

E-cigarette Use Related to Demographic Factors in Hawai'i

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Abstract

E-cigarette use is rapidly expanding in the United States and is projected to be a \$3 billion industry by the end of this year. E-cigarette use in Hawai'i is significantly higher than national averages. The goal of this study was to examine the relationship in Hawai'i between demographic characteristics and several aspects of e-cigarette use including percentage of residents trying e-cigarettes, reasons for use, and perceived effects on health. Survey data were collected from a random sample of Hawai'i residents via the telephone in the summer of 2015, using methodology similar to that of the Hawai'i Health Survey. Chi-squared tests found e-cigarette use to be significantly associated with age ($P=.001$), gender ($P=.03$), ethnicity ($P<.001$), and education ($P<.001$). Among e-cigarette users, 12% said they started smoking regular cigarettes after starting e-cigarettes, 21% said their use of regular cigarettes did not change, 6% said they reduced use of regular cigarettes, and 20% said they completely stopped smoking regular cigarettes. Multivariable logistic regression results suggest Native Hawaiians ($OR=29.1$, $P=.01$) and Filipinos ($OR=24.3$, $P=.01$) were significantly more likely to report perceived improved health due to e-cigarette use compared to Caucasians. Given existing health disparities for Native Hawaiians and Filipinos, the fact that these groups are significantly more likely than other ethnic/racial groups to report that e-cigarettes improved their health bears notice and highlights the need for additional research in this area.

Keywords

Electronic cigarettes, smoking, health disparities, Hawai'i

Introduction

E-cigarettes are small, battery powered devices that heat a liquid into an aerosol that is then inhaled to simulate smoking.¹ Sales in the United States were estimated at \$1 billion in 2013 and are expected to climb to \$3 billion by 2015 as a number of tobacco manufacturers are launching products.²

Despite high use rates, e-cigarettes have not been rigorously studied and there is a great deal of uncertainty as to their effects on health. One hotly debated issue is the relationship between e-cigarettes and conventional cigarettes. Proponents of e-cigarettes cite studies showing that e-cigarettes are often used to aid efforts to stop smoking conventional cigarettes, which are known to cause cancer and lead to premature death.³⁻⁵ Others, however, believe the opposite—that e-cigarettes lead to increased use of other tobacco products.⁶ Potential risks of e-cigarettes are also poorly understood.^{7,8} With e-cigarettes, the quantity of nicotine or other potentially harmful chemicals being inhaled is unclear, as is whether e-cigarette use is associated with both acute and long-term cardiopulmonary and other adverse events.

There is great concern about the prevalence of e-cigarette use among adolescents as e-cigarettes are sometimes sold in flavors (eg, bubblegum, chocolate, cotton candy) that may be appealing to teens.⁹ Marketing is currently unregulated, and e-cigarette companies have heavily invested in television advertisements attempting to make e-cigarette use seem “cool.”

A recent CDC study reports that e-cigarette use among high school students rose from 1.5% to 13.4% from 2011 to 2014.⁹ The largest increase over a one-year period occurred from 2013 to 2014 when e-cigarette use nearly tripled from 4.5% to 13.4%.⁹ In 2014, e-cigarette use surpassed the use of every tobacco product, including conventional cigarettes.

E-cigarette use in Hawai'i exceeds national averages, with use among adolescents estimated to be three times the national rate.¹⁰ An estimated 13% of smokers in Hawai'i have tried e-cigarettes as a means of stopping smoking.¹¹ Moreover, from 2011 to 2015, e-cigarette use increased six-fold from 2% to 12% among middle school students and more than quadrupled from 5% to 22% among high school students.¹² The goal of the current study was to examine the association between demographic factors and various aspects of e-cigarette use in Hawai'i, including reasons for trying, utilization per week, and perceived impact on health.

Methods

The study population ($N=937$) included English-speaking adult respondents to a representative statewide telephone survey in Hawai'i administered by SMS Research Inc, in the spring and summer of 2015. Survey question content was based on information we had obtained from qualitative interviews with e-cigarette users (unpublished). Survey methodology was similar to that of the Hawai'i Health Survey and the survey included all of the demographic questions that are part of that survey.¹³ Cell phones as well as landline phones were included in the sample. Sampling of households was stratified by island and randomized within island. Neighbor islands were oversampled in comparison to O'ahu.

E-cigarette Questions

Four questions regarding e-cigarettes were included in the health survey by the investigators (Table 1). One was whether the respondent had ever tried e-cigarettes. If they responded yes, they were asked their primary reason for use, relation to regular cigarette use, and perceived impact on their health.

Questions related to demographic variables were the same as those administered as part of the Hawai'i Health Survey and included age, gender, education level, chronic diseases, self-reported health status, and birthplace.¹³

For chronic conditions, respondents were asked about each household member: Has anyone in the household been told by a physician or medical professional that they have arthritis? Similar questions relating to diagnosis with asthma, diabetes, high blood cholesterol, and hypertension were also asked. The respondents also gave information on the educational status of each household member who was 18 years and older.

Table 1. E-cigarette survey questions	
Question	Response set
1. Have you ever tried e-cigarettes?	<ul style="list-style-type: none"> • Yes, I have tried and continue to use them; • Yes, I have tried them but I don't use them now; • No I have never tried e-cigarettes
2. Which best describes your main reason for starting to use e-cigarettes?	<ul style="list-style-type: none"> a. To quit smoking conventional cigarettes b. To cut down on use of conventional cigarettes c. More acceptable than smoking regular cigarettes d. Reduce smoking exposure to family members e. Saw friends using them f. For fun or pleasure g. Saw advertisement
3. How would you describe your use of regular cigarettes after beginning use of e-cigarettes?	<ul style="list-style-type: none"> a. I have never smoked regular cigarettes b. I currently smoke both regular cigarettes and e-cigarettes and have not changed my use of regular cigarettes c. I have reduced my use of regular cigarettes since I started using e-cigarettes d. I have completely stopped using regular cigarettes since I started using e-cigarettes e. I have started smoking regular cigarettes since I started using e-cigarettes
4. Overall, what do you believe to be the effect on your health of e-cigarettes?	<ul style="list-style-type: none"> a. Improved my health b. No effect c. Worsened my health

Respondents listed up to four ethnicities for both their mother and their father. The choices were Caucasian, Hawaiian, Chinese, Filipino, Japanese, Korean, Samoan/Tongan, Black/African American, Native American/Aleut/ Eskimo/Inuit, Vietnamese, Asian Indian, Portuguese, and Guamanian/Chamorro, or other race/ethnicity. These were categorized into a single race/ethnicity as follows: If Hawaiian was listed for the mother or father, the person's ethnicity was coded as being Native Hawaiian. Otherwise, the person was categorized according to the first ethnicity listed (other than Caucasian or unknown) for the father. If the father's responses were Caucasian and/or unknown, the person's ethnicity was coded to the first ethnicity listed (other than Caucasian or unknown) for the mother. If there were no other responses other than Caucasian or unknown, the person was categorized as Caucasian. Otherwise, the person's ethnicity was coded as "do not know, refused, or missing."

Statistical Analyses

Descriptive statistics are presented as means for continuous variables and frequencies for categorical variables. Chi-squared tests were used to examine differences in trying e-cigarettes, and reasons for trying them related to demographic characteristics. A logistic regression model was used to examine perceptions of the impact of e-cigarettes on health (better, same, worse) related to demographic characteristics. We included individuals who reported ever using e-cigarettes or currently use e-cigarettes in this model. Independent variables examined were those with *P*-values of at least 0.2 in bivariate analyses. These included age, island, gender, self-reported health status, ethnicity, education, birthplace, and chronic disease. For each independent variable, the largest subgroup was used as the reference group (age 35-64, living on O'ahu, male, Caucasian, high school education, born in Hawai'i, and no chronic disease).

All analyses were completed in SAS. Sample weights were included in the analyses to account for the complex survey design. These weights reflect the probability of household selection, household non-response, a factor for crude completion adjustment, and post-stratification by age-sex-strata. This study was granted exempt status by the University of Hawai'i Institutional Review Board.

Results

Characteristics of the Study Population

The final survey sample included 937 individuals. Our study population consisted of slightly more males than females (53.7% to 46.3%, Table 2). A disproportionate number of participants were over the age of 65 (35.2%). Also, 61% lived on O'ahu. As is consistent with the multiethnic nature of the population in Hawai'i, no one race or ethnicity made up a majority of the sample. The three largest groups by race and ethnicity were Caucasian (35.7%), Japanese (21.4%), and Native Hawaiian (15.5%). Approximately half (46.8%) had a college education or higher, and 40.4% reported having a chronic disease condition.

Tried E-cigarettes

Figure 1 displays the percent of respondents who: (1) tried e-cigarettes and still use them (6.5%); (2) tried but do not currently use (12.9%); and 3) never tried e-cigarettes (80.6%). The proportion of respondents trying e-cigarettes differed significantly by age (*P*=.001), ethnicity (*P*<.001), education level (*P*<.001) and gender (*P*=.03).

Overall, approximately 30% of participants under the age of 24 had ever tried e-cigarettes. The majority (83%) of those who ever tried e-cigarettes said that they did not continue their use. In the subsequent age groups 25-34, 35-54, and 55-64, the percentage of those who tried e-cigarettes gradually decreased.

Table 2. Demographic Characteristics of the Study Population (N=937)		
Factor	Characteristic	Weighted %
Age	Age 18-24	10.1%
	Age 25-34	11.7%
	Age 35-64	43.0%
	Age 65+	35.2%
Island	O'ahu	61.0%
	Other island	39.0%
Gender	Female	46.3%
Self-reported health	Excellent health	28.8%
	Poor, fair, or good health	61.2%
Ethnicity	Caucasian	35.7%
	Filipino	8.9%
	Japanese	21.4%
	Native Hawaiian	15.5%
	Other race/ethnicity	18.5%
Education	College or higher	46.8%
	Junior college	25.2%
	High school or less	27.8%
Birthplace	Hawai'i	53.6%
	Mainland or other country	46.2%
Chronic disease	No	59.6%
	Yes	40.4%

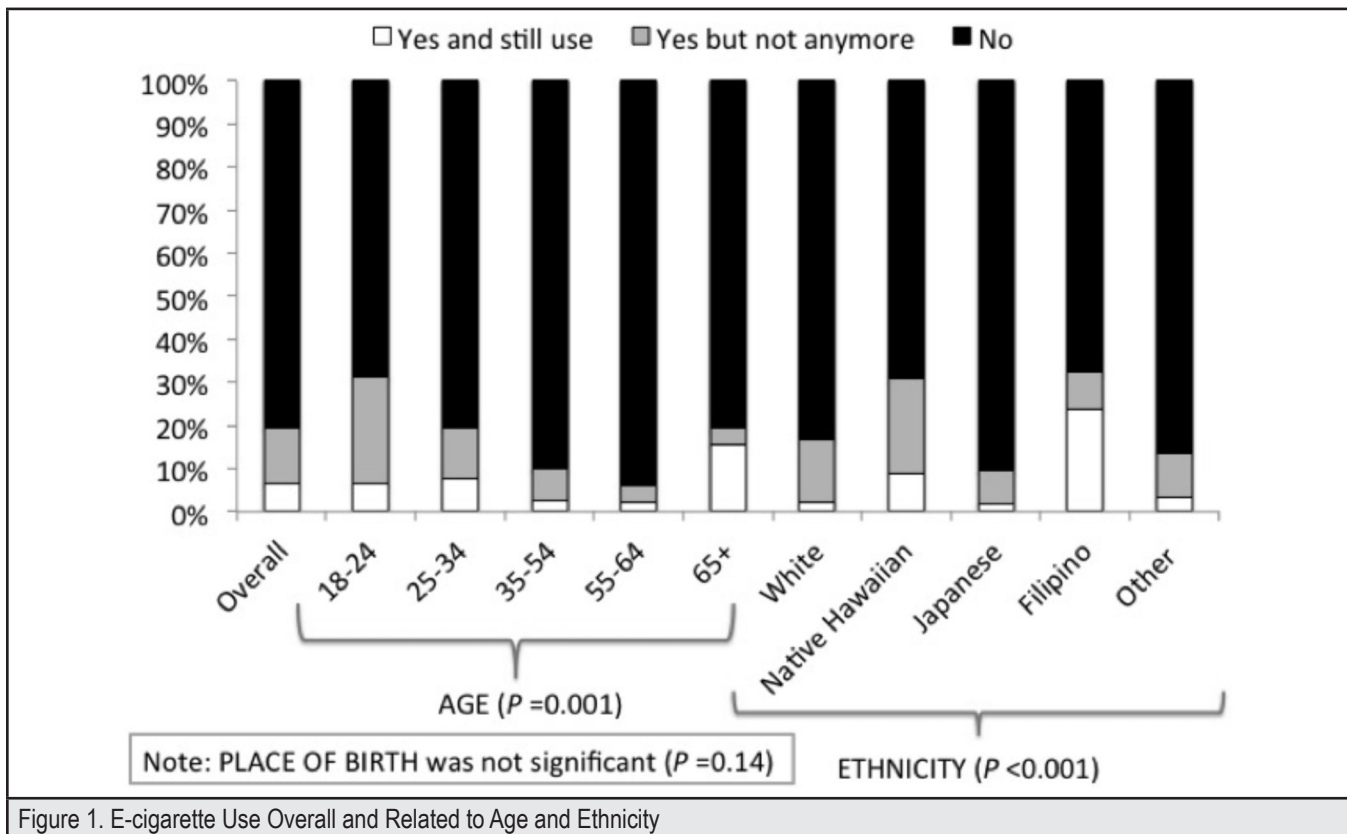


Figure 1. E-cigarette Use Overall and Related to Age and Ethnicity

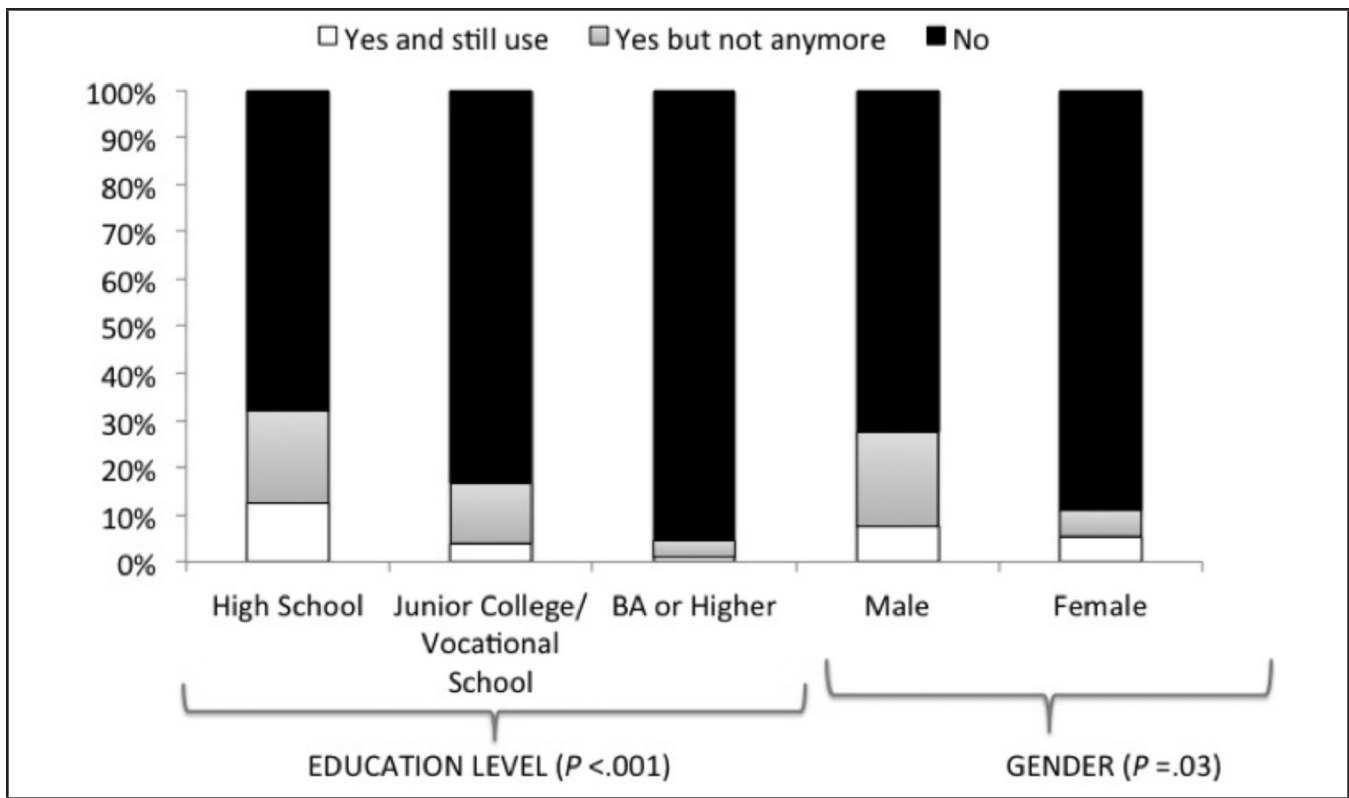


Figure 2. E-cigarette Use Related to Educational Level and Gender

However, for the 65-74 age group, more than 35% of respondents had ever tried e-cigarettes, and the majority of respondents in this age group said that they continued to use e-cigarettes.

E-cigarette use was most prevalent in Filipinos (32%) and Native Hawaiians (31%) followed by Caucasians (17%), other (14%), and Japanese (9%) (Figure 1). With regard to gender, about 28% of males reported having ever used e-cigarettes compared to about 12% of females; a larger percentage of males also reported being former e-cigarettes users (Figure 2, $P=.03$). Our data also shows a striking and significant downward trend, with those at higher levels of education being less likely to have ever tried e-cigarettes ($P<.001$).

Reasons for Using E-cigarettes

Reasons for starting e-cigarettes varied significantly by demographic characteristics. In general, respondents tended to either start using e-cigarettes for recreational use or to quit the use of traditional cigarettes (Table 3). Over half of those under the age of 24 started using e-cigarettes for fun/pleasure while over 90% of those in the 65-74 age group started in an attempt to quit smoking conventional cigarettes ($P<.001$). About 19.2% of those ages 25-34 started e-cigarettes to reduce regular tobacco exposure to family members as opposed to less than 7% across the other age groups.

The reasons for starting e-cigarettes varied significantly by race and ethnicity (Table 3, $P=.003$). Approximately 65% of

Caucasians started e-cigarettes for recreational purposes and about the same percentage of Filipinos started to quit smoking conventional cigarettes. Close to half of Japanese, other Asian/Pacific Islanders, and Native Hawaiians started using e-cigarettes for recreational purposes and the other half reported using them as a replacement for conventional cigarettes.

Over 60% of males started using e-cigarettes either for fun or pleasure or because they saw their friends using, while around 75% of females started e-cigarettes to quit smoking conventional cigarettes ($P<.001$; Table 3). Education level ($P>.05$) and birthplace ($P=.15$) were not significantly associated with reasons for use.

Relation of E-cigarette Use on Use of Regular Cigarettes

When describing use of regular cigarettes after beginning e-cigarettes, 40% said they never smoked regular cigarettes, 21% said their use of regular cigarettes has not changed, 6% said they reduced use of regular cigarettes, and 20% said they completely stopped smoking regular cigarettes, whereas 12% said they started smoking regular cigarettes (Figure 3).

Perceived Health Effects

In the unadjusted logistic regression model, age, island, self-reported health and ethnicity were significantly associated with the perception that e-cigarette use improved health (Table 4). Those older than 65 years ($OR=18.0$; $P=.03$) were more likely

Table 3. Reason for Starting E-cigarettes Related to Age, Gender, Ethnicity, and Place of Birth (Weighted Percent).							
	Quit cigarettes (%)	Cut down on cigarettes (%)	More acceptable (%)	Reduce family member exposure (%)	Saw friends using (%)	Fun or pleasure (%)	P-value
Age							
18-24	12.4	4.9	0.0	6.3	26.0	50.5	<.001
25-34	42.7	7.9	4.5	19.2	8.5	17.1	
35-54	55.0	2.4	6.4	1.2	3.5	21.1	
55-64	46.3	22.5	0.0	0.0	19.4	11.8	
65-74	92.7	3.6	0.2	1.0	0.7	0.6	
75+	42.2	57.8	0.0	0.0	0.0	0.0	
Gender							
Male	22.3	5.1	1.5	8.6	19.0	40.7	<.001
Female	73.8	7.1	2.2	0.4	7.2	9.2	
Birthplace							
Hawai'i, Urban	26.3	11.2	1.4	12.9	16.5	31.3	.15
Hawai'i, Rural	18.4	0.0	0.6	0.8	43.3	25.6	
Other US State	36.1	0.6	4.7	0.3	3.5	54.8	
Overseas	87.3	2.4	0.0	0.0	2.0	8.3	
Race/ Ethnicity							
Caucasian	23.8	1.9	3.6	0.3	3.3	67.1	.003
Native Hawaiian	23.4	12.7	2.6	10.1	28.2	16.7	
Japanese	37.8	8.8	0.0	0.0	34.2	19.3	
Filipino	73.3	2.7	0.0	15.9	5.0	2.7	
Other Asian/ Pacific Islander	41.8	1.9	0.0	0.0	17.9	37.5	
Education Level							
College or higher	32.9	5.6	16.3	0	9.1	34.0	<.001
Junior college	31.6	4.6	2.1	19.7	7.6	28.3	
High school	40.9	6.2	0.16	0.43	19.8	32.5	

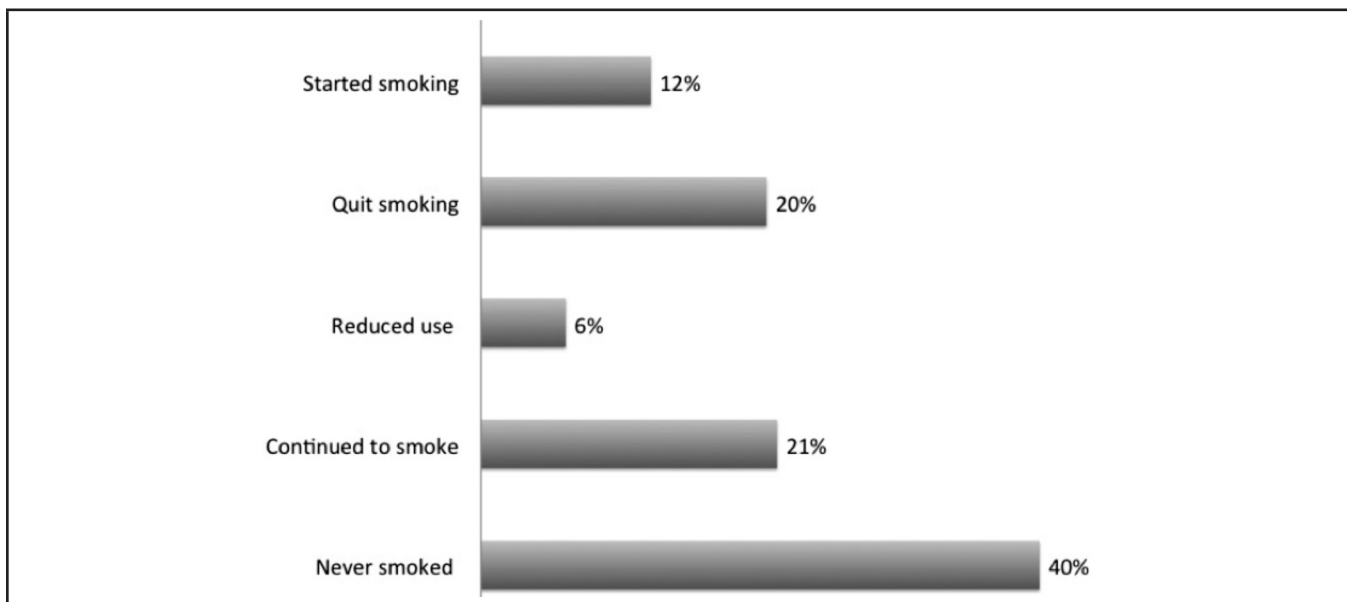


Figure 3. How Would You Describe Your Use of Regular Cigarettes After Beginning E-cigarettes?

Table 4. Factors related to perceived effect on health relative to no effect, unadjusted.			
Factor		Improved my health	Worsened my health
Age	Age Less than 25	0.71 [0.12, 4.1]	3.2 [0.76, 13.3]
	Age 25-34	1.5 [0.13, 18.1]	3.0 [0.65, 13.9]
	Age 35-64	1	1
	Age 65+	18.0 [1.5, 222.7]	0.48 [0.074, 3.1]
Island	O'ahu	1	1
	Other island	0.12 [0.019, 0.78]	2.5 [0.51, 12.0]
Gender	Female	5.7 [0.66, 48.6]	1.3 [0.36, 5.0]
	Male	1	1
Self-reported health	Excellent health	1	1
	Poor, fair, or good health	0.11 [0.016, 0.82]	0.68 [0.11, 4.2]
Ethnicity	Caucasian	1	1
	Filipino	18.9 [1.8, 204.9]	0.21 [0.024, 1.8]
	Japanese	2.3 [0.17, 31.7]	0.83 [0.10, 6.8]
	Native Hawaiian	2.6 [0.36, 19.3]	0.30 [0.046, 2.0]
	Other race/ethnicity	0.17 [0.019, 1.4]	0.053 [0.008, 0.37]
Education	College or higher	1.7 [0.16, 18.8]	1.3 [0.25, 7.3]
	Junior college	0.64 [0.071, 5.9]	0.23 [0.055, 1.00]
	High school	1	1
Birthplace	Hawai'i	1	1
	Mainland or other country	2.2 [0.25, 19.2]	0.63 [0.93, 4.3]

Table 5. Factors Affecting Perception of Impact of E-cigarettes on Perceived Health Improvement: Multivariate Results.				
Health Better (Reference group: health same or worse)	Odds Ratio	Lower CL	Upper CL	P-value
Age 25 or under	0.17	0.03	1.2	.07
Age 25-34	1.1	0.07	15.5	.96
Age 35-64	1			
Age 65+	5.7	0.28	114.3	.26
Oahu (vs neighbor islands)	0.09	0.01	1.1	.058
Female	0.53	0.08	3.5	.51
Health excellent (vs poor, fair, good, very good)	0.11	0.02	0.64	.013
Filipino (vs Caucasians)	24.3	2.2	272.1	.01
Japanese (vs Caucasians)	7.4	0.24	228.6	.25
Native Hawaiian (vs Caucasians)	29.1	2.1	411.0	.01

than middle-aged respondents to report that e-cigarette use had improved their health. Respondents living on an island other than Oahu (OR=0.12; $P=.03$) were less likely to report health improvements. Those in less than poor health (OR=0.11; $P=.03$) were also less likely to report that e-cigarette use had a positive impact on their health. Filipino respondents (OR=18.9; $P=.02$) were more likely than Caucasians to report that e-cigarettes had improved their health.

Table 4 also reveals results of bivariate analyses related to perceptions that e-cigarette use led to worse health. Those of "other" ethnicity (OR=0.053; $P=.003$) were less likely than Caucasians to report that their health had gotten worse because of e-cigarettes.

Finally, in our multivariable analyses (Table 5), having poor self-reported health [OR=0.11, 95% CI (0.02, 0.64)] was significantly associated with reduced odds of reporting that e-cigarettes improved health, while being Filipino [OR=24.3, 95% CI (2.2, 272.1)] or Native Hawaiian [OR=29.1, 95% CI (2.1, 411.0)] was associated with a significant increase in reporting that e-cigarette use improved health.

Discussion

The goal of this study was to examine the association between demographic factors and use of e-cigarettes, reasons for use, and perceived effects on health through a statewide telephone survey. Consistent with the literature, younger people were more likely than older people to have ever tried e-cigarettes and males were more likely than females.¹⁴⁻¹⁶

The groups most likely to continue using e-cigarettes were those over age 65, Filipinos, and those with less than a high school education. Among these groups, the most common reason for starting was to quit regular cigarettes.

Approximately 20% of respondents said they completely quit regular cigarettes after beginning e-cigarette use and another 6% said they reduced regular cigarette use. E-cigarettes have been shown to be more effective than placebo devices for smoking cessation.¹⁷⁻²⁰ They may also aid in smoking reduction, but the quality of available evidence is low. Hence, more research is needed.

Moreover, 12% of e-cigarette users said they started smoking regular cigarettes after beginning e-cigarettes. Although we do not know how many of these smokers would have begun smoking cigarettes without exposure to e-cigarettes, it is still concerning and further research is needed in this area as well.

One of the most striking findings was in the relation between gender and reasons for use. Females were considerably more likely than males to use e-cigarettes in order to quit smoking traditional cigarettes, while males were more likely to report using them for fun, pleasure, or social reasons. These results are particularly unexpected given the fact that males are nearly five times more likely to smoke regular cigarettes than females.²¹

Native Hawaiians and Filipinos were significantly more likely to report that they perceived that their health had improved due to e-cigarette use. Interestingly, these are also the two ethnicities with the highest proportion of participants who have ever used e-cigarettes. It is possible that e-cigarette use is more prevalent in communities in which the perceived health effects tend to be more positive. Also, further research is needed in this area as Native Hawaiians and Filipinos have existing health disparities in cancer and cardiovascular disease.²²

There are several limitations to our study. First, the data are from only one state and are self-reported. Moreover, the sample is potentially biased as it includes only those who are willing to participate in a telephone survey. Another limitation is the small sample size, particularly for sub-groups.

Conclusions

In conclusion, our study of e-cigarette use in Hawai'i reveals that there are vast differences in use, reasons for trying, and perceived health benefits that vary by age, gender, ethnicity, health status, and education level. Understanding the reasons for use, patterns of use, and perceived health benefits will help physicians, nurses, pharmacists, and other health care providers in counseling patients. To inform these discussions, more research is clearly needed regarding the potential health benefits and risks of e-cigarettes.²³ Moreover, policy makers need to consider carefully what types of regulation might be warranted to discourage use among adolescents and those who have never smoked, but also to allow use among current smokers if e-cigarettes are determined to facilitate cessation of tobacco smoking.²⁴

Conflict of Interest

None of the authors identify any conflict of interest.

Disclosure Statement

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