Longitudinal Study of Factors Associated with Consecutive vs. Isolated Cigarette Smoking Behavior in Adult Never Established Smokers (NES) who Used JL ENDS

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Introduction

Use of electronic nicotine delivery systems (ENDS) has increased among adults. There is limited data on the patterns of smoking behavior among Never Established Smokers (NES) ENDS users. This study examined patterns in initiation of combustible cigarette smoking over a 12-month period among NES who newly purchased a JL ENDS device.

Methods

We analyzed longitudinal survey data of U.S. adults (age 21 or older) who recently purchased a JL ENDS Starter Kit—a package that includes a JL ENDS device, a USB charging dock, and one e-liquid pod in each of four flavors (1x Virginia Tobacco, 1x Mint, 1x Mango and 1x Creme) at 5.0% nicotine concentration. At baseline, participants were asked to report their smoking status and demographic characteristics; then at 1-, 2-, 3-, 6-, 9- and 12-month follow-up surveys, they reported their past 30-day smoking status, JL ENDS use days and JL ENDS sessions per day. Subjects were recruited through retail or online sales. Among 19,534 NES at baseline, 4,743 (24.28%) completed follow-up assessments of past 30-day use of combustible cigarettes at 1-, 2-, 3-, 6-, 9- and 12-months.

Eligible participants:
1. Never smoked a combustible cigarette, not even a puff, in their lifetime or smoked less than 100 cigarettes in their lifetime at baseline.
2. Have completed all follow-up assessments (ie, 1-, 2-, 3-, 6-, 9-, and 12-month);
3. Were aged 21 years or older;
4. Reported English language fluency;
5. Had Internet access;
6. Were residing in the United States;
7. Responded to the survey within 7 days of purchasing, for the first time, a Starter Kit from a licensed retail store or online for personal use.

Stratification:
To better understand NES smoking behavior following purchase of an JL ENDS device, we stratified NES into three subgroups:
1) Current Cigarette Experimenters (reported smoking in the past 30 days at baseline, i.e., answered "Some days" or "Everyday" to "Do you now smoke cigarettes…").
2) Former Cigarette Experimenters (reported not smoking at baseline, i.e., answered "no" to "In the past 30 days, have you smoked a cigarette, even one or two puffs?" or "Not at all" to "Do you now smoke cigarettes…"), and
3) Never Smoking Triers (never smoked a cigarette, not even a puff, i.e., answered "No" to "Have you ever smoked a cigarette, even one or two puffs?")

Consecutive Smoking was defined by at least two consecutive reports of past 30-day smoking during follow-up. Isolated Use was defined as an isolated report of past 30-day smoking. Multinomial logistic regression models were used to examine factors (socio-demographics, average JL ENDS use days and JL ENDS sessions per day in the past 30 days at follow-up assessments) associated with Smoking Abstinence (reference) vs. Isolated Smoking vs. Consecutive Smoking.
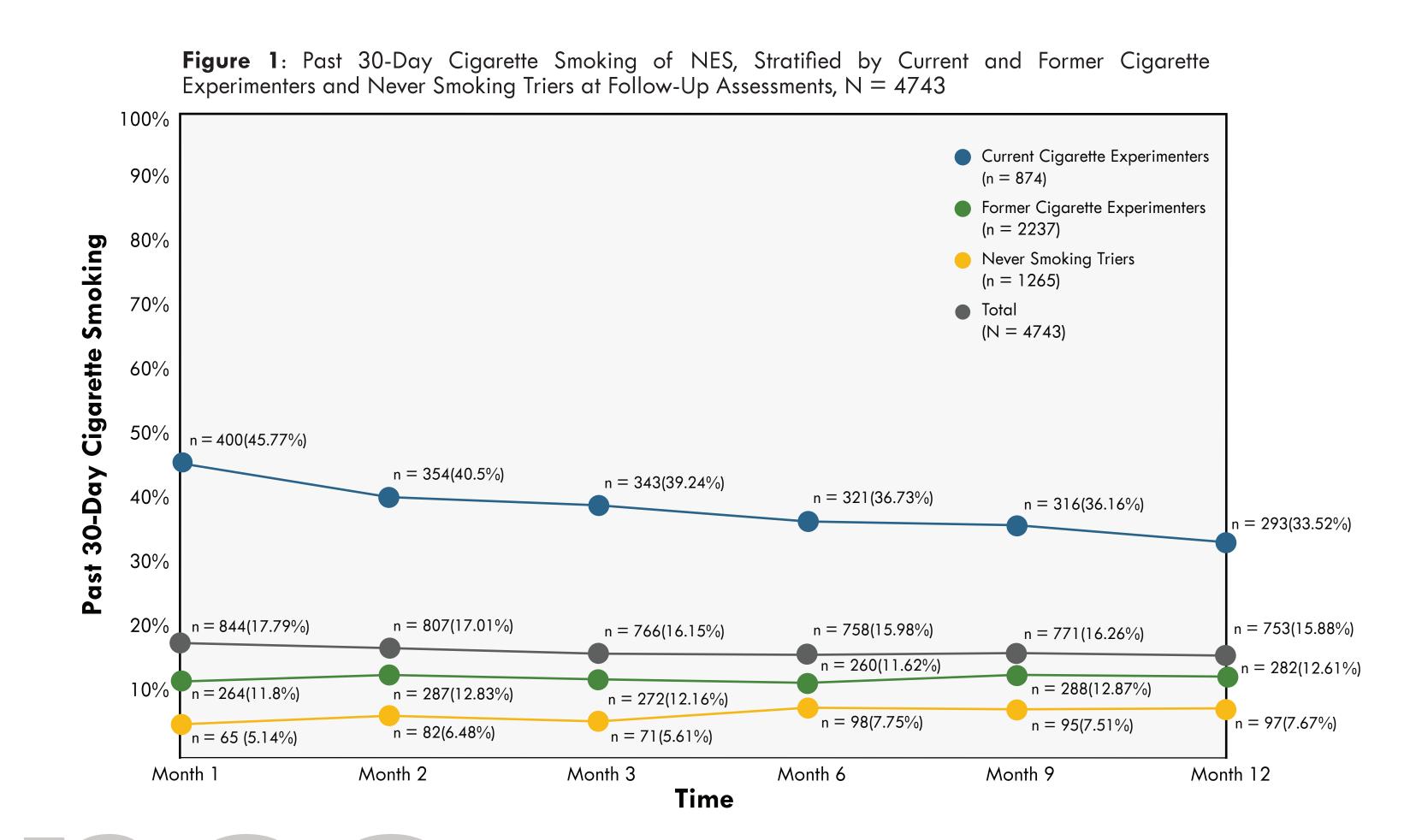
Results

Among 4,743 NES, 18.43% were Current Cigarette Experimenters, 47.16% were Former Cigarette Experimenters and 26.67% were Never Smoking Triers. Most NES were non-Hispanic white (66.94%) male (59.87%), never married (79.76%), had an annual household income below $49,999, and a mean age of 25.94 (SD = 8.24) (**Table 1**).

Current Cigarette Experimenters tended to be older, and were more likely to be married than Former Cigarette Experimenters and Never Smoking Triers. Current Cigarette Experimenters also were more likely to be in minority race or ethnicity groups and have lower income than Former Cigarette Experimenters and Never Smoking Triers.

Table 1: Socio-Demographic Characteristics of NES, Stratified by Current and Former Cigarette Experimenters and Never Smoking Triers, N = 4743

	Current Cigarette Experimenters n = 874	Former Cigarette Experimenters n = 2237	Never Smoking Triers n = 1265	Total N = 4743	p
Age					< 0.01
Mean (SD)	29.09 (10.20)	25.33 (7.54)	24.42 (6.80)	25.94 (8.24)	
Range	21 - 74	21 - 68	21 - 71	21 - 74	
Age Groups					< 0.01
21 to 24	425 (48.63%)	1573 (70.32%)	980 (77.47%)	3191 (67.28%)	
25 to 29	162 (18.54%)	309 (13.81%)	125 (9.88%)	666 (14.04%)	
30 to 39	146 (16.70%)	193 (8.63%)	91 (7.19%)	470 (9.91%)	
40 or older	141 (16.13%)	162 (7.24%)	69 (5.45%)	416 (8.77%)	
Sex					< 0.01
Male	469 (54.16%)	1367 (61.41%)	783 (62.54%)	2818 (59.87%)	
Female	386 (44.57%)	850 (38.19%)	458 (36.58%)	1857 (39.45%)	
Transgender	11 (1.27%)	9 (0.40%)	11 (0.88%)	32 (0.68%)	
Number Missing	8	11	13	36	
Race Ethnicity					< 0.01
Non-Hispanic White	526 (65.02%)	1422 (67.39%)	787 (67.44%)	2735 (66.94%)	
Non-Hispanic Black	38 (4.70%)	122 (5.78%)	88 (7.54%)	248 (6.07%)	
Hispanics	142 (17.55%)	321 (15.21%)	150 (12.85%)	613 (15.00%)	
Non-Hispanic Asian	71 (8.78%)	140 (6.64%)	80 (6.86%)	291 (7.12%)	
Non-Hispanic Other	32 (3.96%)	105 (4.98%)	62 (5.31%)	199 (4.87%)	
Number Missing	65	127	98	290	
Education					< 0.01
High School or Lower	282 (35.56%)	602 (29.98%)	406 (37.18%)	1403 (33.38%)	
Associate Degree or Some College	322 (40.61%)	864 (43.03%)	465 (42.58%)	1763 (41.95%)	
College Degree or Higher	189 (23.83%)	542 (26.99%)	221 (20.24%)	1037 (24.67%)	
Number Missing	81	229	173	540	
Marital Status					< 0.01
Married	183 (21.25%)	302 (13.77%)	129 (10.46%)	674 (14.49%)	
Never Married	592 (68.76%)	1801 (82.12%)	1055 (85.56%)	3709 (79.76%)	
Divorced, Separated, or Widowed	86 (9.99%)	90 (4.10%)	49 (3.97%)	267 (5.74%)	
Number Missing	13	44	32	93	
Income					< 0.01
$0-$49999	453 (61.30%)	1063 (57.58%)	601 (59.92%)	2295 (59.33%)	
$50000-$99999	184 (24.90%)	450 (24.38%)	194 (19.34%)	892 (23.06%)	
$100000 or more	102 (13.80%)	333 (18.04%)	208 (20.74%)	681 (17.61%)	
Number Missing	135	391	262	875	

For Current Cigarette Experimenters, past 30-day smoking rate decreased from 45.77% at 1-month to 33.52% at 12-month (**Figure 1**). Past 30-day smoking rate was stable (~12%) for Former Cigarette Experimenters. For Never Smoking Triers, past 30-day smoking ranged from 5.14% to 7.67%.

Figure 1: Past 30-Day Cigarette Smoking of NES, Stratified by Current and Former Cigarette Experimenters and Never Smoking Triers at Follow-Up Assessments, N = 4743

Across all follow-up assessments, 76% of Never Smoking Triers, 61% of Former Cigarette Experimenters, and 30% of Current Cigarette Experimenters remained abstinent from smoking (**Table 2**). For subjects who did report past 30-day smoking, the most common pattern was isolated to one follow-up for all subgroups of NES at 17.71%.

Table 2: Number of Past 30-Day Cigarette Smoking across Follow-Up assessments of NES, Stratified by Current, Former and Never Smoking Triers, N = 4743

	Current Cigarette Experimenters n = 874	Former Cigarette Experimenters n = 2237	Never Smoking Triers n = 1265	Total N = 4743
Smoking Abstinence across All Follow-Ups	268 (30.66%)	1384 (61.87%)	972 (76.84%)	2803 (59.10%)
Past 30-Day Smoking at 1 Follow-Up	147 (16.82%)	448 (20.03%)	178 (14.07%)	840 (17.71%)
Past 30-Day Smoking at 2 Follow-Ups	105 (12.01%)	193 (8.63%)	62 (4.90%)	398 (8.39%)
Past 30-Day Smoking at 3 Follow-Ups	65 (7.44%)	100 (4.47%)	25 (1.98%)	216 (4.55%)
Past 30-Day Smoking at 4 Follow-Ups	93 (10.64%)	62 (2.77%)	14 (1.11%)	186 (3.92%)
Past 30-Day Smoking at 5 Follow-Ups	73 (8.35%)	29 (1.30%)	9 (0.71%)	129 (2.72%)
Past 30-Day Smoking at 6 Follow-Ups	123 (14.07%)	21 (0.94%)	5 (0.40%)	171 (3.61%)

Current Cigarette Experimenters had the highest rate of Consecutive Smoking, followed by Former Cigarette Experimenters and Never Smoking Triers (**Table 3**). Current and Former Cigarette Experimenters also showed higher percent of Isolated Smoking than Never Smoking Triers.

Table 3: Smoking Abstinence vs. Isolated Smoking vs. Consecutive Smoking Rate of NES, Stratified by Never Smoking Triers, N = 4743

	Current Cigarette Experimenters n = 874	Former Cigarette Experimenters n = 2237	Never Smoking Triers n = 1265	Total n = 4743
Abstinence	268 (30.66%)	1384 (61.87%)	972 (76.84%)	2803 (59.10%)
Isolated	206 (23.57%)	564 (25.21%)	204 (16.13%)	1068 (22.52%)
Consecutive	400 (45.77%)	289 (12.92%)	89 (7.04%)	872 (18.38%)

Results of the multinomial logistic regression model (**Table 4**) showed that smoking status at baseline was the strongest predictor of Isolated and Consecutive Smoking. Specifically, being a Former Cigarette Experimenters or Never Smoking Triers reduced the odds of Isolated and Consecutive Smoking. Marital status and age were also significant predictors of Isolated Smoking.

Table 4: Multinomial Logistic Regression Predicting Isolated vs. Consecutive Smoking with Abstinence as the Reference, Controlling for Demographics and a JL ENDS Device Use among Never Established Smokers, N = 3629

	Isolated Smoking aOR	95% CI		Consecutive Smoking aOR	95% CI	
Intercept	1.03	0.54	1.97	1.04	0.55	1.97
Sex						
Male	-	-	-	-	-	-
Female	0.89	0.75	1.05	0.98	0.80	1.20
Transgender	1.16	0.47	2.83	0.88	0.29	2.67
Age	0.98	0.96	0.99	1.01	1.00	1.03
Race/Ethnicity						
Non-Hispanic White	-	-	-	-	-	-
Non-Hispanic Black	0.75	0.51	1.10	0.67	0.42	1.07
Hispanics	1.19	0.95	1.50	0.96	0.72	1.26
Non-Hispanic Asian	1.22	0.87	1.69	1.27	0.88	1.83
Non-Hispanic Other	0.95	0.64	1.41	1.07	0.69	1.68
Education						
High School or Lower	-	-	-	-	-	-
Associate Degree or Some College	0.96	0.79	1.17	0.91	0.73	1.15
College Degree or Higher	1.03	0.82	1.30	0.91	0.70	1.18
Marital Status						
Married	-	-	-	-	-	-
Never Married	1.41	1.03	1.93	0.98	0.72	1.33
Divorced, Separated, or Widowed	2.66	1.70	4.17	1.24	0.78	1.97
Baseline Smoking Status						
Current Cigarette Triers	-	-	-	-	-	-
Former Cigarette Triers	0.51	0.41	0.65	0.15	0.12	0.19
Never Smoking Triers	0.21	0.16	0.28	0.07	0.05	0.09
JL ENDS Use at Follow-Ups						
Average JL ENDS sessions per day in the past 30 days over 12 months	1.00	0.99	1.01	1.01	0.99	1.02
Average JL ENDS use days in the past 30 days over 12 months	1.00	0.99	1.01	1.01	0.99	1.01

Note. "-" denotes reference levels. **Bold** indicates values that are statistically significant

Conclusions

Among NES who purchased a JL ENDS device, past 30-day smoking at follow-up assessments ranged from ~16% to ~18%, and 59% of all subjects remained abstinent across the entire 12-month follow-up period. Significant differences were seen in rates of abstinence during the 12-months by cigarette history between Current Cigarette Experimenters (31%), Former Cigarette Experimenters (62%) and Never Smoking Triers (77%). Among participants who did report past 30-day combustible cigarette use at least one of the six follow-up assessments, smoking at only a single assessment was the most common pattern for all subgroups of NES (16.82% for Current Cigarette Experimenters, 20.03% for Former Cigarette Experimenters and 14.07% for Never Smoking Triers).

Consecutive Cigarette Smoking rates among NES who purchased a JL ENDS device varied by smoking history, with the lowest rate of 7.04% observed among Never Smoking Triers and the highest rate of 45.77% observed among Current Cigarette Experimenters, those who were smoking at baseline.

Smoking history appeared to be the strongest predictor of Isolated or Consecutive Smoking while frequency of a JL ENDS use was not associated with the outcomes for any of the NES groups. This would suggest that individuals who were at the highest risk for cigarette use were those who were already at risk for continued smoking independent of a JL ENDS device use.