



Short communication

Patterns and perceptions of nicotine use among U.S. adolescents and young adults receiving medication treatment for opioid use disorder

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ABSTRACT

Nicotine use among U.S. youth is cause for concern, as previous studies have shown that nicotine use in adolescence increases the risk of developing substance use disorders later in life. This exploratory study aimed to understand patterns of nicotine use and perceptions of various nicotine products among adolescents and young adults (AYA) receiving medication treatment for opioid use disorder (MOUD). We administered an adapted version of the National Youth Tobacco Survey via REDCap to AYA (n = 32) receiving outpatient care in the Medication-Assisted Treatment of Addiction at Nationwide Children's Hospital in Columbus, Ohio, U.S.A. Thirty (97%) participants had tried a combustible cigarette and 27 (90%) had tried an electronic cigarette. By age 13, nineteen (61%) participants had tried combustible cigarettes and eight (25%) had tried opioids. Twenty-two (71%) participants reported smoking combustible cigarettes every day for the past 30 days, and 15 (48%) reported smoking more than 10 cigarettes per day on average. Only ten (32%) participants reported e-cigarette use in the last 30 days. Participants universally agreed that tobacco products are dangerous, and twenty (67%) current tobacco users reported that they planned to quit in the next year. Nicotine use patterns among AYA receiving MOUD differ from that previously shown in the general population, primarily by high prevalence of nicotine use in early adolescence and high current combustible cigarette use. Interventions such as universal screening for nicotine use before age 13 and tailored smoking cessation programs for AYA with OUD may help optimize care for these individuals.

1. Introduction

Nicotine use among United States (U.S.) adolescents and young adults (AYA) has re-emerged as a public health crisis. Nicotine consumption among middle and high-school aged students had been decreasing until 2017–2018, when rates of nicotine use within this population skyrocketed. This trend is largely attributable to the increasing popularity of electronic (e-) cigarettes. E-cigarettes entered the market around 2014, and quickly replaced combustible cigarettes as the most used nicotine product (Sun et al., 2021; Gentzke et al., 2019).

Though e-cigarettes are presumed to have fewer long-term health risks than combustible cigarettes, the high level of nicotine consumption among U.S. AYA is concerning. In the adolescent brain, nicotine exposure alters pathways that enhance drug reward and reinforcement,

which has been shown to increase the risk of substance use disorders (SUD) (Breslau et al., 1993; Ren and Lotfipour, 2019; Alajaji et al., 2016). Previous studies have shown that individuals who initiated nicotine use between the ages of 14 and 16 were 1.6 times more likely to develop nicotine dependence (Breslau et al., 1993). Furthermore, a meta-analysis (Rajabi et al., 2019) found that initiation of smoking before the age of 14 is associated with future opioid use, and smokers are 8 times more likely to develop opioid use disorder (OUD) than non-smokers (Rajabi et al., 2019). Daily smokers are at the greatest risk and have been found to be five times more likely than non-smokers to use non-prescription opioids, while intermittent smokers were only three times more likely than non-smokers (Rajabi et al., 2019; Zale et al., 2015).

In summary, previous studies suggest a complex interaction of

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biological and environmental factors that may contribute to the correlation between nicotine and opioid misuse. While the exact prevalence of OUD among AYAs is unknown, a 2015–2016 national survey found that nearly 4% of adolescents and 8% of young adults had misused prescription opioids (Hudgins et al., 2019). Additional information is needed to characterize how the changing landscape of nicotine use among AYAs has affected this vulnerable population. Specifically, this study aimed to quantitatively describe nicotine use patterns of AYAs receiving medication treatment of OUD (MOUD). Elucidating how the nicotine use patterns of these individuals may differ from the general population allows for more targeted methods of treatment and harm reduction.

2. Methods

2.1. Participants and setting

AYA receiving care for OUD in the Medication-Assisted Treatment for Addiction clinic at Nationwide Children's Hospital were recruited. This clinic initiates outpatient MOUD treatment to patients between 14 and 25 years of age with OUD. Once initiated, patients can remain in treatment regardless of age.

2.2. Procedures

We conducted a cross-sectional survey via REDCap, between June 2020 and September 2021, of AYA receiving MOUD (Harris et al., 2009; Harris et al., 2019). Patients were approached during regularly scheduled appointments or from phone calls with clinic social workers. Participants provided verbal consent and received a personalized survey link. Participants received a \$10 gift card after survey completion. The Nationwide Children's Hospital institutional review board approved all procedures.

2.3. Measures

We used an adapted version of the National Youth Tobacco Survey (Office on Smoking and Health., 2020) to obtain background information about participants, their OUD diagnosis, as well as a description of their tobacco product habits and perceptions. The specific measures used in this survey are described below:

2.3.1. Survey questions

Participants were asked a series of 58 multiple-choice questions covering demographic information and background for their OUD diagnosis. They were also asked about age at first use and current patterns of tobacco use. Participants were also surveyed about cravings and urges to use tobacco products. Nicotine dependence was assessed using an item from the Fagerström Test for Nicotine Dependence and classified as "high" if participants reported a desire to use nicotine within 30 min or less after waking (Heatherton et al., 1991). Participants were asked about their perceptions regarding cigarettes and e-cigarettes, including relative harm, risk of addiction, and danger of both first and secondhand exposure to cigarette and e-cigarette smoke/vapor. The full questionnaire used in this study is available as supplemental material.

2.4. Analysis

Survey responses were downloaded from REDCap (Harris et al., 2009; Harris et al., 2019). Descriptive analyses included number (percent) for categorical variables. Kaplan-Meier curves were generated for age at initiation of combustible cigarette, e-cigarette use, and opioid use.

3. Results

3.1. Demographics

Forty-four individuals were approached, thirty-two agreed to participate, and thirty provided complete survey data. Available data from incomplete surveys were included in the analyses.

Among the 32 participants, 18 (56%) self-reported gender as female and 14 (44%) male. Thirty-one (97%) identified as non-Hispanic white, and 1 (3%) as Black or African American. Thirty (94%) participants were ≥ 21 years of age; the remaining 2 (6%) participants were 16 and 19 years old. Highest education level was post-high school education for 10 (31%) participants, 12th grade or GED for 9 (28%) participants, 9th–11th grade for 12 (38%) participants, and 8th grade or lower for 1 (3%) participant. Twenty-two (69%) participants reported that they have an immediate family member with an SUD.

3.2. Opioid use

Age at first opioid use is shown in Fig. 1. Eight (25%) participants had tried opioids by age 13. Twenty-eight participants (88%) had been in addiction recovery treatment for over a year at time of survey completion. Two (6%) had been in addiction recovery treatment for less than 6 months, and 2 (6%) had been in treatment between 6 months and one year. Thirteen participants (41%) were in addiction recovery treatment for the first time, 10 (31%) had been in treatment two times, and 9 (28%) had been in treatment 3 or more times.

3.3. Nicotine use initiation

Age at initiation of nicotine use by product is shown in Fig. 1. Thirty participants (96.8%) tried nicotine at least once. Nineteen (61%) first used a combustible cigarette by 13 years of age, and earliest reported age at first use was less than 8 years old. There was a notable increase in cigarette use initiation between 11 and 12 years old. Twenty-seven participants (87%) had also tried e-cigarettes; 24 (77%) did not try an e-cigarette until after 18 years old.

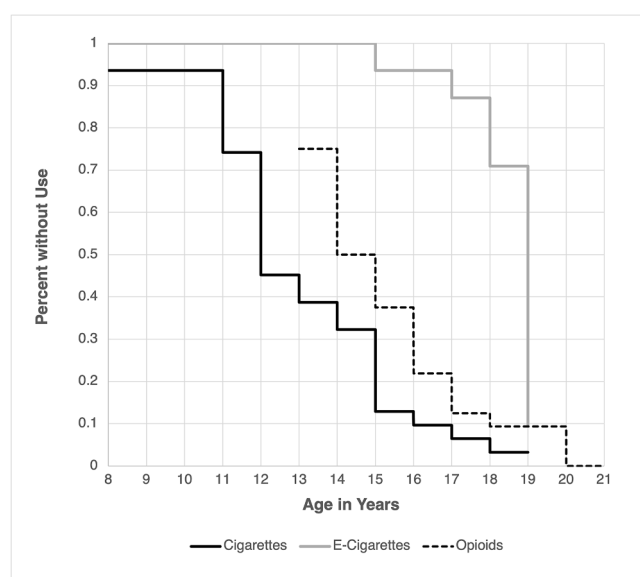


Fig. 1. Age at initiation of nicotine and opioid use. Kaplan-Meier curve demonstrating age that participants reported first trying combustible cigarettes, electronic cigarettes, and opioids.

3.4. Nicotine consumption patterns

Nicotine consumption patterns in the past 30 days are shown in Fig. 2. In the past 30 days, 26 (84%) participants had smoked a combustible cigarette at least once, while only 10 (32%) had used an e-cigarette. Twenty-two (71%) participants smoked combustible cigarettes every day for the past 30 days, and 15 (48%) reported smoking more than 10 cigarettes per day. Nineteen participants (63%) reported a desire to use nicotine within 30 min of waking up, indicative of nicotine dependence.

Participants had also tried a variety of other tobacco products. Nineteen (63%) had tried roll-your-own cigarettes, 10 (33%) had tried tobacco pipes, 9 (30%) had tried snus, 3 (10%) had tried dissolvable tobacco products, 1 (3%) had tried bidis, and 11 (37%) had tried waterpipe with tobacco. Eight (27%) had never tried any of the alternate tobacco products listed.

3.5. Tobacco product perceptions

All participants indicated that they “agree” or “strongly agree” with the statement “all tobacco products are dangerous”. Twenty-one participants (70%) indicated that they believed e-cigarettes are equally addictive to combustible cigarettes, and 5 (17%) believed that e-cigarettes are more addictive than combustible cigarettes.

Twenty participants (67%) reported that they were seriously considering quitting the use of all tobacco products within the next 12 months, and twelve (40%) reported that they had attempted to quit using nicotine products at least once in the past year. Three (10%) participants planned to quit, but not in the next 12 months and six (20%) were not considering quitting the use of tobacco products.

4. Discussion

Survey results showed a high prevalence of nicotine use in childhood and early adolescence among this study population. Data suggest that most participants first tried nicotine before trying opioids. By age 13, 61% of participants had tried combustible cigarettes while only 25% had tried opioids. In addition, most reported current nicotine use, primarily via combustible cigarettes. Early initiation of nicotine use is clinically relevant given the existing evidence that nicotine use in adolescence is associated with opioid use later in life (Breslau et al., 1993; Ren and Lotfipour, 2019; Alajaji et al., 2016; Rajabi et al., 2019). A prospective cohort study of a nationally representative sample of youth never-users

of tobacco estimated that less than 1% of surveyed youth had initiated cigarette use by 13 years old (Pérez et al., 2021). The present study found a stark difference among AYAs with OUD, as 61% of participants reported use of combustible cigarettes by 13 years of age.

There are multiple plausible explanations for the nicotine use trends observed in this study. While the observed trend of nicotine initiation prior to opioid use is consistent with the gateway hypothesis, it is important to consider other factors and social determinants of health that may have resulted in increased risk among this population. Prior studies found higher rates of tobacco use among middle and high school students that reported psychological distress (Gentzke et al., 2022), and an association between a higher number of adverse childhood experiences (ACEs) and risky opioid use (Stein et al., 2017). Notably, presence of an SUD within the home is an example of an ACE (Stein et al., 2017), and 69% of participants in the present study reported that they had an immediate family member with an SUD. Common liability to addiction theory posits that susceptibility to addiction is a quantifiable trait determined by various biological, psychological, and environmental factors (Vanyukov and Ridenour, 2012).

Participants’ responses indicate a preference for combustible cigarettes over e-cigarettes. This differs from the general population, as prior studies showed that e-cigarettes have been the most used nicotine product among AYAs since 2018 (Sun et al., 2021). This pattern could be explained by participants’ initiation of nicotine use early in adolescence. Most participants in this study were ≥ 21 years at time of survey completion. For most participants, e-cigarettes had either not yet entered the market or had not achieved the current level of popularity among youth by the time they started using tobacco products. It is possible that study participants initiated a nicotine habit with combustible cigarettes before e-cigarettes were available and never switched to different tobacco product despite the increasing popularity of e-cigarettes among their peers.

The patterns of current nicotine use in this study population underscore an important target for intervention. In addition to the negative long-term health consequences of cigarettes, there are additional disadvantages of nicotine consumption among patients receiving MOUD. Concurrent use of nicotine and opioids creates treatment obstacles. Previous studies have found that polysubstance use of nicotine and opioids is associated with increased use of both substances (Kohut, 2017). In addition, studies have shown that the current evidence-based smoking cessation treatments are less effective among patients with OUD (Vlad et al., 2020). The high prevalence of nicotine use and desire to stop smoking among this study population reinforce the need for additional research to guide practice when offering smoking cessation treatments to patients with OUD.

Limitations of this study include small sample size and survey of patients within one clinic. As a result, findings may not be generalizable to the community or population level. Generalizability is further limited by participant demographics, as nearly all reported their race as non-Hispanic white. Additional work is needed to characterize the nicotine use patterns of AYAs receiving MOUD from different racial and ethnic backgrounds. In summary, this study population of AYAs receiving MOUD reported patterns of nicotine use that differ from the general population. The early initiation of nicotine use in this population highlights opportunities for intervention, such as earlier screening for tobacco use. In addition, this population had high rates of daily nicotine consumption and nicotine dependence, primarily via combustible cigarettes. Awareness of these differences in nicotine use patterns is essential to provide optimal care for this patient population.

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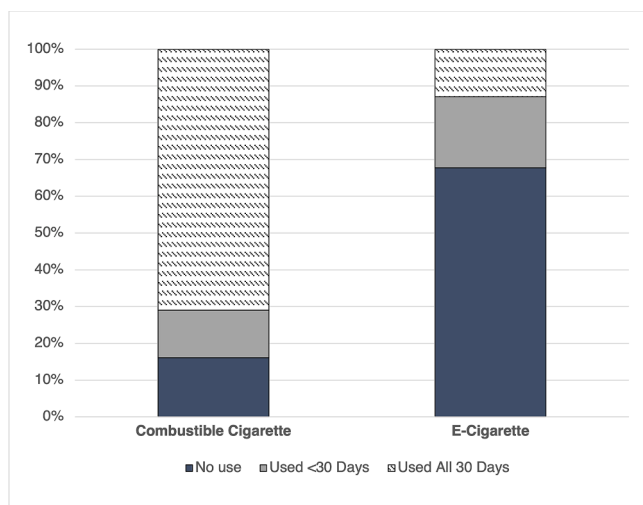


Fig. 2. Frequency of nicotine consumption in past 30 days. This figure depicts reported frequency of combustible and electronic cigarette use in the past 30 days.

CRediT authorship contribution statement

Madeline L. Watson: Writing – original draft, Methodology, Investigation, Visualization. **Erin R. McKnight:** Conceptualization, Methodology, Investigation, Funding acquisition, Writing – review & editing. **Judith A. Groner:** Conceptualization, Methodology, Writing – review & editing. **Brittney E. Manos:** Project administration, Methodology, Writing – review & editing. **Ashley M. Ebersole:** Investigation, Writing – review & editing. **Andrea E. Bonny:** Conceptualization, Methodology, Investigation, Funding acquisition, Writing – review & editing, Supervision.

Declaration of Competing Interest

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

Data availability

Data are publicly available in a digital repository. The access link is included in the manuscript.

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The data underlying this article are available in Dryad Digital Repository at <https://doi.org/10.5061/dryad.612jm646p>. Data containing direct and indirect identifiers have been removed to protect the privacy of study participants.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2023.102303>.

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