Transitions in Cigarette Smoking Associated with Use of the JUUL Vaping Device Among 18,799 Adults in the United States

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1 Executive Summary

1.1 Overview

JUUL vapor products are marketed in the United States to adult smokers as a satisfying alternative to continuing to smoke tobacco. JUUL vapor products are not marketed as and do not claim to be effective for smoking cessation or as a safer, healthier, or less risky alternative to smoking tobacco. JUUL is the fastest growing and highest selling e-cigarette/vapor product in a U.S. market sized at approximately $5.5 billion for 2018.[1] In February 2018, JUUL vapor products accounted for an estimated 49.6% of all dollars spent on e-cigarette products in the past four weeks, with an estimated 652.6% increase in unit sales compared to the previous February.

Assessing the potential population health impact associated with the rapid and substantial increase in sales of JUUL vapor products has therefore become vitally important. Data that address the potential human health impact of JUUL vapor products include, but are not limited to, the cigarette smoking status of adults who initiate use of a JUUL; the likelihood that adult smokers who use a JUUL will switch completely to using a JUUL; the likelihood that former smokers who use a JUUL will re-initiate smoking; and the likelihood that never smokers who use a JUUL will initiate cigarette smoking.

Between 13th April and 14th May, 2018, researchers at the Centre for Substance Use Research (CSUR) in Glasgow, Scotland conducted an online survey assessment of the cigarette smoking and e-cigarette use behaviors of 18,799 adults in the United States who had previously purchased JUUL vapor products from the JUUL website (www.juulvapor.com). The primary purpose of the survey was to collect data on adults' cigarette smoking status (prevalence, frequency, intensity) at the time when they first used a JUUL vaping device and at the time of the survey. These data were used to estimate the prevalence of key transitions in smoking status between the time of participants' first use of a JUUL vaping device and the time of survey, and to identify factors associated with current smokers' likelihood of now being former smokers.

1.2 Cigarette smoking status at the time of first use of a JUUL

The majority (87.2%) of the sampled 18,799 adults were either smoking cigarettes or had smoked cigarettes in the past when they used a JUUL vaping device for the first time.

At the point of their first ever use of a JUUL, 62.2% of participants were smoking cigarettes every day or some days (i.e. current smokers); 25.0% had smoked cigarettes in the past but were smoking not at all when they first used a JUUL (i.e. former smokers); and 12.7% had never smoked a cigarette, not even a puff (i.e. never smokers).

1.3 Transitions in cigarette smoking status between time of first JUUL use and now

1.3.1 Current Smoker to Former Smoker

Of the 11,689 participants who were daily or non-daily smokers when they first used a JUUL, 64.3% are now New Former Smokers. New Former Smokers accounted for 40.0% of all participants.

About half (49.5%) of participants who were daily or non-daily smokers when they first used a JUUL have now stopped smoking completely *and* reported that they 'quit smoking cigarettes by switching to using a JUUL'.[1] New Former Smokers who reported quitting smoking by switching to using a JUUL accounted for 30.8% of all participants.

Approximately 35.7% of participants who were daily or non-daily smokers when they first used a JUUL are Still Current Smokers.

1.3.2 Former Smoker to Current Smoker

Of the 4,695 participants who had smoked in the past but were not smoking when they first used a JUUL, 7.6% are now current smokers. Relapsed Former Smokers accounted for 1.9% of all participants.

[1] The question asked "*Thinking back to when you quit smoking cigarettes, did you…(check all that apply)*", with a list of 13 quit methods and products presented, one of which was "Switched to using a JUUL".

1.3.3 Never Smoker to Current Smoker

Of the 2,385 participants who had never smoked a cigarette when they first used a JUUL, 2.3% are now current smokers. New Smokers accounted for 0.3% of all participants.

1.3.4 Ratio of smoking cessation transitions to smoking initiation transitions

In this sample, there were approximately 137 participants who transitioned from a Current Smoker to a Former Smoker after initiating JUUL use for every one participant who transitioned from a Never Smoker to a Current Smoker after initiating JUUL use. The rate of transition from Current Smoker to Former Smoker was approximately 28 times higher than the rate of transition from Never Smoker to Current Smoker.

1.4 Change in daily cigarette consumption among Still Current Smokers

Of the 3,894 Still Current Smokers who were smoking ≥6 cigarettes per day when they first used a JUUL, 56.3% (n = 1,242) now smoke between 50% and 99% fewer cigarettes per day. Participants who were smoking ≥6 cigarettes per day when they first used a JUUL and are still smoking but have reduced their daily cigarette consumption by at least 50% accounted for 29.8% of Still Current Smokers, 10.6% of all participants who were smoking cigarettes when they first used a JUUL, and 6.6% of the total sample.

1.5 Factors associated with transitioning from a Current Smoker at the time of first JUUL use to a New Former Smoker now.

Current daily use of a JUUL, regular use of a JUUL for more than one year, non-daily cigarette smoking at the time of first use of a JUUL, buying a JUUL 'to help to quit smoking regular cigarettes' and current use of an e-cigarette other than a JUUL were the strongest predictors of transitioning from a Current Smoker at the time of first use of a JUUL to a New Former Smoker now. Participants who were moderate smokers (i.e. smoking 10-19 cigarettes per day) when they first used a JUUL were less likely than light smokers (0-9 cigarettes per day) to be a New Former Smoker now. Participants who were light smokers and heavy smokers (≥ 20 cigarettes per day) at their first use of a JUUL had statistically equivalent adjusted odds for transitioning to a New Former Smoker.

Participants who were smoking when they first used a JUUL were more likely to transition to a New Former Smoker if they first purchased a JUUL vaping device to help them quit smoking regular cigarettes, because they believed JUUL might be less harmful to them and to others compared to cigarettes, because they liked the flavors that JUUL came in, because the vapor from a JUUL smelled better than cigarette because they perceived using JUUL as more acceptable to non-smokers, or because they had read/saw information on the internet about the health benefits of switching from cigarettes to e-cigarettes.

Participants who were smoking when they first used a JUUL were less likely to transition to a New Former Smoker if they first purchased a JUUL vaping device to help them cut down the number of cigarettes they smoke but not quit completely, to use in places where smoking regular cigarettes isn't allowed, to save money compared to smoking cigarettes, if a doctor or other health professional had advised them to switch from cigarettes to e-cigarettes, and if they liked that JUUL came in a variety of flavors.

1.6 Quit methods used at the last quit attempt/when participants quit smoking

Over three-quarters (76.9%) of New Former Smokers reported having quit smoking completely by switching to using a JUUL vaping device. In contrast, 58.6% of Still Current Smokers had tried to quit smoking by switching to using a JUUL vaping device at their last quit attempt. This meant that of the 7,435 participants in this sample who tried to quit smoking at their last quit attempt by switching to using a JUUL vaping device, 77.8% succeeded. Therefore, the rate of smoking cessation attributed to the JUUL vaping device by participants who tried to quit smoking by using the JUUL vaping device is estimated at 77.8%.

1.7 Length of time using a JUUL vaping device before stopping smoking completely

The majority of New Former Smokers had quit smoking completely within the past 12 months (i.e. recent quitters), and were using a JUUL vaping every day or on some days when they stopped smoking completely. At least 45.4% of New Former Smokers reported stopping

smoking completely within their first 30 days of using a JUUL, with 26.9% reportedly stopping smoking completely within their first seven days of using a JUUL.

2 Background

Tobacco smoking continues to kill more people, cause more disease, and contribute more to social inequalities in high-income countries than any other preventable factor [2]. In the United States, 480,000 Americans die annually from smoking-related diseases, including around 41,000 non-smokers who die from exposure to environmental tobacco smoke, with around 16 million American adults living and suffering with a smoking-related disease [3] [4]. Most of the 8 million smoking-related deaths that are projected to occur globally between 2012 and 2030 will be among people who are currently smoking, not those who have yet to start [5].

Quitting tobacco smoking at the soonest opportunity is therefore the best action a person can take to improve one's quality of life and life expectancy [6]. However, quitting smoking is notoriously difficult, with only 3-5% of those who quit without assistance achieving long-term abstinence, and often only after many years of unsuccessful attempts.[7]. Therefore, while prevention efforts are critically important, helping people to quit smoking will have a greater impact on mortality and morbidity in the short term. Developing new and evermore effective ways of helping more people to quit smoking cigarettes as soon as possible is therefore a public health imperative.

Tobacco and nicotine products that present a reduced risk of ill health to an individual relative to smoking cigarettes have potential to benefit the health of the whole population to the extent that (i) they are used in place of more harmful tobacco products (e.g. cigarettes) by individuals who currently use such products *and* were unlikely to have quit or reduced their use of such products in the absence of e-cigarettes, *and* to the extent that (ii) they are not used by individuals who are not current users of more harmful tobacco products *and* would likely have not initiated or re-initiated use of such products in the absence of e-cigarettes.

JUUL Labs Inc. is a San Francisco-based company that manufactures pre-filled e-liquid cartridges known as 'JUULpods' for use in an Electronic Nicotine Delivery System (ENDS) known as 'JUUL'. The JUUL ENDS is a vaporizer that has regulated temperature control and uses nicotine salts as found in the tobacco leaf. JUULpods are currently available in eight flavors: Virginia Tobacco, Cool Mint, Mango, Crème Brulee, Fruit Medley, Cool Cucumber, Classic Tobacco, and Classic Menthol. Each JUULpod flavor is available in one nicotine

strength – 50mg/ml (5% nicotine by weight). Each JUULpod contains 0.7ml, equivalent to 59mg/ml nicotine per JUULpod, which is approximately equivalent to the nicotine content of a pack of cigarettes. JUULpods contains glycerol, propylene glycol, natural oils, extracts and flavor, nicotine and benzoic acid.

JUUL vapor products are marketed in the United States to adult smokers as a satisfying alternative to continuing to smoke tobacco. JUUL vapor products are not marketed as and do not claim to be effective for smoking cessation or as a safer, healthier, or less risky alternative to smoking tobacco. Individuals must be aged 21 years and older to purchase JUUL vapor products from JUUL's online store. The JUUL ENDS (Basic Kit), JUUL Starter Kit (JUUL ENDS plus four JUULpods), and JUULpod refill packs are sold online at www.juulvapor.com and at approximately 10,000 retail stores across the United States.

Under section 910 of the Federal Food Drug & Cosmetic Act, persons wanting to market a new ENDS product (one that was not commercially marketed in the United States as of (i.e., on) February 15, 2007, or any modified tobacco product that was commercially marketed after February 15, 2007) must first must submit a Premarket Tobacco Product Application (PMTA) to the Food and Drug Administration (FDA) under section 910(b) and receive a marketing order under section 910(c)(1)(A)(i) prior to marketing the new ENDS product. FDA's decision as to whether authorizing a marketing order for a new ENDS product would be appropriate for the protection of the public health will be based on a weighing of the risks and benefits to the health of the population as a whole, including users and non-users of tobacco products.

Data that address the human health impact of the JUUL ENDS therefore include, but are not limited to: (i) the likelihood that adult tobacco smokers will switch completely to use of a JUUL; (ii) the likelihood that adult tobacco smokers will use a JUUL in addition to continuing to smoke tobacco; (iii) the likelihood that former tobacco smokers will re-initiate tobacco use through use of the JUUL ENDS and then re-initiate use of more potentially harmful tobacco products; and (v) the likelihood that nonusers of tobacco products will initiate tobacco use through use of the JUUL ENDS and then initiate use of potentially more harmful products.

The purposes of this study were to collect, through an online survey of a large non-probabilistic sample of U.S. adult users of JUUL vapor products, data that: (i) characterize the proportion of adult online purchasers of a JUUL vaping device who were current smokers, former smokers, and never smokers when they first used a JUUL; (ii) estimate the prevalence of key transitions in cigarette smoking status between the time of participants' first use of a JUUL and now; and (iii) identify factors associated with transitioning from a current smoker at the time of first use of a JUUL to a former smoker now.

3 Methods

3.1 Participants

Email invitations to complete an online survey about use of cigarettes, JUUL and other e-cigarettes and vapor products were sent to 88,994 U.S. adults aged 21 years and older who had made at least one online purchase of a JUUL vapor product from JUUL's website (www.juulvapor.com) and consented to be contacted by JUUL Labs to participate in future research and marketing surveys.

To be eligible to participate in this survey, individuals were required to be aged 21 years or older, a permanent resident of the Unites States, had ever purchased a JUUL vapor product from the online store of www.juulvapor.com, not employed by or related to an employee of JUUL Labs Inc. or PAX Labs Inc. Age verification was conducted by JUUL at the time of the individual's purchase of a product on www.juulvapor.com using Veritad age verification software, and then self-reported by individuals as part of the eligibility screener.

A list of potentially eligible individuals was established by the study sponsor, JUUL Labs, from its existing online database of individuals in the United States and US territories who have purchased JUUL products from JUUL online store. The database does not include international customers. Email invitations to complete an online survey about use of cigarettes, JUUL and other e-cigarettes and vapor products were sent to 89,000 U.S. adults who had consented to be contacted by JUUL to participate in future research and marketing surveys and were potentially eligible to participate in this survey. The survey ran between 13th April - 14th May, 2018.

3.2 Procedure

Individuals clicked a link in their email invitation to open the survey webpage. The first page displayed an Informed Consent Form (available upon request). Individuals were encouraged to carefully read this form, take their time before deciding whether they wished to participate, and print the form for their records. The individual was required to give consent to five statements by checking a box next to each statement in order to proceed. Once consent had been given, individuals were asked four questions that assessed their eligibility to participate based on the inclusion criteria described above. Individuals who passed the eligibility check were routed to the first page of the survey instrument.

Participants answered survey questions at their own pace and progressing through the survey by clicking the "NEXT" icon that was permanently visible at the bottom-right of the screen. Participants could also go back pages by clicking the "PREVIOUS" icon, had they wished to change any answers. If a participant did not complete the survey, all data provided up to the point of exit from the survey was excluded from analysis.

Participants were routed to questions that were applicable to them on the basis of a response or combination of responses to a previous question or questions. The survey instrument was designed with the assumption that all respondents to a question will be asked the next question, unless there were specific instructions routing a subgroup of respondents to a different question. The survey took around 15-20 minutes to complete. Participants received a $30 virtual Visa Reward Card by email for completing the survey.

3.3 Survey measures

The survey instrument was largely composed of questions and response options that were extracted or adapted from the Adult Interview Forms administered at Wave 1 (2013/14) and Wave 2 (2014/15) of the FDA Population Assessment of Tobacco and Health (PATH) Study. Questions and response options were also extracted or adapted from peer-reviewed questionnaires that have been validated for assessing tobacco use behaviors, perceptions and use intentions among adults. Data were obtained in the following domains.

3.3.1 Demographics

Questions assessed age, sex, census region, ethnicity, race, sexual orientation, educational attainment and annual household income. Questions also assess participants' military service and health insurance coverage. These demographic variables were selected for assessment on the basis of well-established evidence that smoking prevalence, susceptibility to smoking initiation, and health inequalities in the United States vary significantly as a function of individuals' status on these variables.

3.3.2 Reasons for purchasing a JUUL ENDS

Participants were asked to identify which, if any, of a list of health, social, financial, sensory and convenience reasons were reasons why they (1) first decided to purchase a JUUL ENDS, (2) currently use a JUUL ENDS; and (3) no longer use a JUUL ENDS. Questions will also assess whether participants had planned to use their JUUL ENDS to quit smoking completely, cut down their smoking but not quitting completely, and use in places where smoking is prohibited.

3.3.3 Satisfaction with the JUUL ENDS

Participants were asked to rate their satisfaction with the dose of nicotine delivered from their JUUL ENDS, the extent to which using the JUUL ENDS suppresses cravings to smoke a cigarette, and to rate their enjoyment of using the JUUL ENDS in comparison to smoking cigarettes.

3.3.4 E-cigarette use prior to initiating use of the JUUL ENDS

Questions assessed participants' ever-use and regularity of use of e-cigarettes/vapor products prior to their first use of a JUUL ENDS.

3.3.5 *Past 30-day use of e-cigarettes/vapor products other than the JUUL ENDS*

Participants who indicated they had used an e-cigarette other than the JUUL ENDS in the past 30 days will be asked about the characteristics of the e-cigarette they used most often in the past 30 days, include the brand of this e-cigarette, whether it was rechargeable and refillable, and what flavors and concentration of nicotine they used regularly in this e-cigarette/vapor product.

3.3.6 *Cigarette smoking*

Questions assessed the prevalence of ever-smoking and regular smoking, age of smoking initiation, current smoking patterns, and time since quitting smoking cigarettes, when applicable. Past 30-day prevalence of cigarette smoking was be assessed by the questions, "In the past 30 days, have you smoked a cigarette, even one or two puffs?" For participants who indicate they have smoked a cigarette in the past 30 days, frequency of cigarette smoking will be assessed by a further two questions: (i) Do you now smoke cigarettes… (every day; some days; not at all); and (ii) "On how many of the past 30 days did you smoke cigarettes?" ('some days' smokers only). Intensity of smoking in the past 30 days will then be assessed in 'every day' and 'some days' smokers by the question: "On those days that you did smoke, how many cigarettes did you usually smoke each day? A pack usually has 20 cigarettes in it".

3.3.7 *Use of the JUUL ENDS*

Questions assessed historical patterns of use of the JUUL ENDS, current smoking patterns of frequency and intensity of use, use of flavors and nicotine strengths, and time since stopping use of the JUUL ENDS, when applicable. Questions similar to those used to assess cigarette smoking in the past 30 days were used to assess participants' frequency of use of the JUUL ENDS in the past 30 days and typical number of JUUL use sessions per day. Questions will also assess participants use of JUUL e-liquid flavors in the past 30 days, flavors used regularly, and the number of JUUL e-liquid refill cartridges in each flavor and nicotine strength consumed in the past 30 days.

3.3.8 Quit attempts the past 12 months and quit methods used

Participants were asked if they have made an attempt to quit smoking cigarettes completely or an attempt to quit smoking cigarettes by gradually reducing smoking in the past 12 months. Participants who indicated having made an attempt to quit smoking in the past 12 months were asked about their use of a range of tobacco products, nicotine products, stop smoking medications, and psychosocial methods as part of their last quit attempt, and whether they are currently using any of these products or methods to support an ongoing attempt to quit smoking.

Participants who indicated having quit smoking in the past 12 months were asked about their use of the JUUL ENDS and a range of other tobacco products, nicotine products, stop smoking medications, and psychosocial methods as part of their successful quit attempt. Questions assessed whether participants are currently using any of these products or methods to support an ongoing attempt to prevent a relapse to smoking and/or to alleviate nicotine withdrawal symptoms.

3.4 Data collection

The survey instruments was hosted by *Dacima Survey Software* (www.dacimasoftware.com), advanced web survey software that complies with FDA 21 CRF Part 11, HIPAA, Good Clinical Practices (GCP) and generates comprehensive and complete audit trails that track all changes to study data, and all user access, actions, and sessions. *Dacima Survey Software's* compliance with FDA 21 CRF Part 11, HIPAA and Good Clinical Practices (GCP) was verified in July 2017 by an independent auditor commissioned by the Centre for Substance Use Research. *Dacima Survey Software* is optimized to enable participants to easily view and complete surveys on a range of devices (e.g. laptops, smartphones, tablets) and all web browsers (e.g. Chrome, Safari, Firefox, Internet Explorer).

3.5 Data analysis

The primary outcome assessed in this study was an estimate of the prevalence of key transitions in cigarette smoking status between participants' first use of a JUUL vaping device and at the time of survey (i.e. current smoking status). Participants were classified into one of eight mutually exclusive smoking transition groups based on their answers to questions about their use of cigarettes before their first ever use of a JUUL, their frequency and intensity of smoking when they first used a JUUL, and their current frequency and intensity of cigarette smoking. The definitions of the eight transition groups (Table 1) were adapted from the FDA's Population Assessment of Tobacco and Health (PATH) Study, Adult Interview (Wave 2, 2014/15), a longitudinal cohort study of the prevalence and change in tobacco use behaviors, attitudes and beliefs, and tobacco-related health outcomes among approximately 46,000 adults and youth in the United States. All questions that assessed participants' demographic characteristics, cigarette smoking and e-cigarette use were adapted from the Adult Interview Forms of Wave 1 and Wave 2 of the PATH Study.

Counts and percentages are used to describe the prevalence of each smoking transition in this sample, the prevalence of different magnitudes of change in daily cigarettes consumption among participants who are Still Current Smokers, and quitting characteristics of New Former Smokers.

Two logistic regression models examined factors associated with transitioning from a Current Smoker at the time of first use of a JUUL to being a New Former Smoker now. The first logistic regression model estimated participants' odds of transitioning from a Current Smoker at the time of first JUUL use to a New Former Smoker now (versus a Still Current Smoker) associated with a range of demographic, smoking, e-cigarette use, and JUUL use variables. The second logistic regression model estimated participants' likelihood of transitioning from a Current Smoker at the time of first JUUL use to a New Former Smoker now (versus a Still Current Smoker) associated with their endorsement of various reasons for first purchasing a JUUL vaping device. Odds ratios in these regression models indicate the proportionate change in a participant's odds of being a New Former Smoker associated with the indicator on the categorical predictor variable. P values < 0.05 were considered statistically significant.

Table 1. Labels and descriptions of eight cigarette smoking transitions between the time of first use of a JUUL vaping device and now.

Transition Group	Group Description
Still Never Smokers	Participants who had never smoked a cigarette – not even a puff – in their lifetime when they first used a JUUL vaping device and still have not smoked a cigarette.
Still Current Smokers	Participants who have ever smoked a cigarette, were smoking every day or some days at the point at which they first used a JUUL vaping device, and now smoke every day or some days.
New Daily Smokers	Participants who have ever smoked a cigarette, smoked their first cigarette after the age at which they first used a JUUL vaping device or at the same age at which they first used a JUUL vaping device, were smoking cigarettes not at all at the point at which they first used a JUUL vaping device, and now smoke every day.
New Some-Days Smokers	Participants who have ever smoked a cigarette, smoked their first cigarette after the age at which they first used a JUUL vaping device or at the same age at which they first used a JUUL vaping device, were smoking cigarettes not at all at the point at which they first used a JUUL vaping device, and now smoke on some days.
Still Former Smokers	Participants who have ever smoked a cigarette, smoked their first cigarette before the age at which they first used a JUUL vaping device, were smoking cigarettes not at all at the point of their first use of a JUUL vaping device, and have not smoked a cigarette in the past 30 days or currently smoke cigarettes not at all.

New Former Smokers	Participants who have ever smoked a cigarette, were smoking every day or some days at the point of their first use of a JUUL vaping device, and have not smoked a cigarette in the past 30 days or currently smoke cigarettes not at all.
Relapsed Former Smokers	Participants who have ever smoked a cigarette, smoked their first cigarette before the age at which they first used a JUUL vaping device, were smoking cigarettes not at all at the point of their first use of a JUUL vaping device, and now smokes every day or some days.
Undetermined	Participants who did not satisfy criteria for classification into any of the above seven groups.

4 Results

4.1 Sample

Of the 88,994 individuals who received an email invitation, 35.3% (n = 31,438) clicked the link in the invitation email and started the survey; 4.0% (n = 3,536) were ineligible to participate, and 10.3% (n = 9,103) started but did not complete the survey. This left a final sample of 18,799 (21.1% of all invited) U.S. adults who consented to participate, satisfied eligibility criteria and completed the survey instrument.

4.2 Cigarette smoking status at the time of first use of a JUUL

The majority (87.2%) of participants were either smoking cigarettes or had smoked cigarettes in the past when they used a JUUL for the first time. At the point of their first ever use of a JUUL, 62.2% (n = 11,689) of participants were smoking cigarettes every day or some days (i.e. current smokers); 25.0% (n = 4,695) had smoked cigarettes in the past but were smoking not at all when they first used a JUUL (i.e. former smokers), and 12.7% (n = 2,385) had never smoked a cigarette, not even a puff (i.e. never smokers). A cigarette smoking status at the point of first JUUL use could not be determined for the remaining 0.2% (n = 30) of JUUL users. Of those who were current smokers when they first used a JUUL, 58.7% (n = 6,867) were smoking every day and 41.3% (n = 4,822) were smoking on some days.

4.3 Nicotine use status before and at the time of first use of a JUUL

Overall, 90.2% [2] of participants had ever used nicotine through use of cigarettes and/or e-cigarettes before their first ever use of a JUUL (Table 2). Approximately 6.9% of participants had never used an e-cigarette or smoked a cigarette before their first use of a JUUL, and a prior nicotine use status could not be determined for the remaining 2.9% [3].

[2] Of 7,564 participants who indicated they had never used an e-cigarette before their first ever purchase of a JUUL, 442 (5.8%) subsequently reported using an e-cigarette "every day" or "some days" when they first used a JUUL. These 442 participants (2.4% of all participants) were re-coded as having ever used an e-cigarette before their first use of a JUUL.

[3] Includes Never Smokers who were using an e-cigarette not containing nicotine (0.6%), never smokers who were former e-cigarette users (2.1%), and participants whose smoking status could not be determined (0.2%).

Approximately 74.5% of participants were using nicotine through cigarettes and/or e-cigarettes when they first used a JUUL; 25.3% of participants were not using nicotine through cigarettes or e-cigarettes when they first used a JUUL, most (15.7%) of whom were Former Smokers. Approximately 21.6% of participants were Current Smokers who had never used an e-cigarette when they first used a JUUL. This meant the JUUL vaping device was the first e-cigarette used by 34.5% of Current Smokers.

The 62.2% of participants who were Current Smokers when they first used a JUUL were comprised of 19.2% who were both smoking cigarettes and using nicotine-containing e-cigarettes and 43% who were smoking cigarette but not using nicotine through e-cigarettes. Approximately 21.6% of participants were Current Smokers who had never used an e-cigarette when they first used a JUUL. This meant the JUUL vaping device was the first e-cigarette used by 34.5% of Current Smokers.

The 25.0% of participants who were Former Smokers when they first used a JUUL were comprised of 9.3% who were using nicotine-containing e-cigarettes and 15.7% who were not using nicotine through e-cigarettes. Approximately 9.4% of participants were Former Smokers who had never used an e-cigarette when they first used a JUUL. This meant the JUUL vaping device was the first e-cigarette used by 37.7% of Former Smokers.

The 12.7% of participants who were Never Smokers when they first used a JUUL were comprised of 3.1% who were using nicotine-containing e-cigarettes and 9.6% who were not using nicotine through e-cigarettes. Approximately 3.1% of participants were Never Smokers who had never used an e-cigarette when they first used a JUUL. This meant the JUUL vaping device was the first e-cigarette used by 24.2% of Never Smokers.

Table 2. Nicotine use status of 18,799 participants before and at the time of their first ever use of a JUUL vaping device.

Product use status at first use of a JUUL vaping device				
Cigarettes	**E-Cigarettes**	**N (%)**	**Had Ever Used Nicotine Before First JUUL**	**Was Using Nicotine At First JUUL**
Current Smoker	Using an e-cigarette containing nicotine	3,608 (19.2)	Yes	Yes
	Using an e-cigarette not containing nicotine	188 (1.0)	Yes	Yes
	Former e-cigarette user	3,838 (20.4)	Yes	Yes
	Never e-cigarette user	4,055 (21.6)	Yes	Yes
Former Smoker	Using an e-cigarette containing nicotine	1,740 (9.3)	Yes	Yes
	Using an e-cigarette not containing nicotine	110 (0.6)	Yes	No
	Former e-cigarette user	1,077 (5.7)	Yes	No
	Never e-cigarette user	1,768 (9.4)	Yes	No
Never Smoker	Using an e-cigarette containing nicotine	577 (3.1)	Yes	Yes
	Using an e-cigarette not containing nicotine	119 (0.6)	Und.	No
	Former e-cigarette user	390 (2.1)	Und.	No
	Never e-cigarette user	1,299 (6.9)	No	No
Undetermined		30 (0.2)	Und.	Und.
Total	Total	18,799 (100.0)		

4.4 Transitions in smoking status between the time of first JUUL use and time of survey

Participants' transitions in smoking status between the time of their first use of JUUL and their smoking status now are shown in Figure 1. The prevalence of eight main transition categories in this sample is summarised in Figure 2.

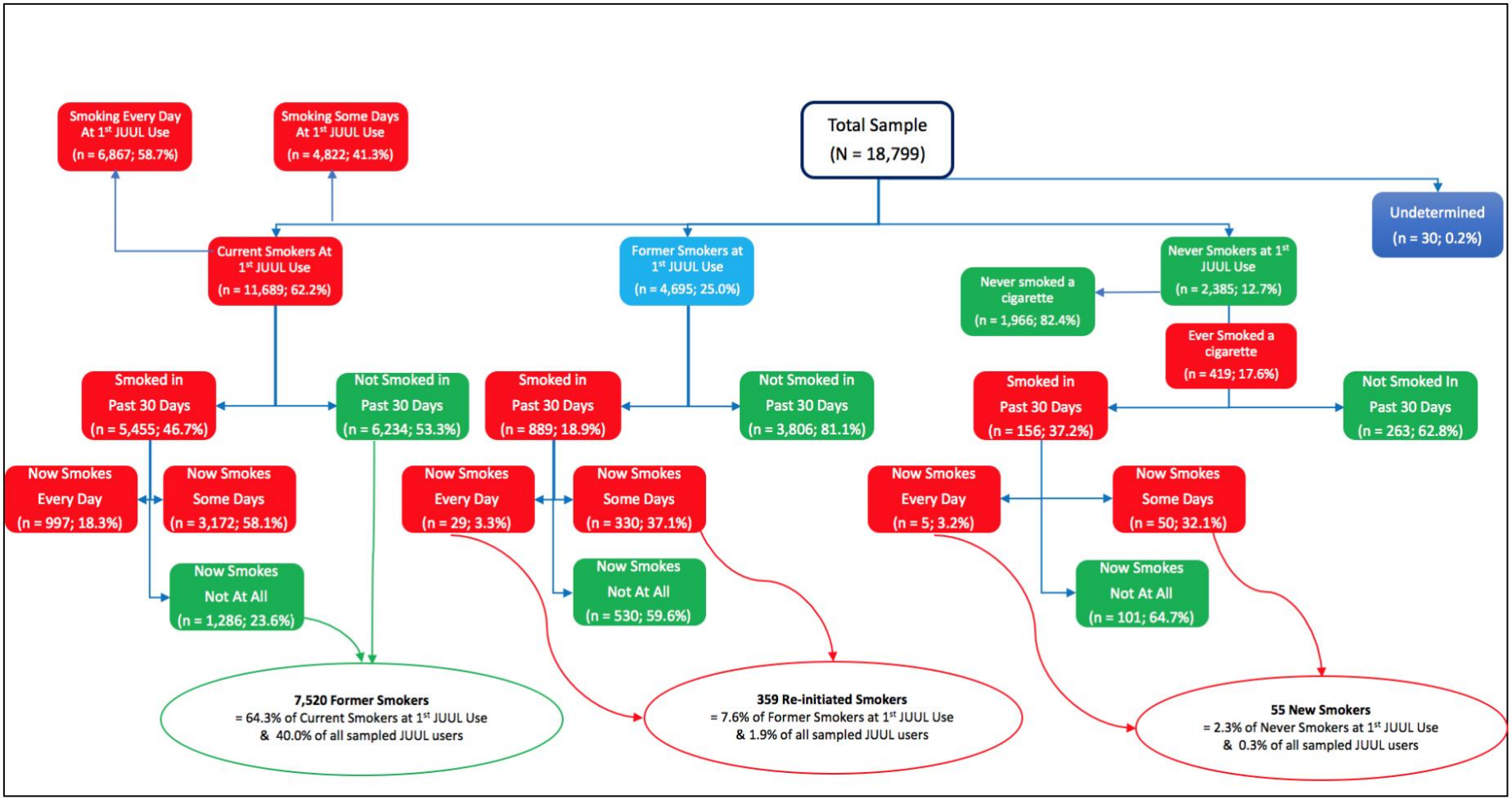

Figure 1. Transitions in cigarette smoking status among 18,799 adults between the time of their first use of a JUUL vaping device and the time of survey.

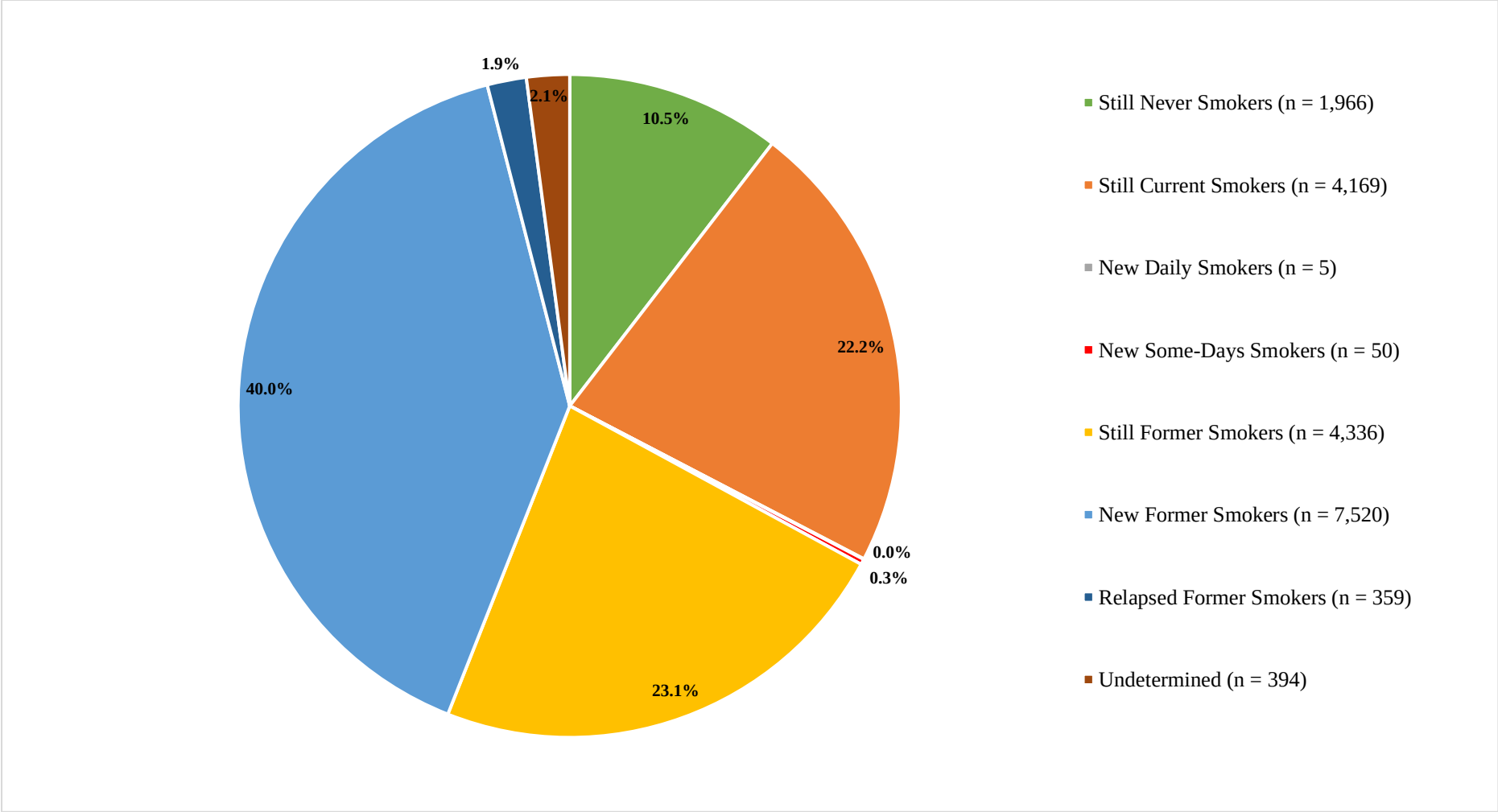

Figure 2. Prevalence of eight cigarette smoking transition categories in 18,799 adults between the time of first use of a JUUL vaping device and the time of survey.

4.4.1 Transition from Current Smoker to Former Smoker

Of the 11,689 participants who were smoking every day or some days when they first started using a JUUL, 64.3% (n = 7,520) are now New Former Smokers ('no smoking in the past 30 days' or 'now smoking not at all') and 35.7% (n = 4,169) are Still Current Smokers (still smoking cigarettes every day or some days). These data suggest that for each participant who was smoking when he/she first used a JUUL and is still smoking now, approximately two participants have now stopped smoking cigarettes completely. Overall, New Former Smokers accounted for 40.0% of all participants, and Still Current Smokers accounted for 22.2% of all participants (5.3% smoking every day; 16.9% smoking on some days).

Just over half (52.9%; n = 6,189) of participants who were smoking cigarettes when they first used a JUUL have now stopped smoking cigarettes completely *and* were using the JUUL vaping device every day or some days when they stopped smoking cigarettes completely (Table 3). Overall, New Former Smokers who quit smoking while using a JUUL every day or on some days accounted for 32.9% of all participants.

Additionally, about half (49.5%; n = 5,782) of participants who were smoking when they first used a JUUL have now stopped smoking completely *and* reported that they 'quit smoking cigarettes by switching to using a JUUL'.[4] New Former Smokers who reported quitting smoking by switching to using a JUUL accounted for 30.8% of all participants.

[4] The question asked "*Thinking back to when you quit smoking cigarettes, did you…(check all that apply)*", with a list of 13 quit methods and products presented, one of which was "Switched to using a JUUL".

Table 3. Transitions in cigarette smoking status among 11,689 (62.2% of sample) participants who were smoking cigarettes every day or some days at the point of their first use of a JUUL vaping device.

Transition	N (% of Current Smokers at First JUUL Use)	% of Sample
Has smoked in the past 30 days	5,455 (46.7)	29.0
Now smokes every day	997 (8.5)	5.3
Now smokes on some days	3,172 (27.1)	16.9
Has not smoked in the past 30 days OR now smokes not at all (i.e. former smokers)	7,520 (64.3)	40.0
Stopped smoking cigarettes completely while using JUUL	6,189 (52.9)	32.9
Stopped smoking cigarettes completely while using JUUL every day	4,895 (41.9)	26.0
Stopped smoking cigarettes completely while using JUUL on some days	1,294 (11.1)	6.9
Stopped smoking cigarettes completely while using JUUL not at all	1,330 (11.4)	7.1
Quit smoking completely by 'switching to using a JUUL'	5,782 (49.5)	30.8

4.4.2 Transition from Former Smoker to Current Smoker

Of the 4,695 participants who had smoked cigarette in the past but were smoking not at all when they used a JUUL for the first time, 7.6% (n = 359) were now smoking every day or some days (Relapsed Former Smokers) and 92.4% (n = 4,336) have either not smoked at all in the past 30 days or are now smoking not at all (Still Former Smokers) (Table 4). Relapsed Former Smokers and Still Former Smokers accounted for 1.9% and 23.1% of all participants, respectively. Of all participants who were former smokers when they first used a JUUL, have re-initiated smoking, 0.6% (n = 29) now smoke every day and 7.0% (n = 330) now smoke on some days.

4.4.3 Transition from Never Smoker to Current Smoker

Of the 2,385 participants who had never smoked a cigarette in their lifetime when they when they first used a JUUL, 17.6% (n = 419) have now smoked at least one cigarette; 6.5% (n = 156) have smoked in the past 30 days; 0.2% (n = 5) now smoke every day; and 2.1% (n = 50) now smoke on some days (Table 5). New Daily Smokers accounted for 0.0% of all participants; New Some-Days Smokers accounted for 0.3% of all participants. of those who had never smoked a cigarette when they first used a JUUL, 82.4% (n = 1,966) have still never smoked a cigarette. Still Never Smokers accounted for 10.5% of all participants.

Table 4. Transitions in cigarette smoking status among 4,695 (25.0% of sample) participants who were smoking not at all when they first used a JUUL vaping device, but had smoked in the past.

Transition	N (% of Former Smokers at First JUUL)	% of Sample
Has smoked in the past 30 days	889 (18.9)	4.7
Has not smoked in the past 30 days	3,806 (81.1)	20.2
Now smokes daily	29 (0.6)	0.2
Now smokes on some days	330 (7.0)	1.8
Has smoked a cigarette in the past 30 days but now smokes not at all	530 (11.3)	2.8

Table 5. Transitions in cigarette smoking status among 2,385 (12.7% of sample) participants who had never smoked a cigarette when they first used a JUUL vaping device.

Transition	N (% of Never Smokers at First JUUL)	% of Sample
Has now smoked at least one cigarette	419 (17.6)	2.2
Has still never smoked a cigarette	1,966 (82.4)	10.5
Has smoked in the past 30 days	156 (6.5)	0.8
Has ever smoked but has not smoked in the past 30 days	263 (11.0)	1.4

4.5 Change in daily cigarette consumption among Still Current Smokers

Approximately 43.3% of Still Current Smokers were smoking 0-5 cigarettes per day when they first used a JUUL, and 56.7% were smoking ≥6 cigarettes per day (Table 6). Of the 3,894 Still Current Smokers who were smoking ≥6 cigarettes per day when they first used a JUUL, 56.3% (n = 1,242) now smoke between 50% and 99% fewer cigarettes per day (Table 7). Participants who were smoking ≥6 cigarettes per day when they first used a JUUL and are still smoking but have reduced their daily cigarette consumption by at least 50% accounted for 29.8% of Still Current Smokers, 10.6% of all participants who were smoking cigarettes when they first used a JUUL, and 6.6% of the total sample.

Of 2,213 Still Current Smokers who were smoking ≥6 cigarettes per day when they first used a JUUL, 66.0% now smoke at least five fewer cigarettes per day, and 50.7% now smoke between 0-5 cigarettes per day. Of still current smokers who were smoking between 11 and 20 cigarettes per day when they first used a JUUL (i.e. moderate smokers), 58.0% now smoke between 50% and 99% fewer cigarettes per day, and 45.5% now smoke between 0-5 cigarettes per day.

Of Still Current Smokers who were smoking 21 or more cigarettes per day when they first used a JUUL (i.e. heavy smokers), 59.9% now smoke between 50% and 99% fewer cigarettes per day, and 33.3% now smoke between 0-5 cigarettes per day. Lastly, of the 1,894 participants who were smoking between 0 and 5 cigarettes per day when they first used a JUUL and are still smoking now, 89.2% are still smoking between 0-5 cigarettes per day, and 7.9% are now smoking between 6-10 cigarettes per day.

Table 6. Change in Still Current Smokers' daily cigarette consumption between the time of first use of a JUUL and now.

		Number of Cigarettes Smoked Per Day Now							
	-	**0 to 5 CPD**	**6 to 10 CPD**	**11 to 15 CPD**	**16 to 20 CPD**	**21 to 25 CPD**	**26 to 30 CPD**	**31+ CPD**	**Total**
Number of Cigarettes Smoked Per Day At First Use of a JUUL	**0 to 5 CPD**	1,690 (89.2)	149 (7.9)	23 (1.2)	28 (1.5)	0 (0.0)	4 (0.2)	0 (0.0)	1,894 (46.1)
	6 to 10 CPD	572 (59.8)	341 (35.7)	24 (2.5)	16 (1.7)	0 (0.0)	3 (0.3)	0 (0.0)	956 (23.3)
	11 to 15 CPD	199 (50.4)	82 (20.8)	100 (25.3)	13 (3.3)	1 (0.3)	0 (0.0)	0 (0.0)	395 (9.6)
	16 to 20 CPD	292 (42.6)	120 (17.5)	62 (9.1)	202 (29.5)	3 (0.4)	5 (0.7)	1 (0.1)	685 (16.7)
	21 to 25 CPD	19 (40.4)	10 (21.3)	4 (8.5)	4 (8.5)	10 (21.3)	0 (0.0)	0 (0.0)	47 (1.1)
	26 to 30 CPD	25 (35.2)	8 (11.3)	6 (8.5)	12 (16.9)	3 (4.2)	17 (23.9)	0 (0.0)	71 (1.7)
	31+ CPD	15 (25.4)	9 (15.3)	7 (11.9)	8 (13.6)	0 (0.0)	3 (5.1)	17 (28.8)	59 (1.4)
	Total	2,812 (68.5)	719 (17.5)	226 (5.5)	283 (6.9)	17 (0.4)	32 (0.8)	18 (0.4)	4,107 (100.0)

Table 7. Percent change in Still Current Smokers' daily cigarette consumption between the time of first use of a JUUL and now.

		Percent Change in Number of Cigarettes Smoked Per Day Now						
	-	**Reduced by 50% to 99% N (% row)**	**Reduced by 1% to 49% N (% row)**	**No Change N (% row)**	**Increased by 1% to 49% N (% row)**	**Increased by 50% to 99% N (% row)**	**Increased by ≥100% N (% row)**	**Total* N (% column)**
Number of Cigarettes Smoked Per Day At First Use of a JUUL	**1 to 5 CPD**	336 (19.9)	148 (8.8)	655 (38.8)	65 (3.9)	72 (4.3)	411 (24.4)	1,687 (43.3)
	6 to 10 CPD	513 (53.7)	121 (12.7)	251 (26.3)	29 (3.0)	22 (2.3)	19 (2.0)	955 (24.5)
	11 to 15 CPD	222 (56.3)	70 (17.8)	84 (21.3)	16 (4.1)	2 (0.5)	0 (0.0)	394 (10.1)
	16 to 20 CPD	401 (58.9)	76 (11.2)	192 (28.2)	7 (1.0)	4 (0.6)	1 (0.1)	681 (17.5)
	21 to 25 CPD	30 (63.8)	8 (17.0)	9 (19.1)	0 (0.0)	0 (0.0)	0 (0.0)	47 (1.2)
	26 to 30 CPD	39 (54.9)	15 (21.1)	17 (23.9)	0 (0.0)	0 (0.0)	0 (0.0)	71 (1.8)
	31+ CPD	37 (62.7)	6 (10.2)	16 (27.1)	0 (0.0)	0 (0.0)	0 (0.0)	59 (1.5)
	Total	1,578 (40.5)	444 (11.4)	1,224 (31.4)	117 (2.6)	100 (11.1)	431 (11.1)	3,894 (100.0)

4.6 Factors associated with transitioning from a Current Smoker at the time of first use of a JUUL vaping device to a New Former Smoker now

Demographic, cigarette smoking, and e-cigarette use characteristics of New Former Smokers and Still Current Smokers are summarized in Table 8. Participants' likelihood of transitioning from a Current Smoker when they first used a JUUL to a New Former Smoker now significantly varied by age, race/ethnicity, annual household income, lifetime frequency of smoking, frequency of smoking at time of first JUUL use, heaviness of cigarette smoking at the time of first use of a JUUL, lifetime years of JUUL use, frequency of JUUL use now, current use of an e-cigarette other than a JUUL, and whether the participant first bought a JUUL to help him/her to quit smoking regular cigarettes (Table 9).

Compared with those aged 21 to 24 years, participants who were 25 years or older were more likely to be New Former Smokers. Compared with non-Hispanic Whites, non-Hispanic Asian, Hawaaiin and Pacific Islanders were less likely to be New Former Smokers (aOR = 0.68; 0.59, 0.78). Compared to those with an annual household income less than $25,000, those with annual household incomes of between $25,000 and $74,999 (aOR = 1.23; 1.07, 1.41) or $75,000 or more (aOR = 1.43; 1.24, 1.65) were more likely to be New Former Smokers.

Participants' likelihood of being a New Former Smoker decreased with more lifetime years of regular smoking. Compared with participants who have smoked regularly for more 20 years in their lifetime, participants who have smoked for less than one year (aOR = 4.32; 3.30, 5.65), between 1-5 years (aOR = 2.37; 1.87, 3.00), between 6-10 years (aOR = 1.77; 1.42, 2.21), and between 11-20 years (aOR = 1.29; 1.06, 1.56) were all more likely to be New Former Smokers.

Compared to participants who were non-daily smokers when they first used a JUUL, participants who were daily smokers when they first used a JUUL were less likely to be New Former Smokers (aOR = 0.59; 0.53, 0.66). Compared to participants who were light smokers (0-9 cigarettes per day) when they first used a JUUL, moderate smokers (10-19 cigarettes per day) were less likely to be New Former Smokers (aOR = 0.81; 0.72, 0.92). Compared to participants who have been using a JUUL for less than one year, participants who have been

using a JUUL for between 1-5 years were more likely to be New Former Smokers (aOR = 2.04; 1.79, 2.33).

Compared to current non-daily users of a JUUL, daily users of JUUL were more likely to be New Former Smokers (aOR = 2.95; 2.59, 3.36). Compared to participants who were not currently using an e-cigarette other than a JUUL, participants who were currently using an e-cigarette other than a JUUL were more likely to be New Former Smokers (aOR = 1.21; 1.03, 1.42). Lastly, participants who first bought a JUUL 'to help them to quit smoking regular cigarettes' were more likely to be New Former Smokers (aOR = 2.17; 1.94, 2.42).

Participants' likelihood of transitioning from a Current Smoker when they first used a JUUL to a New Former Smoker now did not significantly vary by sex, educational attainment, U.S. census region, or age of first smoking.

Table 8. Demographic, smoking and e-cigarette use characteristics of New Former Smokers and Still Current Smokers.

Variable	New Former Smokers (n = 7,520) N (%)	Still Current Smokers (n = 4,169) N (%)	Total (n = 11,689) N (%)
Demographic Variables			
Sex			
Male	4614 (61.4)	2559 (61.4)	7173 (61.4)
Female	2850 (37.9)	1562 (37.5)	4412 (37.7)
Transgender	21 (0.3)	24 (0.6)	45 (0.4)
Missing	35 (0.5)	24 (0.6)	59 (0.5)
Age			
21-24	2416 (32.1)	1328 (31.9)	3744 (32)
25-34	2726 (36.3)	1432 (34.3)	4158 (35.6)
35-44	1271 (16.9)	665 (16)	1936 (16.6)
45-54	724 (9.6)	463 (11.1)	1187 (10.2)
55-64	318 (4.2)	239 (5.7)	557 (4.8)
≥ 65	65 (0.9)	42 (1)	107 (0.9)
Race/Ethnicity			
Non-Hispanic, White	5075 (67.5)	2686 (64.4)	7761 (66.4)
Non-Hispanic, Black	306 (4.1)	145 (3.5)	451 (3.9)
Non-Hispanic, American Indian/Alaskan	105 (1.4)	55 (1.3)	160 (1.4)
Non-Hispanic, Asian, Hawaiian or PI§	14 (0.2)	7 (0.2)	21 (0.2)
Non-Hispanic, 2 or More Races	827 (11.0)	593 (14.2)	1420 (12.1)
Hispanic†	616 (8.2)	313 (7.5)	929 (7.9)
Missing		370 (8.9)	947 (8.1)

	577 (7.7)		
Education			
Not HS graduate	104 (1.4)	74 (1.8)	178 (1.5)
GED	132 (1.8)	104 (2.5)	236 (2)
HS graduate	731 (9.7)	445 (10.7)	1176 (10.1)
Some college or associate's degree	2817 (37.5)	1542 (37)	4359 (37.3)
Bachelor's degree or higher	3642 (48.4)	1952 (46.8)	5594 (47.9)
Missing	94 (1.3)	52 (1.2)	146 (1.2)
Household Income			
< $25,000	1092 (14.5)	703 (16.9)	1795 (15.4)
$25,000 to $74,999	2720 (36.2)	1527 (36.6)	4247 (36.3)
≥ $75,000	3315 (44.1)	1640 (39.3)	4955 (42.4)
Missing	393 (5.2)	299 (7.2)	692 (5.9)
U.S. Census Region			
Northeast	2500 (33.2)	1331 (31.9)	3831 (32.8)
South	2042 (27.2)	1186 (28.4)	3228 (27.6)
Midwest	1214 (16.1)	639 (15.3)	1853 (15.9)
West	1706 (22.7)	971 (23.3)	2677 (22.9)
Missing	58 (0.8)	42 (1)	100 (0.9)
Smoking and E-cigarette Variables			
Age of first smoking			
≤ 11 years	164 (2.2)	106 (2.5)	270 (2.3)
12 to 14 years	1443 (19.2)	825 (19.8)	2268 (19.4)
15 to 17 years	3040 (40.4)	1655 (39.7)	4695 (40.2)
18 to 24 years	2682 (35.7)	1488 (35.7)	4170 (35.7)

≥ 25 years	184 (2.4)	88 (2.1)	272 (2.3)
Missing	7 (0.1)	7 (0.2)	14 (0.1)
Lifetime years of smoking			
≤1 year	1280 (17)	438 (10.5)	1718 (14.7)
1-5 years	2073 (27.6)	1057 (25.4)	3130 (26.8)
6-10 years	1565 (20.8)	885 (21.2)	2450 (21)
11-20 years	1482 (19.7)	923 (22.1)	2405 (20.6)
≥ 20 years	881 (11.7)	713 (17.1)	1594 (13.6)
Missing	239 (3.2)	153 (3.7)	392 (3.4)
Frequency of smoking at first JUUL use			
Every day	4160 (55.3)	2707 (64.9)	6867 (58.7)
Some days	3360 (44.7)	1462 (35.1)	4822 (41.3)
Heaviness of smoking at first JUUL use			
Light (0-9 CPD)	4543 (60.4)	2223 (53.3)	6766 (57.9)
Moderate (10-19 CPD)	1718 (22.8)	1123 (26.9)	2841 (24.3)
Heavy (≥ 20 CPD)	1258 (16.7)	823 (19.7)	2081 (17.8)
Missing	1 (0)	0 (0)	1 (0)
Lifetime years of JUUL use			
≤1 year	5742 (76.4)	3498 (83.9)	9240 (79)
1-5 years	1515 (20.1)	443 (10.6)	1958 (16.8)
Missing	263 (3.5)	228 (5.5)	491 (4.2)
Frequency of JUUL use now			
Every day	6525 (86.8)	3039 (72.9)	9564 (81.8)
Some days	763 (10.1)	926 (22.2)	1689 (14.4)
Not at all	74 (1)	70 (1.7)	144 (1.2)
Missing	158 (2.1)	134 (3.2)	292 (2.5)

Current use of an e-cigarette other than JUUL			
Yes	776 (10.3)	459 (11)	1235 (10.6)
No	6744 (89.7)	3710 (89)	10454 (89.4)
Bought first JUUL ‘to help me quit smoking’			
Yes	5113 (68)	2718 (65.2)	7831 (67)
No	2407 (32)	1451 (34.8)	3858 (33)

§ Includes Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Guamanian, Chamorro, and Samoan.

†Includes Mexican, Cuban, Puerto Rican and ‘other Hispanic’ ethnicity.

HS = High School; CPD = cigarettes smoked per day. PI = Pacific Islander.

Table 9. Per cent of New Former Smokers and model information for a logistic regression analysis of factors associated with smokers' likelihood of transitioning to the New Former Smoker group between the time of first JUUL use and the time of survey.

		Unadjusted		Adjusted	
Predictor Variable	% New Former Smokers	Unadjusted OR	95% CI	aOR	95% CI
Sex					
Male	64.3	Ref.	Ref.	Ref.	Ref.
Female	64.6	1.02	0.94 to 1.09	1.08	0.98 to 1.19
Transgender	46.7	0.49*	0.27 to 0.87	0.49*	0.25 to 0.99
Age					
21-24	64.5	Ref.	Ref.	Ref.	Ref.
25-34	65.6	1.05	0.95 to 1.15	1.45***	1.26 to 1.66
35-44	65.7	1.05	0.94 to 1.18	2.01***	1.66 to 2.43
45-54	61	0.86*	0.75 to 0.98	1.91***	1.51 to 2.41
55-64	57.1	0.73**	0.61 to 0.88	1.60**	1.19 to 2.14
≥ 65	60.7	0.85	0.57 to 1.26	3.04***	1.71 to 5.41
Race/Ethnicity					
Non-Hispanic, White	65.4	Ref.	Ref.	Ref.	Ref.
Non-Hispanic, Black	65.6	1.01	0.73 to 1.41	1.13	0.76 to 1.67
Non-Hispanic, American Indian/Alaskan	66.7	1.06	0.43 to 2.63	1.13	0..41 to 3.12
Non-Hispanic, Asian, Hawaiian or PI[§]	58.2	0.74***	0.66 to 0.83	0.68***	0.59 to 0.78
Non-Hispanic, 2 or More Races	67.8	1.12	0.91 to 1.34	1.06	1.01 to 1.62
Hispanic[†]	66.3	1.04	0.90 to 1.20	0.89	0.76 to 1.05
Education					
Not HS graduate	58.4	Ref.	Ref.	Ref.	Ref.
GED	55.9	0.9	0.61 to 1.34	0.91	0.57 to 1.47
HS graduate	62.2	1.17	0.85 to 1.61	1.06	0.72 to 1.57
Some college or associate's degree	64.6	1.3	0.96 to 1.76	1.13	0.78 to 1.64
Bachelor's degree or higher	65.1	1.33	0.98 to 1.80	1.10	0.75 to 1.60

Household Income					
< $25,000	60.8	Ref.	Ref.	Ref.	Ref.
$25,000 to $74,999	64.0	1.15*	1.02 to 1.29	1.23**	1.07 to 1.41
≥ $75,000	66.9	1.30***	1.16 to 1.46	1.43***	1.24 to 1.65
U.S. Census Region					
Northeast	65.3	1.07	0.96 to 1.19	0.99	0.87 to 1.12
South	63.3	0.98	0.88 to 1.09	0.97	0.85 to 1.11
Midwest	65.5	1.08	0.96 to 1.22	1.06	0.91 to 1.23
West	63.7	Ref.	Ref.	Ref.	Ref.
Age of first smoking					
≤ 11 years	60.7	Ref.	Ref.	Ref.	Ref.
12 to 14 years	63.6	1.13	0.87 to 1.46	1.09	0.81 to 1.47
15 to 17 years	64.7	1.19	0.92 to 1.53	1.08	0.80 to 1.45
18 to 24 years	64.3	1.17	0.91 to 1.50	0.91	0.68 to 1.23
≥ 25 years	67.6	1.35	0.95 to 1.92	0.94	0.60 to 1.46
Lifetime years of smoking					
≤1 year	74.5	2.37***	2.04 to 2.74	4.32***	3.30 to 5.65
1-5 years	66.2	1.59***	1.40 to 1.80	2.37***	1.87 to 3.00
6-10 years	63.9	1.43***	1.26 to 1.63	1.77***	1.42 to 2.21
11-20 years	61.6	1.30***	1.14 to 1.48	1.29*	1.06 to 1.56
≥ 20 years	55.3	Ref.	Ref.	Ref.	Ref.
Frequency of smoking at first JUUL use					
Every day	60.6	0.67***	0.62 to 0.72	0.81**	0.72 to 0.92
Some days	69.7	Ref.	Ref.	Ref.	Ref.
Heaviness of smoking at first JUUL use					
Light (0-9 CPD)	67.1	Ref.	Ref.	Ref.	Ref.
Moderate (10-19 CPD)	60.5	0.75***	0.68 to 0.82	0.81**	0.72 to 0.92
Heavy (≥ 20 CPD)	60.5	0.75***	0.68 to 0.83	0.89	0.77 to 1.03

Lifetime years of JUUL use					
≤1 year	62.1	Ref.	Ref.	Ref.	Ref.
1-5 years	77.4	2.08***	1.86 to 2.34	2.04***	1.79 to 2.33
Frequency of JUUL use now					
Every day	68.2	2.03***	1.46 to 2.82	2.95***	2.59 to 3.36
Some days	45.2	0.78	0.55 to 1.10	Ref.	Ref.
Not at all	51.4	Ref	Ref	NA	NA
Current use of an e-cigarette other than JUUL					
Yes	62.8	0.93	0.82 to 1.05	1.21*	1.03 to 1.42
No	64.5	Ref.	Ref.	Ref.	Ref.
Bought first JUUL 'to help me quit smoking'					
Yes	67.7	1.77***	1.62 to 1.93	2.17***	1.94 to 2.42
No	54.2	Ref.	Ref.	Ref.	Ref.
Model: N = 9,288, $\chi^2 = 965.13$, df = 36, $p < 0.001$					

*** p < 0.001; ** p < 0.010; * p < 0.050

Unadjusted ORs were estimated using only the relevant variable as the predictor variable.

§ Includes Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Guamanian, Chamorro, and Samoan.

†Includes Mexican, Cuban, Puerto Rican and 'other Hispanic' ethnicity.

aOR = adjusted odds ratio; HS = High School; CPD = cigarettes smoked per day. PI = Pacific Islander.

4.7 Reasons for first purchase of the JUUL vaping device

Twelve reasons for first purchasing a JUUL vaping device were significant in predicting participants' likelihood of transitioning from a Current Smoker to a New Former Smoker (Table 10). Participants who were smoking cigarettes at the time when they first used a JUUL were more likely to be New Former Smokers now if they had first purchased a JUUL vaping device to help them quit smoking (aOR = 1.69; 1.52, 1.88); because they believed JUUL might be less harmful to them (aOR = 1.34; 1.20, 1.51) and to others (aOR = 1.18; 1.06, 1.33) compared to cigarettes; because they liked the flavors that JUUL came in (aOR = 1.18; 1.05, 1.33); because the vapor from a JUUL smelled better than cigarette smoke (aOR = 1.20; 1.08, 1.33); because they perceived using JUUL as more acceptable to non-smokers (aOR = 1.13; 1.01, 1.26); and because they had read/saw information on the internet about the health benefits of switching from cigarettes to e-cigarettes (aOR = 1.11; 1.00, 1.23).

Conversely, participants were less likely to transition to a New Former Smoker if they had first purchased a JUUL vaping device to help them cut down the number of cigarettes they smoke but not quit completely (aOR = 0.19; 0.17, 0.20); to use in places where smoking regular cigarettes isn't allowed (aOR = 0.63; 0.57, 0.69); to save money compared to smoking cigarettes (aOR = 0.85; 0.77, 0.94); if a doctor or other health professional had advised them to switch from cigarettes to e-cigarettes (aOR = 0.79; 0.63, 1.00); and if they liked that JUUL came in a variety of flavors (aOR = 0.78; 0.70, 0.87).

Table 10. Per cent of New Former Smokers endorsing reasons for first buying a JUUL, and model information for a logistic regression analysis of reasons associated with smokers' likelihood of transitioning to the New Former Smoker group between the time of first JUUL use and the time of survey.

		Unadjusted		Adjusted	
Predictor Variable	% NFS	Unadjusted OR	95% CI	aOR	95% CI
To help me quit smoking regular cigarettes					
Yes	67.7	1.77***	1.62 to 1.93	1.69***	1.53 to 1.88
No	54.2	Ref.	Ref.	Ref.	Ref.
To help cut down number of cigarettes I smoke, but not stop completely					
Yes	38.9	0.19***	0.17 to 0.20	0.19***	0.17 to 0.20
No	77.3	Ref.	Ref.	Ref.	Ref.
To use in places where smoking regular cigarettes isn't allowed					
Yes	54.0	0.46***	0.42 to 0.49	0.63***	0.57 to 0.69
No	72.0	Ref.	Ref.	Ref.	Ref.
I believed JUUL might be less harmful to me than cigarettes					
Yes	65.3	1.15**	1.06 to 1.25	1.34***	1.20 to 1.51
No	62.1	Ref.	Ref.	Ref.	Ref.
I believed JUUL might be less harmful to people around me than cigarettes					
Yes	65.3	1.10*	1.02 to 1.19	1.18**	1.06 to 1.33
No	63.1	Ref.	Ref.	Ref.	Ref.
JUUL was a modern, trend-setting e-cigarette					
Yes	63.3	0.93	0.86 to 1.02	1.06	0.94 to 1.18
No	64.7	Ref.	Ref.	Ref.	Ref.
JUUL came in flavors I like					

Yes	64.1	0.97	0.91 to 1.07	1.18**	1.05 to 1.33
No	64.5	Ref.	Ref.	Ref.	Ref.
The vapor from a JUUL smelled better than cigarette smoke					
Yes	65.3	1.09*	0.92 to 1.18	1.20**	1.08 to 1.33
No	63.3	Ref.	Ref.	Ref.	Ref.
To save money compared to smoking cigarettes					
Yes	62.2	0.86***	0.80 to 0.93	0.85**	0.77 to 0.94
No	65.6	Ref.	Ref.	Ref.	Ref.
People in the media or other public figures were using JUUL					
Yes	58.0	0.76**	0.63 to 0.90	0.93	0.75 to 1.16
No	64.6	Ref.	Ref.	Ref.	Ref.
People had told me that using a JUUL feels like smoking a regular cigarette					
Yes	64.9	1.03	0.95 to 1.12	1.10	0.99 to 1.22
No	64.1	Ref.	Ref.	Ref.	Ref.
Using JUUL was more acceptable to non-smokers					
Yes	64.5	1.01	0.93 to 1.10	1.13*	1.01 to 1.26
No	64.3	Ref.	Ref.	Ref.	Ref.
People who are important to me were using JUUL					
Yes	65.5	1.06	0.96 to 1.18	1.10	0.96 to 1.25
No	64.1	Ref.	Ref.	Ref.	Ref.
To use JUUL while socializing					
Yes	61.5	0.86**	0.78 to 0.95	0.92	0.81 to 1.05
No	65.0	Ref.	Ref.	Ref.	Ref.
The advertising for JUUL appealed to me					
Yes	60.7	0.85*	0.72 to 1.00	1.02	0.84 to 1.24
No	64.6	Ref.	Ref.	Ref.	Ref.

I was curious to try using JUUL					
Yes	62.3	0.86***	0.80 to 0.93	0.92	0.83 to 1.01
No	65.9	Ref.	Ref.	Ref.	Ref.
Read/saw information on internet about health benefits of switching					
Yes	65.3	1.06	0.97 to 1.16	1.11*	1.00 to 1.23
No	64.0	Ref.	Ref.	Ref.	Ref.
People told me that using JUUL helped them to quit smoking cigarettes					
Yes	66.0	1.15***	1.07 to 1.24	1.09	1.00 to 1.20
No	62.7	Ref.	Ref.	Ref.	Ref.
A doctor or other health professional advised me to switch					
Yes	57.1	0.73**	0.60 to 0.90	0.79*	0.63 to 1.00
No	64.6	Ref.	Ref.	Ref.	Ref.
I like that JUUL comes in a variety of flavors					
Yes	61.4	0.83***	0.77 to 0.90	0.78***	0.70 to 0.87
No	65.8	Ref.	Ref.	Ref.	Ref.
Someone who uses JUUL recommended I buy one					
Yes	64.4	1.01	0.93 to 1.09	1.04	0.95 to 1.14
No	64.2	Ref.	Ref.	Ref.	Ref.
I liked the look of the JUUL device					
Yes	64.3	1.00	0.92 to 1.07	1.06	0.96 to 1.18
No	64.4	Ref.	Ref.	Ref.	Ref.
I had read good reviews of JUUL online					
Yes	65.4	1.07	0.99 to 1.16	1.10	0.99 to 1.23
No	63.9	Ref.	Ref.	Ref.	Ref.
The JUUL device looked easy to use					
Yes	64.4	1.01	0.93 to 1.09	1.08	0.97 to 1.19

No	64.3	Ref.	Ref.	Ref.	Ref.
I had used a JUUL in the past and found it satisfying					
Yes	62.8	0.91*	0.84 to 1.00	1.03	0.93 to 1.14
No	64.9	Ref.	Ref.	Ref.	Ref.
Model: N = 11,689, χ^2 = 2108.08, df = 25, $p < 0.001$					

*** p < 0.001

** p < 0.010

* p < 0.050

Unadjusted ORs were estimated using only the relevant variable as the predictor variable.

aOR = adjusted odds ratio

4.8 Quit methods used

An attempt to quit smoking completely or to quit smoking by gradually reducing consumption in the past 12 months was reported by 2,822 (67.7%) of Still Current Smokers. These 2,822 attempted quitters and the 415 New Former Smokers (i.e. successful quitters) were asked about the products and methods they used the last time they tried to quit smoking/when they quit smoking cigarettes completely (Figure 3).

Over three-quarters (76.9%) of New Former Smokers reported having quit smoking completely by switching to using a JUUL vaping device. In contrast, 58.6% of Still Current Smokers had tried to quit smoking by switching to using a JUUL vaping device at their last quit attempt. This meant that of the 7,435 participants in this sample who tried to quit smoking at their last quit attempt by switching to using a JUUL vaping device, 77.8% succeeded. Therefore, the rate of smoking cessation attributed to the JUUL vaping device by participants who tried to quit smoking by using the JUUL vaping device is estimated at 77.8%.

New Former Smokers were also more likely to have tried to quit by switching completely to using another brand of e-cigarette (9.9% vs. 6.8%). Still Current Smokers were more likely than New Former Smokers to have tried to quit smoking by quitting 'cold turkey' (25.4% vs. 16.3%), substituting some regular cigarettes for e-cigarettes (22.0% vs. 12.7%), and relying on the support of family and friends (16.7% vs. 10.7%).

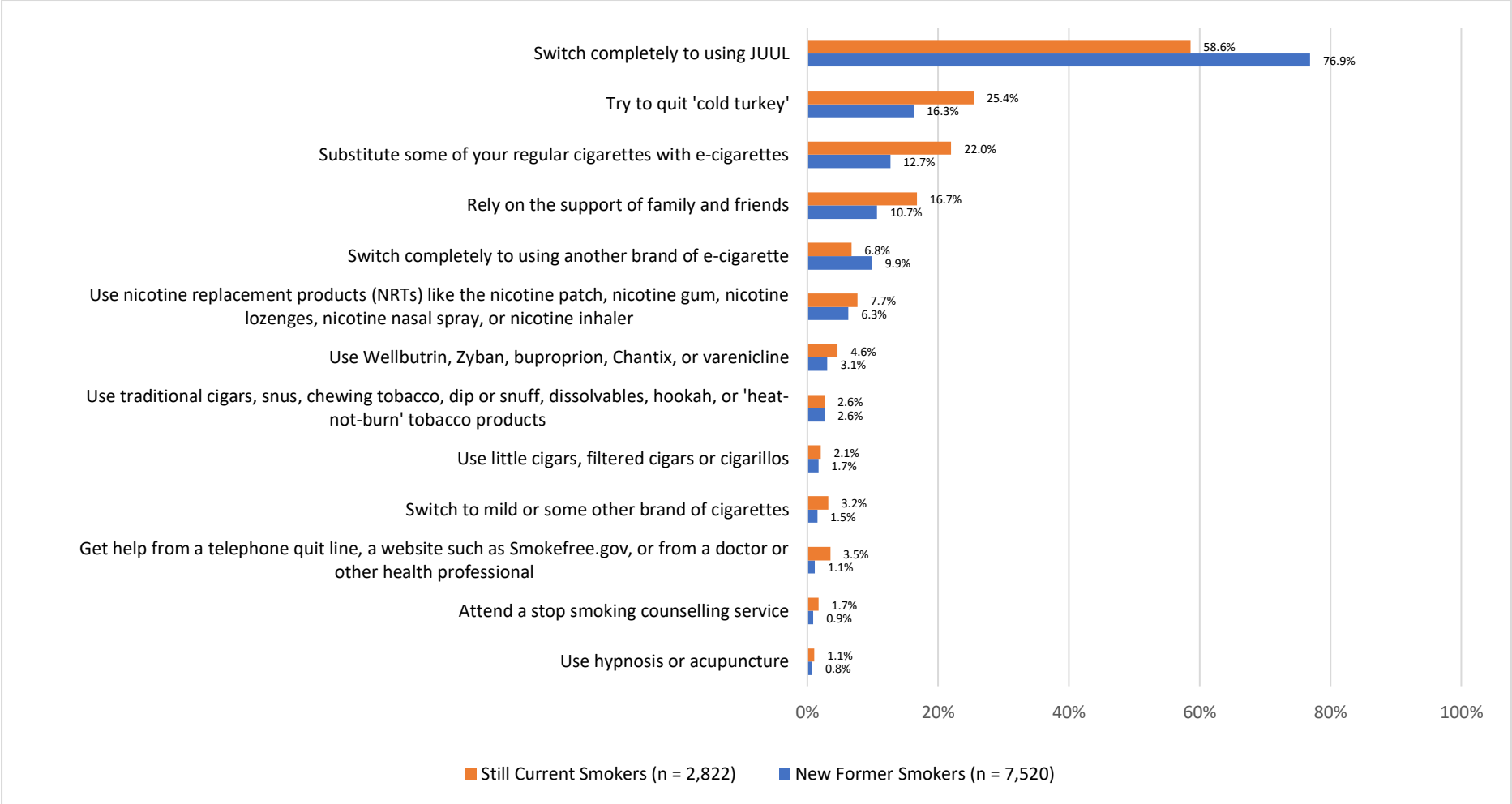

Figure 3. Quit methods used by Still Current Smokers at their last quit attempt and by New Former Smokers when they quit smoking completely.

4.9 Quitting characteristics of New Former Smokers

The majority (78.5%) of New Former Smokers had quit smoking completely within the past 12 months (i.e. recent quitters), with daily users of a JUUL more likely to be recent quitters than non-daily and former users of a JUUL (Table 11). Overall, 82.3% of New Former Smokers were using a JUUL vaping every day or on some days when they stopped smoking completely, with 17.7% of New Former Smokers having stopped smoking while not using a JUUL., Almost all (96.8%) New Former Smokers indicated a belief that they are unlikely to resume smoking within the next year.

At least 45.4% of New Former Smokers reported stopping smoking completely within their first 30 days of using a JUUL, with 26.9% stopping smoking within their first seven days of using a JUUL. New Former Smokers who stopped smoking completely within the first 30 days of using a JUUL (n = 3,417) accounted for 18.2% of all participants.

Table 11. Quitting characteristics of New Former Smokers stratified by frequency of current use of a JUUL vaping device.

	New Former Smokers who now use a JUUL vaping device…				
	Every Day	Some Days	Not At All	Total	Switchers Only*
	(n = 6,525)	(n = 763)	(n = 74)	(n = 7,520)	(n = 5,782)
Variable	N (%)	N (%)	N (%)	N (%)	N (%)
Quit smoking completely…					
Within past 12 months	5,146 (78.9)	581 (76.1)	54 (73.0)	5,902 (78.5)	4,752 (82.0)
0-3 months	1,432 (21.9)	170 (22.3)	14 (18.9)	1,635 (21.7)	1,308 (22.6)
3-6 months	1,335 (20.5)	158 (20.7)	15 (20.3)	1,542 (20.5)	1,256 (21.7)
6-12 months	2,379 (36.5)	253 (33.2)	25 (33.8)	2,725 (36.2)	2,178 (37.7)
More than 12 months ago	1,317 (20.2)	158 (20.7)	19 (25.7)	1,529 (20.3)	983 (17.0)
1-2 years	843 (12.9)	74 (9.7)	9 (12.2)	942 (12.5)	695 (12.0)
2-5 years	372 (5.7)	61 (8.0)	7 (9.5)	456 (6.1)	247 (4.3)
≥ 5 years	102 (1.6)	23 (3.0)	3 (4.1)	131 (1.7)	41 (0.7)
Missing	62 (1.0)	24 (3.1)	1 (1.4)	89 (1.2)	57 (1.0)
Frequency of JUUL use when quit smoking completely					
Every day	4,503 (69.0)	254 (33.3)	50 (67.6)	4,895 (65.1)	4,255 (73.6)
Some days	962 (14.7)	293 (38.4)	10 (13.5)	1,294 (17.2)	955 (16.5)
Not at all	1,059 (16.2)	216 (28.3)	14 (18.9)	1,330 (17.7)	571 (9.9)
Missing	1 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)	1 (0.0)
Number of days using a JUUL before quit smoking completely					
1-7 days	1,841 (28.2)	141 (18.5)	12 (16.2)	2,026 (26.9)	1,734 (30.0)

8-30 days	1,208 (18.5)	142 (18.6)	17 (23.0)	1,391 (18.5)	1,177 (20.4)
31-60 days	418 (6.4)	62 (8.1)	4 (5.4)	503 (6.7)	413 (7.1)
61-90 days	337 (5.2)	33 (4.3)	8 (10.8)	384 (5.1)	327 (5.7)
91-120 days	204 (3.1)	28 (3.7)	2 (2.7)	238 (3.2)	206 (3.6)
121-150 days	111 (1.7)	20 (2.6)	1 (1.4)	134 (1.8)	112 (1.9)
151-180 days	246 (3.8)	30 (3.9)	3 (4.1)	287 (3.8)	243 (4.2)
≥ 181 days	966 (14.8)	72 (9.4)	11 (14.9)	1,068 (14.2)	881 (15.2)
Missing	1,193 (18.3)	235 (30.8)	16 (21.6)	1,489 (19.8)	689 (11.9)
Perceived likelihood of resuming smoking in next year					
Definitely no	5,110 (78.3)	554 (72.6)	60 (81.1)	5,841 (77.7)	4,489 (77.6)
Probably no	1,223 (18.7)	168 (22.0)	11 (14.9)	1,434 (19.1)	1,116 (19.3)
Probably yes	21 (0.3)	0 (0.0)	0 (0.0)	28 (0.4)	16 (0.3)
Definitely yes	5 (0.1)	5 (0.7)	0 (0.0)	5 (0.1)	4 (0.1)
Missing	166 (2.5)	36 (4.7)	3 (4.1)	212 (2.8)	157 (2.7)

*‘Switchers’ are New Former Smokers who selected “Switched to using a JUUL” in response to the question, “Thinking back to when you quit smoking completely, did you…”. Participants could select up to 13 responses to this question.

5 Discussion

This study provides three types of data that characterize the potential impact of JUUL vapor products on tobacco use behaviours among 18,799 U.S. adults who have purchased JUUL vapor products online. First, findings describe the proportion of adult online purchasers of JUUL vapor products who were currently smoking, had smoked in the past, or have never smoked when they first used a JUUL vaping device. Second, we provide estimates of the prevalence of key transitions in cigarette smoking behavior that have occurred in the sample between the time of their first use of a JUUL and the present time. Third, we report data on demographic, smoking and JUUL-related factors that were positively and negatively associated with participants' likelihood of transitioning from a Current Smoker at the time of first JUUL use to a New Former Smoker now.

Based on the observed prevalence of current, former and never smoking at the time of participants' first use of a JUUL, and the observed rate of each transition in cigarette smoking status between the time of first use of a JUUL and now, the data suggest that, for every participant who was a Never Smoker at the time of first use of a JUUL and is now a Current Smoker, approximately 28 participants who were Current Smokers at the time of their first JUUL use are now Former Smokers (i.e. a ratio of 1 New Smoker per 28 New Former Smokers). As participants were approximately five times more likely to be current smokers than they were to be never smokers when they first used a JUUL, there were, therefore, approximately 137 participants in this sample who had transitioned from a Current Smoker to a Former Smoker for every one participant who had transitioned from a Never Smoker to a Current Smoker.

If the rates at which participants had initiated or re-initiated cigarette smoking after their first use of a JUUL are combined, then for every one individual who was either a Never Smoker or a Former Smoker at the time of their first use of JUUL and is now a Current Smoker, six participants who were Current Smokers at the time of their first use of a JUUL are now Former Smokers (i.e. a ratio of six new former smokers per one new smoker/re-initiated smoker). As participants were approximately 1.7 times more likely to be Current Smokers than they were to be Never/Former Smokers when they first used a JUUL, there were,

therefore, approximately 18 participants in this sample who had transitioned from a Current Smoker to a Former Smoker for every one participant who had transitioned from a Never/Former Smoker to a Current Smoker.

5.1 Study limitations

The findings in this report are subject to at least three limitations. First, the sample is not representative of the general U.S. adult population or of the population of U.S. adults who use e-cigarettes, nor was the study designed or intended to represent all U.S. adults or to estimate the prevalence or frequency of use of the JUUL vaping device in the general U.S. adult population. Therefore, the study conclusions about the impact of use of the JUUL vaping device on smoking behavior cannot be reliably compared to conclusions about the impact of other e-cigarettes or smoking cessation interventions or policies that have been derived from analyses of nationally representative sample of cigarette smokers and e-cigarette users.

Second, the study aimed to elicit data on patterns of cigarette smoking and use of the JUUL vaping device from a very large but specific sub-group of adult JUUL user – those who have purchased JUUL vapor products from the JUUL website and who agreed to participate in the survey in exchange for $30. The conclusions of this study therefore cannot be generalised to JUUL users who were invited but did not participate in this study, or to adults who purchase JUUL vapor products in stores. As a result, additional research is underway with the aim of characterizing the transitions in cigarette smoking associated with use of the JUUL vaping device among U.S. adults who typically purchase JUUL vapor products in 'brick and mortar' stores. Readers should therefore view these findings as representative only of the 18,799 participants in which they were found.

Third, the cross-sectional design and non-probabilistic sampling method prevent any conclusions being drawn about the extent to which the rates of smoking cessation, initiation and re-initiation in this sample of participants are causally related to their use of the JUUL vaping device. It must be emphasized that the findings reported here describe an association between using the JUUL vaping device over a period of time during which important changes in smoking behavior occurred. Other than reporting participants' claims that they stopped

smoking completely by switching to using a JUUL vaping device, we have not reported any data here that would permit a reader to conclude that use of a JUUL vaping device was a primary or sufficient cause of any participant to stop, start or restart smoking. Indeed,

While the reported findings appear to suggest that most participants who were smoking cigarettes when they first used a JUUL are today no longer smoking, readers should take care to avoid viewing participants' self-reported cessation of smoking following their initiation of use of the JUUL vaping device as causal evidence of the effectiveness of the JUUL vaping device for aiding smoking cessation. Equally, participants' self-reported initiation of smoking following their initiation of use of the JUUL vaping device should not be interpreted as a cause and effect. Rather, the findings should be cautiously interpreted as suggestive of potential impact of use of the JUUL vaping device on the smoking behavior of U.S. adults who purchase JUUL vapor products online.

Further research that accurately characterizes the historical and potential impact of using JUUL vapor product on the tobacco use behaviors of other sub-groups of the U.S. adult and adolescent is vitally important to enable an informed weighing of the risks and benefits of JUUL vapor products to the health of the whole population, and in turn, of the potential impact of legislative and regulatory actions that affect the availability, affordability and attractiveness of these products to the whole population.

6 Disclosure

Funding for this study was provided by JUUL Labs Inc. JUUL Labs Inc had no control over the study design, implementation, data analysis, interpretation or reporting of findings. The authors alone are responsible for the contents, production and decision to report this study.

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