Heat-not-burn Tobacco Products and the Increased Risk for Poly-tobacco Use

Pallav Pokhrel, PhD, MPH [Associate Professor],

Cancer Prevention in the Pacific, University of Hawaii Cancer Center, University of Hawaii at Manoa, Honolulu, HI, United States.

Thaddeus A. Herzog, PhD [Associate Professor],

Cancer Prevention in the Pacific, University of Hawaii Cancer Center, University of Hawaii at Manoa, Honolulu, HI, United States.

Crissy T. Kawamoto, BS [Project Manager],

Cancer Prevention in the Pacific, University of Hawaii Cancer Center, University of Hawaii at Manoa, Honolulu, HI, United States.

Pebbles Fagan, PhD, MPH [Professor]

Center for the Study of Tobacco, Department of Health Behavior & Health Education, Fay W. Boozman College of Public Health, University of Arkansas for Medical Sciences, Little Rock, AR, United States.

Abstract

Objectives: In this study, we tested the use of ecigarette, cigarette, and dual use of both as predictors of heat-not-burn (HNB) tobacco product use onset among young adults, and examined common predictors of smoking cessation as predictors of HNB product use.

Methods: We collected data from 12229 young adults [mean age = 21.1 (SD = 2.1); 55% women] in Hawaii, at 2 time-points 6 months apart.

Results: Current cigarette-only use was the strongest concurrent predictor of HNB product use, followed by dual use, and ecigarette-only use. Among HNB product never users at Wave 1, dual and ecigarette-only use at Wave 1 significantly predicted HNB product use onset at Wave 2. Among cigarette smokers who had never used an HNB product at Wave 1, current use of ecigarette for help with smoking cessation predicted increased odds of HNB product use at 6-month follow-up.

Conclusions: Although promoted as a safer alternative for exclusive cigarette smokers, HNB products may increase the risk of dual or poly-tobacco product use among young adults, including current exclusive e-cigarette users. Surveillance of HNB product use as a modified risk tobacco

product may need to consider the effects of HNB products on poly-tobacco use among young people.

Keywords

heat-not-burn tobacco products; poly-tobacco use; young adults

The US Food and Drug Administration (FDA) has authorized the marketing and sale of, IQOS, a heat-not-burn (HNB) tobacco product, in the US as a modified risk tobacco product (MRTP). HNB products are promoted as safer alternatives to combustible cigarette smoking.[1] Existing studies[2–4] on the health effects of HNB products, which presently tend to be sponsored mostly by the tobacco industry, suggest that HNB products are likely to expose users to lower levels of toxicants compared with combustible cigarettes – but, are not risk free.

The public health effects of HNB products are unclear. Reduced toxicant exposure does not necessarily guarantee reduced harm. Little is known about the effects of HNB products among users of other tobacco products such as cigarette and ecigarette, or non-users of tobacco products. Concerns have been raised that tobacco products that are considered safer alternatives may influence low-risk young people to initiate tobacco use.[5] Furthermore, availability of a new tobacco product alternative may encourage concurrent use of multiple tobacco products among young people.[6]

Some data indicate that half or more of US youth and young adults who are current tobacco users are poly-tobacco users; that is, they engage in concurrent use of 2 or more tobacco products.[7–10] Among young people, poly-tobacco users tend to show higher nicotine dependence,[7] lower motivation and self-efficacy to quit tobacco use,[7,8] and greater general positive attitudes toward tobacco.[8,11] There are concerns that, among cigarette smokers, using one or more additional tobacco products may reduce the likelihood of smoking cessation.[12] In addition, some data suggest that poly-tobacco use may expose users to higher levels of carcinogens.[13]

To date, only one study[14] has examined HNB product use in a sample of US young adults. In that cross-sectional study, researchers found that 5% of the sample reported lifetime HNB product use and 12% reported being aware of HNB products. Higher HNB product awareness and lifetime use were associated with greater use of all types of tobacco products, including cigarettes and ecigarettes, and with the tendency to use multiple tobacco products concurrently. Among cigarette smokers, higher nicotine dependence was associated with a greater likelihood of having tried an HNB product, but no associations were found between HNB product use and cigarette quit attempts or intentions to quit cigarette smoking. These findings are consistent with the results of studies based on adult samples from Japan and Korea.[15,16] In a Korean sample, Hwang et al[16] found that among current cigarette smokers, intentions to quit cigarettes in the next month were not associated with greater likelihood of using HNB products. Furthermore, a study[17] with adolescents from Canada, the United Kingdom, and the US showed that 25% of the youth sampled were susceptible to trying IQOS, and susceptibility was strongly associated with current cigarette smoking and ecigarette use.

As HNB products become increasingly available in the US market, there is a growing need to study the patterns, correlates, and predictors of HNB product use in young people so as to improve understanding of the public health risks posed by HNB products. Specifically, there is a need to understand whether it is only cigarette-smoking young people who are attracted to HNB products. The current study is one the first longitudinal studies to examine the associations between current cigarette smoking, ecigarette use, and dual use of cigarette and e-cigarette and HNB product use onset 6 months later. We also examine concurrent associations between dual use, ecigarette and cigarette use, and lifetime HNB product use across the 2 time-points. In addition, among current cigarette smokers, we examine the associations of HNB product use with cigarette dependence and smoking cessation-related variables, namely motivation to quit, quitting self-efficacy, number of past quit attempts, duration of the most recent quit attempt, and use of ecigarette for quitting smoking. Overall, the study's objectives are to test if (1) HNB product use increases the risk for dual and poly-tobacco use among young adults, including ecigarette only users; and (2) predictors of smoking cessation such as motivation to quit, quitting self-efficacy, and recent quit duration are associated with HNB product use.

METHODS

Procedures

Data for the current study come from the third and fourth waves of a 4-wave longitudinal study originally designed to study the effects of e-cigarette marketing on tobacco product use behavior among young adults. Participants for the parent study were recruited at baseline from 2 4-year and 4 2-year colleges in Hawaii. To be eligible to participate, participants had to be 18–25 years old at the time of recruitment. We obtained e-mail addresses of all 18–25-year-olds enrolled across the colleges, all of which belonged to the same university system. E-mail invitation for participation in the study was sent to a random sample of e-mail addresses. The e-mail invitation contained a link to the screener survey, which included questions on age, sex, ethnicity, and cigarette smoking behavior. Potential participants received up to 3 reminders to complete the screener. The response rate was 60%. However, those who responded to the e-mail invitation were predominantly women who had never smoked a cigarette. To obtain a sample that was more gender balanced and included proportions of cigarette smokers and experimenters comparable to or higher than the national distribution of smokers in the 18–25 age group, we supplemented the e-mail recruitment with classroom-based recruitment. We randomly selected on average 40 classes from each participating campus and presented the study in classrooms. Students approached in the classroom completed the paper-and-pencil version of the screener survey. The average response rate across classrooms was 80%.

All eligible participants who provided written consent to participate in the study were sent a link to the baseline survey via e-mail. The survey was programmed on Inquisit.[18] A total of 2622 participants completed the baseline survey, of whom 54% were originally recruited through the e-mail method. These participants were contacted every 6 months for 3 additional waves of data collection. Of the baseline participants, 2401 participants completed the second survey (91.5% retention); 2327 completed the third survey (88.7% retention);

and 2335 completed the fourth survey (89% retention). The current longitudinal analysis is based on the data from the third and fourth waves only, because HNB product use was not assessed in the earlier waves. Thus, participants who completed both the third and fourth surveys (N = 2229) were included in the study. Approximately 15% of the baseline sample was not included in the current longitudinal analysis. We compared baseline participants who were not included in the present analysis (N = 393) with those who are included in the analysis on key demographic and tobacco product use characteristics at baseline. Compared to those included in this analysis, those not included tended to represent a significantly higher proportion of current cigarette smokers (34% vs 20%) and current ecigarette users (42% vs 30%). There were no other statistically significant differences.

Measures

Demographics.—For demographic data, we collected information about age, sex, ethnicity, and family/household income. We used single-item indicators for all of these variables except ethnicity, which we assessed with 2 questions. The first provided participants with a list of ethnic backgrounds, for which they were asked to select all that applied to them. The second asked to select one ethnic background that best defined the participant. Both responses were considered while determining a participant's ethnic background.

Cigarette smoking.—Was measured with the standard measures of lifetime use ("How many cigarettes have you smoked in your entire life?" "None, I have never smoked a cigarette," "Less than 100," "100 or more") and past-30-day use ("In the past 30 days, on how many days did you smoke a cigarette?" "0 days, 1–2 days, 3–5 days,…, 20–29 days, All 30 days"). In addition, we asked participants: "Do you currently smoke cigarettes?" with the response options "No, I don't," "Yes, occasionally," and "Yes, regularly." Current use was determined based on this last question and past-30-day use.

Ecigarette use.—Was assessed e-cigarette lifetime use (eg, "Have you ever used an ecigarette or a similar device?") and past-30-day use (eg, "In the past 30 days, on how many days did you use an ecigarette or a similar vaping device?" "0 days," "1–2 days," "3–5 days,"…, "20–29 days," "All 30 days"). We also asked: "How often, if at all, do you currently use an ecigarette?" (Response options: "Daily," "Less than daily, but at least once a week," "Less than weekly, but at least once a month," "Less than monthly," "Not at all").[19] Current use was determined based on this last question and past-30-day use. Just preceding the lifetime ecigarette use question, pictures of a gamut of ecigarette products were shown to participants to illustrate ecigarette or vaping devices.

HNB product use.—We measured lifetime and past-30-day HNB product use, employing items similar to the ones used for ecigarette use. IQOS and Eclipse were provided as examples of HNB products. For participants' benefit, a picture of IQOS was shown preceding the items.

Cigarette dependence.—To estimate cigarette dependence, we used the Fagerström Test for Nicotine Dependence (FTND).[20] A continuous nicotine dependence index (range 0–10)

was created by summing up responses across the 6 FTND items [eg, "How soon after you wake up do you smoke your first cigarette?" (0: After 60 minutes, 1: 31–60 minutes; 2: 6–30 minutes; 3: within 5 minutes); How many cigarettes per day do you smoke? (0:10 or less, 1: 11–20; 2: 21–30; 3: 31 or more)].

E-cigarette dependence.—We assessed e-cigarette dependence with the Penn State E-cigarette Dependence Index (PSEDI). A continuous e-cigarette dependence scale (range: 0–20) was created by summing up responses across the 10 PSEDI items [eg, "How many times per day do you usually use your e-cigarette? (0: 0–4 times, 1: 5–9; 2: 10–14; 3: 15–19; 4: 20–29; 5:   30)].

Motivation to quit cigarette smoking.—We assessed motivation to quit cigarette smoking with a 5-item measure (eg, "Do you want to quit cigarette smoking?" "Do you intend to quit cigarette smoking?") for which we calculated a Cronbach's $\alpha = .80$.[21] Each item was measured on a 5-point scale ("No, definitely not"… "Yes, definitely"). The responses across items were averaged to create a scale of motivation to cigarette smoking.

Past year cigarette quit attempts, quitting self-efficacy, and recent quit duration.—We assessed these variables with a single item for each: "How many times have you quit smoking for 24 hours in the past 12 months?" (5-point scale: "0 times" to "9 or more"); "How confident are you that you will quit smoking in the next 6 months?" (5-point scale: "Not at all" to "Extremely"), and "How long did your most recent quit attempt last?" (6-point scale: "I have never tried to quit," "More than a day but less than a week,"…. "One year or more").[21]

Ecigarette use for help with smoking cessation.—We assessed this variable with a single item: "Are you currently using an ecigarette to quit smoking?" (Yes, No).[22]

Data Analysis

We used SAS statistical software for data analysis.[23] We performed 4 sets of analyses using logistic regression. First, we performed cross-sectional analysis in the entire sample at each time-point, testing the associations between cigarette-only use, ecigarette-only use, dual use of cigarette and ecigarette, and lifetime HNB product use, adjusting for age, sex, ethnicity, college type (4-year vs 2-year), and family/household income. We classified current users of both ecigarettes and cigarettes as dual users. Next, we performed longitudinal analysis in the entire sample, examining the associations between cigarette-only use, ecigarette-only use, dual use of cigarette and e-cigarette at baseline (ie, baseline for the current analysis), and HNB product initiation 6 months later, adjusting for age, sex, ethnicity, college type (4-year vs 2-year), and family/household income. This analysis was performed for HNB product never users at baseline. Next, we performed cross-sectional analysis among current cigarette smokers at each time-point, testing the associations between cigarette smoking characteristics (ie, occasional vs regular, nicotine dependence), smoking cessation-related characteristics (ie, motivation to quit, past year quit attempts, recent quit duration, quitting self-efficacy, and use of ecigarettes for cessation help), and lifetime HNB product use. Lastly, we performed longitudinal analysis among baseline (ie, baseline for the current

analysis) cigarette smokers who had never used HNB product, testing the associations between cigarette smoking characteristics, smoking cessation-related characteristics, and HNB product initiation 6 months later. Across all steps, we excluded cases with missing data from the analysis.

RESULTS

Participants

Table 1 shows the characteristics of the overall sample. Women and 4-year college students were represented slightly more than men and 2-year college students. The 9% "other" ethnic category represented in the sample could be further broken down into Hispanics (4%), African Americans (2%), American Indians (1%), and others (2%). There was little change in prevalence of cigarette-only use, ecigarette-only use, and dual use of cigarette and ecigarette between the 2 data collection time-points (Wave 1 and Wave 2). Lifetime HNB product use increased by 3%, from 4% to 7%, between Wave 1 and Wave 2. Past-30-day HNB product use was at 1% at both time-points. Analyses that focused on current cigarette smokers were performed among all current cigarette smokers, including dual users and cigarette-only smokers. The prevalence of current cigarette smoking at both time-points was approximately 16%. Among current cigarette smokers at Wave 1 and Wave 2, lifetime HNB product prevalence was 13% and 18%, respectively.

Associations of HNB Product Use with Cigarette Use, E-cigarette Use, and Dual Use

Table 2 shows the results of the cross-sectional and longitudinal analyses examining the associations of cigarette-only use, ecigarette-only use, and dual use with lifetime HNB product use and HNB product use onset. Cross-sectional analysis showed that being a woman was inversely associated with the likelihood of lifetime HNB product use. Except for older age in Wave 2, no other demographic variable was statistically significantly associated with increased likelihood of lifetime HNB product use. At both time-points, cigarette-only use was the strongest correlate of increased likelihood of HNB product use, followed by dual use, and ecigarette-only use. For example, in Wave 2, those who were current cigarette-only smokers, relative to non-users of either cigarette or ecigarette, were 10 times more likely to have tried an HNB product. Similarly, dual users and ecigarette-only users were 7 and 5 times more likely to have tried an HNB product, respectively.

Longitudinal analysis did not find a statistically significant association between cigarette-only use at baseline and HNB product use initiation 6 months later. Baseline dual use and ecigarette-only use were significant predictors of HNB product use initiation 6 months later. Those who were dual users at baseline, relative to non-users of either cigarette or ecigarette, were 9 times more likely to initiate HNB product use. Similarly, those who were ecigarette-only users at baseline were almost 3 times more likely to initiate HNB product use.

Associations of HNB Product Use with Cigarette Smoking and Cessation-related Characteristics

Table 3 shows the results of the cross-sectional and longitudinal analyses examining the associations of HNB product use with smoking and smoking cessation-related characteristics among current cigarette smokers. We did not find any statistically significant association between smoking or smoking cessation-related variables and HNB product use for Wave 1. Motivation to quit cigarette smoking was significantly and inversely associated with lifetime HNB product use in Wave 2. That is, a unit increase in motivation to quit cigarette smoking was associated with 8% reduced likelihood of lifetime HNB product use. Other cessation-related variables such as quit attempts, recent quit duration, and quitting self-efficacy did not show significant concurrent associations with lifetime HNB product use.

The longitudinal analysis showed that higher cigarette nicotine dependence was significantly associated with increased odds of HNB product use initiation 6 months later. In a separate analysis with current e-cigarette users at baseline, we found a significant effect of higher e-cigarette dependence on higher odds of HNB product use behavior at follow-up [Odds Ratio = 1.13, 95% Confidence Interval: 1.02–1.24, $p < .05$]. We found higher recent quit duration at baseline to be predictive of HNB product use initiation at 6-month follow-up. That is, one unit increase in recent quit duration at baseline increased the likelihood of HNB product use at 6 months by 32%. Lastly, those who used ecigarette for help with quitting smoking at baseline were 6 times more likely to initiate HNB product use 6 months later.

DISCUSSION

This is one of the first studies to examine the longitudinal predictors of HNB product use among US young adults. The prevalence of lifetime HNB product use in the current sample was comparable to what Dunbar et al[14] reported for their sample of young adults. HNB products are promoted by manufacturers such as Phillip Morris International as safer alternatives to cigarette smoking. We attempted to find out whether young adults who do not smoke cigarettes exclusively also are attracted to using HNB products. In addition, we intended to find out if only individuals who are serious about quitting cigarette smoking are attracted to using HNB products.

We found that not only cigarette smokers, but also ecigarette-only users and dual users were more likely to show higher concurrent use of HNB product. In fact, although we did not find cigarette smoking to be predictive of HNB product use longitudinally, baseline ecigarette-only use and dual use were predictive of HNB product use 6 months later. This finding indicates that young adults who are using ecigarette exclusively or are using both cigarette and ecigarette are at risk for initiating HNB product use. That we did not find a longitudinal association between cigarette-only smoking at baseline and HNB product use 6 months later, may need to be considered alongside the fact that the cigarette-only using group in the current sample was small. There was more room for error in statistical inferences regarding cigarette-only use as a predictor. The odds ratios for cigarette-only use and e-cigarette-only use as predictors were similar, even though only the odds ratio for e-cigarette-only use was statistically significant. Regardless, the findings show that current

ecigarette-only users and dual users are at high risk for HNB product use, thereby suggesting that access to HNB product may encourage dual and poly-tobacco use among young adults.

Except for motivation to quit smoking at Wave 2, we did not find any cessation-related variables concurrently associated with HNB product use. At Wave 2, higher motivation to quit smoking was inversely associated with lifetime HNB product use. However, this association was not replicated longitudinally, which may have been because of the relatively small number of HNB product onset cases. Longitudinally, we found higher nicotine dependence and longer recent quit duration associated with higher likelihood of HNB product use. Additionally, we found that use of ecigarette to quit smoking at baseline was predictive of HNB product use at 6-month follow-up. We did not find past-year quit attempts and quitting self-efficacy to be associated with HNB product use onset.

The findings that higher nicotine dependence and longer recent quit duration were associated with HNB product use initiation may be interpreted in different ways. These findings may suggest that cigarette smokers who are dependent on nicotine and are trying to quit smoking seriously might try HNB products for help with cessation. Alternatively, the findings might suggest that smokers who are likely to successfully quit smoking, based on their history of longer quit duration, might forgo complete cessation by opting for HNB products.

Our finding that use of e-cigarette by smokers for help with smoking cessation was predictive of HNB product use onset 6 months later further indicates the risk of dual and poly-tobacco use posed by the availability of HNB product. Similar to ecigarettes, HNB product are promoted as a safer alternative to combustible cigarettes. Based on currently available evidence, HNB products appear to be intermediate in risk, in terms of toxicant exposure, between combustible cigarette (higher risk) and ecigarette.[24] However, studies[25–27] show that HNB products tend to deliver nicotine more efficiently and smokers tend to rank HNB products higher than ecigarettes on satisfaction and product preference. IQOS use motives[28] such as smoking reduction and cessation, social acceptability, and sensorimotor satisfaction are similar to those noted for ecigarette use.[29] Thus, it is plausible that smokers drawn to ecigarettes for smoking cessation help, also may be drawn to HNB products and use all 3 products opportunistically, matching the products' relative advantages and disadvantages to different contexts.[30]

There are some limitations to this study. This study is based on secondary data analysis; therefore, we could not ask detailed questions on HNB product use experience. We lack data on the types of products used and where were they accessed. In addition, data are lacking on frequency of use other than lifetime and past-30-day use. Secondly, this study is based on young adults. The findings may not generalize to adolescents and older adults. Thirdly, because HNB product use is still a rare behavior, the frequency of use was low in the sample, which limited our ability to perform subgroup analyses. In addition, the low rate of initiation was of some concern in regard to the cigarette smoker subsample, for which 5% initiation rate equaled only 16 new users. In general, because of the relatively low HNB product use frequency, some of the confidence intervals of our findings are large, and we may have failed to detect some of the smaller effects as statistically significant. Thus, our findings should be interpreted cautiously as some of the first findings in the area. Lastly, due

to participant attrition, the current sample included fewer cigarette smokers and ecigarette users than the baseline of the original study. This may have introduced some sampling bias, even though the overall attrition rate was low. Thus, it is a possible that results might have differed if sample attrition had not been an issue.

Implications for Policies and Interventions

Despite these limitations, this is an important study. This is one of the few existing studies on HNB product use behavior among young adults. Using data from a longitudinal study, we showed that not only cigarette smokers but also exclusive ecigarette users and dual users are likely to initiate HNB product use. Among current cigarette smokers, we found that those who are currently using ecigarettes to quit smoking showed increased likelihood of also using HNB products in the future. Overall, our findings suggest that access to HNB products may encourage dual and poly-tobacco use among young adults.

These findings may have implications for regulation of HNB products as MRTPs, and for future tobacco use prevention and cessation programs targeting youths and young adults. In lights of the current data, the approval of IQOS as an MRTP may need to be coupled with a system of surveillance so that the long-term of effects of HNB products on usage patterns of tobacco products among young people may be ascertained. If indeed HBN products are associated with poly-tobacco use among young people, then appropriate regulatory actions might be needed to discourage the misuse of HBN products. For example, accessibility to HBN products may be managed better and the marketing messages of HBN products may be strictly regulated. Regarding use prevention among youth, tobacco control programs may need to address HNB products in addition to other tobacco forms. Currently, HNB products appear not to have garnered enough attention to be targeted in prevention programs or tobacco control campaigns. However, as the use of HNB products become more prevalent among young people, such attention may be increasingly necessary.

Acknowledgements

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Table 1

Demographic Characteristics of Participants (N = 2229)

		SD/Percent	
Age [a]		21.1 (2.1)	
Sex	Women	55%	
	Men	45%	
Ethnicity	White	24%	
	Asian	28%	
	Filipino	19%	
	NHPI	20%	
	Other	9%	
Family income [a]	$0 – $39,999	22%	
	$40K – $79,999	34%	
	$80K – $119,999	26%	
	$120K – $159,999	10%	
	Over $160K	8%	
College type	4 year	57%	
	2 year	43%	
		Wave 1	**Wave 2**
Lifetime cigarette use		50%	51%
Lifetime e-cigarette use		63%	64%
Lifetime HNB product use		4%	7%
Current cigarette only use		6%	5%
Current e-cigarette only use		20%	20%
Current dual use		9%	10%
Current (past-30-day) HNB product use		1%	1%

Note.

[a] Baseline age and income.

SD = Standard deviation. NHPI = Native Hawaiian and other Pacific Islanders. HNB = Heat-not-burn. Wave 1 and Wave 2 refer to the 2 waves of data utilized in the current study.

Table 2

Cross-sectional and Longitudinal Associations among Current Cigarette Smoking, E-cigarette Use, Dual Use, and Lifetime HNB Product Use and Use Onset

Independent Variables		Cross-sectional[a]		Longitudinal[b]
		Wave 1 (N = 2327)	Wave 2 (N = 2335)	(N = 2229)
		Odds Ratio (95% Confidence interval)		
Age		1.03 (0.92–1.14)	1.09 (1.01–1.18) [*]	1.07 (0.95–1.21)
Sex				
	Men	1	1	1
	Women	0.44 (0.27–0.71) [***]	0.57 (0.40–0.81) [**]	0.70 (0.41–1.20)
Ethnicity				
	White	1	1	1
	Asian	0.98 (0.51–1.88)	0.69 (0.42–1.12)	0.42 (0.19–0.94)
	Filipino	0.89 (0.43–1.86)	0.81 (0.48–1.38)	0.69 (0.32–1.51)
	NHPI	0.74 (0.37–1.50)	0.71 (0.43–1.18)	0.57 (0.26–1.24)
	Other	1.23 (0.52–2.88)	1.05 (0.57–1.93)	0.95 (0.38–2.37)
Family income		0.99 (0.90–1.09)	0.97 (0.89–1.03)	0.97 (0.85–1.07)
College type				
	4-year	1	1	1
	2-year	1.25 (0.77–2.03)	1.20 (0.84–1.71)	1.03 (0.58–1.81)
Current cigarette/e-cigarette use status				
	No use	1	1	1
	Cigarette only	18.9 (8.90–40.2) [***]	10.3 (5.99–17.8) [***]	2.32 (0.76–7.06)
	E-cigarette only	6.2 (3.10–12.3) [***]	4.94 (3.17–7.70) [***]	2.69 (1.35–5.4) [**]
	Dual use	13.7 (6.81–27.6) [***]	6.89 (4.24–11.2) [***]	8.89 (4.61–17.2) [***]

[*]
p < .05

[**]
p < .01

[***]
p < .001

Note.

NHPI = Native Hawaiian and other Pacific Islander. Dual use refers to dual use of cigarette and e-cigarette. HNB = Heat-not-burn.

[a]Dependent variable: lifetime HNB product use

[b]Longitudinal analysis was performed among participants who had never used an HNB product in Wave 1.

Dependent variable was lifetime HNB product use at Wave 2.

Table 3

Concurrent and Longitudinal Associations of Cigarette Smoking and Smoking Cessation-related Characteristics with Lifetime HNB Product Use and Use Onset among Current Cigarette Smokers

	Cross-sectional[a]		Longitudinal[b]
	Wave 1 (N = 371)	Wave 2 (N = 368)	(N = 322)
	Odds Ratio (95% Confidence Interval)		
Occasional vs. regular use	1.33 (0.68–2.63)	1.30 (0.74–2.30)	1.69 (0.71–1.06)
Nicotine dependence	0.97 (0.85–1.11)	1.08 (0.96–1.23)	1.25 (0.99–1.60) *
Motivation to quit	0.96 (0.91–1.02)	0.92 (0.89–0.98) **	1.00 (0.93–1.09)
Quitting self-efficacy	0.88 (0.69–1.12)	0.96 (0.79–1.18)	0.88 (0.64–1.22)
Past year quit attempts	0.99 (0.81–1.21)	1.12 (0.94–1.35)	1.10 (0.84–1.44)
Duration of last quit attempt	1.14 (0.94–1.38)	0.99 (0.85–1.17)	1.32 (1.02–1.72) *
Current use of ecigarette for smoking cessation	1.04 (0.48–2.29)	1.61 (0.84–3.07)	6.16 (2.31–16.4) ***

*
p .05

**
p < .01

***
p < .001

Note.

All models adjusted for the following variables: age, sex, family/household income, and ethnicity. Models with cessation-related variables as an independent variable also adjusted for nicotine dependence.

[a]Dependent variable: lifetime HNB product use

[b]Longitudinal analysis was performed among participants who had never used an HNB product in Wave 1.

Dependent variable was lifetime HNB product use at Wave 2.