Exposure to tobacco and betel nut content on social media, risk perceptions, and susceptibility to peer influence among early adolescents in Guam

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ABSTRACT

Introduction: This study aimed to examine the associations between exposure to tobacco and betel nut-related content on social media, perceived risks of tobacco and betel nut use, and susceptibility to peer influence for tobacco and betel nut use among adolescents living in Guam, a United States-Affiliated Pacific Island in the Western Pacific.

Methods: A representative survey of adolescents ($N = 670$) attending public middle schools on Guam was conducted. The survey measured exposure to tobacco and betel nut content on the following social media platforms: (a) Facebook, (b) Twitter, (c) Instagram, (d) Snapchat, and (e) WhatsApp. The survey also measured perceived risks of tobacco and betel nut use and susceptibility to peer influence for tobacco and betel nut use.

Results: Guam adolescents' exposure to tobacco-related content on social media was found to be associated with lower perceived risks toward the use of tobacco ($\beta = -0.18$, $p < 0.001$) and betel nut ($\beta = -0.16$, $p < 0.001$). Also, exposure to tobacco-related content on social media was found to be associated with higher levels of susceptibility to peer influence for uses of both tobacco ($\beta = 0.10$, $p < 0.05$) and betel nut ($\beta = 0.15$, $p < 0.001$). Similarly, exposure to betel nut-related content on social media was associated with lower perceived risks of using betel nut ($\beta = -0.20$, $p < 0.001$) and tobacco ($\beta = -0.24$, $p < 0.001$). Also, exposure to betel nut-related content on social media was associated with increased susceptibility to peer influence for use of both betel nut ($\beta = 0.35$, $p < 0.001$) and tobacco ($\beta = 0.29$, $p < 0.001$).

Conclusions: Adolescents' exposure to tobacco- and betel nut-related content on social media may influence attitudinal risk factors associated with tobacco and betel nut use.

1. Introduction

1.1. General introduction

Morbidity and mortality due to cancers of the lung and bronchus and oral cavity appear to be markedly higher in the United States Affiliated Pacific Islands (USAPI) than the US nationally (Pacific Cancer Programs, 2021; Van Dyne et al., 2020). These higher rates for incidences of the above-mentioned types of cancers in the USAPI may be due to higher rates of tobacco and betel (areca) nut use in the region (Paulino et al., 2017; Pokhrel et al., 2019). Both tobacco and betel nut are widely used addictive substances considered to be carcinogenic (World Health Organization, 2012; World Health Organization, 2021). Adolescence appears to be a critical period during which both tobacco and betel nut use initiation occurs (Oakley et al., 2005; Milgrom et al., 2016; Pokhrel et al., 2019). Yet little is understood about the risk factors associated with tobacco and betel nut use among adolescents living in the USAPI. A recent study conducted in Guam, a USAPI in the Western Pacific, suggested that lower perceived risks regarding tobacco and betel nut use and susceptibility to peer influence may be two of the important proximal risk factors associated with tobacco and betel nut use among USAPI youths (Pokhrel et al., 2019). Recent research has also implied that social media may play a role in promoting substance use among youth in the USAPI (Buente et al., 2020a). Yet not much is known about the role

of social media use in influencing risk factors for USAPI youths' use of addictive and harmful substances, and in particular, their risk factors for using tobacco and betel nut. Such research could inform the development of substance use prevention programs in the USAPI.

To fill the above-noted gap in the literature, the present study aimed to examine the associations between exposure to tobacco and betel-nut related content on social media, perceived risks of tobacco and betel nut use, and susceptibility to peer influence for use of these substances among adolescents in Guam.

1.2. The USAPI and Guam

The USAPI consists of Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI)—which are US territories—and three independent nations in free association with the US: the Republic of Palau, the Federated States of Micronesia (FSM), and the Republic of the Marshall Islands. An estimated 500,000 people live in the USAPI, and together, the islands cover a geographic area on the Pacific Ocean that is larger than the continental US. Pacific Islanders also constitute one of the fastest-growing demographic groups in the US (US Census, 2010; US Census, 2020). Guam, itself, is an island located in the Western Pacific Ocean in a sub-region of the Pacific known as Micronesia. According to the 2020 U.S. Census (2021), Guam has a population of close to 154,000.

1.3. Tobacco use in the USAPI and Guam

Reports suggest that 32–50% USAPI adults regularly smoke cigarettes (David et al., 2013; World Health Organization, 2012). Betel nut use is widely prevalent worldwide and approximately 50% of adults in the USAPI report using betel nut (World Health Organization, 2012). Research indicates that adolescents in Guam show drastically higher rates of tobacco product use compared with rates among similarly aged youths in the US as a whole (Pokhrel et al., 2019). For instance, focusing particularly on cigarette use, past-30-day cigarette smoking prevalence among Guam middle school students is 8% compared with approximately 2% in a nationally representative sample of US middle school students (Pokhrel et al., 2019). Lifetime use for cigarettes among young adolescents in Guam is approximately 25%, and tobacco initiation appears mostly to occur during adolescence (Pokhrel et al., 2019).

1.4. Betel nut use in the USAPI and Guam

Betel (areca) nut is not commonly used on the mainland U.S, but are consumed widely in the USAPI, including Guam. The average age of betel nut use initiation is approximately 11 years in the USAPI (Milgrom et al., 2016). Guam youths are also at risk for the use of betel nuts (Milgrom et al., 2016). An estimated 8% of Guam middle school students report having chewed betel nuts in the past 30 days (Pokhrel et al., 2019).

Betel nut, which is the fruit of a type of palm, *Areca catechu*, contains the addictive psychostimulant arecoline, and are also known to cause cancer (Gupta, 1991). There are several modes of betel nut consumption. For example, the nuts may be chewed fresh or when they have dried. They may be chewed straight or chewed in the form of a quid, by wrapping the nuts in a *Piper betle* leaf, along with slaked lime and tobacco.

1.5. Perceived risks and susceptibility to peer influence

Lower perceived risks regarding tobacco and betel nut use and susceptibility to peer influence may be two of important risk factors associated with tobacco and betel nut use among adolescents in Guam (Pokhrel et al., 2019). Lower perceived risks refer to the tendency to not strongly believe that tobacco and betel nut are harmful to health. Lower risk perceptions may be shaped by lack of knowledge or misinformation

(e.g., Morgan et al., 2017; Sloan & Platt, 2011). In the current context, susceptibility to peer influence refers to the increased tendency of being directly or indirectly persuaded by one's peers to engage in tobacco or betel nut use behavior (Stacy et al., 1992).

Adolescents spend a majority of their waking hours among peers, and thus peers make an integral part of adolescents' social environment. Peers may influence an adolescent into engaging in risky behaviors directly by goading or forcing (i.e., peer pressure) (Sussman, 1989). Peer influence may also occur indirectly (Sussman, 1989). Perceptions that engaging in a risky behavior is normative among their peers may encourage adolescents to engage in the behavior, to fit in better among their peers (i.e., normative influence) (Liu et al., 2017). Moreover, adolescence is a period in which self-concept begins to form, and adolescents are in the process of shaping their identities by espousing certain values and making different lifestyle choices (Sebastian, Burnett, & Blakemore, 2008). For them, peers function as role models who provide examples and information that assist in making decisions regarding how to appear and act, especially in the peer social milieu (i.e., informational influence) (Hoffman et al., 2006).

Peer influence is one of the strongest predictors of adolescent tobacco and other substance use (Hoffman et al., 2006). For example, adolescents who report having more substance-using peers in their networks are more likely to use substance themselves (Zaleski & Aloise-Young, 2013). However, not all adolescents are similarly susceptible to peer influence. Susceptibility to peer influence is mainly reflected in adolescents' ability to resist peer influence (Hays & Ellickson, 1990). Adolescents who have high resistance self-efficacy (i.e., confidence in resisting peer influence), for instance, may resist peer pressure by being assertive in declining to participate in a risky behavior (Choi, Krieger, & Hecht, 2013). Additionally, some adolescents may have more competence about deflecting normative influences (Griffin et al., 2001). Moreover, adolescents may vary in their reliance on peers to inform their values and behaviors (Somerville et al., 2019).

1.6. Social media influence

Social media use (e.g., Facebook, Instagram, Snapchat) is highly prevalent among adolescents in the US, as 95% of this age group report that they have access to a smartphone, while 45% say they are online "constantly" (Pew Research Center, 2018). Given the prevalence of social media use among teens (Pew Research Center, 2018), one important factor that could shape perceived risks of tobacco and betel nut use, and susceptibility to peer influence for use of these substances, is exposure to tobacco and betel nut-related contents on social media. Social media have been used to promote tobacco products (e.g., O'Brien et al., 2020). A number of recent articles have demonstrated the presence of pro-tobacco content, advertisements as well as user-generated content, on social media platforms such as Facebook and Instagram (e.g., Allem et al., 2017; O'Brien et al., 2020). Similarly, Buente et al. (2020a, 2020b) have shown the high prevalence of betel nut contents on Instagram that highlight the cultural and social significance of betel nut in Micronesia, the island region where Guam is located, and the near absence of contents on health implications of betel nut use.

Research has found that exposure to substance-related posts on social media is linked with substance use (e.g., Yoo, Yang, & Cho, 2016). For instance, exposure to tobacco-related content on social media has emerged as a factor that could potentially influence young Americans' beliefs and attitudes about tobacco (Johnson & Mays, 2020) and their use of tobacco products (Hebert et al., 2017). Research also suggests US adolescents who more frequently and actively engage in tobacco-related content on social media are at a higher risk for tobacco use (e.g., Cavazos-Rehg et al., 2021).

Furthermore, social media platforms may also act as potent channels for normative and informational social influence (e.g., Beullens & Vandenbosch, 2016). Higher exposure to tobacco and betel nut content on social media may reinforce the perceptions that tobacco and betel nut

use is normative (Buente et al., 2020; Beullens & Vandenbosch, 2016). Such content may also be projected as "cool" and glamorous (Laestadius, Wahl, & Cho, 2016), which has an appeal to young people on the verge of puberty (Chapman & Egger, 1980).

1.7. Gaps in the literature

Higher exposure to tobacco and betel nut content on social media may increase adolescents' susceptibility to peer influence. Hence, the present study was conducted to test the associations of exposure to tobacco and betel nut-related content on social media with perceived risks and susceptibility to peer influence concerning tobacco and betel nut use among Guam's youths. Few studies have closely examined effects for exposure to betel nut-related content on social media. However, provided that both pro-tobacco and pro-betel nut content are highly prevalent on social media platforms, especially on those which adolescents are more likely to use (e.g., Instagram), we can expect that adolescents who are more exposed to tobacco and betel nut content on social media are likely to show lower perceived risks related to such substances.

1.8. Theoretical framework and hypotheses

The current research is informed by the theories of social learning (Bandura, 1977) and problem behavior (Jessor & Jessor, 1977). The basic postulate of the social learning theory is that individuals engage in new behaviors by observing and modeling after the behaviors of others (Bandura, 1977). Social media provide an apt venue for adolescents to observe the behaviors of their peers and adults. Since social media posts tend to project their content in an attractive way, adolescents are highly likely to model after the behaviors depicted on the posts. Especially, pro-substance use posts are likely to be associated with the pleasant effects of the substances or the glorification of lifestyles involving substance use (Cortese et al., 2018). Hence, it is likely that adolescents who are exposed to higher levels of tobacco and betel nut contents are more likely to believe that tobacco and betel nut use is normative and not high risk. In addition, they are more likely to associate with peers who use tobacco and/or betel nut because of their perceptions of such peers as glamorous or "cool."

Usually, as the problem behavior theory suggests, high risk youths tend to be attracted to attracted to multiple high risk behaviors. Hence, adolescents who are susceptible to tobacco use may also be susceptible to betel nut use (Jessor & Jessor, 1977). This is even more straightforward in the case of tobacco and betel nut use because co-use of betel nut and tobacco is common (Milgrom et al., 2013; 2016; Paulino et al., 2011; 2017). Thus, we propose to test the following hypotheses:

- Increased exposure to tobacco contents on social media will be associated with lower perceived risks of tobacco and betel nut use and increased susceptibility to peer influence for uses of both tobacco and betel nut.
- Increased exposure to betel nut contents on social media will be associated with lower perceived risks of betel nut and tobacco use and increased susceptibility to peer influence for uses of both tobacco and betel nut.

2. Method

We administered the survey in 2017 to 2018. The survey is part of a larger study on substance use and prevention among adolescents in Guam. The regional Institutional Review Board (IRB) committee approved the study. Permission to conduct the study was also granted by the Guam Department of Education (GDOE) and the principals of each of the 8 public middle schools. We randomly selected 4 classes per school, and research staff collected data in the classrooms. The average class size per school was approximately 20–30 students.

2.1. Procedures

Surveys were self-administered and facilitated by a PI and research assistant. The survey contained 73 items and took approximately 30 min to complete. Both parental consent and student assent were sought before students participated in the survey. Participants were assured that their responses would remain anonymous as the survey did not ask for any identifying information. As compensation for their time and effort, all students, regardless of whether or not they chose to participate in the survey, received a $5 gift certificate to a local chain cinema and a free ballpoint pen.

2.2. Measures

Exposure to tobacco- and betel nut-related content on social media. We adapted items from Pokhrel et al. (2021) to measure exposure to tobacco and betel nut-related content on social media. First, we asked respondents how often they see posts related to tobacco (e.g., smoking cigarettes) on the following social media platforms: (a) Facebook, (b) Twitter, (c) Instagram, (d) Snapchat, and (e) WhatsApp. Responses were measured along the following scale: 1 = never/I don't use this, 2 = rarely, 3 = sometimes, 4 = often, and we combined and averaged the responses to form a single measure of exposure to tobacco-related content on social media ($\alpha = 0.85$). We also asked respondents how often they see posts related to betel nuts on the same social media platforms using a similar scale. We averaged the responses to form a single measure for exposure to betel-related content on social media ($\alpha = 0.83$).

Tobacco and betel nut use perceived risks. We focused specifically on perceived risks of combustible tobacco, namely cigarette use. To this end, we used three items to measure perceived risks of smoking cigarettes (e.g., cigarette smoking can cause lung cancer; 1 = disagree, 5 = agree). We averaged responses to the three items to form a single measure ($\alpha = 0.84$). We also used three items to measure risks of betel nut use (e.g., chewing betel nut can cause mouth or throat cancer; 1 = disagree, 5 = agree) and averaged responses to the items to form a single measure ($\alpha = 0.81$).

Susceptibility to peer influence for tobacco and betel nut use. Susceptibility to peer influence for tobacco use was measured with 13 items (e.g., Students my age will like me even if I don't smoke cigarettes; I am able to avoid students my age when they use cigarettes) and 13 items were used to measure susceptibility to peer influence for betel nut use (e.g., students my age will like me even if I don't use betel nut; I am able to avoid students my age when they use betel nut). These items were adapted from Simon et al. (1993). Responses were measured with 1 = Yes, 0 = No. Responses were summed to form two separate indices, one respectively for susceptibility to peer influence for tobacco use ($\alpha = 0.80$) and the other for betel nut use ($\alpha = 0.77$).

2.3. Covariates

We measured several demographic and variables as covariates, including age, sex, grade, ethnicity (Chamorro, Filipino, from the Freely Associated States, and other—including other Asian, Caucasian, Pacific Islander, etc.)[1], household crowdedness (i.e., the number of rooms reported in the participants' home divided by the number of living in the home), which serves as a proxy for socioeconomic status (e.g., Center-well, 1984), and impulsivity, which has been found to predict substance use initiation (Gullo & Dawe, 2008).

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[1] We treated Chamorros as the reference group, and omitted this group as an ethnicity predictor in the regression models. Thus, we included only Filipinos, those originating from the Freely Associated States, and all other ethnicities as covariates in our regression models.

2.4. Data analysis

A series of multiple linear regression models were employed to analyze the data. These models tested whether exposure to tobacco- and betel nut-related posts on social media are associated with the perceived risks of using tobacco and betel nut, and susceptibility to peer influence for using tobacco and betel nut. The models included the covariates we identified previously. Listwise deletion was used to deal with missing data.

3. Results

We invited 882 students to complete the survey, and among this number, 201 were absent during the day of data collection, 4 decided not to participate during the day of data collection, and 7 had parents who did not provide consent for their child's participation. Thus, a total of 670 students, who were all consented, comprised of the total sample. The overall response rate was 76%. The ages of participants ranged from 10 to 14 years (with the mean age around 12.5 years), with 51% male (n = 343) and 49% female (n = 330), which are relatively close to the age and gender numbers of the true population of Guam's public middle school students.

Descriptive results on Table 1 show the proportion of participants reporting exposure to cigarette and betel nut-related posts on the five social media platforms. Overall, our participants reported being exposed more frequently to tobacco rather than betel nut-related posts on social media. Participants were most likely to encounter tobacco-related posts on Instagram, followed by Facebook and Snapchat. Interestingly, almost 50% of the sample reporting being exposed to tobacco content on Instagram. Participants were least likely to be exposed to both tobacco and betel nut posts on Twitter, as that platform was also the least used among the five. Participants were also most likely to encounter betel-nut related posts on Facebook and Instagram, but less likely to be exposed to such contents on Snapchat and WhatsApp.

Table 2 reports zero-order correlations between our key variables. Among other findings, these results show that exposure to tobacco posts on social media is positively related with exposure to betel nut posts ($r = 0.44$, $p < .001$). Both perceived risks of tobacco and betel nut use are also positively related ($r = 0.66$, $p < .001$). Moreover, susceptibility to peer influence for tobacco use was highly positively correlated with susceptibility to peer influence for betel nut use ($r = 0.72$, $p < .001$).

Table 3 shows that exposure to tobacco-related posts on social media was negatively associated with both perceived risks of tobacco ($\beta = -0.18$, $p < .001$) and betel nut use ($\beta = -0.16$, $p < .001$). On the other hand, exposure to tobacco-related posts on social media was positively associated with both susceptibility to peer influence for use of both tobacco ($\beta = 0.096$, $p < .05$) and betel nut ($\beta = 0.148$, $p < .001$). Similarly, as Table 4 shows, exposure to betel nut-related posts on social media was negatively associated with both perceived risks of using betel nut ($\beta = -0.196$, $p < .001$) and tobacco ($\beta = -0.238$, $p < .001$), and positively associated with both susceptibility to peer influence for use of both betel nut ($\beta = 0.346$, $p < .001$) and tobacco ($\beta = 0.294$, $p < .001$).

4. Discussion

The present study attempted to address the limited research on how social media influences risk perceptions and susceptibility to peer influence concerning tobacco/betel nut use among adolescents in the USAPI. By focusing on youths from Guam, the study situated the topic in the context of USAPI, where tobacco as well as betel nut use is highly prevalent. The current findings are likely to have important implications for prevention programming and future research.

The current data indicated that early adolescents in Guam are more likely to be exposed to tobacco and betel nut content on Instagram than any other social media platform. It is possible Instagram plays a similar role among youths from other regions of the USAPI. Although further research is needed to confirm this, it appears that youths in USAPI reflect the patterns of exposure to tobacco products on social media that are observed on different regions of the US (Lee et al., 2021; Pokhrel et al., 2021). We did find youths in the current sample to be more exposed to tobacco content on Instagram than betel nut content. As a form of image-based social media, Instagram facilitates networked photo sharing through the everyday use of smartphones (Cortese et al., 2018; Serafinelli & Villi, 2017). As a result, compelling content can be easily created and shared within one's network (Cortese et al., 2018). In addition, visual tobacco content on social media is largely driven by the tobacco industry (O'Brien et al., 2020). The tobacco industry is to known to bypass any ban on direct marketing of tobacco products on social media by using influencers (O'Brien et al., 2020). On the other hand, there is no organized betel nut industry. Most betel nut content on Instagram appears to originate organically, from lay-people (Buente et al., 2020a). However, a conspicuous presence of youth-centric pro-betel nut messages have been noted in the betel nut content on Instagram originating from Micronesia, including Guam (Buente et al., 2020). Clearly, Instagram is a powerful medium for communication as the platform is largely image-based, which young people are likely to find more attractive (Laestadius et al., 2016). There is thus a need for anti-tobacco/ betel nut campaigns to incorporate Instagram-based strategies in their programming (Fung et al., 2020).

The current data indicated high positive correlations between tobacco and betel nut risk perceptions and between susceptibility to peer influence concerning tobacco and betel nut use. According to the adolescent problem behavior theory (Jessor & Jessor, 1977), which has received strong empirical support over the years (Sussman & Ames, 2008), high risk adolescents tend to be concurrently vulnerable to multiple health risk behaviors. Conversely, what these high positive correlations signify is that intervention strategies that target risk perceptions and susceptibility to peer influence may have effects on multiple types of substance use. In fact, research (Hays & Ellickson, 1990) shows that if adolescents are trained in resisting influences concerning one substance, the effects may generalize to other substances as well. Thus, prevention strategies that have worked well for tobacco control may not only extend to betel nut but also that prevention programming targeting tobacco use may have preventive effects on betel nut use.

Importantly, the current findings indicate that higher exposure to tobacco or betel nut content on social media is associated with reduced risk perceptions concerning both tobacco and betel nut. Additionally,

Table 1
Frequency of exposure to tobacco- and betel nut-related posts on social media.

	Exposure to tobacco-related posts on social media Frequency (%)				Exposure to betel nut-related posts on social media Frequency (%)			
	Never/Don't use	Rarely	Sometimes	Often	Never/Don't use	Rarely	Sometimes	Often
Facebook	421 (66.5%)	75 (11.8%)	75 (11.8%)	62 (9.8%)	486 (77.4%)	57 (9.1%)	54 (8.6%)	31 (4.9%)
Twitter	516 (82.2%)	51 (8.1%)	29 (4.6%)	32 (5.1%)	580 (91.5%)	22 (3.5%)	16 (2.5%)	16 (2.5%)
Instagram	329 (52.2%)	104 (16.5%)	118 (18.7%)	79 (12.5%)	512 (79.8%)	67 (10.4%)	32 (5.0%)	31 (4.8%)
Snapchat	437 (64.7%)	73 (11.6%)	61 (9.7%)	58 (9.2%)	551 (87.6%)	30 (4.8%)	27(4.3%)	21(3.3%)
WhatsApp	490 (77.9%)	57 (9.1%)	40 (6.4%)	42 (6.7%)	558 (87.7%)	34 (5.3%)	19 (3.0%)	25 (4.0%)

Table 2
Zero-order correlations between key variables.

Variables	1	2	3	4	5
1. Exposure to tobacco posts on social media	–				
2. Exposure to betel nut posts on social media	0.441***	–			
3. Cigarette use perceived risks	−0.199***	−0.274***	–		
4. Betel nut use perceived risks	−0.176***	−0.212***	0.655***	–	
5. Susceptibility to peer influence for cigarette use	0.135***	0.339***	−0.322***	−0.297***	–
6. Susceptibility to peer influence for betel nut use	0.177***	0.378***	−0.301***	−0.273***	0.724***

Note. * $p < .05$; ** $p < .01$; *** $p < .001$ (2-tailed).

Table 3
Exposure to tobacco-related posts on social media and associations with tobacco and betel nut use perceived risks and susceptibility to peer influence for tobacco and betel nut use.

	Tobacco use perceived risks	Betel nut use perceived risks	Susceptibility to peer influence for tobacco use	Susceptibility to peer influence for betel nut use
Age	−0.040	−0.019	0.137*	0.075
Sex (female)	0.044	0.070	−0.057	−0.081*
Grade	0.065	−0.023	−0.145*	−0.088
SES-Household crowdedness	−0.074	−0.061	0.057	0.054
Ethnicity-Filipino	0.020	0.050	−0.040	−0.034
Ethnicity-From the Freely Associated States	−0.053	−0.028	0.090*	0.087*
Ethnicity-Other	0.031	−0.019	−0.025	−0.081
Impulsivity	0.017	−0.030	0.104**	0.050
Exposure to tobacco-related posts on social media	−0.176***	−0.158***	0.096*	0.148***
R-squared (%)	**4.40%**	**4.6%**	**5.90%**	**5.4%**

Note. Cell entries are standardized regression coefficients.
*** $p < .001$, ** $p < .01$, * $p < .05$, # < 0.10.

Table 4
Exposure to betel nut-related posts on social media and associations with betel nut and cigarette use perceived risks and susceptibility to peer influence for betel nut and cigarette use.

	Betel nut use perceived risks	Tobacco use perceived risks	Susceptibility to peer influence for betel nut use	Susceptibility to peer influence for tobacco use
Age	0.000	−0.009	−0.002	0.056
Sex (female)	0.059	0.031	−0.072	−0.056
Grade	−0.059	0.016	−0.001	−0.065
SES-Household crowdedness	−0.064	−0.074	0.062	0.061
Ethnicity-Filipino	0.047	0.015	−0.026	−0.032
Ethnicity-From the Freely Associated States	0.006	−0.019	0.035	0.053
Ethnicity-Other	−0.015	0.031	−0.008	−0.001
Impulsivity	−0.039	0.010	0.044	0.089*
Exposure to betel nut-related posts on social media	−0.196***	−0.238***	0.346***	0.294***
R-squared (%)	**5.70%**	**6.6%**	**14.30%**	**12.8%**

Note. Cell entries are standardized regression coefficients.
*** $p < .001$, ** $p < .01$, * $p < .05$, # < 0.10.

higher exposure to tobacco or betel nut content was found to be associated with increased susceptibility to peer influence concerning both tobacco and betel nut use. This study was one of the first in the literature to document the associations between tobacco-/betel nut-related content and risk perceptions and susceptibility to peer influence. Given that risk perceptions and peer influence are strong predictors of tobacco and other substance use behavior (Sussman & Ames, 2008), the current findings suggest potential mechanisms that may explain the plausible relationship between social media tobacco/betel nut content exposure and higher tobacco or betel nut use. Future studies need to test risk perceptions and susceptibility to peer influence as mediators of the effects of social media tobacco/betel nut content exposure on tobacco product/betel nut consumption among adolescents. Such research has potential to guiding prevention programming. For example, social

media campaigns may benefit by specifically addressing risk perceptions and peer influence. Indeed, more longitudinal studies are needed to clearly establish the associations among social media tobacco/betel-nut content exposure, risk perceptions, susceptibility to peer influence, and tobacco/betel nut use behavior.

4.1. Limitations

There are limitations to the current study that need to be considered while interpreting the current findings. First, this was a cross-sectional study; no causal inferences may be drawn based on the current analysis. However, given the lack of prospective, longitudinal data, the cross-sectional design was an appropriate first step. Second, the current sample was drawn from Guam public middle school students. Hence, the

findings may not generalize to private school students or adolescents from other regions of the USAPI. Third, social media content exposure, as operationalized in current research, relied completely on self-report. Because of the potential for recall bias in a self-report measure concerning media exposure, a more objective measure would be desirable. Fourth, although regional research on betel nut use has increased in recent times (Herzog & Pokhrel, 2020), a recent representative global report on betel nut use has been lacking; therefore, some of the evidence we present in the introduction are more than a decade old. Lastly, our survey did not include an item that would have made it possible for us to parse out exposure to posts that may have included both betel nut and tobacco.

4.2. Conclusions

Despite the limitations, the current study has valuable knowledge to add to the literature. The study provides significant preliminary evidence suggesting the role of social media tobacco/betel nut content exposure in shaping risk perceptions and susceptibility to peer influence as related to tobacco and betel nut use among youths from Guam. The support of our hypotheses suggests that social media may exert an important influence in terms of what Guam, or USAPI, adolescents believe about tobacco and betel nut and the kind of peers they are likely to affiliate with. Specifically, adolescents who are more likely to be exposed to tobacco and betel nut contents on social media are more likely to believe that tobacco and betel nut use behaviors are not harmful. In addition, such adolescents appear more open to associating with peers who use tobacco and betel nut.

4.3. Implications

The current findings implicate that tobacco and betel nut use prevention programs among youths, including youths from Guam or USAPI, will need to take into consideration the influence of social media. It may be highly important for such programs to include components of social media literacy. Additionally, such programs may engage in social marketing campaigns that utilize social media to educate youths about the harms of tobacco and betel nut use. Currently the presence of pro-tobacco or betel nut use contents may be more prevalent on social media than the presence of anti-tobacco or betel nut. Hence, efforts are needed that would counter the presence of pro-tobacco or betel nut on social media.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions

First, second, and third authors contributed to the study's conception and design. First author analyzed the data and wrote the manuscript. Second author wrote the manuscript. Third and fourth authors reviewed and edited the manuscript. All authors have read and approved the manuscript.

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