ORIGINAL ARTICLE

Risk and Protective Factors Associated with Electronic Nicotine Delivery System Use in a Hispanic College Sample

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Abstract

Young Hispanics are at greater risk of *electronic nicotine delivery system* (ENDS) use compared to non-Hispanic individuals. A lack of a consistent theoretical framework in ENDS research warrants assessing ENDS use from a socioecological approach. Hispanic college students ($N = 761$; 76.2% female) completed a survey of ENDS use and potentially related sociocultural and behavioral constructs. A logistic regression model indicated that the Attitudinal Familism Scale (AFS) Subjugation of Self for Family, tobacco and cannabis ever use, Comparison of E-Cigarettes and Cigarettes General Benefits were significant predictors of ENDS ever use. A linear regression model indicated that monthly ENDS use was positively associated with AFS Familial Support, monthly cannabis use, Negative Consequences, and the E-cigarette Dependence Scale and negatively associated with monthly alcohol use. Cessation efforts may wish to focus on family support for health-promoting behaviors, reducing dual use of cigarettes and cannabis, and addressing the impact of nicotine dependence.

Keywords ENDS · Vaping · Socioecological · Hispanic · College Students

Introduction

Electronic Nicotine Delivery Systems (ENDS), known commonly as e-cigarettes and vaporizers, use propylene glycol and vegetable glycerin as a vehicle for delivering non-combustible nicotine vapor (Centers for Disease Control and Prevention [CDC], 2018). ENDS were first introduced in 2007 and have increased in popularity, especially among young adults (McMillen et al., 2015; Omoike & Johnson, 2021). National estimates of vaping nicotine suggest that college students report an annual prevalence of 28% and a

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monthly prevalence of 20.4% (Patrick et al., 2022). Concerningly, findings suggest that ENDS products may increase risks for related pulmonary illness and potential death—as traces of industry-contaminated heavy metals and black-market fillers such as vitamin-E acetate have been linked to vaping-related lung problems (Layden et al., 2020; Smith et al., 2020).

Hispanic young adults are at similar risk rates for ENDS use compared to individuals who identify as White and are at higher risk than African American individuals (Substance Abuse and Mental Health Services Administration, 2022). One recent study of a US nationally representative sample observed that 8.6% of Hispanic individuals currently use ENDS, while 21.6% reported ever ENDS use (Spears et al., 2019). Recent literature has suggested that Hispanic adolescents are more at risk of experimenting with ENDS at an early age, and Hispanic never-users are more susceptible of engaging in ENDS use than non-Hispanic never-users (Unger & Falcon, 2022). Hispanic individuals may also be at an increased risk of initiating nicotine vaping without any prior tobacco use (Bostean et al., 2015). More concerningly, a study conducted on the US/Mexico border found that 17.3% of a primarily Hispanic college student sample had engaged in past month ENDS use (Llanes et al., 2019). Given the susceptibility and prevalence of young Hispanic individuals engaging in this deleterious behavior, assessing outcomes and risk factors, both unique to the Hispanic cultural experience on the US/Mexico Border and common across ethnocultural groups, is crucial in understanding how ENDS use can potentially be reduced.

The socioecological framework adopted by the National Institute of Minority Health and Health Disparities (NIMHD) is utilized as a theoretical framework for consistency of metrics and in an effort to better understand factors that influence ENDS use to develop prevention strategies. The framework includes five domains of influence across four levels of influence (see Alvidrez et al., 2019). Two domains of influence (sociocultural environment and behavioral) across a single level (individual) are examined in the present study to narrowly focus on ENDS behaviors in Hispanic college students using Social Cognitive Theory—as applied to addictive behaviors (e.g., Bandura, 1986) and build the foundation for a deeper theoretical understanding of ENDS use in Hispanic young adults. Constructs explored within each domain and level of influence within the NIMHD framework are provided in Fig. 1.

Two studies on the U.S./Mexico border assessing the relationship between substance use and acculturation found inconsistent results; one study found that acculturation was not associated with substance use (Cooper et al., 2011) while another found that greater acculturation was positively associated with increased substance use (Resor & Cooper, 2010). Taken together, these findings may suggest that measures on the border of acculturation are less precise, and the exploration of more pertinent cultural constructs in relation to substance use seems warranted. Interestingly, a longitudinal study found that Latino youth with increasing bilingualism and stable family values were at a lower risk for substance abuse compared to their English-speaking and non-family-oriented counterparts (Cruz et al., 2017); thus, more nuanced constructs, such as language spoken at home, may be more predictive of ENDS use among Hispanic individuals living on the US/Mexico border. Of relevance, Escobedo and colleagues (2018) found that fatalism (e.g., the ideology that attributes events to fate or inevitability) was a risk factor for the use of tobacco products among a Hispanic sample. However, their study did not assess the relationship between fatalism and ENDS use, which seems to be a critical gap in the literature. Familism is a traditional Hispanic value that emphasizes the prioritization of loyalty, cohesion, and strong family connections (Sabogal et al., 1987). Familism has been globally observed as a protective factor within the Hispanic community across both adolescent and adult samples

		Level of Influence
		Individual
Domain of Influence	Sociocultural Environment	Age Sex Language spoken at home Attitudinal Familism Scale Multidimensional Fatalism Scale
	Behavioral	ENDS Use Status (Current vs Never) Monthly ENDS, Combustible Cigarette, Marijuana and Alcohol Use. ENDS use Expectancies, Perceptions (risks and benefits), Comparative beliefs, and Nicotine Dependence. Externalizing behaviors: Depression, Anxiety, and Stress
Based on National Institute of Minority Health and Health Disparities Research Framework (Alvidrez et al., 2019)		

Fig. 1 Socioecological approach to ENDS use in present study

(Corona et al., 2017; Valdivieso-Mora et al., 2016). However, within the substance use literature, Familism's role seems to be more complex. Familism has been observed to be a protective factor against alcohol use (DiBello et al., 2016). Yet, more recent findings suggest that it may serve as a risk factor for binge drinking (Escobedo et al., 2018). Notably, one study found that Familism increased the likelihood of ever cigarette use among adolescent and young adult Latinas (Kaplan et al., 2001). As in previous substance use research, empirical studies are necessary to explore Familism's potential role as a risk factor against ENDS use, specifically on the US/Mexico border.

The substance use literature suggests that ENDS use is positively associated with cigarette (Doran et al., 2017; Llanes et al., 2019; Olfson et al., 2019; Spindle et al., 2017) and cannabis use (Spindle et al., 2017). Additionally, research on concurrent use of nicotine and cannabis indicates that nicotine enhances the effects of cannabis (Ream et al., 2008) and may contribute to increased dependence on nicotine (Jones et al., 2023). Relatedly, ENDS use is also associated with problematic alcohol use (Hefner et al., 2019; Hershberger et al., 2016), and individuals have reported greater perceived pleasure from ENDS when drinking alcohol (Thrul et al., 2019). Taken together, these findings warrant the investigation of alcohol and cannabis use as risk factors for ENDS use on the US/Mexico border.

Expectancies and perceptions are noteworthy predictors of ENDS use and dependence (Morean & L'Insalata, 2017). Similarly, perceived risks (e.g., fear of battery explosions) and benefits (e.g., lower health risk) are also indicators of ENDS and substance use patterns (Copeland et al., 2017). Yet, both perceived expectancies and outcomes of ENDS use have received minimal attention among Hispanic samples. Importantly, it is critical to investigate mental health in relation to ENDS use as it is found to be more prevalent among individuals who report mental health discrepancies (Bandiera et al., 2017; Becker et al., 2021; Hefner et al., 2019; Javed et al., 2022). Thus, assessing the relationship between constructs such as depression, anxiety, and stress, and ENDS use may be insightful in an effort to identify modifiable risk factors among Hispanic individuals on the US/Mexico border.

Study Aims and Hypotheses

Given that the Hispanic population is the largest ethnocultural minority in the USA (U.S. Census Bureau, 2023) and is underrepresented in substance use studies (Vaughan et al., 2018), the primary aim of this study was to assess sociocultural and behavioral correlates of ENDS use and frequency in Hispanic college students on the border of the USA and Mexico. Furthermore, this study specifically sampled participants from the border region of the USA and Mexico, providing a unique insight into culturally relevant factors that may be more salient compared to other areas of the USA, given the geographical location and increased exposure to both American and Mexican culture. Since ENDS products vary in criteria and terminology across the literature, the current study defines "vaping" as using an ENDS product of any kind (e.g., "box mods," Juul, Blu).

Three hypotheses were tested. First, ENDS users would be more likely to be male, speak English at home, and score higher on familism and fatalism relative to never users. Second, ENDS users would be more likely than never users to report cigarette smoking, cannabis use, alcohol use, positive expectancies of vaping, heightened perceived benefits, heightened comparative beliefs about ENDS versus cigarettes, and report higher levels of depression, anxiety, and stress. Third, increased frequency of vaping would be positively associated with male sex, speaking English at home, higher familism and fatalism scores, increased drug use (cigarette smoking, cannabis use, and alcohol use), heightened perceived benefits, heightened comparative beliefs about ENDS versus cigarettes, higher levels of depression, anxiety, and stress, and greater ENDS dependence.

Methods

Participants

After receiving IRB approval, a convenience sample of Hispanic undergraduate students ($N=761$; 76.9% female; $M_{age}=20.6$, $SD=4.0$) was recruited from a university located on the US/Mexico border to participate in the online survey. Inclusion criteria included being age 18 or older and self-reporting Hispanic descent. There were no exclusion criteria.

Measures

Vaping Use and Frequency

Participants were first asked if they had ever used ENDS. If participants indicated ENDS use, frequency and age of first use were then prompted to answer subsequent items. Individuals who reported any lifetime use were coded as *ENDS ever user*s, and those who did not were coded as *never users*. Participants' reports of ENDS use frequency in the past 30 days were coded as past month ENDS use frequency.

Sociodemographics

This 32-item questionnaire collected demographic information (e.g., age, sex, language spoken).

Attitudinal Familism Scale

This 18-item four-factor scale assessed participants' beliefs and attitudes regarding familial support, interconnectedness, honor, and subjugation of self for the family (Steidel & Contreras, 2003). Items were rated on a 10-point scale ranging from 1 (*strongly disagree*) to 10 (*strongly agree*). Mean scores were computed for each subscale; higher scores indicated stronger family-oriented beliefs and attitudes. Internal consistency for the present study ranged from questionable to acceptable ($\alpha = 0.63$–0.77).

Multidimensional Fatalism Scale

This 30-item five-factor scale assessed individuals' beliefs regarding divine control, luck, helplessness, internality, and fatalism (Esparza et al., 2015). Items were rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Mean scores for each subscale were computed; higher scores indicated a greater belief in each respective factor. Internal consistency for the present study ranged from acceptable to excellent ($\alpha = 0.78$–0.95).

Smoking Status

Participants were asked for their combustible cigarette smoking status among categorical options (e.g., "> 10 cigarettes per day," "I have never smoked before," "I no longer smoke"). Options were recoded such that 1 indicated ever use of cigarettes and 0 represented never use, resulting in an ever use of combustible tobacco variable. Frequency of use was calculated as reported number of days in the past thirty the participant smoked multiplied by average number of cigarettes smoked on smoking days to result in the number of cigarettes per month frequency variable. In a light and intermittent smoking group, cigarettes per month are likely more fitting than a daily measure (e.g., Cabriales et al., 2012).

Drug Use Frequency and Ever Use

Participants were asked if they had ever consumed alcohol and/or cannabis. If participants indicated either form of drug use, they were then prompted to answer the frequency of use in the past month.

Short Form Vaping Consequences Questionnaire

This 21-item questionnaire assessed consequences associated with vaping (Morean & L'Insalata, 2017). Items were rated on a 10-point scale from 0 (*completely unlikely*) to 9 (*completely likely*). Mean scores for each subscale were computed; higher scores indicated greater perceived vaping consequences. Internal consistency for the present study was excellent ($\alpha = 0.95$–0.96).

Risks and Benefits of E-Cigarettes Questionnaire

This 30-item questionnaire assesses the perceived risks and benefits of e-cigarette use (Copeland et al., 2017). Items were rated on a 7-point scale ranging from 1 (*totally disagree*) to 7 (*totally agree*). Mean scores for each subscale were computed; higher scores indicated greater perceived risks or benefits of e-cigarettes. Internal consistency for the present study was excellent ($\alpha = 0.90$–0.93).

Comparison of E-Cigarettes and Cigarettes Questionnaire

This 10-item questionnaire assesses comparative beliefs regarding traditional and electronic cigarettes (Hershberger et al., 2017). Items were rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Mean scores for each subscale were computed; higher scores indicated greater perceived benefits of e-cigarettes compared to traditional cigarettes. Internal consistency for the present study was good ($\alpha = 0.81$–0.86).

E-Cigarette Dependence Scale

This 22-item scale assessed participants' e-cigarette dependence (Morean et al., 2019). Items were rated on a 5-point scale ranging from 0 *(never)* to 4 *(almost always)*. Only self-reported current users completed this scale. Mean scores were computed; higher scores indicated greater e-cigarette dependence. Only participants who indicated using ENDs were asked to complete the E-cigarette Dependence Scale. Internal consistency for the present study was excellent ($\alpha = 0.98$).

Depression, Anxiety, and Stress Scale

This 21-item scale assesses depression, anxiety, and stress (Lovibond & Lovibond, 1995). Items are answered on a 4-point scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). Items within each subscale are summed and multiplied by two; higher scores indicated greater levels of depression, anxiety, and stress. Internal consistency for the present study ranged from good to excellent ($\alpha = 0.84$–0.92).

Procedure

After IRB approval was obtained, participants were recruited online via SONA systems, a secure cloud-based participant recruitment website. Participants signed a digital informed consent form confirming that they were over 18 years of age and agreed to participate before they were prompted to complete a series of questionnaires. Participants received course credit upon completion of the survey.

Statistical Plan

All statistical analyses were completed using Statistical Package for the Social Sciences (SPSS), v. 29.0.2.0 (IBM, 2023). Missing data were completely at random, and variables presented to all participants had less than 5% missing data; therefore, it was determined

that multiple imputations were not warranted (Schafer, 1999). The e-cigarette dependence scale was only completed by individuals who indicated ENDS ever use. Additionally, use frequencies for ENDS, cigarettes, cannabis, and alcohol were only completed by individuals who indicated ever use of each respective substance. Descriptive analyses were then conducted to generate participant characteristics. A logistic regression model was used to assess ENDS ever use, using the following independent variables: age, sex, primary language spoken at home, Attitudinal Familism Scale (AFS) subscales, Multidimensional Fatalism Scale (MFS) subscales, ever use of cigarettes, cannabis, and alcohol, Short Form Vaping Consequences Questionnaire (S-VCQ) subscales, Risks and Benefits of E-Cigarettes Questionnaire (RABE) subscales, Comparison of E-Cigarettes and Cigarettes Questionnaire (CEAC) subscales, and Depression, Anxiety, and Stress Scale (DASS-21) subscales. A linear regression model was used to assess the associations between frequency of vaping in the past month and age, sex, primary language spoken at home, AFS subscales, MFS subscales, ENDS age of first use, monthly cannabis frequency, monthly alcohol frequency, S-VCQ subscales, RABE subscales, CEAC subscales, E-Cigarette Dependence Scale (EDS), and DASS-21 subscales.

Results

Participant Characteristics

The present study found that 35.3% ($n = 269$) of the sample reported ever use of ENDS, with the average monthly ENDS use frequency being 7.08 ($SD = 31.33$). Furthermore, 43.2% ($n = 320$) of the sample reported ever use of combustible cigarettes, 41.9% ($n = 307$) reported ever use of cannabis, and 72.1% ($n = 536$) individuals reported ever use of alcohol (see Table 1).

ENDS Status (Ever vs. Never Use)

The logistic regression model was statistically significant, $\chi^2(24) = 202.59$, $p < 0.001$, Nagelkerke $R^2 = 0.37$. Ever use of ENDS was significantly associated with higher odds of AFS subjugation of self for family ($OR = 1.13$, $p < .01$), combustible tobacco ever use ($OR = 3.48$, $p < 0.001$), cannabis ever use ($OR = 2.95$, $p < 0.001$), and comparison of e-cigarettes and cigarettes general benefits ($OR = 1.10$, $p < 0.001$; see Table 2).

Monthly ENDS Use

The linear regression model assessing predictors of monthly ENDS use was statistically significant, $F_{(26, 136)} = 90.02$, $p < 0.001$, Adjusted $R^2 = 0.94$. The model demonstrated monthly ENDS use was positively associated with that AFS Familial Support ($b = 0.70$, $p = 0.02$), monthly cannabis use ($b = 0.93$, $p < 0.001$), S-VCQ Negative Consequences ($b = 0.620$, $p = < 0.01$), and the EDS ($b = 8.08$, $p < 0.001$). Monthly alcohol use ($b = -0.24$, $p = 0.04$) was negatively associated with monthly ENDS use (see Table 3).

Table 1 Participant characteristics ($n = 761$)

	Frequency	n	
Sex			
Male	22.9%	174	
Female	76.9%	585	
Language spoken at home			
English	48.5%	369	
Spanish	50.5%	384	
Ever use of cigarettes	43.2%	320	
Ever use of cannabis	41.9%	307	
Ever use of alcohol	72.1%	536	
Ever use of ENDS	35.3%	269	
	Mean	SD	Range
Age	20.55	3.94	
AFS family support	17.30	3.47	5–25
AFS family interconnectedness	23.93	3.71	6–30
AFS family honor	12.88	3.60	5–25
AFS subjugation of Self	20.42	4.70	6–30
MFS fatalism	19.66	4.49	6–30
MFS pessimistic helplessness	14.04	4.93	6–30
MFS internality	23.90	3.64	10–30
MFS divine control	19.44	6.63	6–30
Cigarette frequency (monthly)	9.59	50.76	0–540
Cannabis frequency (monthly)	5.89	29.65	0–500
Alcohol frequency (monthly)	3.94	5.82	0–45
ENDS frequency (monthly)	7.08	31.33	0–460
ENDS age of first use	17.72	2.61	5–30
EDS	.32	.68	0–4
CEAC general benefits	20.31	6.35	5–35
CEAC general effects	7.85	4.06	3–21
CEAC health benefits	6.33	3.15	2–14
S-VCQ positive reinforcement	2.42	2.09	1–10
S-VCQ negative reinforcement	5.74	3.62	1–10
RABE positive consequences	2.99	1.16	1–7
RABE negative consequences	5.16	1.16	1–7
DASS depression	8.80	10.24	0–42
DASS anxiety	8.74	8.83	0–42
DASS stress	11.21	9.45	0–42

n may differ based on missing responses

AFS = Attitudinal Familism Scale, *MFS* = Multidimensional Fatalism Scale, *ENDS* = Electronic Nicotine Delivery System, *EDS* = E-cigarette Dependence Scale, *CEAC* = Comparison of E-Cigarettes and Cigarettes, *S-VCQ* = Short Form Vaping Consequences Questionnaire, *RABE* = Risks and Benefits of E-Cigarettes, *DASS* = Depression, Anxiety, and Stress Scale

Table 2 Logistic regression: ever vs. never use

	B	SE	OR	p	95% CI	
					LL	UL
Age	−.051	.031	.950	.094	.895	1.009
Sex	.014	.248	1.014	.955	.624	1.648
Language spoken at home	−.333	.209	.717	.111	.476	1.080
AFS family support	−.036	.047	.965	.444	.880	1.058
AFS family interconnectedness	−.045	.048	.956	.356	.870	1.051
AFS family honor	−.039	.048	.961	.409	.875	1.056
AFS subjugation of self	**.128**	**.045**	**1.137**	**.004**	**1.041**	**1.241**
MFS fatalism	−.005	.030	.995	.872	.938	1.056
MFS pessimistic helplessness	.018	.030	1.018	.561	.959	1.080
MFS internality	.015	.032	1.015	.641	.954	1.080
MFS divine control	−.027	.018	.973	.132	.939	1.008
CEAC general benefits	**.094**	**.024**	**1.098**	**<.001**	**1.048**	**1.151**
CEAC general effects	−.011	.030	.989	.706	.931	1.049
CEAC health benefits	.076	.047	1.078	.111	.983	1.184
S-VCQ positive reinforcement	−.031	.033	.970	.356	.908	1.035
S-VCQ negative reinforcement	.044	.052	1.045	.399	.943	1.158
RABE positive consequences	−.186	.127	.831	.143	.648	1.065
RABE negative consequences	−.154	.104	.857	.137	.699	1.050
Ever use of cigarettes	**1.245**	**.231**	**3.475**	**<.001**	**2.207**	**5.470**
Ever use of cannabis	**1.082**	**.235**	**2.952**	**<.001**	**1.862**	**4.681**
Ever use of alcohol	.334	.295	1.396	.258	.783	2.491
DASS depression	.024	.016	1.024	.139	.992	1.057
DASS anxiety	−.022	.019	.978	.257	.942	1.016
DASS stress	.004	.020	1.004	.832	.965	1.045

Overall model was statistically significant, $\chi^2(24) = 202.592$, $p < .001$, Nagelkerke $R^2 = .373$. Significant results are shown in bold

AFS = Attitudinal Familism Scale, *MFS* = Multidimensional Fatalism Scale, *ENDS* = Electronic Nicotine Delivery System, *EDS* = E-cigarette Dependence Scale, *CEAC* = Comparison of E-Cigarettes and Cigarettes, *S-VCQ* = Short Form Vaping Consequences Questionnaire, *RABE* = Risks and Benefits of E-Cigarettes, *DASS* = Depression, Anxiety, and Stress Scale

Discussion

The present study assessed frequency and sociocultural and behavioral correlates of ENDS use in Hispanic college students on the US/Mexico border. Through applying the NIMHD framework and using a SCT lens, multiple modifiable risk factors were highlighted in the current study's findings. The average age of first use of ENDS was 17.72; furthermore, 35.3% of the present sample reported ever using ENDS, which is notably higher than findings from a northeastern US college sample (21.7%). A similar monthly ENDS frequency was observed (< 10 days; Hefner et al., 2019). These findings may suggest that although a significantly larger number of Hispanic individuals on the US/Mexico border are initiating ENDS use compared to other college-age students, overall prevalence rates seem to

Table 3 Linear regression: monthly frequency of ENDS use

	B	SE	t	p	95% CI	
					LL	UL
Age	.174	.251	.695	.489	− .322	.671
Sex	− .768	1.591	− .483	.630	− 3.914	2.378
Language spoken at home	− 1.521	1.348	− 1.128	.261	− 4.188	1.145
AFS family support	**.704**	**.297**	**2.373**	**.019**	**.117**	**1.291**
AFS family interconnectedness	− .558	.318	− 1.751	.082	− 1.187	.072
AFS family honor	− .290	.310	− .935	.351	− .904	.323
AFS subjugation of self	.085	.293	.290	.772	− .494	.664
MFS fatalism	− .100	.200	− .497	.620	− .496	.297
MFS pessimistic helplessness	.141	.190	.742	.459	− .235	.517
MFS internality	− .159	.200	− .798	.427	− .555	.236
MFS divine control	.117	.119	.979	.329	− .119	.353
EDS	**8.080**	**1.331**	**6.070**	**<.001**	**5.447**	**10.713**
CEAC general benefits	− .135	.140	− .965	.336	− .411	.142
CEAC general effects	− .135	.206	− .657	.512	− .543	.272
CEAC health benefits	.213	.314	.679	.498	− .408	.835
S-VCQ positive reinforcement	− .344	.362	− .951	.343	− 1.059	.371
S-VCQ negative reinforcement	**.620**	**.216**	**2.866**	**.005**	**.192**	**1.048**
RABE positive consequences	.555	.800	.694	.489	− 1.027	2.137
RABE negative consequences	− .250	.661	− .378	.706	− 1.557	1.057
Monthly cigarette use	.002	.014	.172	.864	− .026	.031
Monthly cannabis use	**.934**	**.025**	**37.072**	**<.001**	**.884**	**.984**
Monthly alcohol use	**− .242**	**.115**	**− 2.100**	**.038**	**− .470**	**− .014**
ENDS age of first use	− .334	.393	− .851	.396	− 1.111	.442
DASS depression	− .020	.111	− .177	.860	− .238	.199
DASS anxiety	− .024	.125	− .193	.847	− .270	.222
DASS stress	− .049	.130	− .376	.708	− .305	.208

Overall model was statistically significant $F_{(26, 136)} = 90.023$, $p < .001$, with an Adjusted R^2 of .94. Statistically significant results are shown in bold

AFS = Attitudinal Familism Scale, *MFS* = Multidimensional Fatalism Scale, *ENDS* = Electronic Nicotine Delivery System, *EDS* = E-cigarette Dependence Scale, *CEAC* = Comparison of E-Cigarettes and Cigarettes, *S-VCQ* = Short Form Vaping Consequences Questionnaire, *RABE* = Risks and Benefits of E-Cigarettes, *DASS* = Depression, Anxiety, and Stress Scale.

be comparable. It is also critical to underscore the unique interplay between cultures that may be more relevant in the border region and may have influenced study results. Although the variability and exposure of both American and Mexican cultures were not explicitly explored in the current study, these differences may be alluded to given that 50.5% of participants primarily spoke Spanish at their homes.

Sociocultural Predictors

Subjugation of self for family was positively associated with ever use of ENDS, suggesting that the more one subordinates oneself to family, the more likely they are to have vaped.

This may be a function of the student interpreting self-sacrifice with time away from the family. For example, subjugation in college students may be perceived as time spent in class, studying, or living apart from the family to help achieve long-term family goals. Time in these activities may permit ENDS use while eluding family scrutiny. That familial support was associated with monthly frequency of ENDS use suggests that continued use may be related to family members who smoke and/or financial support by family increasing the capacity to vape more frequently (perhaps as an alternative to purchasing combustible cigarettes). Family members may also hold positive beliefs about ENDS use relative to combustible tobacco use (as is true of the students themselves), thus being perceived as supportive (Hefner et al., 2019). Contrary to the broader Hispanic literature that posits familism as a protective factor (Corona et al., 2017; Valdivieso-Mora et al., 2016), here it seems familism may be a risk factor for ENDS use as initiation may be influenced by subjugation of self, and increased use is related to familial support. Future prospective studies should include other relevant cultural constructs that may be related to vaping, such as *simpatia* (Navas-Nacher et al., 2022), machismo (Soto et al., 2011), or ethnic pride (Castro et al., 2009).

Behavioral Predictors

Ever use of cigarettes was positively associated with the ever use of ENDS, suggesting that dual use of cigarettes and ENDS is likely among Hispanic college students on the US/Mexico border. As prior literature suggests, border region college students may be using cigarettes and ENDS products for pleasure (Leventhal et al., 2016), which has also been noted in combustible tobacco use studies in border region college students (Taylor & Cooper, 2010). It is difficult to distinguish whether the current use of cigarettes is on the decline or rise, given the nature of this cross-sectional design, which highlights the need for a strong prospective study into dual-use patterns within the Hispanic community.

Cannabis ever use was positively associated with ever use of ENDS, though given the cross-sectional nature of the present study the directionality of this relationship cannot be assessed. Nevertheless, previous research has found that initiation of either substance is predicted by previous use of the other (Spindle et al., 2017; Unger et al., 2016). Additionally, frequency of ENDS use and marijuana use were positively associated, suggesting that once one initiates use of both substances, concurrent use will likely occur simultaneously. Conversely, consuming alcohol less frequently was associated with greater ENDS use. This finding is contrary to research suggesting that individuals who consume alcohol more frequently are more likely to engage in ENDS use (Hefner et al., 2019). It may be that college students on the US/Mexico border are self-limiting their polysubstance use or choosing to engage in another combination of substances; however, further research is needed to test these hypotheses. Taken together, this quartet of drug associations represents the potential for the simultaneous use of these substances or in various combinations to produce greater pleasure at the risk of long-term health damage (Lanza & Teeter, 2018). Future studies should prospectively explore initiation, frequency, simultaneous use, and motives for using cannabis, alcohol, and ENDS, specifically among college and non-college Hispanic samples.

Perceived general benefits of ENDS were positively associated with ever use of ENDS, suggesting that individuals are more likely to initiate vaping if they believe that ENDS hold more benefits (e.g., lower costs, smoking cessation aid, and social acceptability) than combustible cigarettes, which are common beliefs that have been reported among Hispanic

samples (Hefner et al., 2019). Interestingly, frequency of ENDS use was associated with increased negative consequences associated with vaping, which indicates that once an individual is vaping and escalates their monthly use, perceived negative consequences, such as adverse health impacts, become more salient. These findings highlight the need to educate border region Hispanic college students about the risks associated with ENDS use, given that lack of awareness plays a role in ENDS use susceptibility and attitudes (Olonoff et al., 2022).

The latter perceived negative consequence association may also be a function of perceived nicotine dependence, as dependence scores were also associated with vaping frequency. Taken together, findings seem to indicate that in terms of psychological and physical dependence on nicotine, college students on the border who vape may be more prone to perceiving and/or experiencing the adverse effects of substance use reliance. Future prospective studies should more clearly address ENDS use initiation and continued use patterns, relative to beliefs, expectancies, consequences, and dependence to further elucidate these relationships in Hispanic college students.

Some hypothesized associations were not observed in the present study. First, sex differences were not observed in either model, indicating that typical observed sex differences may not be present among border-region college students (Mirbolouk et al., 2018). Additionally, associations with language differences did not emerge. Future studies of culturally relevant experiences and constructs using the NIMHD framework are warranted. Also, extending to other cultural constructs, physical/built environment domains of influence, interpersonal and community levels of influence, potentially seeking data from family members, and exploring models that include moderating and mediating factors may be optimal. Regarding behavioral influences, neither depression, anxiety, nor stress were associated with vaping. This is only partially aligned with a previous study that found that only depression was significantly associated with vaping in a college student sample (Wattick et al., 2021). Future prospective studies on the border should include further subclinical affect measures and perhaps other externalizing behaviors such as sensation seeking and impulsivity. Additionally, a more thorough use of the NIMHD framework across multiple domains and levels of influence will advance our understanding of ENDS use.

Strengths and Limitations

Limitations include the cross-sectional design of the study. Future studies should use prospective designs to establish the temporality between the observed relationships. The use of biochemical verification of ENDS and/or combustible tobacco use was not collected to validate self-reports. Another limitation is the use of a convenience sample, which resulted in the overrepresentation of females, potentially further limiting generalizability. The sample was also comprised exclusively of Hispanic college students, limiting generalizability to other ethnocultural, age, and non-college student young adult groups. Furthermore, the study conceptualized the present sample as a homogenous group of Hispanic individuals. Future studies should aim to assess Hispanic individuals more nuancedly, given that previous research has found subgroup differences regarding cigarette use within the broader Hispanic population (Medina-Ramirez et al., 2022). Nevertheless, given the paucity of research within the Hispanic community, the homogeneity of the sample here likely represents a strength, as Hispanics are the largest ethnocultural minority group in the USA (63.7 million; US Census Bureau, 2023). Additionally, the socioecological model was limited to the sociocultural and behavioral influences at the individual level; future studies should

expand to assess ENDS use by including other levels and domains of influence within the model across multiple levels of influence while continuing to highlight modifiable factors through a SCT approach.

Conclusion

Given the urgent need to reduce initiation and prevalence of ENDS use in Hispanic college students, some implications are noteworthy. Notably, familism was found to be a risk factor for ENDS initiation and increased use. Vaping prevention efforts should attend to subjugating oneself within the family, the hazards of co-use with cigarettes and cannabis, and the negative consequences of ENDS. Cessation efforts may wish to focus on seeking family support for health-promoting behaviors, reducing dual use with cannabis, and addressing the impact and consequences of nicotine dependence. Lastly, future prospective studies in college and non-college Hispanic young adults that encompass more constructs of the socioecological model and explore the efficacy of theoretically and empirically derived prevention and cessation efforts are warranted.

Declarations

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