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Comparisons of three nicotine dependence scales in a multiethnic sample of young adult menthol and non-menthol smokers

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Abstract

Background—Few studies have compared nicotine dependence among menthol and non-menthol cigarette smokers in a multiethnic sample of young adult daily cigarette smokers. This study examines differences in nicotine dependence among menthol and non-menthol daily smokers and the associations of nicotine dependence with quitting behaviors among Native Hawaiian, Filipino, and White cigarette smokers aged 18–35.

Methods—Craigslist.org, newspaper advertisements, and peer-to-peer referrals were used to recruit daily smokers ($n = 186$) into a lab-based study. Nicotine dependence was assessed using the Fagerstrom Test of Nicotine Dependence (FTND), the Nicotine Dependence Syndrome Scale (NDSS), and the brief Wisconsin Inventory for Smoking Dependence Motives (WISDM). Multiple regression analyses were used to examine differences in nicotine dependence between menthol

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Contributors

Dr. Fagan provided leadership to the overall study. The authors, Drs. Fagan, Pokhrel, Herzog, Pagano, and Moolchan contributed to the conceptual design of the study, analysis, and interpretation of the data. Drs. Trinidad, Sakuma, Fryer, and Sterling, provided input on the analysis of the data, interpretation of the data. All authors contributed to the writing and review of the manuscript.

Conflict of interest

No conflict declared.

and non-menthol smokers and the relationship between each nicotine dependence scale with self-efficacy to quit, quit attempt in the past 12 months, and number of attempts.

Results—Menthol smokers were more likely to report difficulty refraining from smoking in places where forbidden ($p = .04$) and had higher scores on social/environmental goals subscale of the WISDM ($p = .0005$). Two-way interaction models of the FTND and menthol status showed that menthol smokers with higher levels of dependence were more likely to have tried to quit smoking in the past 12 months ($p = .02$), but were less likely to have had multiple quit attempts ($p = .01$).

Conclusions—Components of the FTND and WISDM distinguish levels of dependence between menthol and non-menthol smokers. Higher FTND scores were associated with having a quit attempt, but fewer quit attempts among menthol smokers.

Keywords

Menthol; Nicotine dependence; Race/ethnicity; Young adults; Cigarettes

1. Introduction

Significant progress has been made to reduce cigarette smoking in the U.S. (U.S. Department of Health and Human Services, 2014), but menthol cigarette smoking is a growing problem among young adult smokers (Substance Abuse and Mental Health Services (SAMHSA), 2009). Menthol cigarettes are the most commonly used flavored tobacco product among 18–34 year olds in the U.S. (Villanti et al., 2013), and from 2004 to 2008 menthol smoking increased from 34.1% to 40.8% among adults aged 18–25 (SAMHSA, 2009). Although data are not reported at the national level for all young adult racial/ethnic groups, prevalence rates range from 24% among Whites to 94% among African American young adult smokers (Giovino et al., 2015). National data also show that 53% of Native Hawaiian and Pacific Islander smokers aged 12 and over smoke menthol cigarettes (SAMHSA, 2009). In Hawaii, 78% of Native Hawaiians/Pacific Islanders and 42% of White adult smokers consume menthol cigarettes (Smoking and Tobacco in Hawaii, 2010). Menthol cigarette use is high among Filipinos as well (Euromonitor, 2008). By 2050, conservative estimates suggest that over 300,000 deaths can be averted if it were not for menthol cigarette smoking (Levy et al., 2011).

In 2012, countries like Brazil banned menthol along with other characterizing and non-characterizing flavors (ANVISA, 2012), but in the U.S., menthol is the only characterizing flavor that was not banned by the 2009 Family Smoking Prevention and Tobacco Control Act. Menthol as a characterizing flavor has cooling, soothing, anesthetic, and analgesic effects that mask the bitter taste, smell, and pain sensation of nicotine (Brown and Williamson, n.d.; Bessac et al., 2008; Hummel et al., 1992). Several synthesis studies have concluded that menthol smoking is associated with increased dependence (Tobacco Products Scientific Advisory Committee, 2011; Food and Drug Administration, 2013). However, studies have not specifically focused on young adults or Native Hawaiians who have high rates of menthol cigarette smoking like African Americans (Giovino et al., 2015; Smoking and Tobacco in Hawaii, 2010).

Studies among youth have used the items: time to first cigarette of the day, number of cigarettes smoked per day, depth of inhalation, and the Fagerstrom Test for Nicotine Dependence (FTND) to measure nicotine dependence among menthol and non-menthol smokers, and the evidence suggests that youth menthol smokers show greater signs of nicotine dependence (Hersey et al., 2006; Collins and Moolchan, 2006; Wackowski and Delnevo, 2007; Tobacco Products Scientific Advisory Committee, 2011; Food and Drug Administration, 2013). Evidence varies in whether adult menthol smokers show greater signs of nicotine dependence than non-menthol smokers (Tobacco Products Scientific Advisory Committee, 2011; Hoffman and Simmons, 2011). Mixed findings may reflect variations in the measures used across studies. Studies among adults have primarily used the items: time to first cigarette of the day, number of cigarettes smoked per day, and the FTND total scale to examine differences in dependence among menthol and non-menthol smokers. Some studies that used time to first cigarette of the day as a measure have found higher levels of nicotine dependence among adult menthol compared to non-menthol smokers (Ahijevych and Parsley, 1999; Perez-Stable et al., 1998; Fagan et al., 2010; Muscat et al., 2010; Gandhi et al., 2009; Bover et al., 2008) and others have not (Ahijevych and Garrett, 2004; Hyland et al., 2002; Frost-Pineda et al., 2014). Several studies have not found higher rates of dependence among menthol smokers using the FTND total scale (Muscat et al., 2009; Okuyemi et al., 2004), but found higher rates of dependence on FTND items (Muscat et al., 2009). Other measures show higher rates of dependence among adult menthol smokers compared to non-menthol smokers (Gandhi et al., 2009; Bover et al., 2008).

Nicotine dependence reflects multidimensional factors (Kleinjan et al., 2007), and none of the prior studies compared findings across measures that may capture different components of dependence. While there is no consensus on optimal measures of nicotine dependence, the FTND (Fagerstrom, 1978), the Nicotine Dependence Syndrome Scale (NDSS; Shiffman et al., 2004), and the Wisconsin Inventory of Smoking Dependence Motives (WISDM; Piper et al., 2004) have all been used to assess dependence among young adults. Using and comparing multiple measures of nicotine dependence may help to resolve prior contradictory findings and shed light on the different dimensions that each scale captures.

The Food and Drug Administration (FDA) has specifically called for more research on vulnerable populations (age, gender, race, ethnicity, and geographic location; NIH Office of Disease Prevention, n.d.). The purpose of this study is to compare findings of nicotine dependence among menthol and non-menthol smokers using the FTND, NDSS, and the brief WISDM. We compared behavioral measures of nicotine dependence among daily menthol and non-menthol smokers aged 18–35 years who are Native Hawaiian, Filipino, and White and examined the association of nicotine dependence with quitting behaviors. We hypothesized that nicotine dependence would be higher among daily menthol smokers as compared to non-menthol smokers. We focused on comparisons among groups with the highest lung cancer rates in Hawaii (Hawaii Cancer Facts and Figures, 2010). To date, no studies have compared nicotine dependence and quitting behaviors between Whites and these understudied ethnic groups. Findings from this study can provide additional data to inform FDA policy decisions related to flavored tobacco products.

2. Methods

2.1. Sample

Our study aimed to recruit 200 adult daily smokers aged 18–35 using www.craigslist.com, newspaper advertisements, and peer-to-peer referrals. Advertisements asked participants to contact study staff by email or telephone to determine eligibility. Interested persons were screened by telephone by trained research staff from May 2013 to December 2013. Participants were eligible if they were: (1) between the ages of 18 and 35; (2) self-identified as Native Hawaiian, Filipino, or White; (3) could read and speak English well; (4) had a working phone, email, and home address; (5) were willing to provide consent; (6) stated that they smoked menthol or non-menthol; and (7) smoked daily and at least 5 cigarettes per day. Persons were ineligible if they used tobacco products other than cigarettes, nicotine delivery devices, or pharmacotherapy; indicated that they smoked no usual brand type; or were pregnant. Ninety eight percent ($n = 336$) of eligible participants agreed to voluntarily participate in the study and were invited to come to the University of Hawaii Cancer Center to complete a survey in the translational research laboratory. Among the eligible participants, 59.5% completed the study, a consent rate higher than (Ramo et al., 2014; Ramo and Prochaska, 2012) and comparable to other studies that recruited young adult smokers (Ramo et al., 2010).

The research was reviewed and approved by the Western Internal Review Board and received a Certificate of Confidentiality from the National Institutes of Health.

2.2. Procedures

Study enrollees completed the consent form during the one-hour visit and prior to survey administration. Participants were asked to bring in the pack of cigarette that they usually smoke for brand verification. Trained research staff provided instructions to participants to complete the online survey. Upon completion of the study, participants were provided a \$40 gift card and a one-page fact sheet on quitting smoking. The Western Institutional Review Board approved this study and a Certificate of Confidentiality was obtained through the National Institutes of Health.

2.3. Measures

2.3.1. Sociodemographic measures—Measures included gender, age, race/ethnicity, Hispanic origin, sexual orientation, country of origin, educational attainment/status, marital status, employment status, financial dependence on parents/guardians, overall personal financial situation, and household income. Measured height and weight were also collected from participants to calculate the body mass index (BMI (kg/m^2)). Age groups were categorized as 18–24 and 25–35. *Race/ethnic* categories included Native Hawaiians, Filipinos, and Whites. *Sexual orientation* items included heterosexual/straight, homosexual/gay/lesbian, bisexual, transgender, other, or not sure. *Educational attainment* was categorized as persons with no high school diploma, high school graduate, and college education or higher. *Marital status* included the categories now married, widowed, divorced, separated, never married and living with a partner. *Employment status* was categorized as full-time, part-time 15–34hper week, part-time <15hper week, or do not work for pay.

Financial dependence on parents/guardian response categories included completely/almost completely dependent, partially dependent, and not dependent. *Personal financial situation* response categories included live comfortably, meet needs with a little left, just meet basic expenses, and do not meet basic needs. *Total household income* included the categories < \$20,000, \$20,000–\$49,999, or \$50,000.

2.3.2. Smoking and quitting behaviors—Measures include usual type of cigarette smoked (menthol or non-menthol), age started smoking daily smoking, frequency of smoking, days smoked in past 30 days, number of cigarettes smoked per day (cpd) (smoking intensity), tried to quit smoking completely in past 12 months, number of quit attempts in past 12 months, and self-efficacy to quit (TUS-CPS, 2010–2011). *Usual type of cigarette* was assessed and response categories included menthol, non-menthol, and no usual type. *Age started smoking daily* was assessed by asking those who had smoked at least 100 cigarettes, the age at which they first started smoking daily. *Frequency of smoking* was assessed by asking daily smokers, “On how many of the past 30 days did you smoke a cigarette?” *Number of cigarettes smoked per day* was assessed by asking respondents, “On average, when you smoked during the past 30 days (month), about how many cigarettes did you smoke each day?” (TUS-CPS, 2010–2011).

Quit attempts were assessed by asking participants, “In the past 12 months, have you stopped smoking for one day or longer because you were trying to quit (yes/no). *Number of quit attempts* were assessed by asking smokers, “How many times during the past 12 months have you stopped smoking for one day or longer because you were trying to quit smoking?” Categories included 0, 1, 2–3, and 4 or more quit attempts. *Self-efficacy* to quit was assessed by asking participants, “If they tried to quit smoking altogether in the next 6 months, how likely do you think you would be to succeed how likely they were to succeed in quitting in the next 6 months?” (TUS-CPS, 2010–2011). Responses included not at all, a little likely, somewhat likely, and very likely. Response categories were collapsed to not at all/a little likely and somewhat/very likely.

2.3.3. Nicotine dependence—We used three measures of nicotine dependence: the FTND (Fagerstrom, 1978; Heatherton et al., 1991), the NDSS (Shiffman et al., 2004), and the WISDM (Pancani et al., 2015; Piper et al., 2004; Smith et al., 2010), all of which have been used to assess nicotine dependence among young adults. The FTND is a brief 6-item self-report measure that has been used primarily to assess physical tolerance (Schuster and Johanson, 1974) and predict quit attempts (Haddock et al., 1999; Nonnemaker and Homs, 2007), period of abstinence (Sledjeski et al., 2007), and cessation in young adults (Breslau and Johnson, 2000) and adult moderate and heavy smokers (Ferguson et al., 2003). Scores range from 0 to 10 with higher scores reflecting greater levels of dependence.

The NDSS is a 19-item scale (Shiffman et al., 2004; Shiffman and Sayette, 2005; Sledjeski et al., 2007) that measures 5 domains – drive (cravings, withdrawal, subjective compulsion to smoke), priority (behavioral preferences for smoking over other reinforcers), tolerance (decreased sensitivity to tobacco products), stereopa-ty (sameness of smoking contexts), and continuity factors (regularity of smoking patterns). NDSS has predicted period of abstinence (Sledjeski et al., 2007) and relapse (Shiffman et al., 2004) among adults, but also

predicted increases in smoking among adolescents (Clark et al., 2005). Response are rated using a 5-point Likert scale ranging from 1 = “not at all true” to 5 = “extremely true”. Following Shiffman et al. (2004), we multiplied the item score by the factor loading score and then summed scores for each subscale and the total scale.

The Wisconsin Inventory of Smoking Dependence Motives (WISDM) has been tested among young adult college students (Piasecki et al., 2011). In this study, we used the brief WISDM, which includes 37 items and 11 subscales listed in Table 4 (Smith et al., 2010; Pancani et al., 2015). Response are rated using a 7-point Likert scale ranging from 1 = “not true of me at all” to 7 = “extremely true of me”. Following Smith et al. (2010), we calculated the means for each subscale and then a total score as the sum of the means for the 11 subscales. Since studies suggest that primary dependence motives represent the core features of dependence and differ from secondary dependence motives (Piasecki et al., 2011; Piper et al., 2008), we examined each in this study.

2.3.4. Other substances—Since alcohol and other drugs are also addictive like nicotine, participants were asked to report on the frequency of use of alcohol, marijuana, or other drugs. Response categories included everyday, some days, or not at all. Each measure was dichotomized as current users (yes or no).

2.4. Analysis

The SAS9.4 software was used for all data management and analyses (SAS, 2011). We calculated descriptive statistics for the sociodemographic, nicotine dependence, and quitting behavior data. Chi-square goodness of fit tests and *t*-tests were used to examine differences in menthol and non-menthol smoking by sociodemographic and smoking-related variables. We used Cronbach’s coefficient alpha to assess the internal consistency of the nicotine dependence measures and examined the correlations of the variables with smoking history outcomes.

We used multiple regression (ANCOVA) to estimate differences between menthol and non-menthol smokers, controlling for gender, race/ethnicity, BMI, marital status, education, employment status, number of quit attempts, and current use of alcohol and marijuana. Analyses were conducted for the following outcomes: FTND, NDSS, and WISDM. We also examined specific items within these scales as well. We examined the interactions of menthol/non-menthol smoking status with gender, race, education, and income. Lastly, we ran two-way logistic regression models to assess interactions between nicotine dependence and menthol/non-menthol smoking status on the following smoking-related outcomes: quit attempt in the past 12 months (yes or no), number of quit attempts in the past 12 months (0, 1, 2–3, 4+), and self efficacy to quit. If the outcome had more than two levels, we used an ordered response (cumulative logit) model. A total of 186 daily smokers were included in the analyses. The remaining 14 were excluded since they were nondaily smokers.

3. Results

3.1. Characteristics of the total sample and by menthol smoking status

The sample of young adults included 44% Native Hawaiians, 15% Filipinos, and 40% Whites with twenty-five percent of young adults were of Hispanic origin (see Table 1). The sample was evenly distributed by gender with 48% females, 40% were ages 18–24, 80% heterosexual, 92% were U.S. born, 63% had a high school diploma, 54% were single, 35% were employed full-time, 63% were not financially dependent on their parent/guardian, 12.5% indicated that they do not have enough to meet their basic needs, and 40% earned incomes <\$20,000. Participants had a mean BMI of 28. Approximately 68% of young adult daily smokers were menthol smokers. Seventy-seven percent of women, and 87% of Native Hawaiians, 72% of Filipinos, and 47% of Whites reported menthol cigarette smoking (data not shown).

Chi-square independence tests and *t*-tests showed significant differences between menthol and non-menthol smokers by gender, race/ethnicity, BMI, educational attainment, and marital status. Women, Native Hawaiians, persons with less than college education, and persons with health insurance were more likely to smoke menthol cigarettes than non-menthol. Menthol smokers had a significantly higher BMI compared to non-menthol smokers. There were no significant differences between menthol and non-menthol smokers by age, Hispanic origin, sexual orientation, country of origin, employment status, financial dependence on parents/guardians, overall personal financial situation, and household income.

3.2. Smoking and substance use characteristics by menthol smoking status

Table 2 shows smoking and substance use variables by menthol smoking status. There were significant differences between menthol and non-menthol smokers on the variables: cigarette they would hate to give up most, number of quit attempts in the past 12 months, self-efficacy to quit, and use of alcohol and marijuana. Menthol smokers were significantly less likely than non-menthol smokers to give up their morning cigarette and had lower self-efficacy to quit. Menthol smokers were significantly less likely than non-menthol smokers to report current use of alcohol or marijuana.

3.3. Internal consistency of nicotine dependence scales and smoking history

To better understand the stability and consistency of the scales, we calculated Cronbach's coefficient alpha for the instruments. Table 3 presents Cronbach's alpha for each nicotine dependence scale and the correlations of the scales with quitting behaviors and by menthol smoking status. For menthol smokers, Cronbach's alpha was 0.68 for the FTND, 0.82 for NDSS, and 0.91 for the WISDM. For non-menthol smokers, Cronbach's alpha was 0.72 for the FTND, 0.82 for NDSS, and 0.89 for the WISDM. Quit attempt in past 12 months and number of quit attempts was significantly and negatively associated with the FTND for menthol smokers only. Self-efficacy to quit was significantly and negatively associated with all three scales in menthol smokers, and with the WISDM in non-menthol smokers. As the number of cigarettes smoked per day increased, nicotine dependence, measured by all three scales, also increased significantly for menthol and non-menthol smokers.

3.4. Unadjusted and adjusted multiple regression models to estimate differences in nicotine dependence between menthol and non-menthol smokers

Table 4 presented the unadjusted and adjusted multiple regression models (ANCOVA) models used to estimate the differences in nicotine dependence among menthol and non-menthol smokers. Models were adjusted for gender, race/ethnicity, BMI, education, marital status, quit attempts, and alcohol and marijuana use. The FTND total score was higher among menthol smokers, but did not reach the level of significance. Menthol smokers had higher mean scores than non-menthol smokers on the item, difficulty refraining from smoking in places where it is forbidden, even after adjusting for the covariates [$F(1,160)=4.9, p = .03$]. Menthol smokers were more likely than non-menthol smokers to report that they would hate to give up the first cigarette in the morning more than any other [$F(1,158)=3.8, p = .05$]. The WISDM total score was higher among menthol smokers, but was no longer significantly different from non-menthol smokers after controlling for the covariates. However, the social/environmental goals subscale score was significantly higher among menthol smokers and remained significant even after adjusting for the covariates [$F(1,160) = 11.3, p = .0005$]. The NDSS total and subscales did not reveal differences in nicotine dependence between menthol and non-menthol smokers.

We also examined the interactions of menthol with gender, race, education and income for each nicotine dependence scale to determine if the relationship between menthol differed for each of these variables. We did not find any significant interactions in this sample for gender, race, ethnicity, or income (data not shown).

3.5. Two-way interaction effects of nicotine dependence and menthol/non-menthol status with quitting outcomes

We examined the association of nicotine dependence for menthol and non-menthol smokers with quitting outcomes (see Table 5). We controlled for BMI, gender, education, and ethnicity in each two-way interaction model. The adjusted models showed that for the interaction of the FTND scale with menthol status, the higher the levels of dependence the more likely menthol smokers were to have tried to quit smoking in the past 12 months [$\chi^2(1) = 5.22, p = .02$], but they were less likely to have had multiple quit attempts [$\chi^2(1) = 6.12, p = .01$]. We did not find any significant differences in quitting outcomes for the interactions of NDSS and WISDM scales with menthol/non-menthol status.

4. Discussion

This is the first study to compare multiple measures of nicotine dependence among menthol and non-menthol smokers who are Native Hawaiian and Filipino and who have a high risk for tobacco-caused lung cancer. Compared to non-menthol smokers, menthol smokers reported greater difficulty refraining from smoking in places where forbidden, had greater difficulty than non-menthol smokers in giving up the first cigarette in the morning, and had higher WISDM social/environment goals subscale scores after controlling for the covariates. Higher scores on the FTND scale for menthol smokers were associated with greater odds of having a quit attempt in the past 12 months, but lower odds of having multiple quit attempts. Our findings suggest the need to carefully examine the

multidimensional nature of nicotine dependence measures and their ability to discriminate and characterize aspects of nicotine dependence among different groups of smokers.

Prior studies have used the FTND total scale or select items to assess differences in levels of dependence among adults and differences in dependence among menthol and non-menthol smokers (Collins and Moolchan, 2006; Fagan et al., 2010; Okuyemi et al., 2004). The average FTND score was 3.6 (SD=2.6). This score represents a low to moderate level of dependence for smokers in this sample, but we still found significant differences in the mean scores between menthol and non-menthol smokers on two FTND items, “which cigarette would you hate to give up most?” and, “do you find it difficult to refrain from smoking in places where it is forbidden?” Neither item is reflected in the brief WISDM or NDSS. The FTND item, “time to first cigarette within waking”, which is similar to the WISDM item, “I smoke within the first 30min of waking in the morning”, did not differ among menthol and non-menthol smokers in the adjusted model. Several studies have found that menthol smokers are more likely than non-menthol smokers to have their cigarette within the first 5min of waking (Collins and Moolchan, 2006; Fagan et al., 2010; Bover et al., 2008). Although we did not observe this difference, menthol smokers were more likely than non-menthol smokers to indicate that the first cigarette would be difficult to give up compared to any other. The FTND was designed to capture physical dependence and the specific item, “which cigarette would you hate to give up most?”, captures the construct of giving up a cigarette versus when a smoker intends to consume a cigarette. Since we expect that most daily smokers would hate to give up their morning cigarette than any other, finding this difference among menthol and non-menthol smokers suggest that physical dependence may be more problematic among menthol smokers.

In addition, the smokers in this sample live in a state where there are strong smoke free laws in restaurants, bars and other public places. We have no reason to believe that menthol and non-menthol smokers differentially visit places where smoking is forbidden. Research is needed to understand how policies influence smoking maintenance and quitting behaviors. Furthermore, these findings related to the FTND items, collectively, are indicative of the difficulty menthol smokers have with abstaining from smoking.

We did not find any differences in nicotine dependence using the NDSS total or subscale scores or WISDM total scale in the adjusted models. However, we did find higher scores on the WISDM social/environmental goals subscale for menthol compared to non-menthol smokers. The social/environmental goals subscale of the brief WISDM includes 3 items (most of the people I spend time with are smokers, a lot of my friend or family smoke, and most of my friends and acquaintances smoke) and are reflective of social stimuli or social context that model or influence on smoking (Piper et al., 2009). More than 68% of our young adult sample smoked menthol cigarettes, which is higher than reported by Giovino et al. (2015) who used a national sample. Other data have reported high rates of menthol smoking in Hawaii across racial/ethnic groups and age groups (Smoking and Tobacco in Hawaii, 2010). A prior study found a relationship between social norms and menthol smoking among African American smokers (Allen and Unger, 2007). Future studies that focus on reducing social influence and changing social norms related to menthol smoking may be helpful in preventing and reducing menthol cigarette smoking among young people.

In addition, the social/environmental goals subscale has predicted quitting in prior studies (Piper et al., 2008). Our data were cross-sectional and we were not able to assess the predictive ability of the social/environmental goals subscale among menthol and non-menthol smokers. Future studies may explore the relationship between specific subscales and quitting since synthesis reports indicated that menthol smokers experience greater quitting difficulty (Tobacco Products Scientific Advisory Committee, 2011; Food and Drug Administration, 2013). This information may inform intervention studies that help menthol smokers successfully quit.

This is the first study to report the internal consistency of three nicotine dependence scales by menthol smoking status and among a multiethnic young adult sample of daily smokers. The internal consistency of the FTND and NDSS scales was similar to that in other studies (Shiffman et al., 2004; Okuyemi et al., 2007; Etter, 2005). Studies have reported low internal consistency of the FTND ranging from 0.60 to 0.70 (Heatherton et al., 1991) and in this study, the FTND internal consistency was slightly lower among menthol compared to non-menthol smokers. The results of the internal consistency for the NDSS fall within the range (0.71–0.83) of other studies (Shiffman et al., 2004). Results herein showed that the internal consistency of the WISDM was higher than the FTND and the NDSS, slightly higher among menthol compared to non-menthol smokers, and the range was similar to that reported in other studies (Piper et al., 2004; Smith et al., 2010).

Other studies have found that the FTND predicts quitting (Shiffman et al., 2004; Breslau and Johnson, 2000). While the data from this study were cross-sectional, the FTND was the only measure to distinguish quitting behaviors between menthol and non-menthol smokers. Longitudinal studies are needed to examine the relationship between nicotine dependence and quitting behaviors with and without cessation treatment.

The cross-sectional study design limits our ability to determine the directionality of the relationships. Although we used a community sample, we obtained adequate samples of each ethnic, gender, and age groups. Hawaii state data indicate that 78% of all adult Native Hawaiian smokers use menthol (Smoking and Tobacco in Hawaii, 2010). Our sample of young adults showed that 87% of Native Hawaiian smokers use menthols. Higher rates are expected in young adults because young adults have higher menthol smoking rates than older adults (Giovino et al., 2015; Lawrence et al., 2010). Hawaii state data also show that 40% of White adult smokers use menthols (Smoking and Tobacco in Hawaii, 2010) and 47% of our White young adult smokers reported using menthols. Little is known on how much menthol is delivered by each brand since the contribution of menthol to tobacco weight varies. However, this was not a study on menthol intake, but nicotine dependence related to menthol smoking.

In summary, this study shows that menthol smokers report greater signs of nicotine dependence on specific items within the WISDM and FTND scales. The scales helped to characterize specific dimension of nicotine dependence and showed that menthol smokers have greater difficulty abstaining from smoking and that social stimuli and contextual factors may have a greater influence on maintaining smoking among menthol compared to non-menthol smokers. These data provide important information for the FDA who is considering

how to regulate flavored tobacco products, improve the health of young people, and reduce the toll of nicotine dependence among vulnerable groups of smokers. Future studies should determine how flavored tobacco, as a contextual factor, influences dependence and continued smoking and examine how policies at the local, state, and federal levels might help to reduce smoking behaviors among persons who consume flavored tobacco products such as menthol. Treatment studies are also needed to incorporate messages related to the harmful effects of menthol and non-menthol cigarettes. Furthermore, studies are needed to determine how nicotine and other irritants present in smoke interact with and influence dependence among menthol, non-menthol smokers, and consumers of other flavored tobacco products.

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Table 1

Sociodemographic characteristics of daily smokers by cigarette type, aged 18–35.

Variables	Total (<i>n</i> = 186) Mean (SD) or %	Menthol (<i>n</i> = 127) Mean (SD) or %	Non-Menthol (<i>n</i> = 59) Mean (SD) or %	<i>p</i> -Value
Gender				
Female	47.8	54.3	33.9	.01*
Male	50.5	44.1	64.4	
Transgender	.54	.79	0	
Age				
18–24	40.3	40.9	39.0	.84
25–35	58.6	58.3	59.3	
Race/ethnicity				
Native Hawaiian	44.1	55.9	18.6	.0000***
Filipino	15.6	16.5	13.6	
White	40.3	27.6	67.8	
Hispanic origin (yes)	24.2	26.0	20.3	.43
Sexual orientation ^a				
Heterosexual	80.1	79.5	81.4	.60
Homosexual/bi/other	19.4	20.5	16.9	
U.S. Country of Origin	92.5	92.9	91.5	.89
BMI	27.8 (8.0)	29.4 (8.6)	24.5 (5.1)	.0001***
Education				
No diploma	10.8	15.0	1.7	.001***
High school graduate	62.9	64.6	59.3	
College	25.4	20.5	37.3	
Marital status ^b				
Single	53.8	47.2	67.8	.002**
Married	15.1	14.2	16.9	
Other	30.6	38.6	13.6	
Employment status				
Fulltime (35+h/week)	34.4	32.3	39.0	.09
Part-time (15–34 h/week)	21.0	21.3	20.3	
Part-time (<15 h/week)	9.1	6.3	15.3	
Do not work for pay	33.9	38.6	23.7	
Financially dependent on parents/guardians				
Yes completely or almost completely	11.8	11.8	11.9	.97
Partially dependent	24.7	24.4	25.4	
Not dependent	62.9	63.8	61.0	
Overall personal financial situation				
Live comfortably	16.7	18.1	13.6	.69
Meet needs with a little left	30.6	32.3	27.1	
Just meet basic expense	40.3	37.8	45.8	

Variables	Total (<i>n</i> = 186) Mean (SD) or %	Menthol (<i>n</i> = 127) Mean (SD) or %	Non-Menthol (<i>n</i> = 59) Mean (SD) or %	<i>p</i> -Value
Don't meet basic needs	11.8	11.8	11.9	
Household Income				
<\$20,000	39.8	42.5	33.9	.52
\$20,000–\$49,999	30.1	28.3	33.9	
\$50,000+	26.9	26.0	28.8	

*
p < 0.05.

**
p < 0.01.

p < 0.001.

^aCategories were collapsed due to sample size.

^bCategories were collapsed due to sample size Other category includes separated or widowed.

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Table 2

Smoking and substance use characteristics of daily smokers by cigarette type, aged 18–35.

Variables	Total (<i>n</i> = 186) Mean (SD) or %	Menthol (<i>n</i> = 127) Mean (SD) or %	Non-Menthol (<i>n</i> = 59) Mean (SD) or %	<i>p</i> -Value
Mean age started smoking daily	16.0 (3.3)	16.7 (3.3)	17.2 (3.5)	.41
Mean days smoked in past 30 days	29 (3.4)	28.9 (4.0)	29.3 (1.5)	.50
Mean CPD in past 30 days	14.4 (8.8)	15.0 (9.3)	13.2 (7.4)	.16
Cigarette would hate to give up most (morning cigarette)	47.8	53.5	35.6	.02*
First cigarette within 5min of waking (yes)	24.7	26.0	22.0	.08
Ever tried to quit smoking completely (yes)	77.4	74.8	83.1	.20
Stopped smoking one day or longer because trying to quit in past 12 months (yes)	42.4	43.3	40.7	.74
Number of quit attempts in past 12 months				
0	57.5	56.7	59.3	.05*
1	10.8	7.1	18.6	
2–3	22.6	25.2	16.9	
4+	9.1	11.0	5.1	
Likelihood of succeeding in quitting in the next 6 months				
Not at all/a little likely	37.6	42.5	27.1	.03*
Somewhat/very likely	55.4	49.6	67.8	
Current use of alcohol (yes)	69.9	63.8	83.1	.004**
Current use of marijuana (yes)	44.6	38.6	57.6	.04*
Current use of other drugs (e.g. cocaine, methamphetamines) (yes)	18.3	18.1	18.6	.44

* $p < 0.05$.** $p < 0.01$.

Table 3

Correlations of nicotine dependence scales and quitting behaviors among daily menthol and non-menthol smokers, aged 18–35 ($n = 186$).

	Menthol ($n = 127$)				Non-menthol ($n = 59$)			
	FTND	NDSS	WISDM	WISDM	FTND	NDSS	WISDM	WISDM
FTND	0.68	0.43	0.56	0.52	0.72	0.72	0.72	0.52
p -Value	–	.0000***	.0000***	.0000***	–	.0000***	.0000***	.0000***
NDSS	0.43	0.82	0.65	0.72	0.82	0.82	0.74	0.74
p -Value	.0000***	–	.0000***	.0000***	.0000***	–	.0000***	.0000***
WISDM	0.56	0.65	0.91	0.52	0.74	0.74	0.89	0.89
p -Value	.0000***	.0000***	–	.0000***	.0000***	.0000***	–	–
Stopped smoking one day or longer because trying to quit in the past 12 months (1=no, 2=yes)	–0.28	0.04	–0.08	0.07	0.01	0.01	–0.05	–0.05
p -Value	.001**	.66	.39	.60	.96	.96	.72	.72
Number of quit attempts in past 12 months (0=0, 1=1, 2=2–3, 3=4+)	–0.33	0.03	–0.09	–0.01	0.01	0.01	–0.02	–0.02
p -Value	.0002***	.76	.32	.92	.96	.96	.89	.89
Likelihood of succeeding to quit in the next 6 months	–0.28	–0.34	–0.25	–0.12	–0.14	–0.14	–0.46	–0.46
p -Value	.003***	.0003***	.01*	.38	.34	.34	.0004*	.0004*
Cigarettes per day (1=0–5, 2=6–10, 3=11–19, 4=20+)	0.69	0.34	0.31	0.55	0.41	0.41	0.30	0.30
p -Value	.0000***	.0002***	.0003***	.0000***	.0002***	.0002***	.02*	.02*

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Mean differences in nicotine dependence among daily smokers by cigarette type, aged 18–35.

Table 4

	Unadjusted			Adjusted ^a			<i>p</i> -Value
	Total (<i>n</i> = 179) Mean (SD)	Menthol (<i>n</i> = 122) Mean (SD)	Non-menthol (<i>n</i> = 57) Mean (SD)	Total (<i>n</i> = 179) Mean (SD)	Menthol (<i>n</i> = 122) Mean (SD)	Non-menthol (<i>n</i> = 57) Mean (SD)	
FTND score (total)	3.6 (2.6)	3.9 (2.5)	3.1 (2.6)	3.4 (2.6)	3.5 (2.5)	3.3 (2.6)	.71
Time to first cigarette within waking ^b	2.5 (1.1)	2.5 (1.1)	2.3 (1.2)	2.3 (1.1)	2.4 (1.1)	2.3 (1.2)	.54
Cigarette would hate to give up most ^c	1.5 (0.50)	1.4 (0.50)	1.6 (0.49)	1.5 (0.50)	1.4 (0.50)	1.6 (0.49)	.05*
Difficulty refraining from smoking in places where it is forbidden ^d	1.7 (0.46)	1.7 (0.46)	1.7 (0.47)	1.6 (0.46)	1.7 (0.46)	1.5 (0.47)	.03*
Smoke more frequently during the first hours of waking than the rest of the day ^d	1.7 (0.45)	1.7 (0.45)	1.7 (0.45)	1.8 (0.45)	1.9 (0.45)	1.7 (0.45)	.20
Smoke when you are so ill that you are in bed all day ^d	1.6 (0.49)	1.5 (0.50)	1.7 (0.45)	1.7 (0.49)	1.7 (0.50)	1.8 (0.45)	.31
Mean cigarettes smoked per day ^e	1.7 (0.73)	1.8 (0.76)	1.6 (0.67)	1.6 (0.73)	1.7 (0.76)	1.6 (0.73)	.98
NDSS (total)	-0.31 (1.1)	-0.25 (1.1)	-0.44 (1.0)	-0.17 (1.3)	-0.16 (1.1)	-0.17 (1.0)	.97
Drive	-0.31 (1.3)	-0.28 (1.3)	-0.36 (1.3)	-0.35 (1.3)	-0.30 (1.3)	-0.40 (1.3)	.72
Stereopathy	0.32 (1.1)	0.42 (1.1)	0.11 (0.16)	0.24 (1.1)	0.29 (1.1)	0.19 (1.1)	.64
Continuity	-0.60 (1.1)	-0.62 (1.1)	-0.54 (1.0)	-0.87 (1.1)	-0.99 (1.1)	-0.74 (1.0)	.23
Priority	-0.59 (0.75)	-0.56 (0.83)	-0.66 (0.52)	-0.60 (0.75)	-0.69 (0.83)	-0.51 (0.52)	.21
Tolerance	-0.35 (1.1)	-0.40 (1.1)	-0.26 (1.2)	0.04 (1.1)	-0.04 (1.1)	0.12 (1.2)	.42
WISDM (total)	44.0 (13.9)	45.8 (13.9)	40.2 (13.3)	43.8 (13.9)	44.9 (13.9)	42.6 (13.3)	.40
Affiliative attachment	2.8 (1.8)	2.8 (1.9)	2.6 (1.6)	2.6 (1.8)	2.4 (1.9)	2.8 (1.6)	.35
Automaticity	4.0 (1.9)	4.2 (1.9)	3.6 (1.9)	4.0 (1.9)	4.0 (1.9)	4.0 (1.9)	.99
Loss of control	4.0 (1.7)	4.1 (1.7)	3.7 (1.7)	4.2 (1.7)	4.2 (1.7)	4.2 (1.7)	.96
Cognitive enhancement	3.9 (2.0)	4.1 (2.0)	3.5 (1.9)	4.0 (2.0)	4.3 (2.0)	3.7 (1.9)	.17
Craving	4.4 (1.7)	4.6 (1.8)	4.2 (1.5)	4.3 (1.7)	4.5 (1.8)	4.2 (1.5)	.46
Cue exposure/associative processes	4.4 (1.7)	4.5 (1.7)	4.4 (1.6)	4.6 (1.7)	4.6 (1.7)	4.6 (1.6)	.92
Social/environmental goals	4.9 (1.8)	5.4 (1.5)	3.9 (2.0)	5.1 (1.8)	5.7 (1.5)	4.5 (2.0)	.0005****
Taste	4.4 (1.9)	4.6 (1.8)	4.1 (1.9)	4.0 (1.9)	4.2 (1.8)	3.8 (1.9)	.15
Tolerance	4.2 (1.9)	4.4 (4.0)	3.7 (1.9)	3.9 (1.9)	4.0 (1.8)	3.7 (1.9)	.34

	Unadjusted			Adjusted ^a			p-Value
	Total (n = 179) Mean (SD)	Menthol (n = 122) Mean (SD)	Non-menthol (n = 57) Mean (SD)	Total (n = 179) Mean (SD)	Menthol (n = 122) Mean (SD)	Non-menthol (n = 57) Mean (SD)	
Weight control	2.6 (1.7)	2.7 (1.8)	2.3 (1.5)	2.4 (1.7)	2.3 (1.8)	2.5 (1.5)	.55
Affective enhancement	4.4 (1.8)	4.4 (1.8)	4.2 (1.6)	4.6 (1.8)	4.5 (1.8)	4.6 (1.6)	.82
Primary dependence motives	4.1 (1.5)	4.3 (1.5)	3.8 (1.4)	4.1 (1.5)	4.2 (1.5)	4.0 (1.4)	.60
Secondary dependence motives	3.9 (1.3)	4.1 (1.3)	3.6 (1.2)	3.9 (1.3)	4.0 (1.3)	3.8 (1.2)	.35

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

^aWe adjusted for BMI, gender, education, race/ethnicity, marital status, quit attempts, employment status, alcohol and marijuana use in the regression models.

^bAfter 60min=1; 31-60min=2; 6-30 min=3; within 5min=4.

^cFirst cigarette within the morning=1; any other=2.

^dYes=1; no=2.

^e0-10cpd=1; 11-20cpd=2; 21-30cpd=3; 31 or more cpd=4.

Table 5
Two-way logistic regression models of quitting outcomes among daily smokers, aged 18–35.

Dependent variable	Parameter	Stopped smoking for one day or longer because trying to quit (yes versus no) (n = 184)		Quit attempts (0 versus one or more) (n = 184)		Likelihood of succeeding to quit (not at all/a little likely versus somewhat/very likely) (n = 171)	
		OR (95% CI)	p-Value	OR (95% CI)	p-Value	OR (95% CI)	p-Value
FTND							
Unadjusted	Menthol	1.27 (1.09, 1.48)	.02*	0.76 (0.65, 0.88)	.02*	0.77 (0.65, 0.90)	.51
	Non-menthol	0.94 (0.77, 1.16)		1.02 (0.83, 1.25)		0.84 (0.67, 1.06)	
Adjusted	Menthol	1.28 (1.08, 1.52)	.02*	0.74 (0.63, 0.87)	.01*	0.75 (0.63, 0.90)	.69
	Non-menthol	0.92 (0.74, 1.15)		1.04 (0.84, 2.38)		0.80 (0.62, 1.03)	
NDSS							
Unadjusted	Menthol	0.93 (0.67, 1.29)	.85	1.06 (0.78, 1.46)	.88	0.50 (0.33, 0.74)	.62
	Non-menthol	0.99 (0.57, 1.70)		1.01 (0.59, 1.73)		0.61 (0.31, 1.19)	
Adjusted	Menthol	0.94 (0.65, 1.36)	.86	1.06 (0.75, 1.50)	.87	0.42 (0.27, 0.66)	.70
	Non-menthol	0.88 (0.50, 1.56)		1.12 (0.64, 1.95)		0.50 (0.24, 1.04)	
WISDM							
Unadjusted	Menthol	1.01 (0.99, 1.04)	.88	0.99 (0.96, 1.01)	.73	0.96 (0.94, 0.99)	.11
	Non-menthol	1.01 (0.97, 1.05)		1.00 (0.96, 1.04)		0.91 (0.86, 0.97)	
Adjusted	Menthol	1.01 (0.98, 1.04)	.99	0.99 (0.97, 1.02)	.87	0.96 (0.93, 0.99)	.07
	Non-menthol	1.01 (0.97, 1.05)		1.00 (0.96, 1.04)		0.90 (0.84, 0.96)	

Models are adjusted for BMI, gender, education, and ethnicity.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.