

Adult Smokers' Complete Switching Away from Cigarettes at 6, 9, and 12 Months After Initially Purchasing a JUUL E-cigarette

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Introduction

- Electronic nicotine delivery systems (ENDS) have the potential to benefit public health^{1,2} if smokers who would not otherwise quit in the near term completely switch from cigarettes to ENDS for extended periods of time.
- Among adult smokers who purchased a JUUL Starter Kit (JSK), 46.6% and 51.2% reported past-month switching (no past-30-day smoking, not even a puff) at months 6 and 12, respectively.³
- We analyzed repeated point-prevalence of past-month switching (RPPS) over a 6-month period (at months 6, 9, and 12) and factors associated with RPPS

Methods

- Sample: N=12,537 baseline adult established smokers from the Adult JUUL Users' Smoking and Switching Trajectories (ADJUSST) study.⁴
 - A naturalistic longitudinal follow-up study of US adults who purchased a JSK
 - Follow-up at 1, 2, 3, 6, 9, and 12 months
- Outcome - RPPS: reported past-month switching at all three consecutive follow-up assessments at 6, 9, and 12 months.
 - Participants who reported any past-30-day smoking at 6, 9, or 12 months were considered not RPPS, even if other follow-ups were missing
 - An additional N=2,995 participants who reported past-month switching at 1 or 2 assessments, but were missing the rest, could not be evaluated for RPPS
- Predictors/covariates
 - Demographics (race/ethnicity, sex, age, income, education, marital status)
 - Smoking history and baseline cigarette consumption
 - Baseline cigarette dependence (Tobacco Dependence Index^{5,6})
 - Reported JUUL use frequency (daily/non-daily, sessions/day) at 3 and 6 months
 - JUUL subjective reinforcing effects (average of mCEQ^{7,8} Satisfaction, Psychological Reward, Enjoyment Of Sensation, and Craving Reduction ratings)
- Aim 1: Estimating RPPS
- Aim 2: Factors associated with RPPS
 - Prediction from sociodemographic factors, smoking history, and month-3 and month-6 JUUL use behaviors (month 6 captures maintenance of switching among those switched at month 6).
- Aim 3: Changes in cigarette consumption
 - N=9,829 who did not achieve RPPS (i.e., reported smoking at least once at months 6, 9, or 12)
 - Stratified into those who reported switching at one or two follow-ups (n₁=3,488) and those who did not (n₂=6,341)
 - Reduction in daily cigarette-per-day (CPD) and proportion of those who reduced their cigarette consumption by 50% or more, compared to baseline

Results

- Aim 1: 6-month RPPS was reported by 21.6% of the evaluable sample.
- Aim 2: Factors associated with RPPS (**Table 1**)
 - RPPS was associated with:
 - Lighter baseline smoking history (fewer days/month, cigarettes/day, years smoked)
 - Lower baseline cigarette dependence
 - Daily use of JUUL at month 3 and month 6, respectively
 - Greater subjective reinforcing effects from JUUL use (assessed by the mCEQ) at month 3 and month 6, respectively.

Table 1. Factors associated with 6-month repeated point-prevalence of switching

Components	Univariate model	Month-3 model	Month-6 model
	-	Sociodemographics Baseline smoking Month 3 JUUL	Sociodemographics Baseline smoking Month 6 JUUL
Baseline smoking history			
Years of regular smoking (by decades)	0.86 (0.82 - 0.89)	0.79 (0.71 - 0.89)	0.98 (0.80 - 1.18)
Smoking frequency (by weeks in the past month)	0.84 (0.82 - 0.87)	0.93 (0.89 - 0.99)	1.06 (0.98 - 1.14)
Average cigarettes/day (by 5 cigarettes)	0.88 (0.85 - 0.95)	0.97 (0.92 - 1.01)	1.02 (0.95 - 1.09)
Cigarette dependence (TDI, 1-5) ¹	0.83 (0.80 - 0.87)	0.83 (0.77 - 0.90)	0.88 (0.79 - 0.98)
Planning to quit in next 30 days	No	Reference	
	Yes	1.52 (1.39 - 1.66)	1.34 (1.19 - 1.51)
Month 3 JUUL use			
Daily JUUL use	Non-daily	Reference	
	Daily	2.62 (2.36 - 2.92)	2.25 (1.96 - 2.60)
JUUL sessions/day ² (by 5 sessions)	1.07 (1.05 - 1.09)	1.02 (0.998 - 1.05)	
JUUL dependence (TDI, 1-5) ¹	1.22 (1.16 - 1.28)	1.03 (0.96 - 1.10)	
Averaged score for reinforcing effects of JUUL ^{1,3}	1.22 (1.16 - 1.28)	1.03 (0.96 - 1.10)	
Month 6 JUUL use			
Daily JUUL use	Non-daily	Reference	
	Daily	1.92 (1.65 - 2.23)	1.81 (1.48 - 2.22)
JUUL sessions/day ² (by 5 sessions)	1.00 (0.97 - 1.03)	1.00 (0.96 - 1.03)	
JUUL dependence (TDI, 1-5) ¹	0.95 (0.89 - 1.02)	0.93 (0.84 - 1.03)	
Averaged score for reinforcing effects of JUUL ^{1,3}	1.15 (1.08 - 1.23)	1.15 (1.06 - 1.25)	

Boldface indicates statistically significant results (p<.05)

¹A higher score indicates stronger agreement

²One session was defined as "the use of around 15 puffs, or 10 minutes."

³Average score of satisfaction, psychological reward, enjoyment of sensation, and craving reduction domains of the mCEQ

- Aim 3: Changes in cigarette consumption among those not achieving RPPS
 - Participants who did not achieve RPPS reported substantial reductions in CPD (**Figure 1**)
 - The majority reported reducing CPD by ≥50% (**Figure 2**)
 - Reductions were greater in those who reported switching at 1 or 2 time-points: even when smoking, they reported an 80% reduction in CPD

Figure 1. Changes in cigarette-per-day of those who did not achieve RPPS, compared to baseline, by whether participants reported switching at 1 or 2 follow-ups, or reported not switching at 6, 9, or 12 months

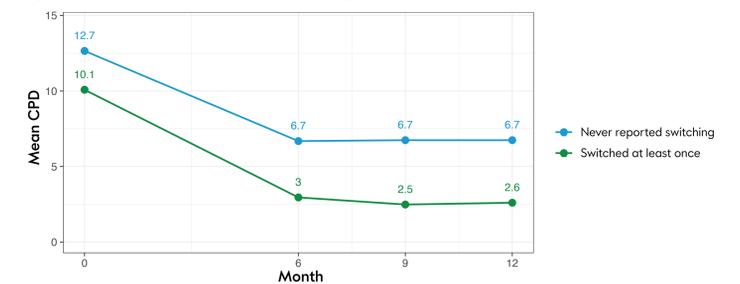
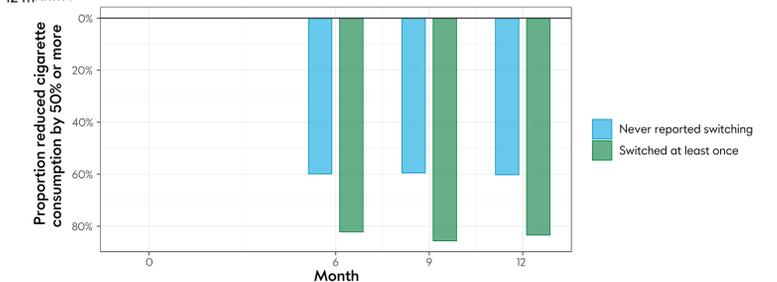


Figure 2. Proportion of those who did not achieve RPPS but reported reducing their cigarette consumption substantially (≥50%) compared to baseline, by whether participants reported switching at 1 or 2 follow-ups, or did not report switching at 6, 9, or 12 months



Conclusions

- Approximately one-fifth of adult smokers reported no past-30-day smoking 6, 9, and 12 months (RPPS) after purchasing JUUL.
 - RPPS has been used as a proxy for long-term sustained switching.⁹
- Greater use of JUUL and stronger subjective reinforcing effects were associated with RPPS.
- Even those who did not achieve RPPS reported substantial reductions in their cigarette consumption, most by ≥50% and many by 80% or more.
 - This suggests many substantially reduced exposure to smoking-related toxicants,¹⁰ and may have been moving towards complete switching.¹¹
- These results provide evidence that ENDS may act as a substitute of cigarettes for smokers, with the potential for positive impacts on individual and population health.

References

- Royal College of Physicians. Nicotine without smoke: Tobacco harm reduction. London: RCP; 2016.
- In: Eaton DL, Kwan LY, Stratton K, eds. Public Health Consequences of E-Cigarettes. Washington (DC):2018.
- Goldenson NI, Shiffman S, Hatcher C, et al. Switching away from Cigarettes across 12 Months among Adult Smokers Purchasing the JUUL System. Am J Health Behav. 2021;45(3):443-446.
- Shiffman S, Senbawer MA, Augustson EM, et al. The Adult JUUL Switching and Smoking Trajectories (ADJUSST) Study: Methods and Analysis of Loss-to-Follow-up. Am J Health Behav. 2021;45(5):419-442.
- Strong DR, Pearson J, Ehke S, et al. Indicators of dependence for different types of tobacco product users: Descriptive findings from Wave 1 (2013-2014) of the Population Assessment of Tobacco and Health (PATH) study. Drug Alcohol Depend. 2017;178:257-266.
- Strong DR, Lees E, Noble M, et al. Predictive validity of the adult tobacco dependence index: Findings from waves 1 and 2 of the Population Assessment of Tobacco and Health (PATH) study. Drug Alcohol Depend. 2020;214:108134.
- Steinberg MB, Zimmermann MH, Delnevo CD, et al. E-cigarette versus nicotine inhaler: comparing the perceptions and experiences of inhaled nicotine devices. J Gen Intern Med. 2014;29(11):1444-1450.
- D'Pozzo J, Caponnetto P, Askin G, et al. Sensory experiences and cues among E-cigarette users. Harm Reduct J. 2020;17(1):75.
- Kalkhoran S, Chang Y, Rigotti NA. Electronic Cigarette Use and Cigarette Abstinence Over 2 Years Among U.S. Smokers in the Population Assessment of Tobacco and Health Study. Nicotine Tob Res. 2020;22(5):728-733.
- Cohen G, Goldenson N, Bailey P, Shiffman S. Changes in biomarkers of cigarette-smoke-related toxicants after 6 days of switching exclusively or partially to the JUUL® System in two nicotine concentrations: a randomized controlled study in adult smokers. Paper presented at the SRNT Annual Meeting 2021.
- Selya AS, Shiffman S, Greenberg M, Augustson EM. Dual Use of Cigarettes and JUUL: Trajectory and Cigarette Consumption. Am J Health Behav. 2021;45(5):464-485.