addition, adolescent poly-tobacco users who become adult poly-tobacco users may postpone tobacco cessation compared with adults who use single tobacco products (Henningfield, Rose, & Giovino, 2002).

Since introduced, electronic nicotine delivery systems (ENDS) have become increasingly popular, especially among adolescents. ENDS are battery powered electronic devices, and include electronic cigarettes (ECs; e-cigarettes),

personal vapors, vape pens, e-cigars, e-hookah, juuls, or vaping devices, that deliver nicotine by inhalation (Grana, Benowitz, & Glatz, 2014). Puffing on these products heats up an element, most commonly a metal coil, that vaporizes a solution (e-liquid) that consists of propylene glycol, vegetable glycerin, distilled water, and flavorings that may or may not contain nicotine. Contrary to the lay belief that ENDS may be safer than combustible cigarettes due to lower levels of nicotine, studies have found that nicotine levels in ENDS products are often similar to those found in combustible cigarettes (Bullen et al., 2010; Hajek et al., 2015) and may sometimes exceed them (Goniewicz, Hajek, McRobbie, 2014). ENDS may be disposable, rechargeable (e.g., lithium batteries), or refillable (i.e., liquid cartridges). They have been rapidly accepted by smokers over combustible cigarettes due to a variety of factors, including the expectation of reducing or quitting smoking, competitive pricing, similar experiences to that of smoking combustible cigarettes (as reviewed in Polosa, Cibella, Caponnetto, Maglia, Prosperini, Russo, & Tashkin, 2017) and the perception of e-cigarettes being less harmful to one's health than combustible cigarettes (Ambrose et al., 2014; Barrington-Trimis, Berhane, Unger, Cruz, Huh, Leventhal, et al., 2015; O'Conner, McNeil, Borland, Hammond, King, Boudreau, et al., 2007; Pepper & Brewer, 2014; Popova & Ling, 2003; Spears, Jones, Weaver, Pechacek, & Eriksen, 2018; Tomar & Hatsukami, 2007). However, past research has found that concurrent use of cigarettes and e-cigarettes among adolescents does not influence their intentions

to quit or attempts to quit smoking (Tworek, Schauer, Wu, Malarcher, Jackson, & Hoffman, 2014).

Although combustible cigarette use is on the decline, electronic cigarette use among youth in the United States continues to increase (CDC, 2014; Jamal et al., 2017; Johnston, O'Malley, Miech, Bachman, & Schulengerg, 2016; Kann et al., 2015). In a nationally representative survey, the current (last 30 days) use of e-cigarettes increased dramatically from the years 2011 – 2015 for both middle (0.6% - 5.3%) and high school students (1.5%-16.0%; Singh et al., 2016). Other national data from the 2016 Youth Risk Behavior Surveillance Survey of high school students found that 44.9% had used electronic vaping devices previously and 24.1% had reported current use (Kann et al., 2015). Similarly, in the 2015 National Monitoring the Future (MTF) survey, current use of e-cigarettes for eight graders was 9.5% and 14.0% for tenth-graders, which is more than twice the prevalence rate of combustible cigarettes (Johnston et al., 2016).

Most adolescents who initiate and currently use e-cigarettes do so out of curiosity, their attractive flavoring, and for pleasure (Patrick et al., 2016). They are also perceived as safer, more normative, and less conspicuous than combustible cigarettes (Goldenson, Khoddam, Sone, & Leventhal, 2018). The appeal and easy accessibility of e-cigarettes to youth is a major public health concern, particularly when combined with use of other tobacco products (CDC, 2016a; Cobb, Byron, Abrams, & Sheilds, 2010). E-cigarettes may re-normalize smoking (Andrade, Hastings, & Angus, 2013; McRobbie, Bullen, Hartmann-Boyce, & Hajek, 2014)

and introduce non-smoking youth to nicotine (Carroll Chapman & Wu, 2012; Dutra & Glantz, 2014; Walley & Jenssen, 2015), suggesting that e-cigarettes serve as a "gateway" to smoking combustible cigarettes or using other tobacco products (Leventhal et al., 2015; Primack, Soneji, Stoolmiller, Fine, & Sargent, 2015). Dual use of e-cigarettes and tobacco products has the potential to undermine smoking cessation and eradicate public health gains made to date (Carroll Chapman & Wu, 2012; CDC, 2014).

A few longitudinal studies have examined whether combustible cigarette use predicts e-cigarette experimentation or initiation, and have produced mixed results (Hanewinkel & Isensee, 2015; Leventhal et al., 2015; Surís, Berchtold, & Akre, 2015). One study reported a significant association between ever use of conventional cigarettes and later e-cigarette experimentation (Leventhal et al., 2015), while other studies failed to find similarly significant results (Hanewinkel & Isensee, 2015; Surís et al., 2015). The majority of longitudinal studies have examined whether use of e-cigarettes is associated with use of other tobacco products. While some findings suggest that a significant number of adolescents who use electronic cigarettes have never tried other tobacco products (Barnett, Soule, Porter, & Tomar, 2015; Johnston et al., 2016; Krishnan-Sarin, Morean, Camenga, Cavallo, & Kong 2015), other studies have consistently shown that high school electronic cigarette users are more likely to use other combustible tobacco products in subsequent years compared to non-users (Barrrington-Trimis et al., 2016; Conner et al., 2017; Leventhal et al., 2015; Primack et al., 2015; Wills et al.,

2017). Likewise, the MTF survey found that teen e-cigarette users were more likely than nonusers to use cigarettes, cigars, or hookahs within 6 months (Johnston et al., 2016). An evaluation of trends in adolescents who use e-cigarettes from the National Youth Tobacco Survey also found that e-cigarette use was associated with past month use of other tobacco products (Chaffee, Couch, & Gansky, 2017). Additionally, adolescent electronic cigarette users are more likely to use smokeless tobacco (Kristjansson, Mann, & Sigfusdottir, 2015; Owusu et al., 2017; Westling, Rusby, Crowly, & Light, 2017), water pipe products (Barrington-Trimis et al., 2016; Leventhal et al., 2015; Pénzes, Foley, Nadasan, Paulik, Abram, & Urban, 2018), and alcohol (Westling, Rusby, Crowly, & Light, 2017), and are at higher risk for use of other substances, like marijuana (Azagba, 2018; Morean Camenga, Cavallo, & Krishnan-Sarin, 2015; Westling, Rusby, Crowly, & Light, 2017), than teen non-users.

Tobacco and ENDS Use in Adolescents with Autism

Populations that may be particularly vulnerable to tobacco use and its health consequences include those with pervasive developmental disorders (PDD) (Arnevik & Helverschou, 2016), which now fall under the umbrella of Autism Spectrum Disorders (ASD), a spectrum of disorders with deficits in social skills and communication, along with restricted interests and repetitive behaviors (American Psychological Association [APA], 2013). However, very little research has examined co-occurring ASD and substance use disorders, resulting in a

"population in need of special attention" (Arnevik & Helverschou, 2016). In a 2016 systematic review, only 18 studies involved ASD and substance abuse disorders, focused primarily on alcohol, marijuana, or other drugs such as cocaine; two studies (e.g., Joshi et al., 2013 & Lalanne, Weiner, Trojak, Berna, & Bertschy, 2015) reported on participant tobacco use. Joshi et al. (2013) examined patterns of psychiatric comorbidity and functioning in clinically referred adults with ASD (n = 63) and found that approximately 1/3 of these individuals reported substance use disorders (e.g., cannabis, hallucinogen, benzodiazepine, and cocaine), consistent with the rate observed in the non-ASD sample (Joshi et al., 2013). Of the total ASD population sampled, 11% (n = 7) had engaged in cigarette smoking over their lifetime. However, these results were obtained from clinical interviews with patients and may underrepresent the rates of current smoking in this population. Lalanne et al., 2015 presented a case study of two individuals with ASD, in which one participant reported nicotine use as a way to help boost executive functioning.

Since then, only a few published studies have examined tobacco use and autism (Butwicka et al., 2017; Fortuna et al., 2016; Shapir et al., 2016). Based on these few studies, rates of tobacco use have generally been low and ranged from 2 to 20 percent (Fortuna et al., 2016; Shapir et al, 2016). However, these studies were methodologically limited by patient selection criteria (e.g., formal diagnosis of autism versus autistic traits) and limited sample sizes (n = 85 and 255, respectively). Additionally, these studies primarily included young adults and may not be representative of rates of adolescent tobacco use. Now that the diagnostic

criteria for ASD has been expanded to include Pervasive developmental disorder, Asperger's syndrome, and Childhood disintegrative disorder in DSM-5 (APA, 2013), it is reasonable to expect that the estimates of tobacco use in this more broadly categorized population will increase. For example, given that rates of smoking in individuals with PDD have been found to be similar to that of the general population in some studies (Shapir et al., 2016), inclusion of PDD under the ASD umbrella may result in even higher smoking rates for ASD. Studies have not yet examined rates of ENDS use among youngsters with ASD or whether their use of alternative tobacco products affects or is affected by use of combustible cigarettes.

A recent large Swedish population-based study conducted by Butwicka et al. (2017) found that individuals with ASD had a higher risk of substance-use related problems than population controls. In their examination of substance abuse-related problems in individuals with ASD (ages 8 – 44), investigators noted the highest risk of substance use disorders was found for drug use disorder (odds ratio [OR] = 8.5), followed by tobacco (OR = 6.4), and alcohol use disorder (OR = 4.0). These results did not change when adjusted for factors such as parental age, region of birth, education, and family income. However, this study was conducted with a mixed sample of children and adults and did not yield an accurate prevalence of tobacco use within the adolescent population.

It has been suggested that higher rates of substance use disorders observed in those with ASD may be attributed to comorbid diagnosis of attention deficit

hyperactivity disorder (ADHD) or intellectual disabilities, which frequently co-occur with substance-use related problems (Carroll Chapman & Wu, 2012; Chang et al., 2014; Lee, Humphreys, Flory, Liu, & Glass, 2011; Palmqvist, Edman, & Bölte, 2014). While tobacco use has been observed to occur frequently within the ADHD population and has been researched extensively, there is no current literature examining the rates of tobacco use in individuals with comorbid ASD and ADHD.

Attention deficit hyperactivity disorder (ADHD). Attention deficit hyperactivity disorder (ADHD) is a common childhood neurological disorder characterized by deficits in executive functions (EF), including hyperactivity (e.g., high energy, interrupting) and inattention (e.g., disorganization, distractibility) (APA, 2013). ADHD is one of the most commonly diagnosed childhood disorders, with a prevalence rate of 3 to 7%. Prior to the introduction of the DSM-5, a co-diagnosis of ASD and ADHD could not be made (APA, 2013). In a review of the relationship between ASD and ADHD, Mateson, Rieske, and Williams (2013) reported co-morbidity prevalence ratings ranging from 20% to 70% across studies. Prior research has also identified the prevalence of ADHD symptoms in toddlers with ASD or those at risk for developmental delays was 4.5% (Turygin, Matson, & Tureck, 2013). However, in another sample of children and adolescents with ASD, 16% were reported by their parents to exhibit clinically significant levels of ADHD (Hanson et al., 2012). Individuals with co-morbid ASD and ADHD often

demonstrate greater severity of autism symptoms than those with ASD alone (Sprenger et al., 2013).

ADHD is also a significant risk factor for the development of cigarette smoking for both genders in children and adolescents (Wilens et al., 2011). National estimates suggest that low levels of ADHD symptoms are present in approximately 40% of adolescents (Kollins, McClernon, & Fuemmeler, 2005). Among adolescents with ADHD, approximately 19% to 46% smoke cigarettes, whereas only 10% to 24% of adolescents without ADHD smoke (Burke, Loeber, White, Stouthamer-Loeber, & Pardini, 2007). Core characteristics of ADHD, including impulsivity, inattention, and hyperactivity, have been linked to health risk behaviors, including tobacco use, independent of an ADHD diagnosis (Dawe & Loxton, 2004; Fuemmeler, Kollins, & McClernon, 2007). Higher severity of inattentive and hyperactive symptoms has been identified to influence smoking initiation at earlier ages and greater nicotine dependence (Biederman et al., 2006; Burke et al., 2007; Fuemmeler, Kollins, & McClernon, 2007; Lambert & Hartsough, 1998; Milberger, Biederman, Faraone, Chen & Jones, 1997; Rodriguez, Tercyak, Molina & Pelham, 2003; Symmes, Winters, Fahnhorst, Botzet, Lee, August, & Realmuto, 2015).

More recently, ADHD has been associated with an increased likelihood of e-cigarette initiation during adolescence (Goldenson et al., 2018). Additionally, the association between ADHD and the use of combustible cigarettes or e-cigarettes may be better explained by other salient risk factors

that are correlates of ADHD, such as delinquent behavior. For example, youth with elevated ADHD symptoms who engaged in higher levels of delinquent behaviors have been found to be at risk for initiating use of combustible tobacco products while those with elevated ADHD symptoms, irrespective of delinquency, preferred use of e-cigarettes. It may be that youth who engage in more delinquent behaviors may be more inclined to smoke combustible cigarettes, as they clearly violate societal rules; those with fewer delinquent tendencies prefer e-cigarettes, which are perceived as more normative and safer than combustible cigarettes and can be used less conspicuously than combustible cigarettes (Goldenson et al., 2018).

Although substance use is common in individuals with ADHD, some studies have shown elevated risks for drugs, alcohol, and tobacco in adolescents with ADHD and autistic traits (De Aliws et al., 2014; Mulligan, Reirsen, & Todorov, 2014). Higher symptom scores on self-reports of ADHD and autistic traits have been associated with elevated levels of smoking and nicotine use disorders (De Alwis et al., 2014; Mulligan, Reirsen, & Todorov, 2014). Given the higher prevalence of tobacco use observed in youth with ADHD and the potential dual diagnosis of ASD and ADHD now allowed in DSM-5, one can reason that estimates of tobacco use in children and adolescents diagnosed with co-morbid ASD/ADHD will increase, or at least leave those with ASD susceptible to the development of a substance use disorder (Palmqvist, Edman, & Bölte, 2014). Results from collective studies suggest that understanding the

risk pathways for e-cigarette and tobacco use is critical for developing effective prevention approaches. Evaluating the role that ADHD and comorbid ASD serve in initiating and maintaining smoking and alternative tobacco product use in this high risk population is an important next step.

Health Risks Associated with Tobacco Use and ENDS Use

Cigarette smoking during childhood and adolescence causes significant health problems, including decreased physical fitness, an increase in the number and severity of respiratory illnesses, and adverse effects on lung growth and function (CDC, 1994). Nicotine has also been determined to have a negative impact on adolescent brain development, leading to lasting cognitive and behavioral impairments (CDC, 2016a). Adolescents are more easily addicted than adults, as their brains are still maturing and can build synapses and stronger connections at a faster rate than adult brains. Nicotine also enhances neuronal activity more robustly in adolescents than adults in several reward-related regions, including the nucleus accumbens shell, basolateral amygdala, and ventral tegmental area (Dao et al. 2011; Shram et al. 2007).

Numerous studies have concluded that smoking leads to disease and disability in almost every organ in the body (CDC, 2014). Smoking also causes cancer, stroke, heart disease, lung diseases, diabetes, and chronic pulmonary disease (COPD). Additionally, it increases risk for tuberculosis, certain eye diseases, and immune system problems, such as rheumatoid arthritis. More than

half of individuals that start smoking before the age of 13 will ultimately die from their smoking habit (CDC, 2006). Approximately half a million Americans die prematurely of smoking or exposure to second hand smoke and 16 million live with a serious illness caused by smoking (CDC, 2017). On average, individuals who smoke die 10 years earlier than individuals who do not smoke (Jha et al., 2013).

Unlike the adverse health effects that have been well substantiated for combustible tobacco products, the toxicity of newer alternative tobacco products such as electronic cigarettes have been largely underestimated. It should be noted that not all ENDS products contain nicotine and some products that claim to have no nicotine may contain it. Initial tests conducted by the Food and Drug Association (FDA) in 2009 found that cartridges labeled as nicotine-free had traceable levels of nicotine. Research has also determined that the amount of nicotine in e-liquid refills may be substantially different from what is listed on the package (Cameron, Howell, Andrenyak, Layton, & Roll, 2014). Similarly, there has been little consistency in the amount of nicotine delivered by ENDS of the same brand and strength (Goniewicz, Hajek, & McRobbie, 2014).

Although electronic cigarettes are presumed to be a less harmful alternative to combustible cigarettes, long-term health effects of e-cigarette use are unknown. A recent study found no harmful long-term health effects of electronic cigarettes in young adults on lung functioning, blood pressure, or heart rate compared to those who had never smoked combustible cigarettes or used ENDS over a 3.5-year span (Polosa et al., 2017). However, this study included a small sample size (n = 16) of

otherwise healthy young adults whose moderate daily usage may not reflect that of the general population. In addition, this study utilized high-resolution computed tomography to observe changes in lung function, while air trapping (a more sensitive measure of early lung damage) was not assessed. Furthermore, this sample was not compared to a reference group of young smokers, which makes it difficult to conclude if e-cigarettes are less or more harmful than combustible cigarettes.

Although long-term health consequences of ENDS remain unclear, many adverse short-term health effects have been reported. A recent systematic review of ENDS noted that the most commonly reported adverse health-related effects of passive ENDS exposure include respiratory symptoms, eye irritation, headache, nausea, sore throat or irritation, dizziness, racing or irregular heart rate (Glasser et al., 2017). Additionally, the most common reported symptoms of vaping include mouth and throat irritation, nausea, headache, and dry cough. Other adverse health outcomes can result from defective batteries, overheating, fires, or explosions, all of which can lead to injuries, such as lacerations, thermal burns, or smoke inhalation (CDC, 2016a; Glasser et al., 2017). Additionally, the CDC has identified that calls to the nation's poison centers for e-cigarette exposure poisonings are increasing rapidly for accidental ingestion, inhalation, or irritation to the eye or skin. Ingestion of ENDS liquid containing nicotine can cause acute toxicity and possible death, particularly in children (CDC, 2016a).

Other studies have found that electronic cigarettes are a potential source of exposure to toxic metals, including Chromium (Cr), Nickel (Ni), and Lead (Pb), as well as metals that are toxic when inhaled, including Manganese (Mn) and Zinc (Zn) (Olmedo et al., 2018). These metals are transferred from the device, likely the coil, to the e-liquid, and then to the aerosol that is inhaled. Research has established Cr and Ni as inhalation carcinogens (as reviewed in Olmedo et al., 2018). Pb is a concern as it relates to users and those involuntarily exposed, particularly children (Olmedo et al., 2018). Pb, a neurotoxicant, is not easily excreted from the body and has been associated with an increased risk for kidney and cardiovascular disease (Fadrowski et al., 2010; Navas-Acien, Guallar, Silbergeld, & Rothernberg, 2007), even at low levels of exposure (Lin, Lin-Tan, Li, Chen, & Huang, 2006). Mn can induce coughing, bronchitis, pneumonia, lung irritation, and pneumonitis as well as reduced lung function, manganism (a Parkinson-like disease), and other neurological outcomes (O'Neal & Zheng, 2015). Zn can cause metal fume fever, with flu-like symptoms, reduced lung function, chest pain, coughing, dyspnea, and shortness of breath (ATSDR, 2005). Currently, the literature is mixed on emission rates of different metals for electronic cigarettes and combustible cigarettes (Olmedo et al., 2018; Saffari et al., 2014). Future research is needed to quantify various metal exposures and determine implications for health.

Another toxic chemical found in some e-cigarettes includes Diacetyl, a buttery flavored chemical that is often added to food such as popcorn, caramel, and dairy products, which can cause a serious and irreversible lung disease known as

"popcorn lung" (CDC, 2002; Kanwal et al., 2006; Kreiss et al., 2002). In addition, ultrafine particles can be inhaled into the lungs, which may cause pulmonary impairments (CDC, 2016a). Arsenic, which has been associated with cancer and cardiovascular disease, has also been detected in 17.9% of aerosol samples (Olmedo et al., 2018). It is important to note that factors other than the device composition, such as voltage, age of the device, temperature, and vaping routine, may influence metal exposure from ENDS use.

Although the extant literature has not specifically examined the effects of chronic nicotine use on health outcomes among youngsters and young adults with ASD, one can assume that this population will be equally at risk, if not more so, than their peers without ASD who use tobacco or ENDS products. Compared to the general pediatric population, children with ASD have higher rates of co-occurring medical illnesses (Johnson & Myers, 2007). In a 2015 study examining the health status of adults with ASD, almost all medical conditions were significantly more common in adults with ASD compared to a control group, including immune conditions, gastrointestinal problems, sleep disorders, seizure, obesity, dyslipidemia, hypertension, and diabetes. Even rare conditions, such as stroke and Parkinson's disease, were significantly more common among adults with Autism (Croen et al., 2015).

Patients with ASD are also more likely to have other chronic health conditions, such as allergies, asthma, epilepsy, and neurological, autoimmune, and endocrine disorders (Cummings et al., 2016) which are likely to be exacerbated by

tobacco use (Fortuna et al., 2016). If those with ASD also have comorbid ADHD, the impulsivity and inattention characteristic of ADHD may also increase their risk for unintentional injuries (Vincenten, 2005) and the practice of risky health behaviors (e.g., binge eating, obesity, earlier sexual activity, sexually transmitted infections, unsafe sex, multiple sex partners) that further increase their mortality risk (Bleck & Debate, 2013; Flory, Molina, Pelham, Gnagy, & Smith, 2006). The increased health risks, earlier mortality of those with ASD relative to the general population, and difficulties finding and accessing medical services (Vogan, Lake, Tint, Weiss, & Lunsky, 2017), call for youngsters and young adults with ASD to refrain from tobacco use and use of ENDS, which could further impair their overall functioning and health status.

The scant literature on whether stimulants, such as nicotine, worsen ASD symptoms is not clear. Stimulants are the most frequently prescribed pharmacological agents to individuals with ASD, despite limited literature regarding the effects of stimulant use in this population (Lippiello, 2005). The Autism Research Institute's database indicates that many individuals with ASD often experience worsened symptoms (Lippiello, 2005) and adverse reactions to stimulants, such as increased hyperactivity, stereotypic behaviors, and aggression (Kerbeshian, Burd, & Avery, 2001). This may be due to the effect of nicotine's agonistic properties on nicotinic acetylcholine receptors (NNRs), which respond to acetylcholine and nicotine. In contrast, improvements in attentional and executive functioning after use of psychostimulants such as nicotine and coffee/tea have been

reported in some adults with ASD (Lalanne, Weiner, Trojak, Berna, & Bertschy, 2015). Cognitive and behavioral impairments in those with ASD have also been effectively treated with psychostimulants, such as methylphenidate, a nicotinic agonistic agent (Kumar, Prakash, Sewal, Medhi, & Modi, 2012). In adolescents with ADHD, use of stimulant-like substances, such as nicotine, may help to manage ADHD symptoms (Castle, Aubert, Verbrugge, Khalid, & Epstein, 2001). Previous exposure to psychostimulant medication, like those prescribed to manage symptoms of ADHD, may lead to behavioral sensitization to nicotine, thus enhancing the self-medication properties of nicotine (Robinson & Berridge, 2000). Whether or not youth with ASD and ADHD use nicotine to help manage their symptoms has yet to be studied.

Risk and Protective Factors Associated with Tobacco and ENDS Use in Youth

Research has identified several risk factors that contribute to smoking initiation. Overall, studies suggest that older age and male gender have been consistently associated with tobacco use (Barbeau, Krieger, & Soobader, 2004; Robinson & Klesges, 1997; SAMHSA, 2014). In addition, smokers tend to come from low socioeconomic backgrounds and have low income or education levels (Cambron, Kosterman, & Catalano, 2018; CDC, 1994; CDC, 2000). The prevalence of tobacco use among teens varies across racial/ethnic groups (SAMHSA, 2014). Cultural factors, immigration status, and level of acculturation may contribute to these racial/ethnic differences (Fortes & Rumbaut, 2005; Parsai,

Voisine, Marsiglia, Kulis, & Nieri, 2009; Unger et al., 2002; Unger, Ritt-Olson, Soto, Soto, & Baezconde-Garbanati, 2011).

Results are generally more mixed in studies examining gender and ethnicity influences on adolescent e-cigarette use. Some studies have found no differences in the likelihood of electronic cigarette use based on gender and ethnicity (Westling, Rusby, Crowley, & Light, 2017) while others have found that white males (Dutra & Glantz, 2014) and Hispanic high school students report the highest use (Kann et al., 2015). Psychosocial factors that affect adolescent tobacco use include lack of parental support or involvement (CDC, 1994; CDC, 2000; Wellman et al., 2016) or parental monitoring (Bohnert, Rios-Bedoya, & Breslau, 2009), permissive family smoking environments (Cambron, Kosterman, & Catalano, 2018), association with deviant peers (Cambron, Kosterman, & Catalano, 2018), and social modeling factors (Sylvestre et al., 2017), including smoking by family members (Bauman, Foshee, Linzer, & Koch, 1990; Komro, McCarty, Forster, Blaine, & Chen, 2003; Li et al., 2002; Moreno et al., 1994; Wellman et al., 2016) and having friends who smoke (CDC, 1994; Wellman et al., 2016). In contrast, more stringent parenting strategies (Chung, Ennett, Bauman, Foshee, 2005), parental disapproval of smoking (Kim & Chun, 2016; Kong, Camenga, & Krishnan-Sarin, 2012; Villagrana & Sei-Young, 2018) increased parental monitoring (Chung, et al, 2005; Gerrard, Gibbons, Stock, Lune, & Cleveland, 2005) and connectedness to family (Carvajal & Granillo, 2006; Patton et al., 2006; Resnick et al., 1997), school (Bond et al., 2007; Carvajal & Granillo, 2006; Patton, et al., 2006; Resnick et al., 1997), and

prosocial peers (Haegerich & Tolan, 2008; Simons-Morton et al., 1999) have been negatively associated with adolescent smoking.

Adolescent smoking has also been linked to individual factors such as low self-image or self-esteem (CDC, 1994; CDC, 2000; Fang, Barnes- Ceeney, & Schinke, 2011; Sylvestre et al., 2017; Wellman et al., 2016), rebelliousness (Chasin, Presson, Sherman, Montello, & McGrew, 1986; Collins et al., 1987; Landrine, Richardson, Klonoff, & Flay, 1994; Soneji, Sargent, & Tanski, 2014; Wellman et al., 2016), decreased problem solving abilities (Fang, Barnes- Ceeney, & Schinke, 2011), sensation seeking tendencies, and perceptions of smoking as a fun and social activity (Chasin et al., 1986; Collins et al, 1987; Landrine et al., 1994; Soneji, Sargent, & Tanski, 2014). Similarly, tobacco use has been associated with increased age/grade (Wellman et al., 2016) and poor academic achievement (CDC, 1994; CDC, 2000; Wellman et al., 2016). Adolescents who smoke also lack social skills to resist social influences to use tobacco (CDC, 1994; CDC, 2000; Wellman et al., 2016).

Intentions and willingness to smoke have also been linked to cigarette smoking (Andrews, Hampson, Barckley, Gerrard, & Gibbons, 2008; Gibbons et al., 1998; van den Eijnden et al., 2006; Wellman et al., 2016). Smoking intention, defined as the lack of a firm commitment not to smoke among never-smokers, is strongly predictive of future established smoking (Choi, Gilpin, Farkas, & Pierce, 2001; Pierce, Choi, Gilpin, Farkas, & Merritt, 1996; Wakefield et al., 2004). Adolescent smoking intention has been associated with variables such as parental

or peer smoking, exposure to secondhand smoke inside or outside the home, pro-tobacco advertising, and school connectedness (Azagba & Asbridge, 2013; Dube, Arrazola, Lee, Engstrom, Malarcher, 2011; Veeranki, Mamudu, Anderson, & Zheng, 2014). Electronic cigarette use has also been associated with increased intentions to smoke combustible cigarettes in middle and high school students (Bunnell et al., 2015; Zhong, Cao, Gong, Fei, & Wang, 2016). Factors such as earlier pubertal development (Walls & Whitbeck, 2011), decreased self-control (Wills et al., 2013), and having friends who smoke cigarettes (Gerrard et al., 2005; Guilamo-Ramos, Dittus, Holloway, Bouris, & Crossett, 2011) have also been related to increased smoking intentions and willingness to smoke as well as future initiation of tobacco use.

Perceptions of harm due to smoking have been found to be inversely associated with adolescent tobacco use, including initiation and experimentation, and positively associated with cessation (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004; Krosnick, Chang, Sherman, Chassin, & Presson, 2006; Song, Morrell, Cornell, Ramos, Biehl, Kropp, et al., 2009). More recently, studies have consistently found that nonsmokers who used e-cigarettes perceived these products to be less harmful than combustible cigarettes (Amrock, Zakhar, Zhou, & Weitzman, 2015; Cooper, Harrell, Pérez, Delk, & Perry, 2016; Gorukanti, Delucchi, Ling, Fisher-Travis, & Halpern-Felsher, 2017). In fact, use of e-cigarettes may reduce the adolescents' estimate of the harmful effects of combustible cigarettes and ENDS products, thereby increasing their susceptibility to use both

products (Pénzes et al, 2018). Adolescents who have not smoked combustible cigarettes but use e-cigarettes are four times more likely to perceive that combustible cigarettes pose minimal health risks (Miech, Patrick, O'Malley, & Johnston, 2017).

Adolescent perceptions of the lower health risk associated with e-cigarettes may largely depend on their knowledge about the toxins present in e-cigarettes, which appears to be variable across studies. While some studies have reported that adolescents are generally aware of the dangerous chemicals in these products (Wiseman et al., 2016), others have shown that they are not knowledgeable about the chemical composition of e-cigarettes, with only one fourth of adolescents recognizing the products may contain nicotine (Anand et al., 2015). Adolescents were also unaware that toxic chemicals (i.e., constituents) such as acetylaldehyde and acroleinin, are present in the aerosol, vapors and smoke of products including cigars, cigarillos, hookah, and e-cigarettes (Wiseman et al., 2016). Findings suggest that first steps in preventative interventions should include brief education about the potential health risks associated with tobacco and ENDS products.

Previous studies have indicated a strong relationship between youth smoking and mental health factors such as anxiety, depression, and stress (CDC, 1994; Groeman, Jassen, & Oosterlaan, 2018; Sylvestre et al., 2017). Mental health difficulties have been shown to increase the probability of nicotine dependence among youngsters who smoke (McKenzie, Olsson, Jorm, Romaniuk, & Patton, 2010). Additionally, some adolescents and emerging adults have reported that

smoking improved their psychosocial functioning in a number of domains (e.g., anxiety, anger, self-esteem, socialization) as compared to their non-smoking peers (Catchpole, McLeod, Brownlie, Allison, & Grewal, 2017). In addition, these youngsters reported that they smoked more when their mental health was worse. Since mood disorders and anxiety are common in adolescents with ASD (Croen et al., 2015) and have already been established as risk factors for tobacco use in pediatric populations (SAMSHA, 2008), the relationships between mental health variables and smoking/ENDS use deserve further examination in the ASD population.

It has been assumed by clinicians and researchers working with the ASD population that the core features of ASD, including lack of social interest, inhibition and non-sensation seeking behaviors, and risk-avoiding tendencies, may reduce the risk of using psychoactive substances in this vulnerable group (Bejerot & Nylander, 2002; Palmqvist et al., 2014; Ramos, Boada, Moreno, Llorente, Romo & Parellada, 2013; Santosh & Mijovic, 2006). Some studies have reported that individuals with PDD smoke at rates that are similar to that of the general population (20.0% vs. 20.6%; Shapir et al., 2016). However, previous research is mixed, as some researchers have identified non-sensation seeking behaviors, rigidity to rules or routines, and lack of access to peers as protective factors from tobacco use (Ramos et al., 2013; Santosh & Mijovic, 2006; Shapir et al., 2016), while others have identified autistic traits, such as social difficulties, as contributing factors to tobacco use (Bejerot & Nylander, 2002; De Alwis et al., 2014;

Lundström et al., 2011). For PDD populations in psychiatric settings, increased supervision, compliance with norms of the PDD population, lower social pressures, and less recreational activities to access tobacco may explain lower smoking rates than observed in other psychiatric populations (Schapir et al., 2016). It has also been suggested that a less sensitive biological reward mechanism (e.g., low D2 receptor density) may contribute to lower rates of smoking in individuals with PDD than that of the general population observed in some studies (Janusis & Weyandt, 2010; Santosh & Mijovic, 2006). The higher rates of smoking and substance use in the ASD population reported in other studies may be attributable to comorbid ADHD (Butwicka et al., 2017; Palmqvist et al., 2014).

Exposure to Second Hand Smoke

Health Effects. Secondhand smoke exposure (SHSe) is carcinogenic and linked to serious adverse health problems in children and nonsmoking adults, with children being particularly vulnerable. SHSe is associated with disease and premature death in nonsmoking adults and children (CDC, 2006, 2010). In fact, over 3200 nonsmokers die annually from exposure to SHS in Florida alone (Campaign for Tobacco-Free Kids, 2018). SHS is linked to coronary heart disease and lung cancer in nonsmoking adults (CDC, 2006, 2010). Children exposed to SHS are at increased risk for sudden infant death syndrome, respiratory and ear infections, exacerbation of asthma symptoms, slowed lung growth, and reduced pulmonary function (CDC, 2006; Jaakkola & Jaakkola, 2002). A previous longitudinal study reported that by age 14, children exposed to SHS in cars were

more likely to have a current wheeze, a persistent wheeze, and decreased lung function, relative to children who were not exposed (Sly, Deverall, Kusell, & Holt, 2007). Although not conclusive, some research suggests that SHSe may increase the risk of leukemia, lymphoma, and brain tumors in children (CDC, 2006; Farioli et al., 2014). The adverse health impact of child SHSe also increases health care utilization and medical costs (Lam, Leung, & Ho, 2001).

A growing number of studies have indicated that the aerosol produced by ENDS products may expose nonusers, including children and infants, to aerosolized nicotine and other potentially harmful substances, such as heavy metals, ultrafine particulates, and volatile organic compounds (CDC, 2016b; Goniewicz & Lee, 2015; Schober et al., 2014). It has been established that e-cigarette aerosol can contain harmful chemicals, including nicotine (CDC, 2016a), and subsequently impair indoor air quality. Substantial amounts of gases produced by e-cigarettes, such as, propylene glycol, glycerin, and nicotine, in addition to high concentrations of atmospheric particle matter (PM2.5) have been associated with electronic cigarette use indoors (Schober et al., 2014). Components of exhaled aerosol are released into the air where it can be inhaled by others and can settle on surfaces, where they can be ingested, inhaled, or absorbed through the skin unintentionally by children (Goniewicz & Lee, 2015; Schober et al., 2014). Children and infants can be exposed to secondhand aerosol in their own homes and vehicles as well as public spaces where vaping is permitted.

Despite the potential health risks, adults may not fully recognize the dangers of secondhand ENDS exposure to children. In a survey of over 4000 adults that assessed perceptions of risk from exposure to vapors associated with ENDS use, only 22% of respondents acknowledged that vapors from ENDS are harmful to children (Nguyen, Tong, Marynak, & King, 2017). Additionally, 5.3% responded that children's exposure to secondhand aerosol from ENDS caused "no harm," 39.9% responded "little harm" or "some harm," 21.5% responded "a lot of harm," and 33.3% responded "don't know." Overall, men, Hispanics, blacks, and current smokers were more likely to report lower harm perceptions. As most adults perceive that exposure to ENDS vapors poses minimal risks, it is reasonable to assume that children are frequently exposed to aerosols and vapors from ENDS products in their environments.

Exposure Rates. Policies that prohibit smoking in public places and workplaces have largely protected adults from SHSe (CDC, 2015) but do not adequately protect children from SHSe in their homes and family vehicles. Parent or caregiver smoking is a frequent source of SHSe in children (Baxi et al., 2014). Over 20 million children in the US are exposed to SHS on a daily basis in the home and/or vehicle (Klerman, 2004). In Florida alone, 38% of youngsters, ages 11 to 17 years, reported SHSe in a room or car in the past 7 days (Florida Department of Health, 2014). The rates of SHSe are highest among non-Hispanic white youth (44.5%). Children between the ages of 3 to 11 years have even higher levels of

SHSe in the home and car settings because they spend a majority of their time in close proximity to a caregiver who smokes (Pirkle et al., 2006; CDC, 2006).

Traditionally, homes have been considered the primary source of tobacco smoke contamination for children, however exposure while traveling in a vehicle may be more frequent (Matt, Bernert, & Hovell, 2008). A recently completed study of parents (N = 275) whose children were seen in 10 pediatric practices across 8 states found that less than 30% reported having a smoke-free car policy and only 24% reported strictly enforcing this policy (Nabi-Burza et al., 2012). Of parents who did not report a smoke-free car policy, 48% reported that smoking occurred in the car while a child was present. Nationally, only 27.0% of smoking adults in the US report voluntary adoption of smoke-free vehicle rules (King, Dube, & Homa, 2013). Similarly, less than one-third (28.7%) of Florida smokers restrict smoking in their vehicles (CDC, 2015), providing the opportunity for exposure to children and other passengers. Results from a national study found that close to 25% of nonsmoking middle school and high school students report being exposed to smoking in a car within the past 7 days (King, Dube, & Tynan, 2012). However, no studies have examined adolescent exposure to parental e-cigarette vapors in their homes and vehicles.

SHSe in the vehicle can be substantially more toxic than SHSe in the home because of the enclosed space of the car cabin in which smoke is circulated (Jones, Navas-Acien, Yuan, & Breysse, 2009). High unsafe levels of SHS contaminants have been reported in passenger cars where smoking occurs, even under the fullest

possible ventilation conditions (Jones et al., 2009; Ott, Klepeis, Switzer, 2008; Sendzik, Fong, Travers, & Hyland, 2009). Rees & Connolly (2006) reported alarmingly high respirable suspended particle (RSP) levels generated from smoking a single cigarette for only 5 minutes in a private vehicle, under normal driving conditions. Significantly higher levels of nicotine have also been reported in the dust, on surfaces, and in the air of cars of smokers who smoked inside their vehicle compared with cars of nonsmokers who banned vehicle smoking (Matt, Quintana, & Hovell, 2008). The residual toxins from SHS, often referred to as 'thirdhand smoke,' can accumulate on interior car surfaces and remain in the air for many hours, and even days, beyond the period of active smoking (Singer, Hodgson, Guevarra, Hawley, & Nazaroff, 2002).

Association Between Exposure and Smoking. Exposure to SHS has also been associated with increased risks of smoking initiation (Becklake, Ghezzo, & Ernst, 2005: CDC, 2007). In a recent systematic review of studies examining the effects of SHSe on smoking behaviors, the majority of studies found that SHSe in homes and vehicles was associated with greater likelihood of being a smoker, increased susceptibility and initiation of smoking, greater nicotine dependence among nonsmokers, and decreased smoking cessation attempts (Healy, Hoek, Wilson, Thomson, Taylor, & Edwards, 2015; Okoli & Kodet, 2015). Car SHSe has been significantly and consistently associated with early stage smoking initiation in preadolescents (Glover et al., 2011), and more frequent smoking behavior among

adolescents (Belanger et al., 2008; Seo, Bodde, & Torabi, 2009; Seo, Torabi, & Weaver, 2008).

Clinical studies have found that SHSe results in increased occupancy of nicotine-acetylcholine receptors in the brains of adult smokers and non-smokers (Brody et al., 2011), suggesting increased neural vulnerability to nicotine exposure from SHS. Researchers have suggested that similar processes with nicotine exposure may promote cigarette smoking initiation in adolescents who used e-cigarettes compared to non-smokers; however, these claims have not yet been supported (Zhong, Cao, Gong, Fei, & Wang, 2016). Therefore, protecting youth from SHSe may be an important step to discourage adoption of a life-long smoking habit.

Interventions to reduce children's SHSe have largely targeted caregiver behavior, by requiring caregivers to quit smoking or by asking them to alter their smoking behaviors around their child (i.e., smoking outdoors, smoking in another room) or adopt voluntary smoke-free policies (Baxi et al., 2014; Kegler, Escoffery, Bundy, Berg, Haardorfer, Yembra et al., 2012; Rosen, Myers, Hovell, Zucker, & Noach, 2014). Complete home and car smoking restrictions (smoking bans) have been shown to lower SHSe for children and nonsmokers (Gehrman & Hovell, 2003) and lead to increased quit attempts and less daily cigarette consumption among smokers (Gilpin, White, Farkas, & Pierce, 1999). Brief education provided to caregivers has also been shown to increase the adoption of smoke-free home and car policies (Kegler et al, 2012; Priest et al., 2008; Rosen et al., 2014).

Study Rationale and Justification

It is well recognized that children with pervasive developmental delays face a variety of challenges throughout their lifespan. As a vulnerable population, these children are at higher risk for a variety of health problems and related functional impairments that can be exacerbated if they smoke (Fortuna et al., 2016) or are exposed to high levels of tobacco smoke (Academy of Pediatrics, 2010). Previous research examining the prevalence of tobacco use in youth with ASD has yielded mixed results, with estimates of self-reported cigarette smoking ranging from 2 to 20 percent across studies (Fortuna et al, 2016; Shapir et al, 2016). The variability of smoking rates may be attributed to differences in study methodologies, participant inclusion criteria, the definitions of smoking employed, and settings from which participants were recruited. Although rates of combustible smoking have decreased nationally, use of e-cigarettes have markedly increased among youth (CDC, 2014; Kann et al., 2015; Jamal et al., 2017; Johnston, O'Malley, Miech, Bachman, & Schulengerg, 2016). However, little consideration has been given to whether these same trends are characteristic of youngsters with ASD. No published studies have examined rates of e-cigarette use in this population. In addition to limited published empirical data, the lack of tobacco use screenings in routine clinical assessments, combined with the assumptions by some, that children with ASD have fewer social contacts and less access to tobacco/ENDS products than their typically developing peers, may lead to underestimates of the risk for tobacco/ENDS use in the ASD population.

Numerous risk factors have been identified for tobacco use among adolescents in general, but less is known about whether these same risk factors operate in the ASD population. The debate in the extant literature regarding whether the core features of ASD serve as protective or risk factors for future smoking and e-cigarette use drives the objectives proposed in the current study. Although studies have demonstrated an association between ADHD symptoms and initiation of combustible cigarette smoking (Biederman et al., 2006; Symmes, Winters, Fahnhorst, Botzet, Lee, August, & Realmuto, 2015; Wilens, Martelon, Joshi, et al., 2011) and more recently e-cigarette use (Goldeson et al., 2018), no studies have examined future intentions to use these products among current non-smoking adolescents with ASD, with or without comorbid ADHD. Youngsters who are exposed to SHS in their homes and cars may likely report greater intentions to smoke (Becklake, Ghezzo, & Ernst, 2005; CDC, 2007) and be at greater risk for later smoking, yet SHSe is often neglected in studies of adolescent tobacco use and has not been examined as a factor for future smoking and e-cigarette use among youngsters with ASD.

The purpose of the proposed study was to describe the rates of current combustible cigarette and e-cigarette use, as well as assess intentions to use cigarettes and e-cigarettes among current non-smoking/vaping children with ASD and co-morbid ASD and ADHD. This study also aimed to examine rates of smoking and vaping bans implemented in the family homes and vehicles of these high-risk youngsters. Additionally, risk factors associated with smoking and ENDS

use were identified. Identification of variables associated with intentions to smoke and use of e-cigarettes is important for screening children at increased risk and development of targeted interventions that prevent initiation of cigarette smoking/ENDS use and possible nicotine dependence in an already vulnerable population.

Aims and Hypotheses

1. To describe rates of past and current use of combustible cigarettes, electronic nicotine delivery systems (ENDS products; e-cigarettes) and dual products (combustible cigarette use and e-cigarette use) among children with Autism, ADHD, and comorbid autism and ADHD. For the purposes of this study, the terms ENDS products e-cigarettes, and vapes will be used interchangeably.

    Hypothesis 1.1: The rates of combustible cigarette use in young individuals with ASD will be lower or comparable to nationally reported rates.

    Hypothesis 1.2: The rates of ENDS use will be higher than rates of combustible cigarette use, consistent with national trends.

2. To examine intentions to use tobacco or ENDS products, a reliable proxy for later tobacco use, among current nonsmokers and non-ENDS users.

    Hypotheses 2.1: Children with ASD will report low rates of intentions to use tobacco and ENDS.

3. To examine rates of smoking and vaping bans implemented in family homes and vehicles among children with Autism, ADHD, and comorbid autism and ADHD.

    Hypothesis 3.1: Rates of smoking bans in families of children with developmental disorders will be comparable to rates of smoking bans reported in previously reported studies of families.

    Hypothesis 3.2: Rates of vaping bans in families of children with developmental disorders will be lower than rates of smoking bans reported in previously reported studies.

4. To determine predictors of intentions to smoke, use e-cigarettes, or use both combustible cigarettes and e-cigarettes (dual use). Primary predictor variables to be examined include but are not limited to demographic factors, child diagnosis, communication about smoking/vaping with parent/providers, exposure to tobacco products and e-cigarettes in the home and car, number of smokers/vapers in the home, and peer tobacco/e-cigarette usage.

    Hypothesis 4.1: Older, low SES, male children with greater exposure to peers and family members who smoke/vape, who have not been informed about the health effects of smoking/vaping, will report greater intentions to smoke/vape.

Method

Participants

Eligibility criteria for child participants included English-speaking children who are (a), ages 10-17 years; (b) had received one of the following diagnoses: a DSM-5 diagnosis, based on parent report, of Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADHD); a DSM-IV diagnosis, based on parent report, of Autism, pervasive developmental delay not otherwise specified, Asperger's Syndrome, Childhood disintegrative disorder, ADHD or a combination of any of the above disorders, per parent report; (c) child was enrolled in a mainstream or special education classes at the 5th grade level or higher and able to read independently, and (d) willingness to participate by completing the online survey. To determine child eligibility, participant's parents were asked about their child's grade placement and ability to read independently. Children were excluded from participation if they are unable to read and comprehend independently, per parent report. A total of 70 children (ages 10-17 yrs) and their parents/guardians were enrolled on this study. An additional 12 parent-child dyads were enrolled on the study but were excluded from the analysis for not meeting the inclusion/exclusion criteria or failure to correctly complete the survey. Ten eligible adults and one child refused to participate.

All parents of eligible child participants were also asked to participate. Parents were asked to provide information about their education level, smoking/vaping status, and household and vehicle rules regarding smoking and

vaping. Either parent was eligible to participate but only one parent per household could complete the study survey. All child participants and their parents were asked to provide written assent and consent, respectively, prior to study enrollment. Approval from the Florida Institute of Technology Institutional Review Board and The Scott Center for Autism Treatment was obtained prior to recruitment. Child and parent participants were granted one entry in a drawing for a chance to win a $50 gift card. Both children and parents were required to complete the study survey to be eligible for entry into the drawing (one entry per parent/child dyad).

Participants were recruited through a range of methods, including a PRWeb press release, posting to Autism Speaks, e-mails sent to national organizations or foundations representing children with autism and pervasive developmental delays, postings on Yahoo and Facebook user groups with words such as *autism support group*, *special needs children group*, and *developmental delays group*, in the group title and groups comprised of children with Autism and/or pervasive developmental delays, and announcements on internet blogs and websites associated with childhood developmental delays. Participants were also recruited from a database of children who have previously sought or are currently seeking developmental evaluations or treatment through The Scott Center for Autism Treatment from the years 2013 to 2018. Parents of eligible participants identified through the database at The Scott Center were contacted by an email created for this study, explaining

the rationale of the study and requesting their participation. Parents were contacted up to two times by email.

Lastly, additional participants were recruited through Amazon Mechanical Turk (MTurk). Amazon MTurk is an online marketplace that allows businesses to recruit workers to complete Human Intelligence Tasks (HITs) and earn money for their work. Casler, Bickel, and Hackett (2013) found that behavioral science research results conducted through MTurk were almost indistinguishable from in-person participation results, even when the studies utilized behavioral tasks. These researchers also suggested unique benefits of using MTurk to conduct research studies in this field, such as an increasingly diverse sample, and quick and reliable participant recruitment. Additionally, further research has suggested than crowdsourcing software such as MTurk may be a useful tool in studying clinical populations (Shapiro, Chandler, & Mueller, 2013). Researchers have noted that the prevalence of depression, anxiety, and trauma-related disorders matches or exceeds what is expected in the general population, and that participants may be more willing to disclose mental health information through online studies. The study advertisement on MTurk was listed as "Psychological study on youth with autism, intentions and use of tobacco and e-cigarettes, earn $2 if you qualify." MTurk workers who previewed the advertisement were provided with information regarding eligibility, compensation, and time commitment for completion. Participants were also initially advised that the study would require them to answer questions about parent and child tobacco and e-cigarette use.

Measures

Child and parent participants completed their respective sections of the online survey. The child survey consisted of 38 items and parents were asked to complete 18 items plus 9 demographic questions. Parents were allowed to view the child survey prior to consenting to the study. In order to promote valid responding and to ensure confidentiality of child data, parents were told they would not be able to access the child's responses to the survey, as per previous studies (Tyc et al., 2003; Tyc et al., 2006). For participants collected online and through flyers, a random number was assigned by a code generator were provided a *family code* to the parent, as part of the parent survey to link parent and child responses to encourage independent responding. This code was entered at the beginning of the child survey. Parents were first asked to verify their child's eligibility by responding to a series of questions as described in Appendix A. Core specific domains addressed by each survey included the following:

Demographics.

Demographic measures included age, gender, race/ethnicity, and education level of child, as well as highest level of parent education. Parents and/or caregivers completed the portion of the survey that requests demographic information. Information about the child's specific diagnosed condition(s) were recorded, as reported by parents/caregivers.

Child Questionnaire.

Questions included in the child survey were taken from previous smoking research, and adapted for the current study, with permission granted from the author, as well as relevant questions from the CDC report on youth tobacco use. Permission was not needed to utilize questions from the CDC, as it was deemed public access. Questions focused on smoking/e-cigarette use status and history, communication with a parent or provider about smoking/vaping, and intentions to smoke/use e-cigarettes or vapor products.

Smoking/ENDS status and history. Standard questions from youth tobacco surveys were used to assess the youngster's current smoking/ENDS status, history of smoking-related behaviors and ENDS use, and smoking/ENDS status of their peers (CDC, 2009; Warren et al., 2008). Never smokers were defined as those who *never smoked a cigarette, not even a puff*. Ever smokers were defined as those who have smoked at least one cigarette but have not smoked in the past month. Current smokers were defined as those who smoked at least one cigarette in the last 30 days. Current ENDS users were defined as those who used an electronic cigarette or other vapor product in the last 30 days. Participants who reported using an e-cigarette or other vapor product in the past or who never used an e-cigarette were considered Ever and Never ENDS users, respectively. Dual users were defined as those who used both a combustible tobacco product (combustible cigarette) and an ENDS product in the past 30 days. Although we collected information about smokeless tobacco use, this information was not used in the analysis and was only

used for descriptive purposes. Child participants were asked about their exposure to e-cigarettes/vaping in their home and vehicles in the last 30 day using yes/no response options. Completion of this scale is estimated to require 5 minutes to complete.

Intentions to smoke. Intentions to smoke were assessed among never-smokers only. This 6-item self-report instrument assesses a youngster's future intentions to smoke (Tyc et al., 2003). Responses were rated on a 5-point scale ranging from *Very Unlikely* to *Very Likely*. Total scores range from six to 30, with higher scores representing greater intentions to use tobacco. The measure has been used repeatedly with samples of preadolescent and adolescent cancer survivors (Tyc et al., 2006; Tyc et al., 2003; Tyc, 2001). Good internal consistency, based on Cronbach's alpha coefficients ranging from .74 to .88, has been established (Tyc et al., 2003; Tyc et al., 2006). Self-reported intention to use tobacco has consistently been used as a proximal outcome measure in adolescent smoking research because prospective studies have demonstrated smoking intentions to be a strong predictor of future smoking behavior (Conrad, Flay, & Hill, 1993; Eckhardt, Woodruff, & Edler, 1994; Klosky et al., 2010). This scale requires less than 5 minutes to complete.

Intentions to use e-cigarettes/ vape. Intentions to use ENDS products (e-cigarettes/vapor products) were assessed only among youngsters who have never used e-cigarettes or vapor products. This 6-item self-report instrument assesses a youngster's future intentions to use e-cigarettes/vape and is similar to measures of

intentions to smoke cigarettes previously published (Tyc et al., 2003). Responses were rated on a 5-point scale ranging from *Very Unlikely* to *Very Likely*. Total scores range from six to 30, with higher scores representing greater intentions to use ENDS or vape. This scale requires less than 5 minutes to complete.

Communication about Smoking and ENDS Use. Child participants were asked if they ever talked with their parent or provider (doctor/nurse) about the effects of smoking, ENDS use/vaping, or secondhand smoke/vapor exposure on their health. Items were scored yes/no.

Parent Questionnaire.

Items included in the parent survey were taken from previous smoking research and adapted for the current study, with permission granted from author, as well as national surveys (National Youth Tobacco Survey [NYTS], 2017). Items asked about parent smoking/ENDS use status and history, as well as rules about smoking/vaping in their family homes and vehicles.

Smoking/ENDS status and history. (Parent). Parents were asked about their past and current smoking/ENDS status. Ever smokers were defined as those who have smoked at least 100 cigarettes in their lifetime as defined in prior studies (CDC, 2015) and who did not smoke at the time of the survey. Participants who denied having smoked at least 100 cigarettes in their lifetime were considered never smokers. Current smokers were defined as those who smoked at least 100 cigarettes in their lifetime and who currently smoke every day or some days. Ever ENDS users were defined as those who have used an e-cigarette or vapor product at

least once in their lifetime. Current ENDS users were defined as those who use e-cigarettes or vapor products on some or every day. Participants who respond they have never used an e-cigarette in their lifetime were considered Never ENDS users. Parents were also be asked to report on the number of smokers in their home. Responses were categorized into 0 smokers, 1-2 smokes, and ≥3 smokers in the home.

Smoking/Vaping Bans. Parents/caregivers were asked to report on the smoking rules or policies in the family home and vehicle as done in prior studies (Bettcher et al., 2007; Martinez-Donate, Hovell, Hofstetter, González-Pérez, 2007; Tyc et al., 2009; Winickoff et al., 2009). For the purpose of this study, a complete ban was defined as a 100% smoke-free/vape-free home and car (defined as absolutely no smoking of any tobacco product, or e-cigarettes, inside the family home and car/truck at any time); a partial ban was defined as smoking/use of e-cigarettes is only allowed by certain people or at specific times (i.e., when child is not present) or no bans (defined as smoking/use of e-cigarettes is allowed anywhere in the home and car/truck at any time). Ban status in the home and vehicle was determined separately for smoking and vaping and then combined. Scoring for this outcome was dichotomized as complete vs. partial/absent ban in the home and vehicle. This measure was estimated to take no more than 10 minutes to complete.

Research Design and Data Analytic Plan

This study utilized a cross-sectional design. Descriptive statistics, including means, standard deviations, and frequencies were calculated for child and parent demographics, the primary outcomes (rates of tobacco/ENDS use/dual use, intentions to use tobacco or ENDS products, communication, and rates of smoking/vaping bans), and all covariates. Chi square testing was conducted to examine the relationship between primary outcomes of child smoking and vaping status (and dual use status) and demographic and tobacco-related variables. When some cells in the cross-tabulations were smaller than five, a Fisher's exact test was performed. Independent sample t-tests were used to compare diagnostic groups on age and to examine group differences on intentions scores. All analyses were considered significant at the $p < .05$ level. Analyses were conducted using SPSS version 25.0.

Results

Participants

Table 1 displays the demographic characteristics for child participants (N = 70). Child participants had a mean age of 12.68 years (SD = 2.29; range, 10 to 17 years). The majority of child participants were White (80%). Consistent with rates observed in the ASD population, the majority of participants were male (78.6%), with fewer female participants (20%). Gender was not provided for one participant. A total of 51 child participants (72.9%) had a diagnosis of ASD only. Of the ASD

sample, 27.1% (n = 19) had a comorbid diagnosis of ADHD. Given the limited number of participants with a diagnosis of comorbid ASD/ADHD, the primary analyses for the study were based on the total sample rather than by diagnostic group. The majority of child participants were in the 5th grade (32.9%) and enrolled in a mainstream classroom (51.4%). Per parent report, the sample also consisted of children enrolled in special education classrooms (34.3%) or in a mainstream class with pull-outs for therapeutic services (14.3%).

The majority of parent participants were between the ages of 30 to 39 years (40%), with 34.3% of parents between the ages of 20 to 29 years. Parent participants were on average 33.0 years of age (SD = 7.23; range, 26 to 55 years). The gender distribution of the parent sample was equally divided. Over half of parents were either a college graduate (52.9%) or had received some college education (27.1%). The majority of parents were also married (67.1%) and parenting with a spouse (65.7%). Demographic data for the parents sampled (N = 70) are presented in Table 2.

Child Smoking Status/History.

For the total sample, 50% of child participants endorsed a history of cigarette use (n = 35), with the remaining 50% identified as never-smokers. The smoking status of child participants in the total sample and for the ASD and comorbid ASD/ADHD groups are presented in Table 3. Of those that endorsed smoking cigarettes, 38.6% (n = 27) were current smokers whereas 11.4% (n = 8)

were ever-smokers (see Table 3). Of smoking youth, 18.2% (n = 6) reported smoking their first cigarette at age 8. Rates of smoking (defined as current + ever smoking vs. never smoker) between children with ASD and co-morbid ASD/ADHD were not significantly different; X^2 (1, N = 70) = 0.07, p = 0.79; however, these results should be interpreted with caution as the ASD/ADHD group was composed of few participants (n = 19).

Of those children who reported smoking, approximately 15% (n = 11) reported smoking less than one cigarette per day on days smoked within the past 30 days. Only 4.3% (n = 3) of youth reported smoking between six to 10 cigarettes per day. Furthermore, the majority of child participants (67%) reported having never used smokeless tobacco products and 7.1% had previously used smokeless tobacco within the past 30 days (n = 5).

Chi square testing and independent t-tests were conducted to examine the association between demographic and tobacco-related variables and child smoking status. Frequencies for child and parent demographic and tobacco-related variables are presented in Tables 4 & 5. For these analyses, ever smokers and current smokers were combined and compared to never smokers. Of the demographic variables assessed, child gender, X^2 (1, N = 70) = 0.44, p = 0.51, race, X^2 (1, N = 70) = 0.75, p = 0.39, and diagnosis, X^2 (1, N = 70) = .07, p = 0.79, were not significantly associated with child smoking status. However, there were significant differences in age between smokers and nonsmokers; (t(68) = -2.36,

p = 0.02), smokers were older (M = 13.29, SD = 2.38) than nonsmokers (M = 12.00, SD = 1.86).

Further analyses revealed a significant relationship between the child's smoking status and having at least one parent who smoked, X^2 (1, N = 70) = 16.95, p =0.00. Likewise, the number of adult smokers in the home was significantly associated with child's smoking status, X^2 (1, N = 70) = 18.51, p = 0.00, with the majority of current smoking youth living in homes where one or more smoker resided. Child smoking status was also significantly related to the number of the child's friends who smoked, X^2 (1, N = 70) = 42.13, p = 0.00; a greater proportion of children who reported having one or more friends who smoked combustible cigarettes were smokers. (See Tables 4 & 5).

A significant association was also observed between child smoking status and child-reported exposure to cigarette smoke in the home, X^2 (1, N = 70) = 13.83, p = 0.00. Of those who reported SHSe within the past 30 days, 86.7% were smokers compared to 13.3% of nonsmoking children. (See Table 4). Similarly, there was a significant relationship between past exposure to smoking in a vehicle and youth smoking status, X^2 (1, N = 70) = 8.00, p = 0.01. Children who reported being exposed to smoking in a vehicle within the past 30 days were likely to be smokers. (See Table 4).

Exposure to ENDS also appears to play a role in child smoking status. Parent vaping status was significantly associated with child smoking status, X^2 (1, N = 70) = 6.34, p = 0.01, with the majority of smoking youth having a parent who

vaped (See Table 5). A significant relationship was observed between the number of adult vapers in the home and youth smoking status, X^2 (1, N = 70) = 21.89, p = 0.00, with youth residing in a home with one or more adults who use ENDS products/vape more likely to be smokers. Significant associations were also noted between child smoking status and child-reported exposure to vapor products in the home, X^2 (1, N = 70) = 17.98, p = 0.00, and car, X^2 (1, N = 70) = 8.23, p = 0.01. Children who reported exposure to vapor products in the home and car were more likely to smoke (See Table 4).

Intentions to Smoke.

Intentions to smoke were evaluated among current nonsmokers only (possible scores ranged from 6 to 35), with higher scores representing greater intentions to smoke in the future. The mean total intentions score endorsed by child participants was 10.5 (SD = 2.42). The total scores observed ranged from six to 11. Only three participants endorsed no intentions to smoke in the future (scores = 6), while the remaining 31 participants endorsed some intentions to smoke (scores > 6). A comparison of mean scores for intentions to smoke between groups based on age (10 to 13 yrs vs. 14 to 17 yrs), gender (male/female), race (white/ non-white), parent smoking status (0 versus 1 or more parent smokers), peers who smoke (0 versus 1 or more friends who smoke) was conducted using independent t-tests. No significant differences in intentions scores were found between the groups based on

age, t (28) = -.456. p >.05, gender, t (32) = -1.58, p <.05, race t (31) = -.278. p >.05, parent smoking status t (32) = 1.11, p >.05, peer smoking status t (32) = -1.76, p >.05, or smoking and vaping bans t (31) = .684. p >.05. Means and standard deviations for these comparisons are indicated in Table 6.

Child Vaping Status/History.

Of the total sample, 45.7% (n = 32) of child participants endorsed a history of e-cigarette/vape use whereas 54.3% (n = 38) were identified as never-ENDS users. Of those that endorsed using e-cigarettes/vapes, 37.1% (n = 26) were current ENDS users whereas 8.6% (n = 6) were ever-ENDS users (see Table 3). Approximately 29.6% (n = 8) of those who used e-cigarettes or vapor products reported first doing so at age 16 and 21.9% (n= 7) using these products by age 15. The youngest reported age of first use of an e-cigarette/vape was age 8 (n = 1). Of current vaping youth, 23.1% (n = 6) reported vaping on one day, 23.1% (n = 6) on two to 10 days, 23.1% (n = 6) on 11 to 20 days in their lifetime, with 30.8% (n = 8) vaping three to five days within the past 30 days. Rates of vaping (defined as current + ever vapers vs. never vapers) observed between youth with ASD and comorbid ASD/ADHD were not significantly different, X^2 (1, N = 70) = 1.56, p = .21; however, there was a limited number of participants in the ASD/ADHD group. (See Table 3). Of current ENDS users who responded to the question about nicotine use (n = 19), 57.7% (n = 15) reported use of e-cigarettes/vapes that contain

nicotine while only 11.5% (n = 3) of users' products did not contain nicotine and 3.8% (n = 1) were unsure if their product contained nicotine.

Chi square analyses were conducted to examine the association between demographic and tobacco-related variables and child vaping status. (See Table 4). For these analyses, ENDS users (defined as ever + current ENDS users) were compared to never ENDS users. Child demographic and tobacco-related variables for child ENDS users and child never ENDS users are indicated in Table 4. Child demographic variables including gender, X^2 (1, N = 70) = 2.66, p = 0.10, race, X^2 (1, N = 70) = 0.36, p = .55, and diagnosis X^2 (1, N = 70) = 1.56, p = 0.21 were not significantly associated with child vaping status. Children who used ENDS products were significantly older (M = 13.52, SD = 2.43) than children who did not use e-cigarettes/vape, (M = 11.91, SD = 1.86); t (68) = -2.99, p =. 004. (See Table 4).

As can be seen with the frequencies in Table 5, child vaping status was also significantly associated with parent vaping status, X^2 (1, N = 70) = 9.11, p = 0.00. Likewise, there was a significant relationship between child vaping status and the number of adult ENDS users/vapers in the home, X^2 (1, N = 70) = 12.73, p = 0.00. (See Table 4). Children who lived with adults who used ENDS products were more likely to use ENDS themselves.

A significant association was also observed between child vaping status and parent smoking status, X^2 (1, N = 70) = 17.82, p = 0.00. Children who vaped were more likely to have parents who smoked (see Table 5). A significant

relationship between reported child-reported past exposure to smoking in the home and youth vaping status was also observed, X^2 (1, N = 70) = 11.09, p = .001. Children who were exposed to SHS in the home were more likely to be ENDS users compared to non-ENDS users. (See Table 4). Likewise, exposure to smoking in the vehicle was also significantly related to the child's vaping status, X^2 (1, N = 70) = 5.57, p = 0.02. Furthermore, significant relationships were observed between the child's vaping status and the number of adult smokers (of combustible tobacco) in the home, X^2 (1, N = 70) = 19.09, p = 0.00, and number of adult vapers in the home, X^2 (1, N = 70) = 12.73, p = 0.00; a greater proportion of children who were exposed to adult smokers (61.7%) and vapers (63.2%) in the home used ENDS compared to the proportion of children who were exposed and did not use ENDS products (38.3% and 36.8%, respectively). (See Table 4).

Past exposure to vaping in the home as reported by child participants was also significantly related to child vaping status, X^2 (1, N = 70) = 14.37, p = 0.00. (See Table 4). A greater proportion of children who reported exposure to vapor products in the home within the past 30 days were ENDS users (76.0%) compared to the proportion of children who were non-ENDS users (24.0%). The relationship between child vaping status and reported exposure in the vehicle was also significant, X^2 (1, N = 70) = 7.99, p =0.01.

Having friends who vaped was also significantly related to child vaping status, X^2 (1, N = 70) = 4.14, p = 0.05; among youth reporting having one or more friends who vaped, 60% were ENDS users compared to 40% who did not use

ENDS. Two smoking variables were significantly associated with the child's vaping status, including child smoking status, X^2 (1, N = 70) = 45.13, p = 0.00 and number of friends who smoked combustible cigarettes, X^2 (1, N = 70) = 40.24, p = 0.00, (see Table 4).

Intentions to Vape.

Intentions to vape were evaluated among current non-vapers in the sample (n = 34) (ranging from 6 to 35), with higher scores representing greater intentions to vape in the future. Four non-vapers did not complete the intentions to vape measure. The mean total intentions score endorsed by child participants was 9.69 (SD = 4.32) with total scores ranging from 6 to 27. Only 12 participants endorsed no intentions to vape in the future (scores = 6) while the remaining 23 participants endorsed some intentions to vape (scores > 6). Mean scores of intentions to vape were compared between groups based on age (10 to 13 yrs vs. 14 to 17 yrs), gender (male/female), race (white/non-white), parent vaping status (0 versus 1 parent vapers), peers who vape (0 versus 1 or more friends who vape). No significant differences in intentions scores were obtained for comparisons between these groups according to age, t (28) = .255, p >.05, gender, t (32) = -.327, p >.05, race t (31) = -.158, p >.05, parent vaping status, t (32) = .351, p > .05, peer vaping status, t (30) = -1.12, p > .05, or smoking and vaping bans, t (31) = -1.29, p >.05. Means and standard deviations for these comparisons are shown in Table 6.

Dual users.

Dual users were identified as individuals who smoked cigarettes and also used ENDS/vaped. Single users were identified as those who used only one product, either cigarettes or ENDS/vapor products. Of identified tobacco users, 31 children (83.8%) were dual users and only 6 (99.2%) were single product users. Of the single product users, 4 children only reported smoking cigarettes whereas only 2 used ENDS products or vaped. Fishers exact test (p = 0.00) revealed that children who vaped were significantly more likely to be dual users. Results are shown in Tables 7 and 8.

Smoking bans.

Overall, 45.7% of parents endorsed implementing a complete smoking ban in the home (n = 32) and 38.6% endorsed a complete smoking ban in the family vehicle (n = 27). A partial ban in the home was implemented by 47.1% of parents and 54.3% of parents reported partial bans in the family vehicle (see Table 9).

Chi square analyses were conducted to examine the association between smoking bans in the home and vehicle and child smoking and vaping status. (See Table 10). Significant relationships were observed between child smoking status and smoking bans in the home, X^2 (1, N = 69) = 29.41, p = 0.00, as well as smoking bans in the vehicle, X^2 (1, N = 69) = 22.18, p = 0.00. As based on the frequencies presented in Table 10, nonsmoking children were more likely to come from homes that implemented complete bans in both the home and car. Similar results were

seen with the implementation of smoking bans in the home, X^2 (1, N = 69) = 22.69, p = 0.00, and vehicle, X^2 (1, N = 69) = 22.18, p = 0.00, on child vaping status, indicating that children who never used ENDS products were more likely to come from homes with complete smoking bans in the home and vehicle.

Vaping bans.

Overall, 37.1% of parents endorsed implementing a complete vaping ban in the home and 34.3% endorsed a complete vaping ban in the family vehicle. About half of parents, 51.4%, reported implementing a partial ban in the home. Additionally, 47.1% endorsed implementing a partial ban in the family vehicle. (See Table 9).

Further analyses revealed significant relationships between child vaping status and vaping bans in the home, X^2 (1, N = 69) = 23.22, p = 0.00, and vehicle, X^2 (1, N = 69) = 22.33, p = 0.00. (See Table 10). Overall, non-vaping children were more likely to come from homes that implemented complete vaping bans in both the home and car. Similar significant results were seen with the implementation of vaping bans in the home X^2 (1, N = 69) = 23.52, p = 0.00, and vehicle, X^2 (1, N = 69) = 22.55, p = 0.00, on child smoking status, indicating that smoking youth were more likely to come from homes and vehicles with partial or no vaping bans.

Of parents sampled, only 35.7% (n = 25) endorsed both complete smoking and vaping bans in both the home and vehicle. Of parents with complete smoking

bans implemented in the home, 78.1% also implemented complete smoking bans in the family vehicle (n = 25). Similarly, 75% of families who implemented complete smoking bans in the home also implemented complete vaping bans in the home (n = 24), while 71.9% implemented complete vaping bans in the vehicle (n = 23). Of families who had complete smoking bans in the vehicle, 85.2% also implemented complete vaping bans in the vehicle (n = 23). (See Table 10). The effects of smoking and vaping bans on dual user status, although not significant, can be observed in Table 11.

Communication.

Table 12 displays reported communication between child participants and their parents and doctors/nurses regarding the dangers of smoking, SHSe, vaping, and exposure to vapor products by child smoking and vaping status. One child did not complete questions in this section. Significant relationships were observed between child smoking status and child communication with their doctor about the dangers of smoking, X^2 (1, N = 69) = 9.12, p = 0.00, and vaping as well as discussions with their doctor regarding the dangers of SHSe, X^2 (1, N = 69) = 7.17, p = 0.01 and X^2 (1, N = 69) = 5.40, p = 0.02, respectively. Child vaping status was also significantly associated with child communication with their doctors about smoking X^2 (1, N = 69) = 5.72, p = 0.03).

Parent Smoking and Vaping Status and Related Perceptions

In regard to smoking behaviors, 25.7% of parents were identified as never smokers (n = 18), 8.6% were identified as former smokers (n = 6), and 57.1% were identified as current smokers (n = 40). (See Table 5). In addition, 40% of parent participants reported having a spouse or partner that smoked. On average, households consisted of 1.74 adult smokers (over the age of 18) and 1.35 child smokers (under the age of 18). In regard to parent vaping status or use of ENDS products, 34.3% were identified as never ENDS users (n = 24), 11.4% were identified as ever ENDS users (n = 8), and 54.3% were identified as current ENDS users (n = 38). Of current vapers, only 12.9% reported using e-cigarettes or vapor products that contain nicotine. Additionally, 31.4% of parents reported having a spouse or partner that vaped. On average, households consisted of 1.6 adults who used e-cigarettes or vape products and 1.2 children under the age of 18 who used e-cigarettes or vape products.

In regard to harm perceptions, about half of parents surveyed (52.9%) viewed e-cigarettes/vapor products as just as harmful as combustible cigarettes, while 35.7% viewed them as less harmful and 11.4% viewed them as more harmful than combustible cigarettes. The relationship between implementing vaping bans in both the home and vehicle and parental harm perceptions about vaping was significant X^2 (1, N = 70) = 5.61, p = .018. Of the parents who viewed ENDS products as less harmful than other tobacco products 82.6% implemented partial or

no bans in the home and vehicle as compared to 17.4% who implemented complete bans.

Discussion

Impact of Study

Previous clinical studies have produced inconsistent findings regarding the frequency of substance use problems among individuals with autism spectrum disorder. Older studies suggested substance-use problems were of low frequency among those with autism spectrum disorders (Santosh and Mijovic, 2006, Sizoo et al., 2010) while more recent studies suggested autistic-like traits increase the risk of substance abuse (Butwicka et al., 2017; De Alwis et al., 2014; Lundstrom et al., 2011). Results from this pilot study indicated that 50% of our child sample were current smokers, approximately 46% were vapers, and 86.5% reported dual use of cigarettes and e-cigarettes, although it is difficult to determine use of which product came first. Our findings suggest that youngsters who used ENDS products were also more likely to be dual users which is concerning as previous research has suggested that ENDS use may renormalize smoking (Andrade, Hastings, & Angus, 2013; McRobbie, Bullen, Hartmann-Boyce, & Hajek, 2014) and serve as a "gateway drug," introducing non-smoking youth to nicotine (Carroll Chapman & Wu, 2012; Dutra & Glantz, 2014; Leventhal et al.,

2015; Primack, Soneji, Stoolmiller, Fine, & Sargent, 2015; Walley & Jenssen, 2015).

While this study was more limited in size, rates of smoking among youth in our sample were at least comparable to recent national studies (CDC, 2016) or higher than those reported in studies involving samples of individuals with autism (Fortuna et al., 2016; Shapir et al., 2016). Additionally, this is the first study to document vaping rates among youngsters with ASD which are equally as prevalent as reported smoking rates in this sample and higher than national rates of vaping among middle and high school students from the general population (Kann et al., 2015; Singh et al., 2016). Although our more recent findings may reflect temporal trends of increased ENDS use in the past two years, these collective findings suggest that having a diagnosis of ASD does not discourage youngsters from using tobacco or ENDs products. Furthermore, rates of smoking and vaping observed between individuals with ASD and those with comorbid ASD and ADHD were similar, suggesting that youngsters with ASD may be at risk for cigarette/e-cigarette use even if they do not have a diagnosis of ADHD.

To our knowledge, this study is also the first to assess intentions to use cigarettes, e-cigarettes, and ENDS products among nonsmoking children with autism. While overall total intentions scores were generally low, only a limited number of participants endorsed total abstinence from smoking and vaping in the

future suggesting that youth with ASD may be at risk for future experimentation and initiation of these products. Lower overall intentions scores observed among children in the sample may reflect a tendency for children in the sample to present themselves in a positive way. However, given the small number of nonsmokers and non-vapers in the sample and the limited variability observed in the intentions scores, the association between demographic and tobacco-related variables on this outcome was difficult to assess. Nonetheless, anticipatory guidance and preventative interventions by parents and clinical providers about future health risks associated with smoking and vaping are warranted in the ASD population.

The finding that many youngsters have talked with their parents about smoking and vaping is a promising step, although less than half have talked with their providers about this habit. However, no association was found between communication with parents or health care providers about vaping and child vaping status or dual user status. Surprisingly, child smokers in our sample were more likely to have talked with their providers about secondhand smoke exposure (SHSe) although it cannot be determined who initiated this discussion and if the discussions preceded or followed inquiry about the child's smoking habits. Given the communication difficulties that are characteristic of youth with Autism, in addition to underestimates of the rates of tobacco use and vaping in this population, it is likely that education regarding the dangers of tobacco use and ENDS use is often overlooked by

healthcare providers. The high rates of tobacco use and vaping among children with ASD suggest that providers should consider integrating tobacco/vaping screening, as well as screening for other forms of substance use, into routine clinical assessments with this population.

The finding that only about 46% and 37% of our sample had complete smoking and vaping bans in their homes, respectively, is disturbing. These results are less impressive than previously reported national rates of home smoking bans which according to the CDC were as high as 83% in 2010-2011 (CDC, 2015; King, Pattel. & Babbo, 2016; Jamal, Dube, Babb, & Malarcher, 2014). Rates of vehicle bans reported in this study (38.6% for smoking and 34.3% for vaping) are comparable to those reported (smoking bans only) in prior studies (CDC, 2015; King, Duba & Homa, 2013; Nabi-Burza et al., 2012). To date, no other studies have examined vaping restrictions in home or vehicles. Of note is that 75% of families who implemented smoking bans in their homes also restricted vaping in their homes and approximately 85% of those who banned smoking in their vehicles also banned vaping. This suggests that most, but not all parents, who recognize the dangers of SHSe from tobacco are also aware of the risks associated with exposure to ENDS products. Additionally, children's vaping and smoking status were also significantly associated with the presence of smoking restrictions in their home and vehicles.

Despite the expansion of smoke-free policies in public places and increased adoption of smoke-free homes across the US (CDC, 2016a), these efforts have not reached a substantial proportion of families in our study who continue to smoke and vape around their child. Given the potential health difficulties and shortened lifespan of those with ASD, it is imperative to reduce second hand smoke exposure to prevent further health complications exacerbated by SHSe. Although the long-term health effects of vaping and exposure to second hand vapors are still under investigation, initial studies have confirmed that second hand vapors expose others to toxic metals and known carcinogens (CDC, 2016a; Olmedo et al., 2018). Approximately 64% of parents in our sample perceived vaping to be just as harmful or more harmful than traditional cigarettes, which is slightly higher than rates observed in previous studies (Nguyen, Tong, Marynak, & King, 2017). While this is encouraging and may be reflective of recent research suggesting serious health consequences associated with vaping as well as increased media coverage of adolescent vaping in recent months, additional psychoeducation regarding harmful effects of vaping/ENDs products is clearly warranted. Whether parental perceptions are influenced by having a child with a neurodevelopmental disorder was not assessed in this study. Interventions that encourage smoke and vape-free policies across settings, and that provide parents with skills to translate their

perceptions of harm into actions to reduce their child's exposure are needed to reach at-risk families.

Exploratory analyses of risk factors associated with smoking and vaping status in children with ASD suggested that many of the same risk factors that influence the general population may also influence whether children with ASD smoke and vape. Results suggested that age, number of adult smokers/vapers in the home and peer smoking/vaping may play an important role in smoking/vaping behaviors and some of these factors are modifiable with intervention. Like their peers without ASD (Cambron, Kosterman, & Catalano, 2018; CDC, 1994; Wellman et al., 2016), children with ASD are exposed socially to peers who smoke and vape and have potential access to tobacco and ENDS products which may influence their own use. Children with ASD may also be inclined to experiment with tobacco and ENDs products if their parents and other family members smoke.

Collectively, these findings move us toward a better understanding of smoking and vaping and ASD. An important implication of our findings concerns diagnostic and treatment strategies for youth with ASD, as increased risk of tobacco use and vaping in youth with ASD suggests the need for preventative measures in this population. Our preliminary data suggests that attempts to encourage parent smokers and vapers in smoking/vaping cessation may help deter

youngsters from developing this habit by reducing exposure. Likewise, establishing clear rules about not smoking or vaping in the child's home and car environment is also critical in smoking/vaping prevention efforts. Furthermore, children with ASD may benefit from learning problem-solving and refusal skills to resist peer pressure to smoke which may need to be tailored to their unique challenges in social interaction and communication and sometimes rigid, norm-abiding styles. Lastly, it is important that providers screen for tobacco /ENDS use at all visits and provide consistent messaging about abstinence from tobacco and ENDS.

Limitations and Future Directions

Although this study was able to meet its objectives to obtain information about rates of tobacco use and ENDS use in individuals with ASD as well as identify variables that are associated with a child's smoking and vaping status, consideration should be given to several methodological limitations. As with any survey of this type, respondents were self-selecting, thus the sample should not be assumed to be representative of the population as a whole. However, as there is no national registry of children with developmental delays, there is no database from which to randomly draw participants. For these reasons, most participants were collected through MTurk. While this recruiting mechanism has been supported for use with social surveys, participants received monetary compensation, which likely

influenced self-selection and motivation to participate and limited the representativeness of the sample and generalizability of this study. In addition, our sample was largely white and limited in racial diversity, further compounding the lack of generalizability of our results. Although ASD occurs in all races and ethnicities, research has suggested that African Americans and Hispanic populations are at a disadvantage in receiving a medical diagnosis, which may have impacted the number of racial minorities represented in the literature as well as our sample (Mandell et al., 2009). Additionally, it was not possible to verify diagnosis of participants recruited online. Thus, it may be possible for individuals to falsify diagnostic information in order to participate in the study. Future research may benefit from identifying participants from established databases, or medical records, where a diagnosis can be verified.

The small sample size of this study was also a concern such that the findings from this study should be interpreted with caution. Given the limited number of participants, it was difficult to complete group analyses across many variables, including a comparison of individuals with comorbid ADHD and ASD. Thus, the opportunity to examine the contribution of ADHD, a known risk factor for tobacco use, was not possible. Similarly, limited variability in our intentions measures restricted our ability to determine clinically meaningful predictors of intentions to smoke and vape in vulnerable youth. Furthermore, the limited sample size of dual users restricted our ability to determine

clinically significant predictors that lead vulnerable youth to engage in dual use of tobacco products. Nonetheless, our exploratory analyses suggest trends that should be further explored in later studies.

The use of self-report data to assess tobacco use in children in our sample may also represent an additional limitation of this study. Although we emphasized that parents allow their children to complete the survey independently, parental monitoring, if present, may have led to under-estimates of reported tobacco and ENDS use among child participants. It is also possible that child participants with lower reading capabilities required assistance from their parents, which may have influenced the responses provided. Future research may benefit from in-vivo surveys where they are able to control for parental monitoring or guidance.

Lastly, this study was limited in its use of cross-sectional data. Because of the nature of the questionnaire data, directionality and causality cannot be established, leaving a degree of uncertainty regarding the relationship between predictors and outcomes. Future research should include a longitudinal approach and seek to utilize increased intervals to better understand directionality of outcomes over time. This will also enable more precise timing for delivery of targeted interventions for vulnerable youth with ASD at varying levels of risk.

Appendix A
Tables and Figures

Table 1
Child Demographic Information

Variable	Total sample (N=70)
	M (SD)
Age (yrs)	12.68 (2.29)
	n (%)
Gender	
Male	55 (78.6%)
Female	14 (20.0%)
Missing/no data	1 (1.4%)
Diagnosis	
Autism	51 (72.9%)
Autism + ADHD	19 (27.1%)
Race/Ethnicity	
Caucasian	56 (80.0%)
African American	1 (1.4%)
Asian-American/Pacific Islander	5 (7.1%)
American Indian/Alaska Native	5 (7.1%)
Biracial	2 (2.9%)
Missing/no data	1 (1.4%)
Academic Level	
5th Grade	23 (32.9%)
6th Grade	10 (14.3%)
7th Grade	14 (20.0%)
8th Grade	5 (7.1%)
9th Grade	6 (8.6%)
10th Grade	3 (4.3%)
11th Grade	6 (8.6%)
12th Grade	3 (4.3%)
Class specifics	
Mainstream classroom	36 (51.4%)
Special education classroom	24 (34.3%)
Mainstream classroom with therapy	10 (14.3%)
Involvement in Extracurricular	
Yes	36 (51.4%)
No	34 (48.6%)

Table 2
Parent Demographic Information

Variable	Total Sample (N=70) n (%)
Age (yrs)	
20-29	24 (34.3%)
30-39	28 (40.0%)
40-49	10 (14.3%)
50-59	2 (2.9%)
Missing/no response	6 (8.6%)
Gender	
Male	35 (50.0%)
Female	34 (48.6%)
Missing/no data	1 (1.4%)
Marital Status	
Single	11 (15.7%)
Married	47 (67.1%)
Separated	2 (2.9%)
Divorced	5 (7.1%)
Cohabitating	5 (7.1%)
Education	
High School Graduate/GED	7 (10.0%)
Some College	19 (27.1%)
College Graduate	37 (52.9%)
Graduate Degree	7 (10.0%)

Table 3

Smoking Status for Total Sample and Diagnostic Groups

Variable	Total Sample (N=70) n (%)	ASD (n=51) n (%)	ASD+ADHD (n=19) n (%)	X^{2*}
Smoking Status				0.07
Never smoker	35 (50.0%)	25 (49.0%)	10 (52.6%)	
Ever smoker	8 (11.4%)	8 (15.7%)	0 (0.0%)	
Current smoker	27 (38.6%)	18 (35.3%)	9 (47.4%)	
Vaping Status				1.56
Never ENDS	38 (54.3%)	30 (58.8%)	8 (42.1%)	
Ever ENDS user	6 (8.6%)	4 (7.8%)	2 (10.5%)	
Current ENDS	26 (37.1%)	17 (33.3%)	9 (47.4%)	

Note. For Chi square analyses, smoking and vaping status were analyzed by Smoker/ENDS user (Current + Ever user) versus Never Smoker/Never ENDS user

*P>.*05*

Table 4
Child Demographic and Tobacco-Related Variables By Smoking and Vaping Status

Variable	Child Smoking status			Child Vaping status		
	Smoking (n=35) M (SD)	Non-smoking (n=35) M (SD)	*t*	Vaping (n=32) M (SD)	Non-vaping (n=38) M (SD)	*t*
Age	13.29 (2.48)	12.00 (1.86)	-2.36*	13.52 (2.43)	11.91 (1.86)	-2.99*
	n (%)	n (%)	X^2	n (%)	n (%)	X^2
Gender			0.44			2.66
Male	26 (47.3%)	29 (52.7%)		22 (40.0%)	33 (60.0%)	
Female	8 (57.1%)	6 (42.9%)		9 (64.3%)	5 (35.7%)	
Diagnosis			0.07			1.56
Autism	26 (49.0%)	25 (51.0%)		21 (41.2%)	30 (58.8%)	
Autism + ADHD	9 (47.4%)	9 (52.6%)		11 (57.9%)	8 (42.1%)	
Race/Ethnicity			0.75			0.36
White	27 (48.4%)	29 (51.8%)		25 (44.6%)	31 (55.4%)	
Non-white	8 (61.5%)	5 (38.5%)		7 (53.8%)	6 (46.2%)	
Friends who smoke			42.13**			40.24**
None	2 (6.9%)	27 (93.1%)		1 (3.4%)	28 (96.6%)	
1 or more	33 (86.8%)	5 (13.2%)		31 (81.6%)	7 (18.4%)	
Vaping/ENDS status			45.13**			
ENDS user	30 (93.8%)	2 (6.3%)				
Non-ENDS user	5 (13.2%)	33 (86.8%)				
Vape harm beliefs			0.06			0.11
Less than/just as	14 (51.9%)	13 (48.1%)		13 (48.1%)	14 (51.9%)	
More harmful	21 (48.8%)	22 (51.2%)		19 (44.2%)	24 (55.8%)	
Friends who vape			3.95*			4.14*
None	11 (37.9%)	18 (62.1%)		10 (34.5%)	19 (65.5%)	
1 or more	22 (62.9%)	13 (37.1%)		21 (60.0%)	14 (40.0%)	
Adult smokers in home			18.51**			19.09**
None	2 (9.5%)	19 (90.5%)		1 (4.8%)	20 (95.2%)	
1 or more	31 (66.0%)	16 (34.0%)		29 (61.7%)	18 (38.3%)	
Adult vapers in home			21.89**			12.73**
None	4 (14.8%)	23 (85.2%)		5 (18.5%)	22 (81.5%)	
1 or more	28 (73.7%)	10 (26.3%)		24 (63.2%)	14 (36.8%)	
Child reported exposure						
SHSe (home)			13.83**			11.09**
Yes	13 (86.7%)	2 (13.3%)		12 (80.0%)	3 (20.0%)	
No	5 (23.8%)	16 (76.2%)		5 (23.8%)	16 (76.2%)	
SHSe (vehicle)			8.00*			5.57*
Yes	10 (83.3%)	2 (16.7%)		9 (75.0%)	3 (25.0%)	
No	8 (33.3%)	16 (66.7%)		8 (33.3%)	16 (66.7%)	
SHVe (home)			17.98**			14.37**
Yes	21 (84.0%)	4 (16.0%)		19 (76.0%)	6 (24.0%)	
No	14 (31.1%)	31 (68.9%)		13 (28.9%)	32 (71.1%)	
SHVe (vehicle)			8.23*			7.99*
Yes	16 (76.2%)	5 (23.8%)		15 (71.4%)	6 (28.6%)	
No	19 (54.3%)	30 (61.2%)		17 (34.7%)	32 (65.3%)	

Note. Some frequencies may not reflect the total sample
*P<.05, ** p<.001

Table 5

Parent Demographic and Tobacco-Related Variables by Child Smoking and Vaping Status

Variable	Child Smoking status			Child Vaping status		
	Smoking (n=35) n (%)	Non-smoking (n=35) n (%)	X^2	Vaping (n=32) n (%)	Non-vaping (n=38) n (%)	X^2
Parent age (yrs)			4.69*			3.25
20 – 39	31 (59.6%)	21(40.4%)		28 (53.8%)	24 (46.2%)	
40 – 69	3 (25.0%)	9 (75.0%)		3 (25.0%)	9 (75.0%)	
Parent gender			1.76			0.38
Male	20 (57.1%)	15 (42.9%)		17 (48.6%)	18 (51.4%)	
Female	14 (41.2%)	20 (58.8%)		14 (41.2%)	20 (58.8%)	
Parent marital status			5.25*			5.25*
Married	19 (40.4%)	28 (59.6%)		17 (36.2%)	30 (63.8%)	
Not-married	16 (69.6%)	7 (30.4%)		15 (62.5%)	8 (34.8%)	
Parent education			Fishers exact test [F]			Fishers exact test [F]
High school graduate	4 (57.1%)	3 (42.9%)		4 (57.1%)	3 (42.9%)	
Some college	7 (36.8%)	12 (63.2%)		8 (42.1%)	11 (57.9%)	
College/graduate degree	24 (54.5%)	20 (45.5%)		20 (45.5%)	24 (54.5%)	
Parent smoking status			16.95**			17.82**
Smoker	33 (66.0%)	17 (34.0%)		31 (62.0%)	19 (38.0%)	
Non-smoker	2 (10.5%)	17 (89.5%)		1 (5.3%)	18 (94.7%)	
Parent vaping status			6.34*			9.11**
Vaper	28 (60.9%)	18 (39.1%)		27 (58.7%)	19 (41.3%)	
Non-vaper	7 (29.2%)	17 (70.8%)		5 (20.8%)	19 (79.2%)	
Harm beliefs			0.06			0.05
Less than/just as harmful	12 (48.0%)	13 (52.0%)		11 (44.0%)	14 (56.0%)	
More harmful	23 (51.1%)	22 (48.9%)		21 (46.7%)	24 (53.3%)	

Note. Some parents elected to not provide specific information such that frequencies may not reflect the total sample.

[F]= Fishers exact test, $p > .05$

*P<.05, **p<.001

Table 6
Tobacco/ENDs Related Variables and Child Intentions to Smoke and Vape

Variable	Intentions to Smoke (n= 34)				Intentions to Vape (n=34)			
	n	M	SD	*t**	n	M	SD	*t**
Child age (yrs)				-.456				
10-13	24	10.46	2.36		25	10.4	4.56	.255
14-17	6	11.00	3.52		5	9.80	63.8	
Child gender				-1.58				-.327
Male	30	10.73	2.41		29	9.20	1.79	
Female	4	8.75	1.89		5	9.90	4.65	
Child race				-.278				-.158
Caucasian	28	10.46	2.33		27	9.85	4.70	
Non-Caucasian	5	10.80	3.35		6	10.27	2.40	
Peer smoking status				.264				
None	29	10.21	2.29					
1 or more	5	12.20	2.68					
Peer vaping status								-1.12
None					19	9.05	2.90	
1 or more					13	10.85	6.08	
Parent smoking status				1.11				
Smoker	30	10.33	2.14					
Non-smoker	4	11.75	4.19					
Parent vape status								.351
Ends user					17	10.05	5.71	
Non-ENDS user					17	9.53	2.43	
Smoking and vaping				.697				-1.29
Complete bans	22	10.73	2.29		20	9.00	3.48	
Partial + no bans	11	10.09	2.81		13	11.00	5.46	

*p>.05

Note. Some information was not provided such that frequencies may not reflect the total sample. One non-smoker did not complete the intentions to smoke measure. Four non-ENDS users did not complete the intentions to vape measure.

Table 7

Child Demographic Variables by Single Product or Dual User Status

Variable	Child Single Product User or Dual User Status	
	Dual user (n= 31) M (SD)	Single user (n= 6) M (SD)
Age	13.52 (2.44)	13.00 (2.52)
	n (%)	n (%)
Gender		
Male	21 (77.8%)	6 (22.2%)
Female	9 (100.0%)	0 (0.0%)
Diagnosis		
Autism	21 (80.8%)	5 (19.2%)
Autism + ADHD	10 (90.9%)	1 (9.1%)
Race/Ethnicity		
White	24 (82.8%)	5 (17.2%)
Non-white	7 (87.5%)	1 (12.5%)
Friends who smoke		
None	1 (50.0%)	1 (50.0%)
1 or more	30 (85.7%)	5 (14.3%)
Smoking status		
Smoker	30 (85.7%)	5 (14.3%)
Non-smoker	1 (50.0%)	1 (50.0%)
Vaping/ENDS status**		
ENDS user	31 (96.9%)	1 (3.1%)
Non-ENDS user	0 (0.0%)	5 (100.0%)
Vape harm beliefs		
Less than/just as harmful	12 (75.0%)	4 (25.0%)
More harmful	19 (90.5%)	2 (9.5%)
Friends who vape		
None	10 (83.3%)	2 (16.7%)
1 or more	20 (87.0%)	3 (13.0%)
Adult smokers in home		
None	1 (50.0%)	1 (50.0%)
1 or more	28 (84.8%)	5 (15.2%)
Adult vapers in home		
None	4 (66.7%)	2 (33.3%)
1 or more	24 (85.7%)	4(14.3%)
Child reported variables		
SHSe (home)	12 (85.7%)	2 (14.3%)
Yes	5 (100.0%)	0 (0.0%)
No		
SHSe (vehicle)		
Yes	9 (81.8%)	2 (18.2%)
No	8 (100.0%)	0 (0.0%)
SHVe (home)		
Yes	19 (90.5%)	2 (9.5%)
No	12 (75.0%)	4 (25.0%)
SHVe (vehicle)		
Yes	14 (82.4%)	3 (17.6%)
No	17 (85.0%)	3 (15.0%)

Note. Some frequencies may not reflect the total sample.

[F]= Fishers exact test

**p<.001

Table 8

Parent Demographic Variables by Single Product or Dual User Status

Variable	Child Single Product or Dual User Status*	
	Dual user (n= 31) n (%)	Single user (n= 6) n (%)
Parent age (yrs)		
20 – 39	28 (87.5%)	4 (12.5%)
40 – 69	2 (50.0%)	2 (50.0%)
Parent gender[a]		
Male	17 (85.0%)	3 (15.0%)
Female	13 (81.3%)	3 (18.8%)
Parent marital status		
Married	17 (85.0%)	3 (15.0%)
Not-married	14 (82.4%)	3 (17.6%)
Parent education		
High school graduate	4 (100.0%)	0 (0.0%)
Some college	7 (77.8%)	2 (22.2%)
College graduate/Graduate Degree	20 (83.3%)	4 (16.7%)
Parent smoking status		
Smoker	30 (85.7%)	5 (14.3%)
Non-smoker	1 (50.0%)	1 (50.0%)
Parent vaping status		
Vaper	26 (86.7%)	2 (13.3%)
Non-vaper	5 (71.4%)	4 (28.6%)
Harm beliefs		
Less than/just as harmful	11 (84.6%)	2 (15.4%)
More harmful	20 (83.3%)	4 (16.7%)

Note. Some parents elected to not provide specific information such that frequencies may not reflect the total sample.

*Fishers exact test, $p > .05$

[a] Demographic included male/female for purpose of chi square analyses

Table 9
Frequency of Smoking Bans and Vaping Bans

Variable	Total Sample (N=70) n (%)
Smoking ban (home)	
Complete ban	32 (45.7%)
Partial ban	33 (47.1%)
No ban	4 (5.7%)
Smoking ban (vehicle)	
Complete ban	27 (38.6%)
Partial ban	38 (54.3%)
No ban	3 (4.3%)
Vaping ban (home)	
Complete ban	26 (37.1%)
Partial ban	36 (51.4%)
No ban	1 (1.4%)
Vaping ban (vehicle)	
Complete ban	24 (34.3%)
Partial ban	22 (47.1%)
No ban	2 (2.9%)

Note. Some parents elected to not provide specific ban information such that frequencies may not reflect the total sample.

Table 10

Frequency of Smoking and Vaping Bans by Child Smoking and Vaping Status

Variable	Child Smoking status			Child Vaping status		
	Smoking (n = 35) n (%)	Non-smoking (n =35) n (%)	X^2	Vaping (n=32) n (%)	Non-vaping (n=38) n (%)	X^2
Smoking ban (home)			29.41**			22.69**
Complete ban	5 (15.6%)	27 (84.4%)		5 (15.6%)	27 (84.4%)	
Partial/no ban	30 9 (81.1%)	7 (18.9%)		27 (73.0%)	10 (27.0%)	
Smoking ban (vehicle)			22.88**			22.18**
Complete ban	4 (14.8%)	23 (85.2%)		3 (11.1%)	24 (88.9%)	
Partial/no ban	31 (73.8%)	11 (26.2%)		29 (69.0%)	13 (31.0%)	
Vaping ban (home)			23.52**			23.22**
Complete ban	3 (12.0%)	22 (88.0%)		2 (8.0%)	23 (92.0%)	
Partial/no ban	32 (72.7%)	12 (27.3%)		30 (68.2%)	14 (31.8%)	
Vaping ban (vehicle)			22.55**			22.33
Complete ban	3 (12.5%)	21 (87.5%)		2 (8.3%)	22 (91.7%)	
Partial/no ban	32 (72.7%)	12 (27.3%)		30 (68.2%)	14 (31.8%)	
Complete smoking ban (home + vehicle)			23.52**			23.22**
Yes	3 (12.0%)	22 (88.0%)		2 (8.0%)	23 (92.0%)	
No	32 (72.7%)	12 (27.3%)		30 (68.2%)	14 (31.8%)	
Complete vaping ban (home + vehicle)			22.40**			22.73**
Yes	2 (9.1%)	20 (90.9%)		1 (4.5%)	21 (95.5%)	
No	33 (70.2%)	14 (29.8%)		31 (66.0%)	16 (34.0%)	

Note. Some information was not provided such that frequencies may not reflect the total sample.

**p<.001

Table 11
Frequency of Smoking and Vaping Bans by Child Single Product Use or Dual Use

Variable	Child Single Product Use or Dual User*	
	Dual user (n=31) n (%)	Single user (n=6) n (%)
Smoking ban (home)		
Complete ban	4 (66.7%)	2 (33.3%)
Partial/no ban	27 (87.1%)	4 (12.9%)
Smoking ban (vehicle)		
Complete ban	3 (75.0%)	1 (25.0%)
Partial/no ban	28 (84.8%)	5 (15.2%)
Vaping ban (home)		
Complete ban	2 (66.7%)	1 (33.3%)
Partial/no ban	29 (85.3%)	5 (14.7%)
Vaping ban (vehicle)		
Complete ban	2 (66.7%)	1 (33.3%)
Partial/no ban	29 (84.3%)	5 (14.7%)
Complete smoking ban (home + vehicle)		
Yes	2 (66.7%)	1 (33.3%)
No	29 (85.3%)	5 (14.7%)
Complete vaping ban (home + vehicle)		
Yes	1 (50.0%)	1 (50.0%)
No	30 (85.7%)	5 (14.3%)

Note. Some information was not provided such that frequencies may not reflect the total sample.
*Fishers exact test, p >.05

Table 12

Frequencies for Tobacco-Related Communication Between Child, Provider, and Parent by Child Smoking and Vaping Status.

Variable	Smoking status			Vaping status		
	Smoking (n= 35) n (%)	Non-smoking (n= 35) n (%)	X^2	Vaping (n= 35) n (%)	Non-vaping (n= 35) n (%)	X^2
Smoking (parent)			0.09			0.01
Yes	27 (49.1%)	28 (50.9%)		25 (45.5%)	30 (54.5%)	
No	8 (53.3%)	7 (46.7%)		7 (46.7%)	8 (53.3%)	
Smoking (pediatrician)			9.12*			5.72*
Yes	26 (66.7%)	13 (33.3%)		23 (59.0%)	16 (41.0%)	
No	9 (30.0%)	21 (70.0%)		9 (30.0%)	21 (70.0%)	
SHSe (parent)			0.08			0.02
Yes	27 (50.9%)	26 (49.1%)		24 (45.3%)	29 (54.7%)	
No	8 (47.1%)	9 (52.9%)		8 (47.1%)	9 (52.9%)	
SHSe (pediatrician)			5.40*			2.26
Yes	20 (66.7%)	10 (33.3%)		17 (56.7%)	13 (43.3%)	
No	15 (38.5%)	24 (61.5%)		15 (38.5%)	24 (61.5%)	
Vaping (parent)			1.64			0.07
Yes	25 (55.6%)	20 (44.4%)		20 (44.4%)	25 (55.6%)	
No	9 (39.1%)	14 (60.9%)		11 (47.8%)	12 (52.2%)	
Vaping (pediatrician)			7.17*			3.58
Yes	21 (67.7%)	10 (32.3%)		18 (58.1%)	13 (41.9%)	
No	13 (35.1%)	24 (64.9%)		13 (35.1%)	24 (64.9%)	
SHVe (parent)			0.06			0.12
Yes	20 (48.8%)	21 (51.2%)		18 (43.9%)	23 (56.1%)	
No	14 (51.9%)	13 (48.1%)		13 (48.1%)	14 (51.9%)	
SHVe (pediatrician)			3.59			2.15
Yes	17 (65.4%)	9 (34.6%)		15 (57.7%)	11 (42.3%)	
No	18 (41.9%)	25 (58.1%)		17 (39.5%)	26 (60.5%)	

Note. Some information was not provided such that frequencies may not reflect the total sample.

*p<.05

Table 13
Frequencies for Tobacco-Related Communication Between Child, Provider, and Parent by Child Single Product Use or Dual User Status.

Variable	Child Single Product or Dual User Status*	
	Dual user (n= 31) n (%)	Single user (n= 6) n (%)
Smoking (parent)		
Yes	24 (82.8%)	5 (17.2%)
No	7 (87.5%)	1 (12.5%)
Smoking (pediatrician)		
Yes	23 (88.5%)	3 (11.5%)
No	8 (72.7%)	3 (27.3%)
SHSe (parent)		
Yes	24 (88.9%)	3 (11.1%)
No	7 (70.0%)	3 (30.0%)
SHSe (pediatrician)		
Yes	17 (85.0%)	3 (15.0%)
No	14 (82.4%)	3 (17.6%)
Vaping (parent)		
Yes	20 (80.0%)	5 (20.0%)
No	10 (90.9%)	1 (9.1%)
Vaping (pediatrician)		
Yes	18 (85.7%)	3 (14.3%)
No	12 (80.0%)	3 (20.0%)
SHVe (parent)		
Yes	18 (85.7%)	3 (14.3%)
No	12 (80.0%)	3 (20.0%)
SHVe (pediatrician)		
Yes	15 (83.3%)	3 (16.7%)
No	16 (84.2%)	3 (15.8%)

Note. Some information was not provided such that frequencies may not reflect the total sample.
*Fishers Exact Test, p >.05

Appendix B

Tobacco Assessment

You are invited to participate in this study about tobacco use, intentions, and attitudes toward smoking/vaping in children with autism. You do not have to be a biological parent of the child to participate. If you are a primary caregiver for the child, you are invited to participate. The survey is designed to focus on parents/caregivers of children from ages 10 -17 years of age. The items marked with and asterisk* MUST be completed to determine eligibility to participate in the study. Thank you very much for your time and support.

In order to determine your child's eligibility to participate, please answer the following questions.

What is your marital status?
- __Single, Never married
- __Married
- __Separated
- __Divorced
- __Widowed
- __Cohabitating

What is your current parenting situation?
- __I am parenting with my spouse
- __I am a single parent, living with a partner, and my child or children
- __I am a single parent, living with my own parents
- __I am a single parent, living with my child or children only

What is your highest level of education?
- __Less than High School
- __High School Graduate
- __Some College
- __College Graduate
- __Graduate Degree

What is your gender?
- __Female
- __Male
- __Transgender
- __Other _____

What is your age? _____

*What is the diagnosed condition of your child? (Please select all that apply):
__Pervasive Developmental Delay
__Asperger's
__Autism
__Attention Deficit Hyperactivity Disorder
__Other: _____
__No Diagnosis

How old is your child? ____

*Which of the following best describes your child's academic level?
__My child is enrolled in a mainstream class
__My child is enrolled in a special education classroom
__My child is enrolled in a mainstream classroom with pull-outs for therapy (e.g., speech, behavior).

*What grade is your child currently enrolled in?
__5th grade
__6th grade
__7th grade
__8th grade
__9th grade
__10th grade
__11th grade
__12th grade

Is your child enrolled in any extracurricular activities?
__Yes
If yes, please list: _____
__ No

*What is the gender of your child?
__Female
__Male
__Transgender
__ Other: _____

PARENT QUESTIONNAIRE
The following questions should be completed by PARENTS about their OWN tobacco use. Please mark the response that best describes YOU:

<u>Smoking Status and History</u>:

1. Have you smoked at least 100 cigarettes in your entire life? (5 Packs = 100 Cigarettes)?
   __Yes
   __No

2. Do you NOW smoke cigarettes?
   __Every day
   __Some days
   __Not at all

3. Does your spouse/partner currently smoke cigarettes?
   __Yes
   __No
   __N/A (No spouse/partner)

4. How many smokers currently live in your household?
   __0 smokers
   __1 – 2 smokers
   __ ≥ 3 smokers

Vaping Status and History - Parent

The next 6 questions are about electronic cigarettes or e-cigarettes/vape pens. E-cigarettes are battery operated devices that are similar to smoking a cigarette but do not involve the burning of tobacco. Many e-cigarettes contain a liquid that is vaporized and inhaled. They are also called e-cigs, vape pens, hookah pens, e-hookas, e-cigars, e-pipes, personal vaporizers, or mods.

1. Are you aware that e-cigarettes/vapes may contain nicotine?
   __Yes
   __No

2. Which of the following do you believe is true?
   __ E-cigarettes are less harmful than other forms of tobacco, such as cigarettes
   __ E-cigarettes are just as harmful as other forms of tobacco, such as cigarettes
   __ E-cigarette are more harmful than other forms of tobacco, such as cigarettes

3. Have you ever used an electronic cigarette, or e-cigarette, or electronic vapor product even one time in your life?

__Yes
__No (if no, go to question 6)

4. Do you NOW use electronic cigarettes, e-cigarettes, or electronic vapor products every day, some days, or not at all?
__Every Day
__Some Days
__Not at all

5. If you use or have used e-cigarettes/vapes, does your e-liquid usually contain nicotine?
__Yes
__No
__Don't know/not sure
__I do not use e-cigarettes or vape

6. Does your spouse/partner currently use e-cigarettes/vape?
__ Yes
__ No
__N/A (No spouse/Partner)

Smoking Ban Questions

1. Which best describes the rules about smoking in your home? (Mark all that apply)

__Smoking is absolutely not allowed anywhere, anytime, or by anyone in the home (no exceptions).
__Smoking is only allowed in some rooms of the house.
__Smoking is only allowed in the home when the children are not present.
__Smoking is only allowed at some times.
When? _____
__Smoking is only allowed in the home when the windows are open and/or fans are on.
__Smoking is only allowed by some people (family, friends, or guests) in the home.
__Smoking is allowed in the home anywhere and at any time; there are no rules about smoking in the home.

2. Which best describes the rules about smoking in the car/truck? (Mark all that apply).

__Smoking is absolutely not allowed anywhere, anytime, or by anyone in the car/truck (no exceptions).
__Smoking is only allowed at some times.
When? _____
__Smoking is only allowed in the car/truck when the children are not present.
__Smoking is only allowed under certain conditions (e.g., with the windows down, on long trips).
__Smoking is only allowed by some people (family, friends, or guests) in the car/truck
__Smoking is allowed in the car at any time; there are no rules about smoking in the car/truck.
__We do not have a family car/truck.

3. How many adults ≥18 years of age living in your household currently smoke? _____

4. How many children <18 years of age living in your household currently smoke? ____

E-cigarettes/Vaping Ban Questions

1. Which best describes the rules about use of e-cigarettes/vaping in your home? (Mark all that apply)

__Vaping is absolutely not allowed anywhere, anytime, or by anyone in the home (no exceptions).
__Vaping is only allowed in some rooms of the house.
__Vaping is only allowed in the home when the children are not present.
__Vaping is only allowed at some times.
When? _____
__Vaping is only allowed in the home when the windows are open and/or fans are on.
__Vaping is only allowed by some people (family, friends, or guests) in the home.
__Vaping is allowed in the home anywhere and at any time; there are no rules about vaping in the home.

2. Which best describes the rules about use of e-cigarettes/vaping in the car/truck (Mark all that apply).

   __Vaping is absolutely not allowed anywhere, anytime, or by anyone in the car/truck (no exceptions).
   __Vaping is only allowed at some times.
   When? _____
   __Vaping is only allowed in the car when the children are not present.
   __Vaping is only allowed under certain conditions (e.g., with the windows down, on long trips).
   __Vaping is only allowed by some people (family, friends, or guests) in the car/truck.
   __Vaping is allowed in the car at any time; there are no rules about vaping in the car/truck
   __We do not have a family car/truck.

3. How many adults ≥18 years of age living in your household currently vape/use e-cigarettes? _____

4. How many children <18 years of age living in your household currently vape/use e-cigarettes? ____

Thank you. This completes the parent portion of the survey. For the following questions, please have your child independently answer the questions in terms of his/her own tobacco use. To help your child understand the purpose of this survey, please read them the following script:

You are being asked to participate in a survey that asks about the use of different tobacco products. You do not have to participate if you feel uncomfortable or do not want to. If you decide to participate, you and your parent will have the chance to be entered into a drawing for one $100 gift card.

Child participant assent:
__Yes, my mother/father has explained this survey to me and I agree to participate.
__No, my mother/father has explained this survey to me and I do not want to participate (exit survey).

CHILD QUESTIONNAIRE

Smoking Status and History

1. Which of the following best describes your cigarette use?
   __I have never smoked a cigarette, not even a puff.
   __I have smoked a cigarette or a few cigarettes just to try, but I have not smoked in the past month.
   __I have smoked one or more cigarettes in the past month.

2. How many of your closest friends smoke combustible cigarettes?
   __None
   __1
   __2
   __3
   __4
   __More than 4

3. How old were you when you **first tried** cigarette smoking, even a puff or two?
   _____years old
   _____I have never smoked a cigarette, not even a puff

4. How many cigarettes have you smoked in your entire life?
   __I have never smoked a cigarette, not even a puff
   __I have smoked 1 or more puffs but never a whole cigarette
   __I have smoked 1 cigarette
   __I have smoked 2 to 5 cigarettes
   __I have smoked 6 to 15 cigarettes
   __I have smoked 16 to 25 cigarettes (about ½ a pack total)
   __I have smoked 26 to 99 cigarettes (more than 1 pack, but less than 5 packs)
   __I have smoked 100 or more cigarettes (5 or more packs)

5. When was the last time you smoked a cigarette, even one or two puffs?
   __I have never smoked a cigarette, not even a puff
   __Earlier today
   __Not today, but sometime during the past 7 days
   __Not during the past 7 days, but sometime during the past 30 days
   __Not during the past 30 days, but sometime during the past 6 months
   __Not during the past 6 months, but sometime during the past year
   __1 to 4 years ago
   __5 or more years ago

6. During the past 30 days, how many days did you smoke cigarettes?
   __0 days
   __1 or 2 days
   __3 to 5 days
   __6 to 9 days
   __10 to 19 days
   __20 to 29 days
   __All 30 days

7. During the past 30 days, **on the days you smoked,** about how many cigarettes did you smoke a day?
   __I did not smoke cigarettes during the past 30 days
   __Less than 1 cigarette per day
   __2 to 5 cigarettes per day
   __6 to 10 cigarettes per day
   __11 to 20 cigarettes per day
   __More than 20 cigarettes per day

8. Which of the following best describes your smokeless tobacco (chew/snuff) use?
   __I have never used smokeless tobacco
   __I have used smokeless tobacco before, but I have not used in the past 30 days
   __I have used smokeless tobacco in the past 30 days

NEVER SMOKERS GO TO INTENTIONS TO SMOKE QUESTION 1.

EVER SMOKERS AND CURRENT SMOKERS GO TO VAPING STATUS AND HISTORY QUESTION 1.

Vaping

The next 25 questions are about electronic cigarettes or e-cigarettes/vape pens. E-cigarettes are battery operated devices that are similar to smoking a cigarette but do not involve the burning of tobacco. Many e-cigs contain a liquid that is vaporized and inhaled. They are also called e-cigs, vape pens, hookah pens, e-hookas, e-cigars, e-pipes, personal vaporizers, or mods.

Vaping Status and History

The following questions examine your e-cigarette/vape use.

1. Are you aware that e-cigarettes/vapes may contain nicotine?
   __Yes
   __No

2. Which of the following do you believe is true?
   __ E-cigarettes are less harmful than other forms of tobacco, such as cigarettes
   __ E-cigarettes are just as harmful as other forms of tobacco, such as cigarettes
   __ E-cigarette are more harmful than other forms of tobacco, such as cigarettes

3. Which of the following best describes your e-cigarette/vape use?
   __I have never used an e-cigarette/vaped. (Go to question 5)
   __I have used/vaped an e-cigarette or a few e-cigarettes just to try, but I have not vaped in the past 30 days.
   __I have used one or more e-cigarettes in the past 30 days.

4. If you use or have used cigarettes/vapes, does your e-liquid usually contain nicotine?
   __Yes
   __No
   __Don't know/Not sure
   __I do not use e-cigarettes or vape

5. How many of your closest friends use electronic cigarettes or vape?
   __None
   __1
   __2
   __3
   __4
   __More than 4

6. How old were you when you **first** tried e-cigarettes/vaped?
   _____years old
   _____I have never use an e-cigarette or vaped

7. In total, how many days have you used e-cigarettes/vaped in your entire life?
   __0 days
   __1 day
   __2 to 10 days
   __11 to 20 days
   __21 to 50 days
   __51 to 100 days
   __Over 100 days

8. During the past 30 days, how many days did you use e-cigarettes/vaped?
   __0 days
   __1 or 2 days
   __3 to 5 days
   __6 to 9 days
   __10 to 19 days
   __20 to 29 days
   __All 30 days

9. Have you ever used an e-cigarette pen/vape to inhale other products, such as CBD oil?
   __Yes
   __No

10. What are the reasons you have used e-cigarettes/vaped? (**Select one or more**)
    __I have never tried an e-cigarette/vaped
    __Friend or family member used them
    __Try to quit using other tobacco products, such as cigarettes,
    __They cost less than other tobacco products, such as cigarettes
    __They are easier to get than other tobacco products, such as cigarettes
    __Famous people on TV or in movies use them
    __They are less harmful than other forms of tobacco, such as cigarettes
    __They are available in flavors, such as mint, candy, fruit, or chocolate
    __They can be used in areas where other products, such as cigarettes, are not allowed
    __I used them for some other reason

NEVER-ENDS USERS GO TO INENTIONS TO VAPE QUESTION 1

EVER-ENDS USERS AND CURRENT ENDS USERS GO TO COMMUNICATION QUESTION 1.

<u>Intentions to Smoke</u>

Please answer these questions as it relates to smoking *<u>cigarettes</u>:*

1. How likely is it that you will smoke cigarettes in the next month?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely

2. How likely is it that you will smoke cigarettes in the next 6 months?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
3. How likely is it that you will smoke cigarettes in the next year?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
4. How likely is it that you will be tempted to smoke cigarettes in the future?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
5. How likely is it that you will be able to resist the urge to smoke a cigarette in the future?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
6. If a friend of yours asked you to smoke a cigarette, how likely would it be that you would say "yes"?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely

NEVER-SMOKERS GO TO VAPING STATUS AND HISTORY QUESTION 1.

Intentions to Vape

Please answer the following questions as it relates to *electronic cigarettes and vaping*:

1. How likely is it that you will use e-cigarettes/vape in the next month?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
2. How likely is it that you will use e-cigarettes/vape in the next 6 months?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
3. How likely is it that you will use e-cigarettes/vape in the next year?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely

4. How likely is it that you will be tempted to use e-cigarettes/vape in the future?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
5. How likely is it that you will be able to resist the urge to use e-cigarettes/vape in the future?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely
6. If a friend of yours asked you to use an e-cigarettes/vape, how likely would it be that you would say "yes"?	Very Unlikely	Unlikely	Not Sure	Likely	Very Likely

If you plan to use electronic cigarettes or vape at any time in the future, will your e-liquid contain nicotine?
___Yes
___No
___I don't plan to use e-cigarettes or vape in the future

In the last 30 days, has anyone used e-cigarettes/vaped in your home when you were present?
__Yes
__ No

In the last 30 days, have you rode in a car or truck with someone who used e-cigarettes/vaped?
__ Yes
__ No

NEVER-ENDS USERS GO TO COMMUNICATION QUESTION 1.

Communication

1. Have your parents ever talked with <u>you</u> about the health effects of smoking on your health?
   __Yes
   __No

2. Have your parents ever talked with you about the effects of second hand smoke on your health?
   __Yes
   __No

3. Has your doctor or nurse ever talked with you about the effects of smoking on your health?
   __Yes
   __No

4. Has your doctor or nurse ever talked with you about the effects of secondhand smoke on your health?
   __Yes
   __No

5. Have your parents ever talked with you about the health effects of electronic cigarettes/vaping on your health?
   __Yes
   __No

6. Have your parents ever talked with you about the effects of second hand vapors from electronic cigarettes/vaping on your health?
   __Yes
   __No

7. Has your doctor or nurse ever talked with you about the effects of electronic cigarettes/vaping on your health?
   __Yes
   __No

8. Has your doctor or nurse ever talked with you about the effects of secondhand vapors from electronic cigarettes/vaping on your health?
   __Yes
   __No

Thank you for your time. This concludes the child portion of this survey. Please allow your parent to continue the survey. At the end, your parent will be provided with directions on how to enter the drawing for a gift card.

Appendix C
Resources about Tobacco and E-cigarettes

1. Youth Tobacco Prevention Basic Information https://www.cdc.gov/tobacco/basic_information/youth/index.htm
2. E-Cigarettes Shaped like USB Flash Drives: Information for Parents, Educators, and Health Care Providers: https://www.cdc.gov/tobacco/infographics/youth/pdfs/e-cigarettes-usb-flash-508.pdf
3. Youth and Tobacco Use: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/youth_data/tobacco_use/index.htm
4. Smoking in the Movies: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/youth_data/movies/index.htm
5. Teachers and Parents: The USB Stick Might Be an E-cigarette: https://www.cdc.gov/tobacco/infographics/youth/index.htm#e-cigs-teachers-parents
6. Tobacco Use Among Middle and High School Students – United States 2011-2015: https://www.cdc.gov/tobacco/infographics/youth/index.htm#youth-tobacco
7. Youth Exposure to Advertising and E-Cigarette Use: https://www.cdc.gov/tobacco/infographics/youth/index.htm#ads-exposure
8. E-cigarette Use Among Youth is Rising as E-Cigarette Advertising Grows: https://www.cdc.gov/tobacco/infographics/youth/index.htm#ecigs
9. Youth are Exposed to E-cigarette Advertisement from Multiple Sources: https://www.cdc.gov/tobacco/infographics/youth/index.htm#ecigs-ad-sources

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